

### Cascade Natural Gas Integrated Resource Planning Feedback Report

Item #	Date	TAG Meeting	Name/Company	Comment/Question	Cascade Response
1	4/4/2022	TAG 1	WUTC	Will Cascade consider more frequent breaks throughout the TAG meetings?	Cascade would be open to ideas on how often the Company should break during TAG meetings. Cascade suggests we shouldn't break more often than once per hour, with a 5-minute maximum for each break, unless we need a longer lunch break.
2	4/4/2022	TAG 1	WUTC	Will Cascade consider adding in at least 15-minutes of unscheduled time during meetings, perhaps at the end, for the sole purpose of encouraging questions?	Cascade intended for the penultimate TAG 1 slide to be that unscheduled time as you indicated. Key Cascade members will remain in the meeting as long as needed to respond to questions.
3	4/4/2022	TAG 1	WUTC	During the virtual presentation, is hand raising encouraged or unmuting? Any guidance in future meetings on how to participate would be beneficial for stakeholders. Perhaps laying this groundwork at the beginning of TAG meetings would be useful.	Cascade's meetings are very informal so either unmuting or raising your hand, or even typing questions into chat is fine with Cascade. Cascade will clarify this in future TAG meetings as well as include this information in the Stakeholder Engagement Design Document.
4	4/4/2022	TAG 1	WUTC	Does Cascade plan on sending out minutes/summaries of each meeting? Staff's hope is that such summaries would include any comments or questions from TAG members and Cascade's initial response to those items, in addition to including such as an appendix in the final IRP.	Yes, Cascade will provide minutes that include questions, stakeholder comments, and Cascade's responses.
5	4/4/2022	TAG 1	WUTC	On slide 17, Cascade staff noted natural gas volatility of 179.1%. Staff is not familiar with volatility as a metric. It would be helpful to have a bit more explanation of what it is, how it is measured, and what it signifies. Could this volatility result in supply risk/interruption, rather than simply pricing risks? What do volatility projections look like for the future? Does this spike in volatility have greater meaning to Cascade beyond hedging and prices?	<p>Volatility is a statistical measure of the magnitude of changes for a particular value, regardless of direction. Volatility is often measured with terms such as variance or standard deviation. A low variance/standard deviation would mean low volatility.</p> <p>The EIA defines their measure of volatility as the magnitude of daily changes in the closing price for natural gas in a 30-day window, based on rolling front-month contracts. For example, the EIA would measure what future contracts are for February 2022 each day in January 2022. A high volatility might show low February priced contracts earlier in January, but as time goes on, the market begins showing very high February contracts, resulting in a high volatility measure. This could be due to a number of market conditions, supply issues, production issues, unexpected weather; even related to pricing hubs in Europe and Asia where Henry Hub price volatility has historically corresponded.</p> <p>Volatility is key metric in Cascade's Value at Risk analysis. A high volatility environment presents high risk to the both the hedged and unhedged portion of the Company's portfolio. Short term, the Company is projecting that high volatility will continue into the upcoming heating season, as there is still great uncertainty surrounding the variables discussed above. Long-term, however, Cascade does expect the market to stabilize, leading to lower volatility in the outer years of Cascade's hedging horizon and beyond. Cascade does not see any significant relationship between volatility and supply/interruption risk.</p>
6	4/4/2022	TAG 1	WUTC	Since the UTC has new staff assigned to this IRP, it would be helpful to staff to schedule a walkthrough of the load forecast, avoided cost methodology, upstream emissions methodology, stochastic analysis, and resource integration. Additionally, if Cascade does indeed intend to use Plexos rather than SENDOUT as its resource integration software for this IRP, it will be helpful to schedule a demonstration of the software and how Cascade uses it.	Cascade's next four TAG meetings are intended to dig into these models and much of the TAG meetings will be a walkthrough of these models. Cascade's recommendation would be that after each TAG meeting, if there is still a request for a walkthrough, Cascade would gladly set up a meeting to further dive into a model/methodology.
7	4/4/2022	TAG 1	WUTC	UTC staff commend Cascade for starting a conversation around stakeholder engagement and their demonstrated openness to amendments to the IRP stakeholder engagement document.	We appreciate this comment. Cascade is committed to implementing best practices for stakeholder engagement while recognizing stakeholders have a full workload.
8	4/4/2022	TAG 1	WUTC	During the meeting Cascade Staff noted previous engagement strategies (e.g. Facebook posts regarding the Bend TAG and consideration of a mailer), for the sake of clarity, would it be possible to have anticipated outreach strategies outlined in the IRP stakeholder engagement document during a future update? Clearly outlining Cascades outreach plans/efforts may make it easier to have future discussions about improving outreach strategies. For example, "Cascade staff plans to publish TAG meeting notices on their Twitter account 2 weeks prior to each meeting" – this example would clearly communicate one step Cascade plans to take.	Cascade appreciates this comment and perspective. The Company understands the importance of stakeholder engagement and wants to ensure customers and interested parties know how and when to participate in Cascade's IRP efforts. Cascade will include on the TAG 2 meeting agenda a discussion of Cascade's engagement strategies. The Company looks forward to this discussion.
9	4/6/2022	TAG 1	OPUC	OPUC checked in on the plan to not hold separate DSM-related workshops noted in Order 21-127 and in Slide 14 of Cascade's TAG presentation and just addressing through the TAG meetings. OPUC is fine with that plan as long as the Company will be addressing all the issues that were raised in the Order on that topic.	Cascade agrees with this and is amenable to any follow up workshops if those topics are not discussed in detail to OPUCs satisfaction during Cascade's TAG meetings.
10	5/26/2022	TAG 2	WUTC	Has Cascade considered using the RCP8.5 emissions pathway for its climate modeling? This is the modeling pathway used by the Northwest Power and Conservation Council in their 2021 Northwest Power Plan. Avista has chosen to follow suit and also uses the RCP8.5 pathway.	Yes, Cascade considered RCP2.6, RCP4.5, RCP6.0, and RCP8.5. RCP 8.5 is the most extreme scenario and described as "to be very unlikely, but still possible as feedbacks are not well understood." Cascade also believes taking a more conservative approach to ensure the Company doesn't underplan other decarbonization strategies is the best approach. In the two- to four-year action plan, Cascade will continue to research and gain a better understanding on the potential impacts of climate change.
11	5/26/2022	TAG 2	WUTC	Staff recommends that Cascade update their Consumer Forecast in light of the recent changes by the State Building Code Council.	Due to recent changes to the State Building Code, Cascade will be making changes to the load forecast models. However, given the timing of the changes, Cascade will not be able to make this change for this IRP. Revamping the load forecast model to account for end use changes will be a 6 month to year long project, which falls outside of the IRP Planning timeline. Cascade will include this in the two- to four-year action plan.

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12	5/26/2022	TAG 2	WUTC	Staff would like to commend Cascade for their responsiveness to previous comments. Cascade outlining their strategies for outreach provided more clarity regarding their outreach process. Cascade made it clear how participants could interact during the TAG; this improved the accessibility of the meeting.	Cascade appreciates this comment and perspective. The Company understands the importance of stakeholder engagement and wants to ensure those attending our meetings have the ability to interject and ask questions or make comments.																																	
13	5/26/2022	TAG 2	WUTC	Why doesn't the pricing forecast include cap and trade, renewable natural gas, green hydrogen, the social cost of carbon or other environmental risks?	The price forecast presented in TAG 2 is intended to be the Company's projected forecast for the price of geologic natural gas. Cascade does believe that exogenous factors as listed by Staff are incorporated into the various basin forecasts that the Company references as appropriate regarding their potential impact to regional traditional natural gas processes. This forecast is ultimately one input, of many, to the Company's processes that utilize the price forecast. In Cascade's resource optimization process, the Company models the costs and availability of geologic natural gas, renewable natural gas, green hydrogen, and offset credits (typically priced as a function of the Social Cost of Carbon). The resulting projected cost of gas is an optimized blend of all of these factors. Cascade will present the price of RNG, green hydrogen, and offset credits in future TAG meetings.																																	
14	5/26/2022	TAG 2	WUTC	On slide 4, of the TAG 2 presentation, it states "The Company believes that customers and interested parties were made aware of Cascade's IRP meetings" – what is this belief based on?	Cascade has a designated web page that informs customers and interested parties of the IRP process and how to participate. Cascade also reached out via email to dockets where the Company felt those intervenors would be interested in Cascade's IRP. With that said, Cascade does have a plan to continue and better bolster our communication for future IRP processes.																																	
15	7/13/2022	TAG 3	WUTC	1. On slide 19, the Winter Supply Stack graph features two datasets in the same color. Would it be possible to get new draft of that graph with each element in a different color?	Cascade has updated this slide, along with an updated slide 9 due to coloring issues, in the TAG 3 presentation that is on Cascade's Washington IRP website.																																	
16	7/13/2022	TAG 3	WUTC	On slides 82-101, Cascade discusses new methodology for determining Avoided Costs. This analysis, in part, focuses on Distribution System Costs. a. For slides 87-95, what is the net outcome of these changes on avoided costs? b. As shown in slides 87-95, does this result in a kind of double counting of what is already considered in avoided costs? Does the "time value of money" apply to most components of Cascade's avoided cost calculation such as Commodity Costs, Variable Storage Costs, or even Fixed Transportation Costs?? c. For slides 93 and 94, what are Cascade's assumptions of the "time value of money"? How does it plan to value the delay shown in the charts? d. Slides 93 and 94 suggest that it is a sort of timed cost savings between present real costs and lower presumed future real costs for upgrades as opposed to traditional "time value of money" that relies upon a default ROI assumption. Is this a correct interpretation?	a. In appendix A at the bottom of the feedback report Figure 1 and 2 show distribution costs for the 2023 IRP as well as the avoided distribution system costs in the filed 2020 WA IRP. b. It is important here to recognize that distribution system costs are a unique element of the avoided cost mix because they represent a variable that is not avoidable, but rather deferrable. For an element such as commodity cost, for instance, for every therm that is not consumed by an end use customer but instead is conserved, that is one therm that Cascade will never need to purchase. Regarding distribution system costs, however, assuming that the Company is continuing to grow, reducing demand peak load does not remove the need for a distribution system enhancement, but rather delays when the forecasted point of deficit will occur (see slide 91 for a visual example.) One exception to this could be fixed transportation costs, where energy efficiency may not be able to remove the need for incremental upstream capacity but rather defer it to a later year, but Cascade has not identified a need for any incremental upstream capacity and thus has no avoidable fixed transportation costs in the 2023 IRP. c. It is important to note that slides 93 and 94 are illustrative examples and not representative of actual numbers. The assumption of the time value of money is the standard valuation formula, where $PV = FV / (1+i)^t$ where $i$ = Cascade's weighted average cost of capital (WACC) and $t$ = number of years. In slide 93, the assumption is that costs rise by inflation over time. In slide 94, ceteris paribus, Cascade's WACC exceeds inflation, leading to lower future valuations over time. d. Slides 93 and 94 suggest that it is a sort of timed cost savings between present real costs and lower presumed future real costs for upgrades as opposed to traditional "time value of money" that relies upon a default ROI assumption. Is this a correct interpretation? – As discussed in Cascade's answer to 2c. the cost savings shown between slides 93 and 94 are a function of default ROI assumptions. Any money that does not need to be immediately spent on distribution system projects should generate an ROI for the Company equal to its WACC. That fundamental principle supports the calculation of the Present Value of Deferral illustrated on slide 95.																																	
17	7/13/2022	TAG 3	WUTC	For slides 85 and 86, what is the difference between the previous "carbon compliance costs" from the 2020 IRP and the new "Environmental Compliance Costs"?	This value is, for the most part, relatively unchanged. The name has been updated to reflect the fact that these compliance costs do not just reflect carbon but all emissions under the banner of CO <sub>2</sub> e. The SCC was also updated to be expressed in Real \$2021. A comparison of the values can be found with Figure 3 and 4 in appendix A.																																	
18	8/17/2022	TAG 4	WUTC	On slide 8, does this graph include Cascade's methane emissions discussed in slide 10?	No. The emissions on this graph are emissions from natural gas combustion from customer use.																																	
19	8/17/2022	TAG 4	WUTC	The bar graph on slide 8 is very useful. It does a good job communicating the scope of baseline emissions growth. Staff would like to request a similar graphic showing Cascade's combined portfolio of fuels and CCA compliance options over time to meet that demand while complying with its various legal and regulatory requirements?	Cascade will be providing graphics with this information at TAG 5.																																	
20	8/17/2022	TAG 4	WUTC	On slide 27, Cascade notes that their gas is 93.4% methane. What is the other 6.6%?	Natural gas is composed mostly of methane and small amounts of other constituents. Literature <sup>1</sup> provides a typical composition in the table displayed below. <table><tr><th colspan="3">Typical Composition of Natural Gas</th></tr><tr><th>Name</th><th>Formula</th><th>Volume (%)</th></tr><tr><td>Methane</td><td>CH<sub>4</sub></td><td>&gt;85</td></tr><tr><td>Ethane</td><td>C<sub>2</sub>H<sub>6</sub></td><td>3-8</td></tr><tr><td>Propane</td><td>C<sub>3</sub>H<sub>8</sub></td><td>1-2</td></tr><tr><td>Butane</td><td>C<sub>4</sub>H<sub>10</sub></td><td>&lt;1</td></tr><tr><td>Pentane</td><td>C<sub>5</sub>H<sub>12</sub></td><td>&lt;1</td></tr><tr><td>Carbon dioxide</td><td>CO<sub>2</sub></td><td>1-2</td></tr><tr><td>Hydrogen sulfide</td><td>H<sub>2</sub>S</td><td>&lt;1</td></tr><tr><td>Nitrogen</td><td>N<sub>2</sub></td><td>1-5</td></tr><tr><td>Helium</td><td>He</td><td>&lt;0.5</td></tr></table> The US Energy Information Administration (EIA) notes on their webpage on Natural gas explained <sup>2</sup> , "The largest component of natural gas is methane, a compound with one carbon atom and four hydrogen atoms (CH <sub>4</sub> ). Natural gas also contains smaller amounts of natural gas liquids (NGLs, which are also hydrocarbon gas liquids), and nonhydrocarbon gases, such as carbon dioxide and water vapor." Cascade notes there is some variability in gas quality on pipelines and between pipelines, but gas quality typically falls in the ranges indicated above.	Typical Composition of Natural Gas			Name	Formula	Volume (%)	Methane	CH <sub>4</sub>	>85	Ethane	C <sub>2</sub> H <sub>6</sub>	3-8	Propane	C <sub>3</sub> H <sub>8</sub>	1-2	Butane	C <sub>4</sub> H <sub>10</sub>	<1	Pentane	C <sub>5</sub> H <sub>12</sub>	<1	Carbon dioxide	CO <sub>2</sub>	1-2	Hydrogen sulfide	H <sub>2</sub> S	<1	Nitrogen	N <sub>2</sub>	1-5	Helium	He	<0.5
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21	8/17/2022	TAG 4	WUTC	On slide 27, Cascade notes that their gas is 93.4% methane. Does the End of Use Emission rate include the combustion of these non-methane gasses in Cascade's natural gas?	The End of Use Emission rate used is published in EPA rulemaking. Cascade is confirming with EPA that this emission rate includes combustion of the non-methane gasses and will provide an update when we receive EPA's feedback.																																	

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22	8/17/2022	TAG 4	WUTC	On slide 28, Cascade notes "The 93.4% methane in natural gas is in line with EPA estimates of 95-98% and therefore, can be maintained." What percent would be out of line with EPA estimates? What is the basis for this in vs out of line assessment?	Cascade determined to maintain the previous IRP's assumption of 93.4% methane in natural gas for this IRP. This value represents an average percentage of methane in natural gas from past EPA GHG inventory data. In comparison, there are several sources listing the methane composition of commercial natural gas: Yale Climate Communication lists the range as 70-90%, Britannica lists it at 85-90%, and the EPA Pipeline Quality Estimate lists 95-98%. Cascade believes the 93.4% is in line with the EPA estimates of 95-98%. Cascade also recently reviewed methane content data available from GTN/Williams at citygates representing natural gas delivered from the US Rockies and confirmed natural gas received is about 93.7% methane.
23	8/17/2022	TAG 4	WUTC	On slide 10, staff would appreciate data presented on "other operational emissions". Have the number of these other operational emissions changed over time?	<p>Emissions estimated from distribution mains and services, meter/regulating station equipment, and larger combustion equipment, such as compressor engines, total approximately 24,000 to 25,000 metric tons of CO<sub>2</sub>e per year. These emissions have been quantified since 2010 and have remained about the same over time as default emissions factors are required to quantify most of the emissions.</p> <p>Emissions which include excavation damage, natural force damage and other outside force damage, corrosion, and equipment/weld issues were approximately 6,154 metric tons of CO<sub>2</sub>e in 2021 and were similar in 2020. These emissions could have a greater potential for annual variability due to the types of causes. Cascade has been collecting and reporting this data to the UTC for a couple years and the Company will use this data for evaluating emissions trends ongoing.</p> <p>Other operational emissions (blowdowns, pressure relief/venting and routine maintenance, meters, and smaller combustion equipment) are being added to Cascade's inventory this year and are preliminarily estimated to be about 10,000 to 15,000 metric tons of CO<sub>2</sub>e. Cascade is exploring the use of company specific data to more accurately estimate these emissions. The Company's approach to quantifying these emissions may also change in future with EPA's proposed emission factor changes in the agency's 40 CFR Part 98 Subpart W rule amendments.</p> <p>Cascade is committed to reducing operational emissions. As a comparison, when considering customer emissions of approximately 2 million metric tons CO<sub>2</sub>e, Cascade's total operational emissions are a very small percentage. Total operational emissions are currently projected to be in the range of 1-2% of total Cascade emissions regulated under the WA Climate Commitment Act.</p>
24	8/17/2022	TAG 4	WUTC	On slide 11, Cascade discussed their active efforts to track and decrease operational emissions. Does Cascade have data reporting these efforts?	Data demonstrating reductions is limited at this time. However, UTC does receive leak mitigation data reports from Cascade annually in March. Also, internal data tracked by the Company's operations shows few open leaks on the system and those are scheduled for repair according to Cascade's expedited leak management program. Expediting leak mitigation on the system shows that the Company's efforts have reduced leak emissions since implementing the program. Also, a more robust emissions inventory will be available in 2023 for 2022 emissions. Cascade plans to use this comprehensive emissions inventory to evaluate emissions and trends, identify additional emissions reduction opportunities, and better quantify emissions reductions.
25	8/17/2022	TAG 4	WUTC	On slide 21, Cascade assessed "The result was approximately 50 customers per year. Cascade decremented customer counts by 50, cumulatively, each year for the forecast." Does this mean that total customers from this city is anticipated to decrease by 50 customers per year or that, relative to the anticipated trend in customers, future values are 50 customers per year smaller? Are these losses entirely residential customers or are they randomly distributed among commercial, residential, and industrial customers?	This means that relative to the anticipated forecast in customers, future values are smaller. Cascade applied this cumulatively, so a 50 customer decrement to the forecast in the first year, 100 customers the second year, and so on and so forth through the 28-year planning horizon. Cascade believes this gas ban will have a bigger impact to the commercial customers than the residential and industrial customers so the decrement was applied to the commercial customers. Cascade will be monitoring the actual effects of this ban and will reassess this analysis in future IRPs.
26	8/17/2022	TAG 4	WUTC	On slides 21 through 24, Cascade discusses the impacts of various local natural gas policies. However, the April 2022 revision of the Washington State Building Code was not discussed. What impacts will that revision have?	Cascade discussed the Washington State Building Code changes during TAG 2. Cascade indicated at that meeting that due to the timing of the building code votes, and the fact that Cascade does not do end use forecasting, implementing these changes would require Cascade to delay the IRP six months to a year to change the load demand forecast methodology. Cascade will be monitoring the effects of these building code changes as well as adjusting the load forecast methodology to account for these building code changes with end use forecasting in future IRPs.
27	10/26/2022	TAG 5	WUTC	On slide 27, the slide notes the amount of incremental RNG. Are these levels consistent with anticipated requirements of RCW 80.28.390?	The RNG amounts on slide 27 include the amounts needed for Washington and Oregon. RCW 80.28.390 only requires gas utilities to offer RNG as an offset to traditional gas. There are no statutory amount Cascade needs to require or supply under the voluntary program. Once the voluntary RNG program, Cascade will be able to monitor the amount of interest and enabling the Company to update the models with accurate voluntary RNG information.
28	10/26/2022	TAG 5	WUTC	On slide 28, the graph shows that emissions costs will result in total costs more than quadrupling. How much is this expected to impact ratepayer bills? How will these bill impacts shift demand?	Cascade is currently analyzing the ratepayer bill impacts and will provide that information in the draft filing of the IRP narrative.
29	10/26/2022	TAG 5	WUTC	On slide 79, Cascade describes the attributes of scenario 5. What impact does limiting Hydrogen to 20% have on the portfolio?	If Cascade were to constrict the model to only hydrogen to comprise 20% of supply by volume, the Company would need to acquire additional allowances through the auction mechanism. The Company still projects that it would be able to comply with emissions reduction requirements through this, but costs would increase, particularly in later years as the cost of hydrogen is forecasted to decline over time while the cost of allowances will rise. Cascade has modeled this, and in Figure 5 shows that total system costs rise when only allowing a 20% hydrogen blend.
30	10/26/2022	TAG 5	WUTC	On slide 65, there is a chart with a row labeled "Natural gas bans" with some columns filled "current bans." However, later slides, such as 70, refer to this scenario assumption as "Consideration of all expected bans in load forecast." Are these the same assumption?	Yes, those are the same assumption. Cascade will clarify that language in the IRP Narrative.

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31	10/26/2022	TAG 5	WUTC	On slide 65, there is a chart with a row labeled "Natural gas bans" with the electrification column filled "Additional Bans." However, the electrification scenario on slide 75 refers to this assumption as "Consideration of all expected and proposed bans in load forecast." Are these the same assumption?	Yes, those are the same assumption. Cascade will clarify that language in the IRP Narrative.
32	11/3/2022	Additional Q's	WUTC	On slide 101 of TAG 4, Cascade lists "Enhancement Selection Guidelines", the 3rd line notes "Segment of pipe that minimizes environmental concerns and impacts to the community"  Could Cascade please expand on this?	Every system deficit will have a unique enhancement to address the deficit.
33	11/3/2022	Additional Q's	WUTC	What environmental concerns are analyzed?	Environmental concerns will depend on the enhancement considered. An example of environmental concerns would be minimizing water crossing. Pipeline routes could be modified to avoid stream, river crossing or wetlands.
34	11/3/2022	Additional Q's	WUTC	What types of community impacts does Cascade assess?	Community impacts will depend on the enhancement considered. An example of a community impact would be modifying pipeline routes to avoid road moratoriums (roads that have recently been improved) or high consequence areas.
35	11/3/2022	Additional Q's	WUTC	Does this include an equity assessment of the impacts?	Equity assessments are not currently directly involved in enhancement selection but could be a future consideration.
36	11/3/2022	Additional Q's	WUTC	What type(s) of methodology and data does Cascade use here?	Not currently being considered.
37	11/3/2022	Additional Q's	WUTC	How are these criteria weighted against the other listed points?	Not currently being considered.
38	1/20/2023	Draft IRP Comments	WUTC	At page 3-2, to ensure adequate policy analysis, Staff questions if Cascade could extend the assumptions for the customer count forecast out to 2050 to line up with the imperatives of the CCA?	Cascade has extended all forecasting assumptions out to 2050 for both the customer forecast and the use-per-customer forecast. Cascade will make this detail clearer on page 3-2.
39	1/20/2023	Draft IRP Comments	WUTC	At page 3-5, Staff questions how Cascade chose its climate models and how those choices compare to the models relied upon by the NWPCC?	See Response to item 40.
40	1/20/2023	Draft IRP Comments	WUTC	At Page 3-6, Staff questions Cascade's citation of Wikipedia for the proposition that Cascade's climate model portfolio is the most probable? Staff further questions why RCP 4.5, representing Western North American emission goals, is preferable to climate modelling that represents global emissions goals?	a. According to the IPCC, the RCP 4.5 scenario is their intermediate scenario. There are scenarios with more aggressive assumptions and some with worst case climate results. RCP 1.9 or 2.6 are very stringent pathways, with requirements like CO2 emissions starting to decline in 2020, going to zero by 2100. RCP 7 would represent a baseline outcome instead of an emissions target, and RCP 8.5 represents a worst-case climate scenario with emissions continuing to rise. Cascade discovered multiple research specialists' papers regarding the most probable scenario, as noted in the Wikipedia references. Cascade believes the RCP4.5 scenario to be a reasonable scenario with assumptions balanced between aspirational mitigation targets with plausible ones. This decision was further backed up by the research previously stated. Cascade is open to a discussion around providing demand scenarios with different climate assumptions in future IRPs. b. Cascade's approach to selecting a climate scenario was not based on global emissions goals versus Western North American emissions goals. Instead, Cascade analyzed each of the RCP scenarios from the IPCC. RCP 1.9 actually represents global emissions goals, similar to the Paris Agreement. Cascade believes this could be a useful scenario to model, but ultimately wanted a more intermediate scenario to use as a forecast baseline going forward.
41	1/20/2023	Draft IRP Comments	WUTC	At page 3-9, Staff questions if Cascade's customer count estimates incorporate Cascade's price-competitiveness? For example, vis-à-vis other utility options in the future.	Cascade's forecast models are sensitive to trends happening in historical data, such as an uptick in industrial fuel switching for example, but Cascade does not include any alterations to its baseline forecast. Cascade does include an electrification scenario to model the impacts on Cascade's system. This analysis can be found in Cascade's scenario modeling which includes assumptions like increased electrification or low growth (in Chapter 9, specifically Figure 9-3 on page 9-5.) Cascade is also investigating a price/customer elasticity factor that can be applied to the customer or load forecast model for future IRPs.
42	1/20/2023	Draft IRP Comments	WUTC	At page 3-9, Staff questions if Cascade has considered the attrition rate of the existing building stock with natural gas fixtures, and whether the Company has accounted for the likely change in attrition rate of furnaces due to the adoption of hydrogen-blended fuel.	Cascade is very interested in the demand results of customers adopting hydrogen-blended fuel strategies, but with little to no information on how this will effect Cascade's demand, no changes were made to the baseline forecast. Further analysis that this topic is covered under would be Cascade's scenario modeling in Chapter 9, specifically Figure 9-3 on page 9-5.
43	1/20/2023	Draft IRP Comments	WUTC	At Page 3-13, Staff questions why figure 3-6 has 4-year cycles and requests more information.	This is a result of leap years; the extra day of load is showing as growth. Cascade will investigate a better way to visualize this without confusion.
44	1/20/2023	Draft IRP Comments	WUTC	At Page 3-20, figure 3-18, Staff questions why the peak day growth increases faster than Washington Base load minus DSM in figure 3-15? Additional narrative would be helpful to include in the final IRP.	Despite using a baseline climate scenario showing decreasing HDDs, peak days are remaining volatile and are not declining over time like the normal annual HDDs do. Therefore, the current growth of annual load is declining at a higher rate than peak day.
45	1/20/2023	Draft IRP Comments	WUTC	At Page 3-21, regarding non-core outlook, Staff questions whether the Company has assessed the impact, if any, the environmental policy discussed in Chapter 6 will have on this customer count? Additional narrative and analysis would be helpful to include in the final IRP.	Cascade has assessed the impact the environmental policies in both Washington and Oregon have on the non-core outlook. When a non-core customer wants to connect to Cascade's system, Cascade must determine if the customer could put the Company in a position where meeting carbon compliance is at risk. Cascade is also analyzing whether non-core customers will seek other sources of fuel, naturally reducing Cascade's customer count.
46	1/20/2023	Draft IRP Comments	WUTC	At Page 3-26, Staff would like further explanation for the bullet that reads "An understanding that an increased cost of improved precision sometimes has decreasing customer benefits;"	This is a general concept comparing the added effort put into a task versus the actual benefit received. As a quick example, it might not make sense for an analyst to spend an inordinate amount of time trying to increase a forecast's accuracy metric of 99.1% to 99.2% when this time could be better spent analyzing more climate scenarios or challenging the robustness of a baseline forecast assumption. This bullet point was not referring to any particular case, but simply conveying transparency in Cascade's forecasting assumptions and the philosophy behind forecast decision making.
47	1/20/2023	Draft IRP Comments	WUTC	At Page 4-2, Staff notes the last bullet in the cyan box appears incomplete; it is not clear to what the "lowest" refers.	Thank you for this comment. This should read "Modeling of Cascade's available resources results in the lowest reasonably priced optimum portfolio." This will be edited for the final version.

### Cascade Natural Gas Integrated Resource Planning Feedback Report

Item #	Date	TAG Meeting	Name/Company	Comment/Question	Cascade Response
48	1/20/2023	Draft IRP Comments	WUTC	At Page 4-8, Staff questions how many customers participate in the voluntary tariff for renewable natural gas service? For example, how has this participation changed over time?	Cascade does not currently have any customers participating in a voluntary RNG program. Cascade is still in the process of procuring RNG as a supply side resource. Without having RNG to offer, Cascade is unable to offer the supply in a voluntary program. Cascade anticipates a tariff will be filed in May or June allowing customers several months in advance to sign up before the service is actually available.
49	1/20/2023	Draft IRP Comments	WUTC	At Page 4-11, Staff questions what role transporting RNG without owning environmental attributes plays in Cascade's portfolio and CCA compliance?	As a point of clarification, Cascade does not claim that it will be able to use environmental attributes that the Company does not own towards CCA compliance. Cascade views the role of these transactions similar to that of its transportation customers, where the Company enters into an agreement with the third party to transport that customer's RNG, with the customer paying a designated rate for this service. Cascade believes the Company plays an important role in decarbonization and is open and willing to connect RNG suppliers as a good neighbor, even when we are not receiving the environmental attribute.
50	1/20/2023	Draft IRP Comments	WUTC	At Page 4-14, Staff requests additional narrative and explanation regarding the following assertion: "For both the CCA in Washington and the CPP in Oregon, hydrogen is considered a one-for-one offset to traditional natural gas."	Cascade has added language starting on Page 4-14 explaining its rationale behind the proposed utilization of hydrogen.
51	1/20/2023	Draft IRP Comments	WUTC	At Page 4-16, Staff questions if Cascade considered the impacts of competing uses for hydrogen such as industrial applications, vehicle fuels, and energy storage for electricity generation? Staff recommends additional narrative and explanation regarding the company's impact assumptions.	In Figure 9-3 on Page 9-5 of the Resource Integration chapter of the 2023 IRP, the Company details a number of sensitivities related to hydrogen (expected availability, high availability, low availability.) These sensitivities are explained quantitatively in the subsequent glossary, and qualitatively in the scenario descriptions themselves. In scenario 3, for instance, the Company evaluates a low RNG scenario on page 9-27, where "This scenario models a world where higher than expected competition for RNG, coupled with stagnation in technological developments related to RNG and Hydrogen, leads to a constraint of a limited amount of RNG and Hydrogen available for acquisition." Cascade will add some language to chapter 4 to inform the reader that analyses of externalities that can impact hydrogen, and how those factors impact resource acquisition decisions.
52	1/20/2023	Draft IRP Comments	WUTC	At Page 4-15, Staff questions if Cascade has assessed green hydrogen fuel prices. For example, are they likely to be less expensive than compared to electricity while produced at sufficient scale to meet Cascade's portfolio needs?	Regarding pricing, Cascade has had challenges finding current pricing projections for green hydrogen beyond the 2020 source documented in the 2023 IRP. The Company reached out to its consultant Guidehouse, who agreed that its assumptions for hydrogen pricing were valid. This consultant also concurred with Cascade's position that the primary constraint regarding hydrogen volumes will be the ability to integrate hydrogen into the Company's system as opposed to availability for Cascade to acquire its portfolio needs. That being said, the Company acknowledges this is a very nascent market and will update these assumptions in future IRPs as more information becomes available.
53	1/20/2023	Draft IRP Comments	WUTC	At Page 4-16, figure 4-4, Staff questions why the RNG/hydrogen potential stops growing around 2040? Staff requests additional narrative and explanation.	Cascade based its assumption around the availability of RNG on the 2019 ACF/ICF study cited on page 4-15. In this study, it can be seen in Figure 8-23 that RNG level off at or before 2040. While this is the end of the study period, a common theme from these figures is that growth does not appear to be significant leading up to 2040, leading to Cascade's assumption that these resources will mature at or before this point. This is substantiated by the statement on page 27 of the study, where the ICF says F54 Hydrogen growth potential does not stop around 2040, although it does slow as it is constrained as a function of by volume of traditional natural gas in Cascade's system (20% by volume in the base case.) The Company will add narrative to the final draft with regards to this.
54	1/20/2023	Draft IRP Comments	WUTC	At Page 4-17, figure 4-5, Staff questions if green hydrogen costs are projected to go below RNG by 2029; for example, why is RNG a large portfolio item in figure 4-4?	It is important to note that figure 4-4 is not meant to signify the portion of RNG in the Company's Preferred Portfolio, but rather the potential volume of RNG and Hydrogen resources that the Company forecasts to be available to acquire. This is identified on page 4-16 "Figure 4-4 shows the potential RNG volumes available to Cascade." Staff is correct that Company projects Green Hydrogen cost to fall below that of RNG by 2029 as per figure 4-5.
55	1/20/2023	Draft IRP Comments	WUTC	At page 4-23, Figure 4-8 regarding volatility, did Cascade consider any long-term uncertainty or probability relating to the price forecast? Further, does Cascade consider any volatility in the price forecast, and how might these impact the performance of portfolios? Finally, has Cascade compared its forecast to the volatility and stability of historical gas prices?	<p>Cascade has many approaches to dealing with uncertainty and probability in the price forecast. The first approach is by creating scenarios for low and high pricing environments. The second approach is to take several different price forecasts from multiple consultants and publicly available sources like the EIA and blend the forecasts together. Each source is weighted by its historic performance and accuracy. Each source is also dampened if its original release date is older than others. The details of this process are described on pages 4-22 through 4-24. Lastly, Cascade performs Monte Carlo simulations on price to include in scenario analysis found in Chapter 9 – Resource Integration. For example, scenario 6 is a high price and interrupted supply scenario. Page 9-35 explains that "the price of traditional natural gas is modeled to be follow the Company's base case modeling until an incident occurs, at which point prices spike to the 99th percentile of stochastic pricing of the basin where the incident occurs, with other basins experiencing correlated increases."</p> <p>Figure 6 in Appendix A was presented at Tag 5 on October 20th, 2022 via Microsoft Teams. It shows one example of a Monte Carlo simulation on price, in this instance, on the Sumas basin.</p> <p>As the graph on the right shows, Cascade's 99th percentile hit the \$40-\$50 range, where January 2023 Sumas pricing reached.</p> <p>Finally, regarding comparing to historical gas prices, Cascade's price forecast methodology involves comparing all forecast sources' historical accuracy in predicting futures. If a forecast is particularly bad at predicting, it is dampened, and the other sources are relied on more heavily. Lastly, the first 15 months of Cascade's price forecast are 100% futures pricing as analysis has shown that this is historically the most accurate.</p>
56	1/20/2023	Draft IRP Comments	WUTC	At Page 4-26, GTN capacity Acquisition, Cascade states, "which was shown in the 2018 and 2020 IRPs as needed resources to meet central Oregon capacity." Staff questions whether Cascade can demonstrate that this added capacity is needed? Staff questions whether this is in line with future long-term projections?	The contract for this capacity was signed to a binding agreement, utilizing the analyses in the acknowledged 2018 and 2020 IRPs as the rationale for the prudent acquisition of this resource. This decision is further reinforced by the Company's As-Is analysis, which identifies shortfalls in Oregon by 2028 even including the additional GTN capacity. This shortfall would only be exacerbated without the upstream GTN capacity

### Cascade Natural Gas Integrated Resource Planning Feedback Report

Item #	Date	TAG Meeting	Name/Company	Comment/Question	Cascade Response
57	1/20/2023	Draft IRP Comments	WUTC	At Pages 4-26 and 4-27, Staff questions if Cascade has demonstrated the need for these additional pipeline capacity resources elsewhere in the IRP? Staff requests additional narrative.	As a point of clarification, these resources are part of a section labeled "Incremental Supply Side Resource Options." With the exception of the additional GTN capacity that has already been justified, the Company is not claiming it needs these resources, but rather that they are options that are modeled in the 2023 IRP. With the exception of the already agreed upon GTN capacity, none of the other options are selected as part of the Preferred Portfolio.
58	1/20/2023	Draft IRP Comments	WUTC	At page 6-17, the IRP states "The Climate Commitment Act requirements are modeled in this IRP and have some representation of natural gas system decarbonization. Cascade will consider the published study in the next IRP." Staff requests additional information regarding what stage of decarbonization planning Cascade is in, if any?	Cascade is in the early stages of exploring decarbonization and has utilized the Washington Climate Commitment Act compliance modeling from the IRP to inform on decarbonization strategies. In addition to purchasing and retiring emissions allowances at auction, Cascade is expecting to accomplish some decarbonization through carbon offsets, renewable natural gas and renewable thermal credits, hydrogen, and through implementing energy efficiency and conservation programs.
59	1/20/2023	Draft IRP Comments	WUTC	At page 9-30, figure 9-27, Staff questions what impact increasing annual customer costs consistent with the figure would have on customer counts? Staff recommends the Company include more analysis on this outcome as well as any risks posed to customers that might result from this scenario such as energy burden as well as the likelihood of overinvestment, and stranded assets.	Cascade does include price as a variable in Cascade's load forecast model in an attempt to capture price elasticity. Cascade believes this could be improved to capture customer count elasticity when it comes to fuel switching and has been working with its consultant Guidehouse to develop a methodology for future IRPs. Additionally, the Company did already include adjustments to customer counts in the scenario referenced in figure 9-27. As per the explanation of the scenario: "This scenario models lower than expected load growth projections due to both discretionary electrification and increased regional bans on natural gas. In this scenario, customer growth in Cascade's residential, and commercial rate classes gradually slows to zero growth in 2025 and afterwards, residential and commercial customer count reduced to 10% by 2050."
60	1/20/2023	Draft IRP Comments	WUTC	At page 9-30, figure 9-27, Staff requests additional information regarding the primary driver for bill increases. For example, is it the higher ratio of fixed costs per customer or increasing fuel and compliance costs?	The primary purpose of this scenario is to analyze the relationship between electrification and bill impacts. The reduction of customer counts is described in the scenario explanation, and this reduction of customer count leads to the higher ratio of fixed costs per customer that produces the rate impacts shown in figure 9-27.
61	1/20/2023	Draft IRP Comments	WUTC	Regarding equity considerations in the IRP analysis: a. At page 7-16, figure 7-5, Staff notes the low-income budget is about 1/20th the budget for Residential. Staff questions how this aligns with "progress towards equitable distribution of nonenergy benefits" (pg 7-6) or "the triple bottom line of economics, equity, and sustainability." (pg 6-5, emphasis added)? b. Page 7-24, section titled "Importance of Outreach and Cohesive Messaging", Staff asks if Cascade can demonstrate, and provide additional narrative explaining, how equity is incorporated into each of the bullet points, and also address the efficacy of each strategy as it relates to advancing equity? c. 8-9,8-10, section title "Distribution System Enhancement Selection Guidelines" Staff asks if Cascade can provide examples of how equity is incorporated into each of the bullet points? d. At page 9-30, figure 9-27, Staff questions what the equity impacts of increasing bills are and whether Cascade has considered these impacts?	Cascade has added language to the Company Overview chapter that discusses the Company's Equity Considerations.
62	1/20/2023	Draft IRP Comments	WUTC	State building code: a. At page 3-9, Staff questions whether Cascade's customer count estimates adequately anticipate further reductions from building codes. Staff would like to highlight RCW 19.27A.020(2)(a), which states that the Washington state energy code shall be designed to construct increasingly energy efficient homes and buildings that help achieve the broader goal of building zero fossil-fuel greenhouse gas emission homes and buildings by the year 2031. Staff recommends the Company include more information and narrative regarding building code assumptions. b. At page 3-17, has the Company quantified the DSM impact in figure 3-13, if the scenario customer counts were to match the expectations of RCW 19.27A.020(2)(a)? Staff questions how large the DSM impact would be in figure 3-13. c. At page 6-16, Staff would like to highlight RCW 19.27A.020(2)(a). d. At page 9-5, figure 9-3, Staff questions how Cascade modeled customer growth assumptions – "Current expectations," and whether they should align closer with RCW 19.27A.020(2)(a).	Cascade has included narrative in Chapter 3 regarding the building code impacts.
63	1/20/2023	Draft IRP Comments	WUTC	Appendix K, Staff requests that Cascade label each customer class in layperson terms. It is not clear which types of customers are affected in each chart.	Cascade has updated the labels for each customer class in Appendix K.
64	1/20/2023	Draft IRP Comments	WUTC	Staff would like to highlight the decarbonization plan in connection to the next IRP in (1) Final Order for Avista in Docket UE-210854 contained in the Settlement Stipulation, and (2) Final Order for PSE in Docket UE-220066. Staff looks forward to more discussion on this topic.	Cascade appreciates Staff highlighting these two decarbonization plans. Cascade looks forward to discussing this topic further.

### Cascade Natural Gas Integrated Resource Planning Feedback Report

Item #	Date	TAG Meeting	Name/Company	Comment/Question	Cascade Response
65	1/20/2023	Draft IRP Comments	WUTC	Staff questions whether PLEXOS's optimized portfolio choices might change in light of path-dependent and knowledge-limited decision making. Staff looks forward to more discussion regarding modeling and how the company uses it to develop compliance resource portfolios.	Cascade appreciates Staff's question on path-dependency and knowledge-limited decision making. Cascade would like to highlight that due to uncertainty around some of the projections is the main reason for scenario modeling. The scenario's are supposed to simulate likely paths that Cascade may see in the future. Cascade also runs monte carlo simulations to show the different load and price scenarios the Company could experience. This is also a big reason why IRPs are run every 2 years as the information in the IRP either becomes solidified or adjusted as more knowns are determined.
66	1/20/2023	Draft IRP Comments	WUTC	Staff questions whether Cascade has considered incorporating electrification strategy into its next IRP?	Cascade included an electrification scenario in the current IRP process. Cascade does not serve electricity to customers, so analyzing the impact on the electric side will require a region wide analysis on the impacts to natural gas and electric customers under and electrification strategy. Cascade looks forward to further discussions on electrification in future IRPs.
67	1/30/2023	Draft IRP Comments	Public Counsel	In Figure 4-5, What is the reason for the sudden forecasted price increase?	On page 4-16, Cascade explains "To model the pricing of RNG, the Company followed the example of another regional LDC in using a forecast that does not employ a traditional supply curve because of the "lumpy" nature of RNG projects coming online. To that end, prices are split into two tranches. The first tranche, covering the first 1/3rd of projected supply, is priced at \$13/dth, while the second tranche, covering the remaining 2/3rd of supply, is priced at \$19/dth. "
68	1/30/2023	Draft IRP Comments	Public Counsel	How does futures pricing play into recent price instability in the Western U.S.?	Cascade's usage of future's market pricing was vital in producing an accurate short term forecast during recent price instability. Most long term forecasts did not project the extreme pricing that the Company saw, but the utilization of futures pricing ensured that Cascade's price forecast was accurate in the short term each week. As prices have recently regressed back to normal levels, the Company is still confident in its long term forecasts from sources beyond futures market pricing.
69	1/30/2023	Draft IRP Comments	Public Counsel	How does current price instability play out in the High Price sensitivity on Page 9-6? Put another way, does this approach account for the magnitude of instability we have witnessed?	Cascade does believe that recent price instability does validate the philosophy behind this approach, but provides insights as to how this process could be improved. As discussed during the TAG process, during a stochastic incident in Cascade's modeling, prices at Sumas spiked between approximately 10 and 25 dollars per dekatherm. During the 2022-2023 heating season, prices ranged between approximately 15 and 45 dollars per dekatherm. Cascade took a somewhat conservative approach in modeling price volatility as a result of feedback from the 2020 IRP process, where stakeholders informed the Company that they believed Cascade's stochastic modeling may have resulted in prices that were too extreme. In future IRPs the Company will look at higher volatility inputs in stochastic modeling to allow for modeled extreme events to reflect recently observed pricing.
70	1/30/2023	Draft IRP Comments	Public Counsel	Was the current price instability in the Western U.S. anticipated in Cascade's stochastic price modeling?	The objective of stochastic analysis is to model extreme pricing events such as the events that occurred during the 2022-2023 heating season. While the Company didn't necessarily anticipate this specific event, the impacts of such extreme pricing to PVRP can be anticipated to some extent as a result of stochastic modeling.
71	1/30/2023	Draft IRP Comments	Public Counsel	As I'm sure your team has witnessed, there has been tremendous instability in western gas prices at AECO, Sumas, and Rockies/Opal since December 2022. Although prices have moderated somewhat since December of last year, they remain elevated over Henry Hub prices and remain volatile from day to day. Generally speaking, how has the IRP team responded to this recent instability? I have some additional questions (items 67-70) relating to specific content in the IRP related to the recent price instability, so this is detailed context for what exactly I'm referencing in those comments/questions.	Please see response to items 67-70. Cascade would also like to highlight that the Company does have a Hedge Plan, which is provided in Appendix H. In the Hedge Plan, Cascade indicates on page 17 that the Company's Hedge Plan saved customers approximately \$41.5 million of gas costs compared to the market. Cascade will continue to monitor and update the Hedge Plan as well as the Company's stochastic modeling as more information around price instability becomes known.
72	1/30/2023	Draft IRP Comments	Public Counsel	Public Counsel is aware that Oregon CUB has raised concerns about continued load growth projected in Oregon, despite state policy moving away from GHG emitting resources. Washington policy moves in a similar direction. We're aware that this draft IRP accounts for changes in state policy, but I'm curious how Cascade has responded to CUB's concerns in Oregon.	Cascade appreciates Public Counsel's question around customer growth and current state policies. Cascade has included more narrative around the GTN Express expansion in Chapter 4 of the IRP. Cascade will also add that the 2023 IRP includes Cascade's plan to meet the decarbonization compliance obligations from both the CCA and the CPP while continuing to grow the customer base. In future IRPs, Cascade will continue to monitor customer growth as more policy changes come in effect and bill impacts become realized.



**Figure 1: Draft 2023 Avoided Distribution System Costs**

\$/dth	Zone 1	Zone 2	Zone 3	Zone 4	Oregon	Washington	System
2023	0.91321002	3.12080498	2.05795516	2.01678461	2.01678461	1.81227098	1.91356241
2024	0.00000000	2.71203016	1.87062160	6.17641314	6.17641314	2.69564406	4.41959799
2025	0.93970316	2.08661663	1.12964956	1.40916221	1.40916221	1.27706815	1.34249164
2026	1.22866014	2.98390713	1.68604792	1.96593125	1.96593125	1.81934573	1.89194655
2027	1.01349731	1.86768539	0.93345949	1.36296144	1.36296144	1.14668822	1.25380393
2028	0.90999050	1.39810979	0.72419499	0.98422414	0.98422414	0.91079405	0.94716247
2029	0.62831183	1.33064563	0.61367536	0.8813022	0.8813022	0.75568008	0.81789815
2030	0.00000000	1.39641684	0.52416385	1.00885332	1.00885332	0.89291870	0.95033876
2031	1.04367617	1.89042661	0.91988573	1.26611812	1.26611812	1.14754440	1.20627155
2032	0.87249321	1.85008927	0.98867865	1.15504381	1.15504381	1.13856069	1.14672444
2033	0.51298999	1.26099274	0.56181444	0.73441624	0.73441624	0.67646187	0.70516549
2034	0.51232936	0.88941043	0.37767526	0.5199821	0.5199821	0.50248425	0.51115058
2035	0.42294758	0.75986421	0.36707085	0.46771964	0.46771964	0.46015886	0.46390356
2036	0.00000000	0.88996281	0.32556048	0.54462577	0.54462577	0.55768123	0.55121512
2037	0.40591469	1.04080725	0.55803519	0.71059515	0.71059515	0.60827385	0.65895150
2038	0.40627074	0.68822626	0.33395934	0.43826705	0.43826705	0.42313867	0.43063145
2039	0.39775740	0.65586520	0.30556349	0.39816944	0.39816944	0.39587271	0.39701023
2040	0.35987509	0.45787451	0.22382584	0.27444211	0.27444211	0.29829774	0.28648253
2041	0.00000000	0.00000000	0.15058588	0.3252165	0.3252165	0.32781245	0.32652673
2042	0.47435308	0.70444011	0.32166149	0.44283477	0.44283477	0.42851170	0.43560563



**Figure 2: Filed 2020 WA IRP Avoided Distribution System Costs**

\$/dth	Zone 1	Zone 2	Zone 3	Zone 4	Oregon	Washington	System
2021	0.17435758	0.17140622	0.17201064	0.18054241	0.18054241	0.17276028	0.17499891
2022	0.184021695	0.180921018	0.181531687	0.19079733	0.19079733	0.18232985	0.184778914
2023	0.188933316	0.185818523	0.186390201	0.19614467	0.19614467	0.187204523	0.189804404
2024	0.171094367	0.168304602	0.168936266	0.17794185	0.17794185	0.169605082	0.172060762
2025	0.20503093	0.201738289	0.202504462	0.21348958	0.21348958	0.2032673	0.206288953
2026	0.184611244	0.181679137	0.182180908	0.19234188	0.19234188	0.182957391	0.18572383
2027	0.184601138	0.18173303	0.182148696	0.19255561	0.19255561	0.182951579	0.185801045
2028	0.184269064	0.181431862	0.18181788	0.19240622	0.19240622	0.182631676	0.185539723
2029	0.184255467	0.181457928	0.181837777	0.19259725	0.19259725	0.182646487	0.185626518
2030	0.185133729	0.182381187	0.182880775	0.1938037	0.1938037	0.183591233	0.186686648
2031	0.18246011	0.179785675	0.180309637	0.19119067	0.19119067	0.180965571	0.184071226
2032	0.182086652	0.179438936	0.179699186	0.19085196	0.19085196	0.180501383	0.18364219
2033	0.184826789	0.182161249	0.182413949	0.19390931	0.19390931	0.183233204	0.186486497
2034	0.185716139	0.183100254	0.183313172	0.19501154	0.19501154	0.184136506	0.187464527
2035	0.185858798	0.183253198	0.183453781	0.1953277	0.1953277	0.184287017	0.187679667
2036	0.185496781	0.182960943	0.183378919	0.19520604	0.19520604	0.184046863	0.187506907
2037	0.182587532	0.180091432	0.180271681	0.19217151	0.19217151	0.181064002	0.18449511
2038	0.186232782	0.183747613	0.183901224	0.196162	0.196162	0.18470451	0.188262644
2039	0.186358129	0.183884086	0.184047586	0.19644579	0.19644579	0.184840619	0.188453087
2040	0.186004908	0.183568945	0.183639798	0.19620377	0.19620377	0.184482658	0.188156182

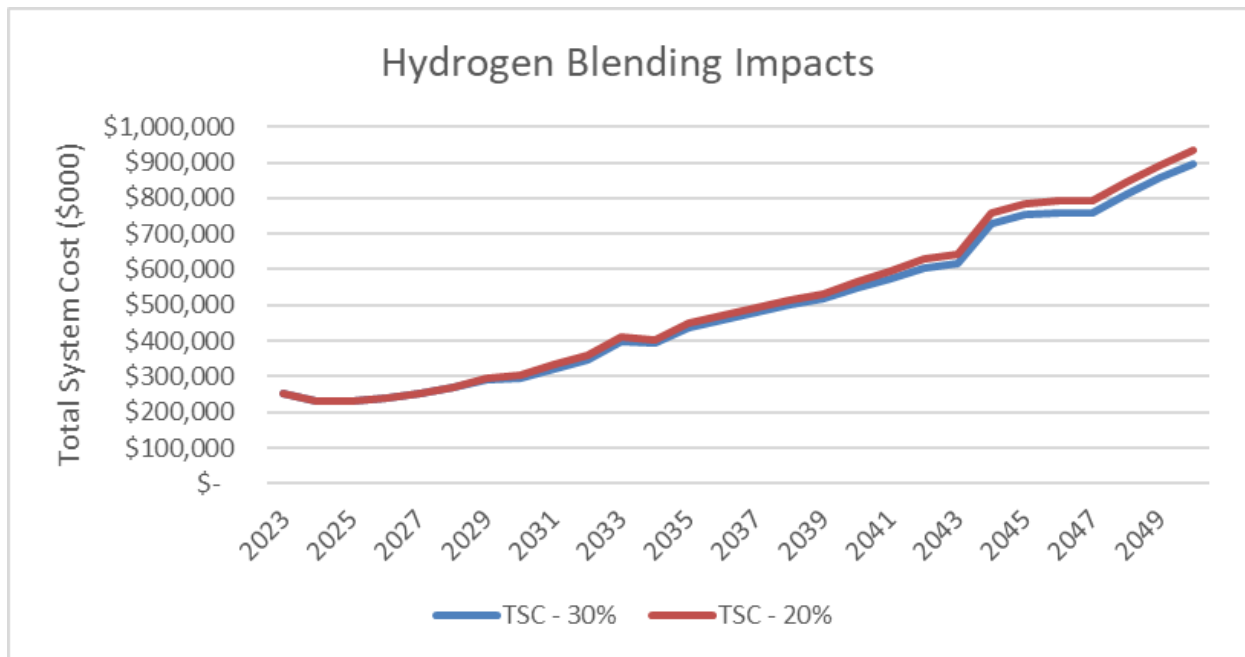
**Figure 3: Draft 2023 Environmental Compliance Costs**

\$/dth	System
2023	4.48879
2024	4.557849
2025	4.695965
2026	4.765024
2027	4.834082
2028	4.90314
2029	4.972199
2030	5.041257
2031	5.110315
2032	5.179374
2033	5.248432
2034	5.31749
2035	5.386549
2036	5.455607
2037	5.593723
2038	5.662782
2039	5.73184
2040	5.800898
2041	5.869957
2042	5.939015

**Figure 4: Filed 2020 WA IRP Environmental Compliance Costs**

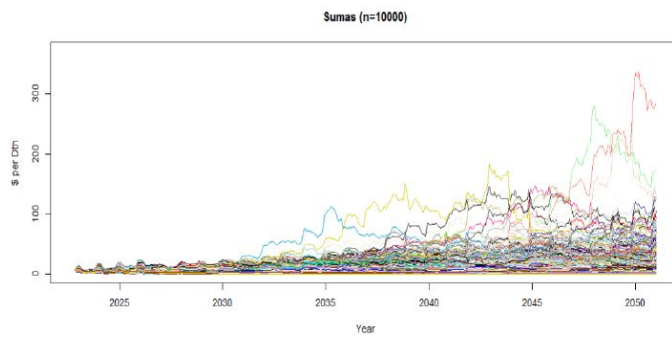
\$/dth	System
2021	4.02043
2022	4.084246
2023	4.148063
2024	4.211879
2025	4.339512
2026	4.403328
2027	4.467145
2028	4.530961
2029	4.594777
2030	4.658594
2031	4.72241
2032	4.786226
2033	4.850043
2034	4.913859
2035	4.977675
2036	5.041492
2037	5.169124
2038	5.232941
2039	5.296757
2040	5.360573

Figure 5: Hydrogen Blending impact to Scenario 5



**Figure 6: Monte Carlo Price Results**

10,000 Simulations



99<sup>th</sup> Percentile

