Northwest Power and Conservation Council
Systems Analysis Advisory Committee
November 6, 2019

John Ollis, NWPCC, began the meeting at 9:30 by calling for introductions and reviewing the agenda.

Review of Price Forecast and Avoided Emissions Rate Methodology and Scope
John Ollis, NWPCC

Nora Xu, PGE, asked about available resource options for long-term capacity expansion [Slide 5,] adding that she is specifically interested in hybrid resources like solar + storage and other storage options. Ollis said he starts with AURORA's default data set which includes new, single-access solar. He said there is a four-hour battery storage resource, wind with different costs and shape profiles depending on location and a number of gas types. Ollis said there will also be solar+ storage, modeled as a sub-portfolio resource with a fixed shape. He concluded by saying there is also small amounts of geothermal and enhanced geothermal.

Xu asked if staff used costs from the default override data base or if costs were modified. Ollis said all fixed costs are modified except for regional cost modifiers in the capital workbook.

Sibyl Geiselman, Avangrid Renewables, asked if additional economic retirements are allowed on [Slide 6.] Ollis answered that only known retirements are used, but called for ideas on how to approach economic retirements external to the region.

Jim Litchfield, Consultant to the ID Office, asked about the trapezoidal approximation [Slide 7, 8] that's estimating the capability of the Hydro "Training Wheels." Ollis called it a big player, explaining the process.

Geiselman asked how the daily shape with traditional on/off peak hours will evolve as more renewables come on line. Ollis said he uses four different sample points for retirements and builds, and classic GENESYS, an adequacy model is used to develop the hydro bounds for the sample points. He said some of the effect is muted for out-of-region resources which is why there is a redeveloped GENESYS.

Ollis added that he's seen the hydro system become "spikier" as more renewables are added.

Fred Heutte, NW Energy Coalition, asked if the 3.2 TB on [Slide 9] are inputs or outputs. Ollis said they are outputs and he has tried to limit them.

Tomás Morrissey, PNUCC, suggested testing bounds with a monthly or daily price run. Ollis said he has done tests like that before and didn't find a huge difference but is willing to revisit it.

Rob Diffely, BPA, confirmed that the long-term resource build is not that different when using average hydro versus critical hydro. Ollis said there are some flexibility challenges but he thinks of long-term buildout as a way to keep the WECC whole.

Diffely then asked if resources from the Pacific NW are also being added along with outside resources. Ollis said yes. Diffely called this essentially two Power Plans with the AURORA stuff going on in AURORA. Ollis countered that there are not two different Power Plans and this is just a price forecast for stakeholders. Ollis did say that there are two different capital buildouts that the SAAC can choose from after locking down methodology.

Diffely said we're now locking down Power Plan prices that assumes a resource build that may, or may not, be consistent with the Power Plan. Ollis agreed, adding that AURORA doesn't include EE or DR resources and this is just a way to get prices.

Litchfield asked what water years BPA suggested [Slide 11.] Ollis said he used 1931 and 1960, explaining that BPA approved of the other water years. Litchfield said that "critical "doesn't tell you a percent of January-July run off. Ollis said that's not in the NOAA data set and everyone seems to be interested in 1937. Ollis said a lot went into the selection of the years with the idea of getting representative samples that captures both seasonality and high/med/low.

Geiselman asked if equivalent hydro setup was used for other WECC regions. Ollis answered no, all hydro outside is expected. Geiselman recalled seeing BPA data that had hydro years for BC and CA. She thought the CA hydro would be important to know. Eric Graessley, BPA, stated he had that data and offered to share.

Geiselman asked how a transitional RPS is handled [Slide 13.] Ollis said he raised the Clean Resource requirements and left the RPS the same. He will present a graph to illustrate that in a few slides.

Morrissey asked if there is a different reduction from an east to west side alteration [Slide 16.] Ollis said he hasn't had time to check but thought there wouldn't be much of a change.

Wholesale Price Forecast: Resource Buildout *Preliminary Results*
Diffely asked about the reserve margin used on [Slide 3] and who decided the number. Ollis answered that he used the AURORA default with the exception of the Northwest.

Morrissey asked if Ollis looked at utility IRPs. Ollis answered that taking every utility's reserve margin creates an enormous buildout so he used reserve sharing groups instead. Morrissey asked if there were different margins. Ollis said yes and they were around 15-16%.

Litchfield asked for a definition of "plant." Ollis said you couldn't build more than 10 gas plants in any one area over the course of the study.

Morrissey asked if more renewables were seen in areas with limited gas builds. Ollis said he will show that information soon.

Geiselman asked what reserve margin contributions was used on the renewables. Ollis said he left the renewable peak default for the credit and thought more work could be done with the dynamic peak credit.

Diffely asked if the .7 is capacity factor on peak. Ollis answered that .7 is how much credit it gets from its nameplate capacity at peak. Diffely pointed to CAL PUC updates that might offer a good comparison. Ollis agreed that it might be a good starting point if the dynamic peak doesn't work.

Litchfield asked about assumptions around existing gas retirements. Ollis said announced retirements are reflected. Litchfield pointed to CPUC asking for an additional extension for resource adequacy.

Litchfield said this looks like it's trying to create a scenario that's impossible to know, particularly when resource adequacy is in play. He added that the hard constraint of 2025 doesn't feel right. Ollis clarified that some places, like Alberta, Utah and Wyoming, can build throughout the study.

Litchfield asked if gas is over by 2025. Ollis clarified that, for instance, the state of Idaho has made no statements about limiting gas but Idaho Power wants to move to a 100% clean portfolio. Ollis added that he chose 2025/2026 because most plants are amortized over 20 years.

Litchfield cautioned that whatever number is picked is a moment in time and the situation can change dramatically. Ollis agreed that this is a snapshot and wanted to explore the topic further with the SAAC. Litchfield confirmed that if the model builds a huge amount of gas it's because of economics and reliability. Ollis said it's economics.

Ollis displayed the [Results Slide] and called for a **BREAK.**

Morrissey asked how solar + storage breaks out. Ollis said it's a 100 MW nameplate solar plant coupled with 100 MW storage. Morrissey asked if that adds up to 6000 MW of storage on the top graph. Ollis answered yes.

Heutte said the slide reflects a strong versus moderate policy approach. Ollis countered that the bottom graph shows no policy. Heutte asked if the gas is combined cycles, peakers or a mix. Ollis answered that it's a mix and combined cycles are being built in traditional places like Arizona and Utah. Heutte noted a double-humped "camel" curve to account for growing Arizona solar.

Heutte addressed transmission, saying more transmission could get wind out of Montana, Wyoming and New Mexico and shift things. Heutte then asked about pumped storage. Ollis said he would put in pumped storage in if he had the data but he is seeing a storage signal and there's more work to be done.

Heutte stated that we still don't know how solar + storage will ultimately be dispatched and it's different looking than longer-duration pump storage. Ollis stressed that this is the first time he's had an AURORA storage resource which sends a strong signal. Heutte said these two graphs look like bookends. Ollis agreed, stressing that they are not intended to be bookends.

Heutte wondered what would happen if gas prices rose considerably or the cost of renewables goes down faster. Ollis said these graphs represent aggressive cost decline curves. Heutte said there's a lot more to learn about storage and raw costs of new solar and wind.

Morrissey thought the top graph was more realistic but worried about the front end build-outs on both graphs. Ollis agreed. Morrissey agreed that adequacy may be an issue a couple of years out but these graphs imply inadequacy with today's system which didn't feel right to him. Morrissey suggested looking deeper into the margin assumptions. Ollis wished he had better margin assumption data adding that the graphs are optimized and the actual buildout could be pancaked.

Morrissey asked what the delta is between the planning margin requirement and what the model thinks is economic. Ollis didn't know adding that he gets no adequacy issues when running the system today, but the model optimizes to get a better outcome.

Geiselman suggested a more granular look as a lot of building is in Alberta where data is limited.

Heutte wondered about offshore wind for California, referencing Jason Bush's, POET, work [Slide 7.] Ollis agreed saying geothermal was also available, but expensive.

Geiselman asked where the demand forecast for areas outside the Northwest comes from. Ollis pointed to Massoud Jourabchi, NWPCC. Jourabchi said he works closely with the CEC to get a good look at California and also works with the Canadians. Geiselman confirmed that it incorporates the hourly demand shape changing over time. Jourabchi answered yes, to the extent that these entities incorporate it. Ollis added that hourly shaping on loads tends to be static.

Xu thought the top plot on [Slide 9] was less constrained by RPS and clean constraints but had higher shadow prices on average. She said she was struggling to reconcile this. Ollis interpreted this as a possible proxy for rec pricing but there's also an adequacy criterion. Xu said she would think further on this.

Heutte said he didn't understand the chart on [Slide 10.] Ollis explained the costs are cumulative. Heutte complained about how fixed/not fixed costs were represented. Ollis explained the graph. Heutte found the gap between the two production costs surprising. Ollis said it comes down to renewables replacing fossil fuels.

Heutte asked what happens to prices during the hours when the grid is mostly renewables. Ollis said they're negative because of rec but by the time they get to Mid-C they are mostly not negative on a monthly or annual basis.

Heutte wondered if generation curtailment was high during those periods. Ollis thought so but hadn't looked. Heutte suggested digging deeper. Ollis said the SAAC hasn't set it up that way in the past but they could get more nuance for the Plan. Heutte stressed that we curtail gas all the time by not running it.

LUNCH

Modeling Solar + Storage
Mike Starrett, NWPCC
Heutte wondered if the ability to capture the clipped energy in a battery would lead to more, or less, overbuilding [Slide 6.] Starrett thought this would very likely lead to more overbuilding to capture as much as possible.

Morrissey wondered how much DC Coupling (with charging from grid) [Slide 9] matters to the value of the project. Starrett said he was initially surprised by how much the battery wanted to charge off of the grid to get the morning price benefit adding that if you don't, it will borrow early solar to shift it one hour.

Heutte noted that CA charges with overnight wind for the morning ramp and waits for the solar to come on. Starrett noted a tax barrier with that.

Heutte said [Slide 11] creates modeling complexity. Ollis agreed saying if it gets too complex we can punt and come up with a heuristic that's close.

Litchfield asked what physical configuration was modeled for the first box on [Slide 14.] Starrett said it was the GRAC-approved reference plant of 100MW solar and 100MW storage, adding that it is DC coupled and not bidirectional.

Geiselman asked why an average price was used instead of locational pricing. Ollis said it had to do with the timing of the work, the desire for a more robust number and better shaping. Ollis added that a locational price would be better in the future.

Litchfield asked if rules around letting batteries get completely empty or full applies to utility storage [Slide 15.] Starrett answered yes, and he included bounds of 95% and 15%, adding that technology is improving but these better batteries are not what's on the grid now.

Modeling Demo

Litchfield asked about the morning spike. Starrett said it really reflects putting MWhs in the battery. Ollis said locational pricing would change this.

Geiselman asked if co-located project only need to charge from solar for the first 10 years which means the profile would change after ITC restrictions would roll off [Slide 16.] Starrett called the question interesting and wondered about the tax benefit. Ollis said there might be a way to reflect that in AURORA with a time series.

Geiselman asked about the original incentive for using the fixed profile instead of the AURORA logic. Ollis explained that AURORA can model it but he didn't have time to investigate the process for building a coupled resource. He called for ideas. Deborah Smith, EPIS, explained the functionality to model a coupled resource.

Starrett asked about the clipping piece. Ollis thought the coupling requirement would cover that. Smith agreed with Ollis and explained the flexibility that allows different ways to simulate solar plus storage.

Wholesale Price Forecast: Mid-C Prices

Litchfield asked about the purpose of the avoided emission rate study [Agenda.] Ollis said it isn't part of the 2021 Plan but is a starting point for building up information and methodology.

Litchfield asked what causes Mid-C prices to diverge [Slide 3.] Ollis said they are very close, adding that he used to use BPA WA, which is also very close, but this is what others use. Heutte asked why change methodology. Ollis said less people complain when he does it this way.

Litchfield asked what happened in 2035 on [Slide 4.] Ollis didn't know and offered to follow up. Xu asked if these were nominal prices. Ollis answered no, they are 2016 dollars. Litchfield said this looked overbuilt. Ollis said this is on an annual basis.

Xu wondered if the jump from 2034-35 was due to retirements. Ollis said there are not that many retirements and he will dig deeper.

Geiselman wondered if storage maxes out as it looks like it stops growing. Ollis said there's no maximum put on storage. Geiselman wondered if that points to longer-duration storage. Ollis said maybe and would check the spreadsheet later in the presentation.

Heutte said this represents the entire WECC so there might be big retirements outside of the NW. Ollis thought the retirements happened earlier and suggested demand side curtailments.

Litchfield called [Slide 9] hard to interpret.

Spreadsheet
Heutte asked what happens when Mid-C is looked at through an hourly price. Ollis said the AURORA version he uses doesn't have that kind of staging. Heutte thought this would be worth exploring over the year of Plan work.

Adam Schultz, ODOE, asked to look at April and May, noting that the winter looked "duckier." Ollis showed 2020, agreeing that the winter has more of the traditional duck curve while the summer looks flat with a spike. Heutte recalled past ISO work that revealed four distinct seasons.

Morrissey asked to see 2035. The room said a collective, "whoa!" Geiselman had a hard time believing that there's not enough arbitrage there to get more storage built. Ollis theorized that it may get built in the final iteration, reminding the room that this is close to the end of the study.

Heutte asked what the Loss of Load price is in AURORA. Ollis thought $4500 was the first curtailment block.

Morrissey wondered if an event like this should be included in a price forecast. Ollis answered that he will have to include this if the final solution shows it. Morrissey asked if it's reasonable that the NW will lose load every night in August. Ollis clarified that this is not every night and this a sample with 1937 water.

Geiselman called this an example of how the initial hydro shape and boundaries could be causing long-term problems in the higher renewables scenario. Ollis said this is a potential limitation with binding the models and thought the redeveloped GENESYS might show a more dynamically flexible hydro system.

Morrissey wondered about the huge price increase between 2034-39. Ollis thought it might reflect running out of reserve in the system, but didn't know for sure.

Morrissey confirmed that the RPM sees two price blocks [Slide 14.] Ollis confirmed. Morrissey suggested splitting the non-sequential. Ollis said the RPM gets away with a lot of simplification in its dispatch logic by being broadly contiguous.

Heutte was confused as the NW peak hours are 5-6:00 pm, later in CA and much later in AZ. Ollis said he's trying to find the right price signal for the RPM to pick up, adding that it's not for adequacy. Ollis stated that he is looking to redefine on-peak and off-peak and might propose hour 6-10pm. Heutte was concerned that this really diverges from Mid-C.

Morrissey wondered if Heutte's idea is to have actual resource development follow existing market structures. Heutte wasn't sure. Litchfield said this is the future, but for now the RPM needs a way to trick it.

Heutte offered data that shows Mid-C and California prices converging over time which means CALISO prices might be used. Ollis said this will be deeply discussed in future SAACs.

Litchfield wanted to discuss the future role of the RPM in another meeting.
Heutte congratulated Ollis on his promotion.

Ollis ended the meeting at 3.

Attendees

John Ollis	NWPCC
Sibyl Geiselman	Avangrid Renewables
Massoud Jourabchi	NWPCC
Adam Schultz	ODOE
Rob Diffely	BPA
Fred Heutte	NW Energy Coalition
Tomás Morrissey	PNUCC
Jim Litchfield	Consultant to ID Office

Attendees via Webinar

Andrea Goodwin	NWPCC
Aaron Bush	PPC
Bill Saporito	Umatilla Electric
Dave LeVee	PwrCast
Deborah Smith	EPIS
Elizabeth Osborne	NWPCC
Frank Brown	BPA
Eric Graessley	BPA
Ian Bledsoe	Clatskanie PUD
Kathi Scanlan	WA UTC
Leann Bleakney	NWPCC
John Lyons	Avista Corp
Jennifer Magat	PSE
Garrison Marr	Snohomish PUD
Mike Starrett	NWPCC
Paul Nissley	Seattle City Light
Nora Xu	PGE
Patrick Ma	Energy Exemplar
Paul Dockery	Clatskanie PUD
Robby Branom	TEA Inc
Shauna Jensen	PGN
Shirley Lindstrom	NWPCC
Torsten Kieper	BPA
Villamor Gamponia	Seattle City Light
Brian Dekiep	NWPCC