

**Northwest Power and Conservation Council
Generating Resources Advisory Committee
December 6, 2019**

Gillian Charles, NWPCC, began the meeting at 9:30 with introductions and a look at the day's agenda.

James VandenBos, BPA, asked if the GRAC will be getting cost curves for any of the technology on [Slide 4.] Mike Starrett, NWPCC, said they will be presented at a later date and offered to follow up.

Fred Heutte, NW Energy Coalition, added that NREL's ATB might provide some good baseline information for future resource costs. Charles said that the NREL ATB is already included in existing analysis and any significant new data will be considered until the final Plan.

Tom Haymaker, Clark PUD, asked if the Council is considering hydrogen opportunities under emerging resources [Slide 8.] Starrett said he spoke to Ken Dragoon, Flink Energy Consulting, and may incorporate it on the fuel price side. Haymaker suggested noting that in the Plan's narrative as he would like to reference to Council work and expertise on the matter.

Proposed Reference Plants for Natural Gas Technologies

Gillian Charles, NWPCC

Heutte asked about the gas peaker trend after 2009 [Slide 6.] Starrett thought they might be from out-of-region market purchases and high prices in CA.

Dhruv Bhatmagar, PNNL, asked if there is a typical time of year or hours when they are used more. Charles offered to get that information to him.

Starrett asked Haymaker his opinion on River Road in 2020-30. Haymaker answered that operation of the plant will be dictated by economics as they will not be mandated to do anything differently until 2030.

Brian Neff, CA Energy Commission, requested the research on peaker capacity factors. Charles said she will bring the monthly numbers to the January meeting.

Jim Woodward, WA UTC, asked if the graph [Slide 8.] includes the latest IRP information. Charles answered yes, she used PacifiCorp's IRP which identified Colstrip 3, 4 for potential retirement in 2027. Charles cautioned that PacifiCorp is only one of many owners of those units and therefore the dates should be considered tentative. Heutte suggested looking at Tom Lutey's article for a good summary about the state of play.

Greg Cullen, Energy Northwest, asked if there are any plans to replace some coal sites like Centralia with gas or other technology [Slide 10.] Charles answered that at one point Trans Alta

was considering alternatives for Centralia but didn't know if any plans have been made. Heutte was also unsure. Starrett added that BPA's transmission plan will increase sales of long-term firm transmission through the Centralia corridor after the unit retires.

Tomàs Morrissey, PNUCC, asked if the CA units on [Slide 11] are re-powers or rebuilds. Charles recalled that some are planned re-powering and offered to send data. Morrissey thanked her.

Heutte said a relatively big gas build is coming to Alberta [Slide 12.] Charles agreed and noted the slide only represents the US portion of the WECC.

Heutte asked about the aggregate NW capacity factor for 2017 [Slide 18.] Charles offered to provide that after the lunch break.

Woodward asked if [Council's latest electricity forecast summary of NG builds] is WECC-wide or just for the NW. Charles confirmed that it is WECC-wide [Slide 21]. Heutte noted that the bottom chart showing a 9000MW gas build out seemed implausible and said the real question is what kind of constraints to apply.

Heutte voiced confusion on the EIA monthly chart on [Slide 23] asking why capacity would vary monthly for a year. Starrett countered that the plot on the left still seemed reasonable. Heutte agreed that coal going down 10 GW a year made sense but questioned gas. Haymaker said the chart represents more than the WECC. Heutte said ok.

Heutte asked if anyone has seen actual acquisitions of the F Class turbine [Slide 24.] Charles said no. Heutte said newer machines are driving the market which says something about their life cycle.

Heutte asked what net plant output means [Slide 25.] Charles said it's the ISO rating ability generation. Woodward asked if the lower heat rate means increased efficiency. Charles confirmed that it does.

Heutte added that two of the three big turbine manufacturers have pulled back, making [Slide 26] more complicated.

BREAK

Woodward asked what HRSG on [Slide 27] stands for. Starrett answered Heat Recovery Steam Generator.

Heutte thought that reciprocating engines don't have altitude issues [Slide 28.] Charles offered to check.

Heutte said PAC is committed to repowering of Naughton 3 [Slide 30] and asked how that will be assessed. Charles said she hasn't considered repowering but if it's a viable resource option

she could go back and look. Heutte agreed that it's a bit of a mystery box but it could happen. Charles said some repowering is happening in wind that may be included in the next Plan.

Charlie Black, Charlie Black Energy, noted that Invenergy is not due for a repower and offered to look into it. Black then asked about the repowering of gas. Charles said it's not included currently but perhaps it should be explored. Cullen thought that it fits into the same discussion as new gas. Heutte thought it deserved some narrative in the Plan.

Black called this a gap in how IRPs and resource acquisitions are done, saying he's aware of several expensive repowering or relicensing projects that never appeared in an IRP but should be included in a regional Plan. Charles said resources that are not modeled can always go into the narrative.

Proposed 2021 Plan Reference Plants

Heutte approved of [Slide 41] particularly the costs derived from PGE data. He suggested going with an H or J model at this point.

Black referenced Lazard 12.0 which showed overnight capital costs from \$700 to \$950. Charles moved to [Slide 37] saying that Lazard is in the F class which are higher cost.

Morrissey liked [Slide 41] but said it's large in terms of MW and suggested looking at something smaller like a 7HA.01. Charles had data on that unit and offered to check and potentially test.

Heutte added that ATB capital cost is below \$900 [Slide 36] which ranged higher than the prices he liked better on [Slide 41.] Starrett confirmed that their price comes from a hybrid.

Heutte asserted that NW Energy Coalition will oppose the unnecessary building of new gas but said it's important to get these numbers as "good as we can." He offered to further investigate variations with the ATB. Charles said she will look at it again as well.

Haymaker pointed to a typo on [Slide 47] that showed variable O&M in \$/kw-y. Charles said she will change it to \$/MW-h.

Woodward asked if eastside/westside is delineated by the Cascade Range [Slide 55.] Charles confirmed.

VandenBos asked about separating out gas plants that have firm pipeline capacity versus dual fuel. Charles said she's proposing keeping it simple with the most straight forward approach as a reference plant, but could explore it if the committee wanted. Heutte said dual fuel has to be on the table for any westside new gas that gets built due to the FERC no-bump rule.

Natural Gas Price Forecast Steve Simmons, NWPCC

Starrett noted that PSE is looking for firm gas for peakers [Slide 1] and asked about east side firm gas limitations. Simmons answered that firm pipeline capacity is not limited on the east side. Heutte agreed, but added that there's not much right now. Simmons agreed that there is more on the west side.

Starrett confirmed that people talk about gas price forecasts as a "stacked bowl" where each year the gas price forecast is below the next. Simmons said they may be finally going down, adding that this forecast is similar to the Seventh Plan's mid-term, probably because of shale.

Cullen asked how WA's CETA factors in [Slide 7] saying he can see prices go up until 2030 and then dropping. Simmons said he is not modeling policy yet and wasn't sure what CETA's impact will be on prices. He added that RNG will probably be more "behind the city gate" rather than a hub price.

Starrett asked if the slide is meant to reflect some of the spot price volatility or delivery costs. Simmons said delivery costs are fixed and variable, adding that these prices are not meant to capture volatility but mapping to a specific hub.

Heutte had a problem with the Potential Gas Committee [Slide 5] as they only talk about resources and never talk about reserves. He called the industry self-certification process broken as there's no independent, public, transparent assessment of gas potential. He said this distorts the apparent view of gas. He called for a scenario that looks at a post-Marcellus-Peak gas price.

Haymaker countered that 10-12 years ago the region was looking at \$7-12 gas. He said prices might go down if extraction technology improves. Heutte responded that production and productivity seem to be leveling off, adding that the industry has been in the red for the decade which means it could turn quickly on pricing. Haymaker agreed, adding that we should recognize that it could go the other way too.

Simmons agreed there's a risk with a highly-leveraged industry but stated that money is cheap right now. Charles confirmed that the forecast has a high/low bound [Slide 6]. He added that the Potential Gas Committee's assessment comes out every two years and is higher each time.

Cullen asked how staff models increased interdependence and gas as a capacity peaker tool [Slide 5], referencing the March price spike where utilities wouldn't start their peakers. Simmons agreed that there are a lot of unknowns when it comes to interdependence and thought that adding more price volatility might capture the effect.

Starrett referenced Heutte's paper, the Double Squeeze, saying that WECC look at the reliability of gas around pipeline disturbance found that CA and the desert SW might have issues but the NW is fairly sound. Heutte said we felt the effect of the pipeline explosion, particularly on the west side, which led him to conclude that it's not a price issue but a deliverability issue. Simmons voiced interest in Canada's report on the ruptured pipeline.

LUNCH

Small Modular Reactors in the 2021 Plan

Mike Starrett, NWPCC

NuScale Overview

Dom Claudio, Director of Sales, NuScale

Starrett confirmed that each module can go down to 20% [Integrating Renewables: Load Following Strategies.] Claudio said the turbine bypass can go down to zero.

Morrissey asked if there are any fuel savings associated with ramping. Claudio said not on the turbine bypass stressing that fuel is a very small portion of costs. Cullen said variable costs are low in exchange for storing fuel on site and having it available.

Haymaker asked what the differences are between the three methods, wondering why you wouldn't use turbine bypass all the time. Claudio said turbine bypass is for a quick response but would be inefficient if you didn't need all that steam.

Starrett noted that the French nuclear fleet can load follow due to how they use their control rods.

Heutte asked if individual modules could be manipulated to do other industrial applications along with power production. Claudio answered yes, noting that matching ramps may present a limitation. He offered to provide data on the issue.

Morrissey asked if refueling can be staggered [Steam Generator Tests (2)]. Claudio answered yes the process allows that you would never be out.

Heutte asked plans for the testing phase. [Upper Module Mock-up.] Claudio said they have a customer, UAMPS, scheduled for their first module installation in 2026. Heutte asked if all 12 will be installed. Claudio said that's up to the customer but the first module is slated to be installed at the end of 2026 and the plan is to add one every 2-3 months. Cullen said the Nuclear Regulatory Commission has a clear testing approach outlined.

Heutte asked when they will fully test the unit at load. Claudio said after passing the test process you can go right on the grid with no minimum number of modules necessary.

Heutte asked if NuScale is evolving to a joint venture relationship with Fluor [Blazing the Trail to Commercialization.] Claudio said Fluor invested over \$500 million making them lead investors/parent company. He also pointed to other strategic partnerships.

Starrett said he thinks of Fluor as the EPC, NuScale as the OEM and not to expect IPPs until it's developed.

Heutte asked about resubmission and the NRC process. Claudio said the standard design for 50MW module was submitted years ago and a revision was submitted for a 60MW module. Claudio added that the time it will take to have it reviewed has already been factored in to the timeline.

Heutte asserted that “safety case” is a more European term [Slide 27] and asked for clarification. Claudio said he thinks of it as core damage frequency which is an actuarial view and offered to provide details. Heutte asked about the fuel. Claudio said there’s a spent fuel pool that can hold five years of fuel which is then moved to dry cast storage. Cullen added that Fukushima’s fuel pool survived the tidal wave accident without damage.

Haymaker confirmed that each module and generator can be dispatched separately [Slide 30.] Claudio replied yes, there’s no limitations based on where it’s located in the pool.

Morrissey asked about the lifespan of the unit. Claudio said the base case is a 40-year license with the expectation to renew to 60 and the building could go for 100 years.

Haymaker confirmed that the Idaho Falls plant will go to 12 units. Claudio answered yes, with one module dedicated to for the National Labs Jump Program and a second module with a purchased power agreement to support the lab.

VandenBos asked about the timeline from the date someone shows up at the shop to getting a 12-reactor unit in the ground. Claudio said it’s driven more by the licensing process than supply. Cullen said he’s using eight years.

Pacific Northwest Zero-Emitting Resources Study

Greg Cullen, Energy Northwest

Heutte asked how much coordination is done with the lab on storage technology development [Slide 6.] Cullen answered a little and explained the work.

Starrett confirmed that every scenario presumes the load on the right of [Slide 19.] Cullen answered yes.

Woodward confirmed that the presumed 5% of overgeneration would be sold out of state [Slide 22.] Cullen said yes.

Heutte said [Slide 24] shows a real hockey-stick curve where the last 5% is really expensive. Haymaker asked if the rates shown are regional or just for Washington. Cullen said it’s an average retail rate of the studied region.

Haymaker asked for clarity around the Zero-GHG % numbers being above 100%. Cullen said that reflects a scenario where you are exporting and curtailing overgeneration.

Morrissey asked for gigawatt nameplate for SMRs [Slide 27.] Cullen said they used 5.2 or 5.3GW.

Starrett said E3 doesn't normally use estimated retail rates and asked why they used that frame of reference [Slide 35.] Cullen said our utility members and policy makers use it as it's easier to understand. Morrissey suggested using a MWh-month.

On Slide 32, Cullen said the model allows a certain amount of import with a cap. Haymaker said that E3 reports don't get too granular into the reliability picture. Huette pointed to a flexibility study due out in the next week that examines what happens when you have no gas and a long duration of high demand during a low renewable period. He stressed that hope is not a plan.

Heutte said land use should be examined for other generating sources [Slide 36] and spoke about CA fires that started at a renewable energy generation source.

Heutte asked about the Extended Power Uprate [Nuclear—A Carbon-Free Energy Source] admitting he hadn't heard anything about it. Cullen stated that it's not new but never penciled out before, explaining that it's a licensing process with the NRC to increase reactor output. Heutte asked how long a 12% nameplate increase would take. Cullen said most plants do this in phases and it takes a couple months.

QUESTIONS at conclusion of presentation

Starrett said his push to not include incremental costs with new renewables would lead to different results. Cullen confirmed that this means not adding transmission costs [Slide 37.] Starrett said staff uses tranches and if load growth is modest and you're building resources why would you need transmission. Morrissey asked if this would lead to more curtailment. Starrett said Aurora might show more curtailment associated with extra nameplate and offered to talk more offline.

Starrett spoke to incorporating policy into base case, saying CETA, as it's written now, doesn't demand 100% clean but takes a more "neutral." Haymaker said that, right now, it's more aspirational with no compliance penalties until 2045. Cullen called this an open discussion for rule making, adding that the Governor's energy policy advisor says that intent says this is the law and there's no penalties because there's no choice but to follow the law. Cullen added that we have to see where the rule making lands.

Starrett said staff tests a variety of scenarios to account for this uncertainty. Haymaker stated that there are penalties from 2030 to 2045 that allow you to generate and bring to load. Haymaker said the rule making might allow that to continue or allow you to generate and export.

Cullen said he's hearing a lot of different voices about intent and gas (penalties until 2045, reluctance to build new gas, etc.) and suggested the Council consider them all as scenarios.

2021 Plan Scenarios [Slide 4]

Heutte appreciated the effort and transparency that went into NuScale's work but said without a traditional technology approach, i.e. a demo or research project on the grid, operation characteristics can't be confirmed. He said costs can vary for a lot of different reasons. Heutte concluded that this uncertainty around availability, performance and cost means the resource should probably not be included until post 2040.

Starrett said he wrestles with the same ideas adding that it shows up in high decarb scenarios and none of these are base case. He took comfort in knowing that if there are scenarios without a high carbon price it wouldn't matter that much, saying he is leaning towards testing it under the #4 scenario (paths to decarbonization).

VandenBos agreed that testing SMRs in #4 made sense as seeing multiple gas builds right outside of the study area doesn't seem reasonable.

Morrissey agreed and said it could be included in #3 (GHG cost tipping points) as well.

Heutte said the SMR's flexibility characteristics look similar to a gas recip and is somewhere between a conceptual and firm resource. He was interested in the lessons learned as NuScale moves from their first resource to the second, saying just putting in just one resource is not a full representation.

Cullen countered that this is the evolution of a long-lived technology. He said the main difference—how steam is generated—has been tested using resistance heat, adding that fuel design has been proven via model for decades. He said there is high confidence that this will work and licensing is in its final stages. Cullen argued that he thinks it will be commercially available by the end of 2020 and could be considered a secondary resource in the Plan.

Claudio said, as a market-facing rep, he is hearing fewer questions about the technology and more about project execution.

Cullen admitted that they may come across as biased but stressed that his organization approached the project objectively and concluded that it would be irresponsible, from a carbon-constrained standpoint, to not evaluate resources to meet objectives in a lowest cost way.

Haymaker said the technology has been around and the real question is why hasn't been looked at sooner. He said he was concerned with public but planned to investigate SMRs from a qualitative perspective in their next IRP.

Dave LeVee, PwrCast, called for a scenario that looked at a smart grid reaction to customers given an appropriate pricing signal. Starrett offered to follow up with customer-side work.

Charles pointed to future meetings and ended at 3:00.

Attendees

Gillian Charles	NWPCC
Mike Starrett	NWPCC
Dom Claudio	NuScale
Greg Cullen	Energy Northwest
Fred Heutte	NW Energy Coalition
Dhruv Bhatmagar	PNNL
Jim Woodward	WA UTC
James VandenBos	BPA
Tom Haymaker	Clark Public Utilities
Aaron Bush	PPC

Attendees via Webinar

Angela Tanghetti	CA Dept of Energy
Baili Conners	Northwestern
Brenna Vaughn	
Bryan Neff	CA Dept of Energy
Charlie Black	Charlie Black Energy
Christopher Allen	Cowlitz PUD
Dave LeVee	PwerCast
Dan Davis	US Army Corp of Engineers
Elizabeth Osborne	NWPCC
Frank Brown	BPA
Greg Nothstein	WA Commerce
Henry Tilghman	
John Goroski	
Tom Kaiserski	Montana Dept of Commerce
Kathi Scanlan	WA UTC
Kurt Conger	N Wasco PUD
Leann Bleakney	NWPCC
Jennifer Magat	PSE
Mike Hoffman	PNNL
Will Price	EWEB
Paul Nissley	Seattle City Light
Rebecca Smith	Oregon
Rich Flanigan	Grant PUD
Rob Diffely	BPA
Robert Campbell	Northwestern
Steve Andersen	EES Consulting
Ted Light	EES Consulting
Terry Toland	Clark PUD
Tomàs Morrissey	PNUCC