

**Northwest Power and Conservation Council
Generating Resources Advisory Committee
November 2, 2017**

Gillian Charles, NPCC, began the meeting at 9:30 by calling for introductions and a brief synopsis of how GRAC members spent their summer. She then reviewed the agenda and timelines.

Conclusion of ANLYS-17: White Paper on the Value of Energy Storage to the Future Power System

Mike Starrett, NPCC

Brad Spangler, Snohomish PUD, asked if the White Paper gave any policy direction on valuing the capacity of pumped storage as a commodity. He noted that the goal would be to include it into the net present value future calculation for marketing purposes. Starrett pointed to his summary of other regional work which assigned a capacity value similar to a peaker. Starrett noted that this will be revisited during the modeling work.

Dave LeVee, PwrCast, suggested that there are two ways to think about the value of capacity: the expected value of conditions that require additional capacity or the value of energy given the full range of possible conditions that might exist. LeVee stated that he favored the second option and asked if the modeling would do this as well. Starrett admitted that the modeling process has just begun but stated that a typical Portfolio Model usually assigns the next cheapest resource that can be procured.

Rick Williams, PSU, approved of the discussion of cost but noted that landing on a price is difficult without a wholesale market. He noted that location, resource and situation often drive price. Williams then stated that the situational value of storage as a generating reserve, particularly for an isolated region, will be difficult to ascertain and he looked forward to a robust discussion.

Ken Dragoon, Flink Energy Consulting, thanked Starrett for including his previous notes mentioned at the GRAC meeting and asked if there are any plans to look at the cost of the storage he mentioned. Starrett answered yes, they would be covered under Action Item 14.

Ocean Energy Technology Costs, Potential, & Resource Diversity

Tomás Morrissey, PNUCC, asked for an explanation of the UK policy [Slide 7.] Starrett explained that the government held a Contract for Differences auction for emerging renewable resources that didn't include on-shore wind or solar and the strike price that clears the market (for example, \$100) is the amount the developer will be paid. The difference between the market price and the strike price is made up by a subsidy.

Morrissey asked if [Slide 13] represented a monthly average. Starrett answered yes, monthly average and hourly shape within that month. Morrissey thought a probability density function (PDF) of the hourly data would be useful. Starrett agreed with Morrissey's point and suggested that a PDF would be interesting to look at.

Jeff Kugel, PNGC Power, asked if the Council will explore if it makes economic sense to spend \$200+/MWh for offshore wind in a region rich in hydro, or will you just look at how the resource integrates with California's Duck Curve. Starrett answered that the goal is to have a confident sense of what the costs look like, why they look like that and the shape of the resource and it's up to utilities to plug it into their resource stack and see where it fits. Kugel theorized that it would be close to the bottom.

Jason Busch, POET, noted that CA was pleased with this study as it could help their Duck Curve issues.

Shamus Gamache, Central Lincoln PUD, asked if there is any research that looks at the appropriateness of floating versus anchored offshore wind in the Cascadia Subduction Zone. Starrett answered no, but there may be an opportunity to drive a forthcoming BOEM study on this.

Williams added that anecdotally, mariners view any depth deeper than 100 meters to be safe during a tsunami although there are back flush and shore scouring issues.

Jimmy Lindsay, PGE, pointed to proposed OR legislation that would require IOUs to purchase Principal Power's WindFloat with an above market PPA price. Starrett recalled that price was around \$240 and looked forward to seeing prices after a few are installed.

Diane Broad, Oregon Department of Energy, praised the presentation and asked that transmission costs be evaluated and included. Starrett said he plans to include them and is looking for the most recent update. Charles noted that Montana wind was evaluated using several different scenarios for the Seventh Plan including using transmission from a retired coal plant and building new transmission. Starrett said his analysis will include substation connections and available capacity.

Williams stated that the International Electrotechnical Commission looks at ocean and river current energy, noting that river current is important in Alaska and could be important here too.

Lindsay added that evaluating floating offshore wind depends on the questions asked by the Eighth Plan. He agreed that traditional analysis would not likely find floating offshore wind to be cost competitive but expressed curiosity on how aggressive regional de-carbonization and elevated renewable requirements along with a drive for geographic diversification will shape the analysis. Would the diversity of offshore wind provide an adequacy benefit relative to other

resource types? Starrett agreed, expressing a desire to see a Resource Adequacy study that looks at offshore wind versus Gorge wind.

Lindsay said he's interested in seeing how our Resource Adequacy results change with a stringent CO2 cap. Charles noted that the Seventh Plan included a scenario that capped all new thermal builds, but wasn't sure if it included offshore wind as an option.

BREAK

Council's Generating Resources—Project Database

Morrissey asked whose wind farm is represented on [Slide 11.] Charles was not sure, guessing it was an out-of-region farm in Montana and offered to follow up later.

Gamache asked if the Power Generation Map includes the Pacific Marine Energy Center (PMEC.) Charles answered no, not currently. Gamache asked if the PMEC will be added to the database once it is connected to the grid. Starrett answered probably not as the database is an input to the regional portfolio model and including a non-generating resource might be confusing. Charles suggested placing it under the New Projects tab.

Williams agreed that there is value in acknowledging PMEC but suggested citing it as a test site. Charles agreed.

Morrissey asked if the average heat rate on [Slide 15] is historical averages. Charles answered not necessarily as averages change by year depending on outages and planned maintenance. Morrissey mentioned an BPA source called eGRID that also varies year to year.

Qihui Qi, Puget Sound Energy, noted that SNL Energy also provides heat rate information. Charles agreed but pointed to the same problem of misleading data.

Morrissey noted that IRPs probably have Seasonal Capacity data but they would all be different. Starrett agreed, saying that's why the Council has its own data.

Dragoon asked if the new Power Generation Map will include under-construction or proposed generation. Charles answered that a secondary map is planned for that information.

Charles asked the GRAC for suggestions and requests for the website, database and map [Slide 20.]

Dragoon asked what the granularity is on the map. Charles said the Google-maps coordinates are included.

Gamache asked if pump storage is represented. Charles answered yes.

Qi noted historical monthly energy supply data available at PSE and mentioned that there might be a fuel price difference for natural gas based on location. She asked if the Council has fuel price data based on location or other natural gas resources. Charles stated that price is not tracked in the database but connections are. She continued, saying that tracking monthly data would be too cumbersome but there is annual, historical generation. She concluded by noting that monthly information is tracked elsewhere. Morrissey added that you can get the monthly information from the EIA.

Cameron Yourkowski, Renewable NW, approved of adding a ramp rate data field and asked if there is any consideration to add other flexible metrics like minimum run time or start up time. Charles answered yes, moving to [Slide 15] to illustrate.

Greg Brownell, EWEB, noted that California's energy commission website tracks development costs for new projects, especially renewables and asked if the Council does something similar. Charles answered yes in separate tracking workbooks.

Dragoon reminisced that when he was at the Council there was talk of moving to a more advanced database structure and asked if there are still plans to do that. Charles said some options, including an online interface were explored but it was decided to stay with the Excel model. Dragoon agreed that it is a convenient, easy-to-use platform.

Gamache pointed to CALISO's mobile app and asked if the Council would ever have one. Charles called that an exciting idea. Morrissey thanked Charles for the database, calling it a useful tool.

Regional PURPA development and transmission utilization

Sylvia Tanner, Renewable NW, noted that Montana decided to extend their contract for 15 years [Slide 8]. She then stated that in Oregon, PacifiCorp and Idaho Power already had a 3 MW cap in their standard offer through previous requests for relief.

Dragoon approved of reassessing the old rules around firm transmission to deliver, which he suggested was an attempt by utilities to "protect" themselves from PURPA.

Henry Tilghman, Tilghman Associates, referenced NIPPC's active PURPA dockets as proof of interest from developers. He hoped the Council staff would reach out to Robert Kahn, Executive Director, for more insight and contacts. Tanner echoed Tilghman's point of engaging active PURPA actors. Starrett reiterated that he had no stake in PURPA in general but was trying to gauge if a large solar resource would be coming online any time soon for the purpose of regional planning and resource adequacy.

Broad stated that PURPA projects can be as large as 80 MW but only projects 10 MW or smaller have the guaranteed standard contract prices and interconnection process streamlining. She stated that Idaho Power's IRP has 20-40MW projects coming on-line which are negotiated power purchase agreements. Broad stated that the cost of solar, the strength of the resource and an appetite for renewables are driving the projects and not just the standard contract

prices. She called this an interesting topic to explore but suggested putting boundaries on the conversation as transmission utilization is a complicated, time-consuming topic.

Lindsay asked if Starrett wanted to know about transmission utilization more broadly or its role as a barrier to PURPA developments. Starrett answered the former as he is not specifically interested in PURPA development beyond tracking the activity for planning. Lindsay referenced conversations at the BPA about changing transmission products, but he admitted that it might be hard to forecast where that would land.

Tilghman wondered if PURPA was the right scope for this conversation, suggesting it might be anything outside the utility IRP. He pointed to server farms negotiating their own power purchase agreements and community solar as other potential generation development drivers. Starrett agreed and agreed to schedule a webinar for further discussion.

LUNCH

Charles reviewed the afternoon agenda and introduced Jason Busch, POET, Ken Dragoon, Flink Energy and Kevin Banister, Principal Power as the afternoon presenters.

Marine Renewable Energy: Opportunity Knocks

Starrett asked for the weight differences between a monopile versus a spar structure. Kevin Bannister, Principal Power, stated that there are many variables but monopile would have steel in the seabed and that you therefore have to make modest adjustments on the monopile length across a site to account for differences in depth.

Gamache asked if the Morrow Bay turbines would be connected to Southern Cal Edison. Brian Neff, CA Energy Commission, said it would connect to Diablo Canyon intersection which is PG&E territory. Williams added that there are still some pesky details with the transmission paths. Busch agreed, adding that it will be a complicated next two years.

David Nightingale, WA UTC, expressed surprise that the presenters capitulated on near-shore, shallow water technology especially for southern Washington state. Busch explained that in Oregon the near-shore environment is busy but Washington has begun a planning process and he expressed curiosity in what areas the state found as least conflicted. Williams agreed that there are opportunities closer to shore, but issues like jurisdiction squashed a project at Grays Harbor. Williams noted that while other parts of the world treat the technology as a tourist attraction or a navigational aid, he didn't think local stakeholders would view them similarly.

Starrett agreed that there would be less conflict 12 miles out from shore based on DOE studies and emphasized that studies show much more opportunity out there as well. Nightingale agreed.

Busch asked if there were any questions about tidal technology.

Brownell asked if there is any analysis on the total potential of tidal as a resource. Busch answered yes pointing to NREL and IEA and offered to send it along. He reminded Brownell that Snohomish tried to install this technology but ran into trouble and felt that most of the opportunity is in BC and Alaska.

BREAK

Discussion of Leading Questions

Williams pointed to a study on the OWET site that analyzed what was needed for a good wind energy site. He stated that, while it was used to site P MEC, it could be applied to any marine or hydrokinetic site assessment. Gamache added that you should look at where your loads are and who you could serve.

Starrett asked Gamache what Central Lincoln PUD's peak load looks like. Gamache said they are winter peaking at 250MW with about 80MW of that in a single GP mill.

Broad relayed that WECC's transmission expansion planning process agreed to consider a scenario of 3000MW of offshore wind in Northern California or Southern Oregon. She noted that it is a medium priority item but she is urging them to classify it as high priority as the technology appears to be moving quickly.

Tilghman asked the room to think of the alternatives when considering costs. He noted that California is looking at Wyoming or New Mexico wind which would require \$3 billion in transmission upgrades while 20 miles of undersea cable costs much less.

Onno Husing, Lincoln County, OR, discussed his deep involvement with offshore energy and marine policy and thought the sector was reaching a maturation point. He acknowledged that it has been a difficult path and was hopeful that real price points, real customers and real comparisons were forthcoming. He saw tremendous opportunities ahead but felt that there was also a woefully inadequate, 19th-century-esque Federal statute environment.

Husing felt the best course forward was complying with the statute, as opposed to resisting it, and building that compliance into the budget. He acknowledged the gauntlet of regulations an offshore developer must contend with and hoped that there would be more transparency, thought and an anchor in reality. He concluded by voicing astonishment at how far the price points for off-shore wind have come especially in the last six months which made his above concerns more pressing.

Busch asked to discuss how to bring above-market power online.

Dragoon discussed past attempts and places to look for support like utility R&D budgets, BPA's technology innovation program and the MOD wind projects. He referenced early wind projects, SnoPUD's work on tidal energy and PGE's alternatives for repowering Boardman with biomass.

Dragoon mentioned PacifiCorp's investment of shareholder money in Blacklight Power that relied on the hydriano atom. He said this work resulted in gaining expertise.

Banister added that the Foote Creek Project is above market with multiple owners. Dragoon agreed.

Lindsay added the Salem Smart Power Center to the list and said the central theme is should we pursue actions that aren't lowest cost at the moment. He noted that the value or policy based proposition was easier to communicate with other technologies but offshore wind is not as inherently more environmentally benign than a terrestrial installation. He felt an important question to explore would be: Can we imagine a future where this kind of resource is more valuable and essential than the tools we already have. He speculated that if the answer is yes, or a strong maybe, then answering the other questions becomes easier.

Husing piggybacked on that, saying legislators need to know what has been properly vetted and peer-reviewed so they can make the tough votes.

Banister touched on the last question: How we monetize the benefits (geographic diversity, avoidance of long transmission builds, time of generation) of these resources and others as well. He stated that to get at universal values we need a common tool to judge them.

Williams pointed to PGE voluntary market and OWET's blue tag study as ways to bring above market power online. He stressed the need to value system benefits of location and availability because when the grid goes down people die. He noted that Oregon's Public Utilities have a docket on the resource value of solar and wondered what it would take to get a docket on marine energy and offshore wind. He concluded by pointing to Copenhagen's use of offshore wind as a tourist attraction and wondered if the coastal communities might rethink their position after a few more grid outages.

Nightingale recognized that PSE did some of the work Banister referenced in their upcoming IRP. Garret LaBove, Puget Sound Energy, agreed that there is work in their IRP but cost effectiveness is an issue. Nightingale added that a consultant used backward looking data which would affect price points. Nightingale was intrigued by capacity factor and times of use and compared it to Montana wind.

Qi said PSE's long-term optimization model helps choose an optimal portfolio for the next 20 years. She expressed interest in the investment costs of offshore wind calling it most important to the model. She pointed to other parameters like capacity factor, transmission cost and peak capacity contribution as other important factors to know.

Husing reiterated that the market is evolving quickly and prices are coming down astonishingly fast.

Elizabeth Hossner, PSE, explained the significant work they've done on offshore wind and said they were stymied by two questions: How far off the coast they needed to go and the cost of marine cable.

Husing stated that when doing the monetization, he hoped there would be a look at the cost to other industries, the communities and the environment 50 miles off the Oregon coast.

Busch thanked the room for their input and hoped for more cooperation in the future.

Charles reviewed conclusions which included ways to get involved and contact information. She adjourned the meeting at 4:00.

Attendees on Site

Gillian Charles	NPCC
Mike Starrett	NPCC
Shamus Gamache	Central Lincoln PUD
Qihui Qi	Puget Sound Energy
Garret LaBove	Puget Sound Energy
Leann Bleakney	OR NPCC
Tomás Morrissey	PNUCC
Cameron Yourkowski	Renewable NW
Mitch Green	Bonneville Power Administration
Diane Broad	Oregon Department of Energy
Jason Busch	POET
Ken Dragoon	Flink Energy Consulting
Rick Williams	PSU
Jimmy Lindsay	PGE
Greg Nothstein	WA Energy Office
Greg Brownell	EWEB
Henry Tilghman	Tilghman Associates
Onno Husing	Lincoln County, OR
Kevin Banister	Principle Power

Attendees via Go-To-Meeting

Alaine Ginocchio	Western Interstate Energy Board
Andrew Warren	
Brad Spangler	Snohomish PUD
Cam LeHouillier	Tacoma Power
Dave LeVee	Pwrcast
Delia Kelly	OSU
Elizabeth Osborne	NPCC
Elizabeth Hossner	PSE
Jan Lee	NW Hydro
Jeff Kugel	PNGC Power

John Lyons	Avista
Garrison Marr	SNOPUD
Matt Sanders	Oregon Wave
Mike Hoffman	PNNL
Nate Sandvig	National Grid
Brian Neff	CA Energy Commission
David Nightingale	WA UTC
Will Price	EWEB
Robin A. Rego	Energy Northwest
Adam Rue	EWEB
Silvia Tanner	Renewable NW
Terry Toland	Clark PUD
Zac Yanez	PSE
Zeecha Van Hoose	Clark PUD