

Generating Resources Advisory Committee Meeting

December 18, 2014

Meeting Time: 10:00 A.M. to 2:30 P.M
Meeting Location: Northwest Power and Conservation Council
Facilitators: Steven Simmons & Gillian Charles, NW Power & Conservation Council
Note Taker: Amy Milshtein

Attendees On-Site

Tom Eckman	NWPCC
Gillian Charles	NWPCC
Steve Simmons	NWPCC
Jeff King	J.C. King and Associates
Fred Huetter	NW Energy Coalition
Jeff Kugel	PNGC Power
Eddie Abadi	Bonneville Power
Kathleen Newman	Oregonians for Renewable Energy Progress
Will Price	EWEB
Stefan Brown	PGE
Rick Sterling	Idaho PUC
Brian Skeahan	Consultant
Ken Dragoon	Flink Energy Consulting
Tomás Morrissey	PNUCC
Cameron Yourkowski	Renewable NW
Thad Roth	Energy Trust of OR
Robert Brown	PGE

Attendees via Go-To-Meeting

Ashley Bennett	Seattle City Light
Russ Schneider	Flathead Electric Coop
Ryan Hoppe	City of Tacoma
James Gall	Avista
Leann Bleakney	NWPCC
Dave LeVee	Pwrcast
Greg Nothstein	Washington State Dept of Commerce
Nathan Sandvig	NWH Global

Mike Murray	Benton PUD
Zac Yanez	Snohomish PUD
Elizabeth Hossner	Puget Sound Energy
Tom Kaiserski	Montana Dept of Commerce
Elizabeth Osborne	NWPCC
Phil Carver	Oregon Dept of Energy
Larry M Stene	BPA
Jeff Deren	Snohomish PUD
Sandra Elverud	PGE
Denise Hill	BPA
Keith Knitter	Grant County PUD
Robin Rego	Energy Northwest
Mike Hoffman	PNNL

Steven Simmons, NWPCC, began the meeting by welcoming the GRAC, going over the agenda and reviewing the role of the committee. He presented follow up data on Utility Scale Solar PV.

Gillian Charles, NWPCC, presented a review of Hydropower Potential. The minutes were adopted. Russ Schneider, Flathead Electric Co-op asked about how the information pipeline from the GRAC to the Council works. Simmons explained the process and noted that additional information is available in the posted staff-prepared agenda materials for the Council Meetings. He then noted upcoming GRAC meetings.

Preliminary Assumptions for On-Shore Wind Technologies

Charles presented information on what happened at the last meeting. She then outlined the present discussion.

Capacity Factors

Charles noted that last time she only had EIA data through 2012 that did not reflect an upward trend. She planned to present data from 2013 but cautioned the GRAC that it is only data from one year and wind is variable.

Spion Kop

Charles presented the data.

Judith Gap

Charles presented the data. Jeff Kugel, PNGC Power, noted that using a median instead of averages for capacity factors might be better for hydro. Charles noted that RPM uses an annual average.

Palouse

Charles presented the data.

Lower Snake River

Charles presented the data noting that the average annual for 2013 was lower than anticipated; 27.2%. Cameron Yourkowski, Renewable NW, agreed that that number caught his eye and asked PGE what they think. Robert Brown, PGE, answered that the expected capacity factor for Tucannon (which is located on the same site) is higher than 27.2%. He then said that there were two capacity factor estimates that have been used publicly: 36.8% and 38.2% but the second number is less transparent. Stefan Brown, PGE, called the 38.2% a rate case settled number and not based on actual projects.

Yourkowski noted the big difference but acknowledged that it is new technology coming on line. Robert Brown noted that the final turbine set up for Tucannon was a 2.3 mW Siemens 108. Elizabeth Hossner, Puget Sound Energy, notes that the Lower Snake River project was built with 101 meter rotors and the site itself is big with lots of variability between the phases so what PGE sees now will be different. Charles asked if the 27.2% strikes her as low. Hossner admitted that it was lower than they expected and that they thought it would be averaging about 30%. Charles reminded them that it's only one year. Hossner agreed and suggested looking at Hopkins as well.

Fred Huette, NW Energy Coalition, said based on Judith Gap data trend you should look at 5-6 years of data to get a good dispersion. Charles agreed.

Meadow Creek, High Mesa, Rockland

Charles narrated the slides.

Comparison of Regional 2013 Generation Shapes (MWh)

Charles compared the monthly average generation shapes for the seven projects. Yourkowski asked how this would factor into the GRAC analysis. Charles answered that it shows the variability of the locations. Thomas Morrissey, PNUCC, asked if the model differentiates power prices for different months. Simmons answered that the differentiator the model sees is more of the generation wind patterns based on location. Charles further explained that the Council is planning on including two wind reference plants into the RPM from two different locations.

Dave LeVee, Pwrcast, asked how the Council plans to incorporate hourly variability and compare month to month. Simmons answered that he's not sure and will get the RPM people on that question. Charles reminded the GRAC that a new RPM is being developed but she doesn't think it will offer hourly capability.

Capacity Factors

Charles presented data from the Sixth Power Plan and Proposed Draft Seventh Power Plan noting that the Columbia Basin stays at 32%. Eddie Abadi, Bonneville Power, asked if RPM puts a band around 32%. Simmons answered that he is not sure. Abadi stated that he thinks it's fine for now but reminds the Council that they are pulling from a distribution where you don't know a mean.

James Gall, Avista, noted that outages might have skewed the numbers and he is seeing upward trends in wind production but it is still less than the 38% they anticipated.

Jeff King, J.C. King and Associates, asked if the Council will be using the same capacity factors for the installed wind capacity as for the new. He further noted that he sees lower-than-predicted capacity factors in the existing fleet (28% for the Gorge area). Charles acknowledged the lower numbers and stated that if the RPM allows it they wouldn't apply these capacity factors to the existing projects. Eckman agreed with Charles.

Charles polled the room about using a 32% capacity factor for the Columbia Gorge and Southern Idaho regions. Schneider stated that the 32% doesn't make sense to him for the Southern Idaho projects given the updated results showing lower capacity factors. Charles defended the number, restating the annual average capacity factors for Meadow Creek and Rockland - 30%, 33% and 35% - make the case and noting that High Mesa seems to be an outlier. She called on Rick Sterling, Idaho PUC to elaborate.

Sterling stated that High Mesa is quite different than the other two locations. He agreed that the Eastern Idaho projects of Meadow Creek and Rockland will deliver higher capacity factors.

King stated that developers will gravitate to the better areas as long as land and transmission is available. He wonders about the transmission capability in Eastern Idaho but thinks it will develop over time. Sterling stated that the High Mesa area needs transmission upgrades to accommodate new wind.

Charles noted that she is not sure that Southern Idaho will make it into the RPM as is the focus will likely be more on the Columbia Basin and Montana. King asked Sterling if development gravitated to the PacifiCorp area of Idaho would it need additional transmission requirements

to serve the Boise area. Sterling stated it would depend on the size and timing of the projects. He noted that if Gateway West was completed it would provide a lot of capacity east to west. He stated that Meadow Creek is under contract to California and the rest is PURPA.

Phil Carver, Oregon Dept of Energy, asked if the Boardman/Hemmingway line frees up space. Sterling answered that it would provide a little export capability and more import and it's seasonal.

Charles moved to Central Montana where the proposed capacity factor moved from 38% to 40% for the draft Seventh Plan.

Yourkowski asked about a technology lag and the Production Tax Credit and wondered if there would be sensitivity around those two issues when it comes to wind. Charles answered that it is a possibility and they could consider it as a scenario even though the PTC expires in the New Year.

Simmons stated the real question is what the capacity factor for emerging technology is. Eckman stated we could treat it either as a reduction in cost or an improvement in efficiency. Yourkowski said he would provide an improved-technology-based capacity factor to the Council.

Kugel voiced a conflicting opinion stating that Judith Gap and Spion Kop data does not support 40%. He noted that both had a good wind year but the middle would be about 38%. Charles stated that she thought the Spion Kop project used reclaimed turbines and that might account for the lower than expected numbers. Yourkowski agreed. Tom Kaiserski, Montana Dept of Commerce, stated that he would look into it.

King reminded the GRAC that in the past the Council had not looked deeply at North Central Montana but that they found less than inspiring capacity factors. However the Council intends to model additional development from Central Montana as an import into Oregon and Washington area. Huette brought the conversation back to Judith Gap saying it averages to 39.88% and thinks that 40% is okay. He further noted that it's an older project and improvements will bring higher numbers.

Charles moved to the **Reference Plant**. Changes include changing economic life to 25 years and lowering construction lead time to two years, based on previous GRAC discussions and analysis. The GRAC agrees. Charles stated that she did not make any changes to **Capital, O&M Cost Assumptions** but removed the higher and lower bounds. She noted that the PTC has expired

(through 2014) but it could be modeled as a scenario. King suggested thinking about the PTC as a substitute for carbon control. Schneider supported Charles's assumption that the PTC would not be renewed. Stefan Brown asked if the Council assumes the ITC would go to 10% or go away. Simmons answered 10% in 2017, but just for solar per the rules.

Levelized Cost Cost Assumptions

Simmons presented **Remote Wind Transmission Cases**. Huette asked for clarification on the 10% transmission losses for wind: MT>OR via Colstrip Transmission System Upgrade. King answered that the numbers came together during the Fifth Power Plan under the auspices of Columbia Grid. Huette reiterated that 10% seems high. Stefan Brown agrees that 10% is high but reminds the GRAC that you have to pay average system losses. Stefan Brown then asked if the Council plans to model the MSTI option. Simmons answered that the Council would likely not be modeling MSTI and instead focus on the Colstrip upgrade.

Yourkowski asked for a breakdown of the fixed transmission cost. Simmons said he will provide it. King stated that the Colstrip upgrade was not included in the original work and the preliminary cost numbers might have come from preliminary estimates of the upgrades. King then addressed the losses stating that they were based on Colstrip to the I-5 corridor, not Judith Gap. If they were recalibrated from Judith Gap the losses might be less.

Yourkowski suggested digging into the fixed transmission cost number more. Simmons admitted that it was an initial stab and asked for more data. Hossner mentioned that Bonneville presents an average system loss rate of 1.9%.

Simmons presented **Wind- Levelized Cost of Energy**. King commented that some of the lower cost estimates may be coming from freeing up capacity, not upgrading Colstrip. Simmons agreed. Schneider asked if the Council is assuming a build decision by Bonneville on the Colstrip upgrade in the model. Simmons answered that it would be a potential path for Montana wind and we would have to figure out a realistic timeline.

Modeling Wind in the RPM

Simmons asked what the Council should limit Columbia Gorge wind development to. Morrissey asked if the limit would be that there were not enough suitable sites or too much wind in the area to integrate. Simmons said yes, it could be both. Charles mentioned that the resources to meet RPS are pretty much set until 2020. She mentioned that there were about 7000 MW of proposed projects being tracked in the Council's new project database and asked what is realistic. Morrissey answered that you might not need a number at all and pointed to the Sixth Plan and the model didn't pick much wind outside of RPS.

Simmons stated that the constraint might come into play if the model has to choose between Gorge and Montana wind. Eckman stated that there will be scenarios that constrain carbon to a low level that would expand the RPM's reliance on carbon-free generation.

Huette asked on what basis you make a limit decision and suggested that if you have to put in a limit you should make it high. King stated that the GRAC must consider the transmission situation. Huette stated that Columbia Gorge Regional Wind's shape is not the best for the system as it has low capacity factor.

Simmons stated that there will be more data and development to come. Will Price, EWEB, stated that it seems arbitrary to have a cap and a cap may hide some other information.

Preliminary Assumptions for Natural Gas Peaking Technologies

Charles presented the data for Frame, Aeroderivative and Intercooled technology and noted that there are no changes since the last GRAC meeting. Simmons presented Reciprocating Engines data.

Charles moved to **Capacity Factors** and pulled annual average data from Dave Gates, Danskin, Bennett Mountain and Fredonia 3 & 4.

Dave Gates Generating Station

Charles stated that this project appears to be an outlier compared to the other projects.

Danskin

Charles presented data.

Bennett Mountain

Charles called this resource more of what you would expect. Levee asked if the capacity factors would be used to evaluate the economic dispatch of the resources in the model. Charles said yes and pointed to a slide further in the presentation.

Fredonia 3 & 4

Charles presented.

Representative Capacity Factor for Comparative Levelized Cost Estimates.

Charles presented the data noting that the Council only uses capacity factors for comparison purposes but that it needs some estimate to look at levelized costs. She emphasized that the

capacity factor is not a direct input into the RPM. Huette stated that this highlights how Port Westward II is not a pure peaker but another technology altogether. Morrissey agreed with Huette's comments and asked how the Council plans to differentiate between units in the RPM. Charles stated they will not put all four technologies in as representative prospective resources, but rather two – likely a recip and one of the single cycles (probably intercooled or aero). Simmons stated that they are looking at cost differential and heat rate. He noted that the model will not catch fast start up times.

Levelized Cost Assumptions

Simmons presented data. He asked for thoughts on transmission costs. He noted that currently they use a fixed levelized cost of \$20/kW-yr and wonders if they can use a different transmission cost estimate to reflect incremental system cost of bringing on a new generating resource.

Stefan Brown said the BPA point-to-point is okay for the greater Northwest but asked if the Council is putting in an extra pancake for Montana and Southeast Idaho. Simmons answered yes.

Hossner asked why the Council isn't considering modeling the frame in the RPM. Simmons said they could. Hossner stated that the frame is the lowest cost resource and we are subject to prudence to provide power at the lowest cost. Simmons stated that the lower cost vaporizes as you move up to higher capacity factors like 25-40%. Hossner agreed but stated that she had never seen any peakers run that high. Abadi said if you have to pick two it makes sense to have one that will just sit and one that will balance. Simmons agreed, stating that a frame would just sit.

Huette stated that this is where the different operation characteristics really come into play. Simmons stated that they want to give the model lots of options. Price asked for clarification on variable energy resource (VER) integration into the system asking if there is a heat rate change over time. Simmons stated he believes so. Charles agreed stating it is .5% annually.

Price then asked if this is an hourly model. Simmons stated it can be considered an hourly model. Price then said that it would seem like the other VERs would have the same kind of protections, like improving capacity factors for wind.

King stated that in the past you did not have time to play with different technologies in the RPM. He stated the RPM probably will not pick up the specific differences of these technologies. You need to pick one or two that will most likely serve future resource needs in

the Northwest, citing the heat rate curve differences between these technologies. He continued saying that frames worked in the past when they complimented bad hydro years but that they would not be good for following solar or wind or serving afternoon peaks. These are the kinds of needs we will be seeing in the future.

Stefan Brown stated given the limits of the RPM and its ability to pick up characteristics of plants, he doesn't see how it would pick a Recip. Simmons answered that the heat rate would help it – if the model found itself in a future where it needed to run a peaker more, the recip would get the edge and overcome its higher capital cost. Charles added that we may just need to consider the reference plant as a proxy for one of the peakers. Eckman agreed with Stefan Brown and King stating that we should put in a proxy for a resource and we should start with the presumption that we need a recip even if it has a higher cost. Stefan Brown stated that until you get extra characteristics in the model we have to, as Charles said, view the results as a proxy for “some sort of flexible resource.”

Briefing on the Council's Direction for the Methodology for Quantifying Environmental Costs and Benefits of Resources.

Charles presented the data and noted the four points for **Environmental Costs and Benefits Methodology for New Resources**. She quickly narrated **Treatment of Existing Resources in Terms of Environmental Costs** and presented **Guidance from the Council-New and Existing Resources**.

Eckman stated to the GRAC that 111d is not the only carbon constraint that the Council will look at. Schneider asked if comments were summarized before they went to the Council. Charles answered that the Council received and reviewed all of the comments. Schneider asked if it is final. Charles stated that none of this is final – once the Council releases a draft plan there will be opportunity to comment before a final plan is adopted.

Kathleen Newman, OREP, asked why there is no plan going forward about the approach on residual environmental effects/damage/social costs and approach on quantifiable environmental benefits. Charles noted that she was just pointing to the direct recommendations from the Council that resulted in GRAC-related action and analysis. Eckman assured Newman that these issues will not be ignored but under due consideration.

Charles asked for resources and data on regulatory compliance costs to be sent directly to her. She also summarized the hydro scoping study noting that it will be treated as a secondary resource and not put into the RPM.

Emerging Technologies-Assumptions and Treatment

Simmons presented the data. He asked what might be developable over the life of the 20-year-plan. He mentioned that the Council is looking into a Zero Carbon Future Scenario.

Energy Storage Opportunities and Challenges

Ken Dragoon, Flink Energy Consulting

Dragoon introduced himself and noted the exploding interest in energy storage. He presented a **Generalized View of Energy Storage** where he drew the GRAC's attention to Power to Fuels where an end-use device puts power back into Primary Energy Storage and an **Energy Storage Comparison**.

He presented a slide on **Technologies** and pointed out the variety and complexity of options. He discussed **Modeling and Valuation Challenges** and spoke about the value stacking that they do in California. Eckman noted that they do the same for generation.

Dragoon moved to **Matching Capabilities and Needs**.

Dragoon discussed **Table of Storage Resources** noting that there is a lot of uncertainty in the numbers. Charles asked if the costs were based on specific projects or reports. Dragoon answered that in some cases they looked at a number of different projects but probably not all. Huette stated that the dollars/kilowatt looks like a lot but it might not be and gave an example of a fly-wheel being worth the money if you are running a server and needing instantaneous up time.

Dragoon said that storage has other value like meeting peak demands. King asked what the costs are based on. Dragoon answered that they may be based on a certain number of cycles per year or the storage value itself. He encouraged the GRAC to take a look at the source material, which was referenced on the slide.

Stefan Brown asked how you use the full range of storage stating that if you have a battery at 100% you can only go down. Dragoon pointed to solution from Germany where when the wind comes up they need flexibility and gas plants are off but a storage unit can be storing at that time. So the storage can generate 100 and consume 100.

Resource Planning and Energy Storage was discussed next as was **Policy Considerations** and **Integrating with Utility Operations**. He discussed the pros and cons of a single standard. Huette brought up the Dutch smart grid and noted that no one wants one unified standard but a

coherent set. He also stressed the importance of open versus proprietary signaling. Dragoon agreed and said that coordinating is another issue.

Dragoon discussed **Sidelights and Observations** and opened the floor to discussion. LeVee hypothesized that correct price signals would influence customer behavior and asked if there is any research to support this. Dragoon acknowledged that there are deep believers in this theory and that he hasn't done any studies but reminds the group that some of the value goes away. He likened it to cheap gas triggering big car sales. He concluded by saying there is a lot of risk in making an investment based on market signals. LeVee countered by saying the dynamics of pricing and value changes as you penetrate the markets and asks which is the greatest benefit alternative. LeVee agrees there are certain locations where the value is high i.e. Fox Island where the value of a small amount of storage might be really high. But the risk needs to be spread beyond the end user putting in a battery. LeVee reiterated his belief in market theory /market prices, stating that the utilities are obstructionists or non- believers that real time prices would have that effect and reiterates his belief that customers can add real value based on prices.

Simmons asked if Dragoon has followed California's progress and if there are any takeaway lessons for this region. Dragoon answered that the jury is still out but anecdotally he's aware of developer activity and utilities are encouraging this. He stated he would guess utilities are more predisposed of that than demand side management.

Huette stated that there is a lot of work done in California and gave the example of Edison. He then asked about the potential of water heaters and the effect of heat pump water heaters. Dragoon stated that a heat pump water heater takes $\frac{1}{3}$ to $\frac{1}{2}$ of the electricity to produce the same amount of heat so from a storage view you get $\frac{1}{3}$ to $\frac{1}{2}$ less of storage capabilities. He recalled a study that showed that you can efficiently use water heaters as storage without an energy penalty. Dragoon pointed to new technology, the trans critical carbon dioxide heat pumps which are twice as efficient as today's heat pump. This opens two possibilities, using electricity to heat homes and using water as thermal storage. Dragoon thinks this could be huge for both heating and cooling spaces.

Carver asked about the scale of pre-cooling large commercial buildings compared to water heater storage. Dragoon said he didn't know but suspects it's pretty large.

Mike Hoffman, PNNL, suggested looking at California Demand Response numbers to get an answer. Dragoon answered that those DR programs tend to be 5-9% of peak demand so that would be helpful. Dragoon stated that water heaters are small devices and there are a lot of

them so going after them will not be cheap and easy. Eckman further stated that they have a limited lifetime so this problem could be solved over time as they are replaced but retrofitting every water heater would be problematic.

Dragoon stated that the control would have to be installed before it left the factory and give people a choice of a standard water heater or one that the utility controls but is free.

Eckman asked about scenario construction time and wonders if the Audi methane production project is anywhere near going to scale. Dragoon answered that he doesn't know. He then mentioned that getting back to electric and fossil-fuel boilers side by side could solve the oversupply problem cheaply. He mentioned the 5000 megawatts of fossil-fuel boilers in Oregon noting that it is a huge potential for absorbing oversupply. He concluded, saying that right now no one has the incentive to do this but it is coming.

Dragoon and Eckman agree that oversupply will be the issue of the future. Dragoon stated that predicting ramps is like gold and wished that Bonneville did more of that. He further stated that we do want to get to a point where we control renewables. Eckman stated that we've done hydro firming for years and this is the same problem.

Price stated that the time scales go down to the second now and wondered how you translate short term operational values into a long term context of the Seventh Plan. He then asked how you deal with storage in a 20-year-plan.

Eckman answered that the granularity is a separate question and reiterated that the Council is not an operational entity and will not do transmission or power flow studies to determine system integration needs.

Eckman then moved to the strategic question of what do we do with oversupply due to a 30-50% RPS mandate in California. He called these scenarios that the Council has to play out if we got that market signal.

Hoffman mentioned that there is room on the DC Intertie for another line which would mean another 3000 megawatts. Huette stated that if BPA sees a market opportunity they might be interested. Eckman stated it might go the other way.

Huette stated that the big question is customer-driven energy like rooftop solar. Eckman said market prices are hard to predict.

Huette moved back to longer term planning versus operational planning and praised the various players for keeping data consistent. He feels there is no one-size-fits-all model and coordination is the most important thing. He suggested that Bonneville might want to start looking at the value and flexibility of the river in that big grid.

Carver stated the heuristics of the river rules are 50 years old. He conceded that they are hard to change but there has not been good -multi –objective planning. Eckman stated the courts run the river for fish right now. Huette stated that it is not that simple and that we need more dynamic drivers. He also pointed to the Columbia River Treaty and said it will be interesting.

Stefan Brown moved to answer Huette's comments on transmission planning and called it a chicken and egg problem with transmission and resource planning. He said transmission takes 10 years to build and resources take two to three years. He stated the problem is you don't know what resources you can get delivered to load if you need transmission and you can't get transmission funded until you have the resources to connect with it. Brown said that having a transmission planners get together is great but it doesn't get rid of the chicken /egg problem.

Simmons mentioned that this opens up the issue of distributed generation that bypasses transmission. He pointed to solar companies in CA trying to develop small scale storage for their system. Dragoon stated he was aware of that but it is a niche market today but there is the hope that prices will come down.

Huette brought up the stacked value for storage but called this example synergistic; integrated solar and storage could be extraordinary.

Charles moved the conversation back to storage resources and wondered which one will rise to the top in a 20-year scenario. Dragoon mentioned lithium ion and flow batteries and super capacitors but if you are trying to balance wind you are looking at pump storage or compressed air. He then said if you're looking for fast-acting response then fly wheels and capacitors would be a possibility.

Price asked about basalt formations that BPA was testing for compressed air energy storage. Hoffman pointed to a PNNL study that he will send to Charles. Huette further explained the project calling it serious.

Simmons ended the sessions by reviewing future meetings.