

**Northwest Power and Conservation Council
Generating Resources Advisory Committee
March 16, 2017**

Gillian Charles, NPCC, began the meeting at 9:40 and called for introductions. Participants spoke about their storage interests and expertise. The agenda was reviewed.

Discussion of Energy Storage/ ANLYS-16: White Paper on the Value of energy Storage to the Future Power System

Gillian Charles, NPCC, Mike Starrett, NPCC

Mike Hoffman, PNNL, stated that along with the DRAC there have been EE groups in the past that are exploring the value of demand impacts of EE and asked if they will be included in a larger, planning model [Slide 6.] Starrett answered yes and mentioned internal discussions.

Ken Dragoon, Flink Energy Consulting, stated that there could be ramifications from taking a too-narrow focus. Charles reminded the room that this White Paper and meeting is a first step in looking at storage. Brian Skeahan, Klickitat PUD, asked if there will be time in this meeting to talk about the issue. Charles assured him there would be.

Silvia Tanner, Renewable NW, offered a correction to [Slide 17], saying June 1, 2017 is a draft storage potential evaluation, which is a precursor to a draft proposal. Starrett agreed.

BREAK

Why Energy Storage?

Ken Dragoon, Flink Energy

Dragoon noted that he understands why back-of-the-meter storage is excluded but cautioned that we exclude them at our peril.

Fred Heutte, NW Energy Coalition, noted that discussions about water heaters have been going on for 10 years and there are new motivations to move forward. He noted that thermal storage doesn't easily fit into one category. Heutte referenced an unpublished study that found that water heaters potentially house an enormous amount of frequency response along with a huge amount of storage. He suggested a full session on this resource in the future.

Dragoon voiced support for exploring water heater potential, but stated that they are not the lowest hanging fruit or biggest opportunity available. He pointed to EWEB's success with water pumping storage.

Hoffman asked how communications could be subsidized, noting that control systems and accounting are an expensive challenge for utilities.

Charles added that Analy-14 mandates tracking emerging technology which includes “other” meaning there will be opportunities to evaluate and discuss other technologies. She then spoke to Heutte, saying the White Paper is an initial stab at storage and will be open to all once it’s published. She concluded by referencing the System Integration Forum which will discuss cross-cutting topics like storage.

Ben Kujala, NPCC, pointed to the White Paper’s focus on finding values. He asked the room to dig into finding appropriate values for front-of-meter, utility-scale storage. He acknowledged the fear of missing an opportunity by not exploring every technology and suggested noting them for Staff to explore internally.

Hoffman asked if there is a plan on how to separate out distribution-level benefits and transmission benefits. Starrett stated that he hoped the GRAC can do that. He reiterated that the goal is to focus on values, then create a templet to overlay on valuations or technologies.

Dragoon voiced concern that leaving storage out of the conversation implies that behind-the-meter technology is different, therefore the evaluation does not apply. He reinforced that thermal energy storage and municipal water pumping is just like pump storage for much less money, yet by leaving them out gets classified as “something else that doesn’t bring the values.”

Kujala cautioned about the scope of the White Paper, saying it is not a holistic analysis for the Eighth Power Plan or a portfolio analysis. Dragoon clarified that he doesn’t want the exclusion of behind-the-meter technologies to be read as the technology doesn’t count as energy storage.

Kujala encouraged the group to write comprehensive notes on the White Paper while keeping the Council’s scope in mind. He noted that the DRAC is exploring behind-the-meter technologies. He acknowledged that the White Paper needs a careful approach and suggested an introduction that identifies technologies that have similar characteristics but are not in scope. Dragoon agreed with that approach, saying even a reference to other technologies with similar values would be helpful. Kujala stated that he was especially interested in the unique values of back-of-meter technologies that could not be found elsewhere.

Dragoon argued that the values are virtually identical but the implementation and costs are different. Kujala stated that the goal is a good list of values provided by the technology, likening it to a checklist.

Charles pointed to the technology scope found in the White Paper’s introduction where the issue is addressed. She asked the GRAC to look at it and offer improvements.

Dave LeVee, PowerCast, noted that this is a dynamic process and going after low-hanging fruit changes the economic value of what's left on the table. Kujala reiterated that this is not a re-do of the Seventh Plan but a conversation that is looking forward the Eighth.

Michael Grenier, independent consultant, asked for an acknowledgement that the existing methodologies and tools used to evaluate values of a number of different storage technologies are inadequate. He stated that because of inadequacy, the values will be wrong. Kujala agreed that power system models can't capture all of the elements of storage, but did not think that current results are wrong. He did note that price trajectories are going down quickly. Kujala urged the room to not sell the IRP analysts short as they engage with models thoughtfully.

Grenier pointed to PJM and the amount of capacity freed up. Kujala countered that an organized market and other structures change the answer, but PJM lacks hydro and is different in other ways as well.

Charles noted that modeling energy storage is new for the region and the country. She said the goal is to improve on capturing values.

Heutte asked for details on the System Integration Forum. Kujala explained that it's a delicate balance with the Advisory Committees and does not want to schedule anything until everyone is ready.

Heutte then commented that there are three broad use cases for storage: DR/peak load reduction which is well characterized, ancillary services which is not well defined but people are working on it and arbitrage which is easy to characterize and hard to monetize. He hoped that the White Paper would not be the end all as more information is coming.

Elaine Hart, PGE, addressed Grenier's earlier comment that "we know the analysis will be wrong," calling it correct as a flexible resource derives its value from inefficiencies, constraints or friction. She thought that individual utilities would define these constraints differently leading to different values and asked that we keep in mind that this is a system-specific evaluation exercise and a regional look will probably be low. Starrett agreed but hoped that the region could attempt consistency in the value streams.

John Ollis, NPCC, suggested putting water heaters on the agenda for the June 7, 2017 DRAC and asked for comments to be sent to him or Tina Jayaweera, NPCC.

Hoffman stressed that the complexity of the issue coupled with real-world economic drivers make a universal model impossible. Kujala agreed saying multiple models can help with evaluations while reminding the room that models are tools and their output requires careful expert consideration.

Nate Sandvig, National Grid, referenced his work and finding significant benefit to the Northwest. He stated the importance of finding value stream common ground. Sandvig then

pointed to the highly-fragmented market and wondered about contracting the values and benefits. He offered to share output with the group along with technology.

Starrett pointed to the Action Item, stating that the second paragraph addresses Sandvig's concern. Starrett then stated that they are looking at which approaches to take to accommodate the values.

Jeff Kugel, PNGC, stated that his utility did not use water heaters for utility-scale storage because they can't put energy on the grid. He stated that his DR programs include a necessary opt-out clause differentiating them from a battery that can be dispatched at will. Starrett disagreed and offered take the conversation off-line. Heutte stated that from the grid's perspective these things provide INCs and DEC's, end of story.

Dragoon questioned the list of technologies [Slide 26] asking why a comprehensive list is important as new technologies and capabilities are developing all the time. Kujala clarified that Staff is not looking for a comprehensive list but a good list of candidate technologies to inform value streams.

Starrett asked for feedback on the technologies listed on [Slide 27]. Hoffman questioned the viability of compressed air. Heutte referenced a serious effort in central Utah. There were head nods of agreement in the room. He asked if there were amenable geological structures in the Northwest. Charles recalled an BPA scoping effort.

Dragoon pointed to producing fuels from electrical energy, i.e. ammonia, hydrogen and methane, calling that energy storage. He acknowledged that these are customer-side options and preliminary.

Jeremy Twitchell, WA-UTC, went back to compressed air storage noting that PNNL and EPA found two small (200-300 MW) but economically viable locations.

Kujala suggested adding production of fuels to the list but perhaps identifying technologies that are on the cusp of economic evaluation versus technologies that are not.

Dragoon hoped that fuel production would be added, noted that energy efficiency isn't high but capital costs are low.

Starrett moved to [Slide 30] and asked if there were any major disagreement. Grenier stated that the numbers for the first two: Battery Li-ion and Battery Flow, are high saying the total installed cost is about \$400 less. Grenier asked about the forward price curve. Starrett stated that he knows that they are aggressive. Grenier pointed to 2018 quotes for Lithium-Ion that are under \$300. He offered to get information to Staff.

Grenier asked about a potential cost-curve scenario that would be baked into the Plan, noting that some technologies have a gradual cost decline while others are much more dramatic. He noted that the decline would impact analysis for a 2020 time frame saying that there are quotes for totally installed a four-hour lithium system that is under \$200.

Starrett asked Hart what numbers she used for PGE's analysis. Hart didn't know off hand but said the IRP costs were quite a bit higher than recent cost data. She then asked for consistency between overnight and system-life costs that addresses extra racks that offset degradation. Starrett agreed, noting that the appendix will address the guaranteed output over time.

Grenier stated that the expected lifecycle number is going up.

Sandvig asked for Expected Life to be expressed in years as it would be helpful from an investment standpoint. Starrett agreed saying it would be benefit a discussion on planning practices.

Grenier asked about Opex costs. Starrett stated that he didn't have good Opex numbers and asked if he could send some. Kujala stated that if a discussion on levelized costs might be worthwhile in the future.

Starrett asked for more feedback on the White Paper by March 31, with an emphasis on value streams. He noted that there will be follow up meetings in the future. Charles stated an email will be sent to the GRAC referencing slides that need more comments.

Kujala emphasized Staff's interest in setting up a good foundation for future work and sees this as a first step towards evaluating this for the Eighth Plan.

LUNCH

Discussion of Ocean Energy Technologies Gillian Charles, NPCC, Mike Starrett, NPCC

Charles reviewed Action Item ANLYS-15 and discussed the GRAC's intentions to analyze ocean energy potential.

Marine Renewable Energy: A Pacific Northwest Advantage. Jason Busch, Pacific Ocean Energy Technologies, Ken Dragoon, Flink Energy

Busch presented the history of wave, tidal and floating wind technologies and an update on the industry. He discussed the Pacific Marine Energy Center, Oregon's grid connected test site.

Charles again reminded the room about Action Item ANLYS-15 and the need to recognize new technologies and opportunities.

Heutte stated that Japan seemed like the big player in offshore wind. He asked if any of their companies are showing interest in the Northwest market. Busch reported that he has not experienced any direct outreach from Japan, but pointed to heavy replication of wave energy devices from China.

David Nightingale, WA-UTC, stated that NOAA buoy data from the Washington coast shows that offshore wind is winter peaking, which matches load. Busch stated that the wind resource varies as you move south to north. He noted that the highest value waves are between Coos Bay and San Francisco.

Shamus Gamache, Central Lincoln PUD, discussed their connection to the project.

Dragoon presented a technical look at ocean energy technology.

Henry Tilghman, Tilghman Associates, stated that he's heard WECC engineers bemoan the lack of Ocean Energy data and asked Jimmy Lindsay, PGE, and others what kind of data he needs to incorporate offshore wave or wind into his IRP.

Lindsay wondered what questions could be answered with a grid connected test site versus a non-grid connected test site. Busch answered that NETS, the existing, non-connected site is too shallow for some technologies and only test during the summer while the connected site will have a full-scale device deployed year-round. Busch stated that this will allow a better estimate of O&M costs and service issues.

Dragoon added that in the steps to commercialization, devices must reach TPL (Technology Performance Level) which shows success in both the lab and the environment. Connecting to the grid, according to Dragoon, helps meet that specification. Busch added that the standards and certification process (TC114) can be met with grid-connected technology, referencing wet-connect, at-sea technology.

Hoffman pointed to the importance of stress-testing the technology at sea for three years.

Charles moved back to the Agenda and asked the room if there were any other technologies that should be considered. Heutte asked about ocean thermal energy conversion. Busch explained that that technology works better at the equator where there is warm surface water with access to deep cold water. Charles stated that analysis will be done on technologies, costs, and available resource and brought back for vetting. She then asked if there is a role for the GRAC to facilitate furthering the technology.

Busch pointed to the State's desire to use these technologies to improve coastal resiliency noting ODOE's study bill.

Lindsay asked what deliverables for part B and C would look like. Charles said that they are open-ended and pointed to the possibility of a sub-group. Dragoon wondered if coordinating utilities to share risks and benefits would be helpful. He then stated that this is an opportunity to not just “let things happen” like wind did but make regional, collective decisions about an emerging technology.

Heutte recalled the 9000MW of wind that never made it into Council Plans, calling it a lesson learned. He hoped in the future we would think beyond the modeling box. Heutte noted that ocean resources match regional load better, are coming at us and should be considered by the Council.

Hoffman stated that offshore wind looks economically viable and the test bed provides a great resource and early opportunity for studies.

Dragoon noted the Council’s focus on reliability and resource adequacy, noting that the region is underprepared for a Cascadia Subduction and ocean energy could play a role in resiliency. He asked if the Council is also concerned about this issue. Charles stated she does not have an immediate answer and can get back to him.

Hoffman agreed with Dragoon, noting that the word “resilience” can be more impactful than “renewable.”

Lizzie Rubado, Energy Trust of Oregon, agreed that resiliency is an important theme, a major driver and an increasingly valuable value stream. She also pointed Ocean Energy’s locational value, calling it important to coastal communities. Rubado referenced part B of the Action Item and wondered if the resource’s unique set of opportunities could be framed along the lines of regional goals and values.

Charles noted the increased interest she’s hearing about this technology from the room and stated that the next meeting will include an analysis of cost (Part A) and scoping of what B and C may look like. There were head nods of approval in the room. Charles suggested a GRAC webinar specifically on the energy storage White Paper.

Charles ended the meeting at 2:40.

Attendees

Gillian Charles	NPCC
Mike Starrett	NPCC
Ben Kujala	NPCC
John Ollis	NPCC
Jeff Kugel	PNGC
Fred Heutte	NW Energy Coalition
Lizzie Rubado	Energy Trust of Oregon
Silvia Tanner	Renewable NW

Cameron Yourkowski
Michael Grenier
Nate Sandvig
Brian Skeahan
Ken Dragoon
Will Price
Jimmy Lindsay
Elaine Hart
Chris Zentz
Erik Steimle
Blake Rector
James Vandebos
Saul Villarreal
Jeremy Twitchell
Julie ???
Chris Castelli
Mike Hoffman

Renewable NW
Renewable NW
National Grid
Klickitat PUD
Flink Energy Consulting
EWEB
PGE
PGE
Troutman Sanders LLP
Rye Development
Portland State University
BPA
Seattle City Light
WA-UTC
Oregon PUC
Oregon Dept of State Lands
PNNL

Attendees-via-Webinar

Brad Spangler
Brain Dekiep
Bryan Neff
Cindy Taylor
D. Churchman-Grant
Dave LeVee
David Nightingale
Philip DeVol
Elizabeth Osborne
Kyle Frankiewich
Mitchell Green
Henry Tilghman
Stephanie Hun
Jan Lee
Tom Kaiserski
Kelly Larimer
Kevin O'Meara
Jason Salmi Klotz
Leann Bleakney
Lloyd Reed
John Lyons
Michael Goetz
Michael Rosenmeier
Greg Nothstein
Paul Dietz

Snohomish PUD
NPCC
California Energy Commission
Oil States International
Grant County PUD
Powercast
WA-UTC
Idaho Power
NPCC
WA-UTC
BPA
Tilghman Assoc

NW Hydro
Montana
Kleinschmidt Group
Public Power Council
Oregon PUC
NPCC
Lloyd Reed Consulting
Avisa
Citizens' Utility Board of OR
Rizzo Associates
WA Dept of Commerce
Aces Power Marketing?

Elaine Prause
Dawn Presler
Jose Restrepo
Shamus Gamache
Terry Toland
Zac Yanz
Shamus Gamache

Oregon PUC
Snohomish PUD
Suncor Energy
Central Lincoln PUD
Clark PUD
PSE
Central Lincoln PUD