

**Northwest Power and Conservation Council**  
**Systems Analysis Advisory Committee**  
**February 26, 2015**

Ben Kujala began the meeting. He introduced the room reviewed the current SAAC member list.

Dick Adams, PNUCC, asked if Kujala has 90% realistic numbers for the RPM redevelopment. Kujala answered he's about 90% there but he needs the existing resources updated.

Jim Litchfield, consultant, asked about the patterns coming from the load and price forecast, [Slide 5] calling them monotonic. Kujala agreed. Litchfield asked if you are starting in the middle is it equally probably to go above or below. Kujala stated that he is going to recommend that it is tied to the median.

Jump Factors [Slide 7]

Tomas Morrissey, PNUCC, stated that the Sixth Plan futures jumps were large and extended and wanted to know if the Seventh Plan will tame them. Kujala said yes. Morrissey asked for a percentage. Kujala stated that he will be looking for guidance on that. Morrissey said he was also looking for the magnitude of possible jumps. Kujala agreed.

John Ollis, NPCC, stated that the magnitude of the jumps and recoveries don't have to be the same. Litchfield asked for clarification. Kujala explained. Michael McCoy, PSRI/Becker Capital, asked where the idea of a jump and recovery come from. Kujala stated it comes from financial theory and commodity pricing.

Kujala stated that he is uncomfortable applying this to the load forecast but is less uncomfortable with the price forecast. Litchfield asked why. Kujala answered he has a better sense of prices being log normal.

The presentation moves to [Slide 24] Jump Factors

Morrissey suggests including small and non-persistent downward jumps. Kujala explains the structure of the load jumps and reiterates his recommendation that they not be included.

Sibyl Geiselman, EWEB, suggested a slope change over a quadratic factor to represent shorter term economic cycles. Kujala stated that would be an inflection point model saying that could be something to look at for the action plan.

Ehud Abadi, BPA, asked if the same could be same about the jumps in general and asked how much more variation the jumps capture. Kujala answered that this is why an inflection point might make a difference and explained the difference.

Litchfield stated that the new world doesn't deal with long lead times and wondered what jumps evaluate. Kujala stated that the model helps understand the future landscape and risk elements, particularly in purchasing conservation and plants by size.

Litchfield stated that this makes it challenging for him to advise whether to use a jump or not. Kujala agreed that is his concern and why he's discussing it.

Adams asked for an explanation on how temperature affects loads. Kujala explained the seasonal element in the load model. Adams asked how the model captures a cold week. Kujala stated that the model only has quarterly information. Adams asked how it addressed cold or warm temperatures in the load duration curves. Kujala stated that will be covered when the group discusses dispatch. Adams stated that for giving feedback it would be helpful to him look at what the model produces in lieu of equations.

Slide 26 Natural Gas Price Jumps

Morrissey asked what Kujala used for the historical record. Kujala stated that electricity is from 2000, gas started in 85 and offered a zip file with all of the information.

Morrissey stated that the suggestion is for symmetric jumps not proportional. Kujala agreed. Geiselman asked if they are quarterly jumps and not annual. Kujala stated that these stack so jumps and seasonal aspects could both apply. Kalich asked who provided the information. Kujala answered that they are from the natural gas and demand forecast advisory committee.

Litchfield asked if the 50% chance of a jump came from the same committees. Kujala stated that is his input as he couldn't get reasonable feedback from the groups. Litchfield asked for what the parameters do. Kujala stated that they will and there are also check boxes to turn them on and off.

Morrissey stated that the historical record and shift in natural gas production makes him nervous about quadrupling natural gas price jumps in the first 5-10 years of the model.

Charlie Grist, NPCC, stated that these are going into the future and not supposed to represent the expected. The model is to test out expectations.

Kalich stated that he is concerned about oversampling tail events for the base data set.

Tom Chisholm, USACE, asked if you could only have one jump in a game. Kujala answered two stating that the first one has to end before the second starts.

Abadi responded to Grist and Kalich, stating that it boils down to risk but our best information states we've been burned by gas prices over and over and load has not. He suggested if you going to put bias in natural gas makes sense. Kujala said the question is how high or low.

Morrissey asked how the 18% downward jump lines up. Kujala answered it was the energy crisis. Morrissey stated he was confused by how much more shallow the down ramp was over the up ramp. Kujala stated that this is the magnitude and the jumps did not persist for years. Morrissey stated that a long energy crisis seems strange. Litchfield asked for clarity about the base price. Kujala said it would drop from \$30 to \$4 or \$5.

Kalich stated that during the energy crisis electricity prices were not driven by natural gas. He wondered if they should be connected in the extremes. Kujala stated that jumps do not have to relate to natural gas jumps. Kalich asked why not use natural gas history to create natural gas variability. Kujala answered that electricity jumps could happen independently but natural gas couldn't.

Independent Price Distribution [slide 10]

Litchfield asked what's the probability after mean and median adjust. Kujala answered that's the median of the futures. Litchfield asked why you have to adjust. Kujala answered the seasonal factors and jumps could push it off of the median. McCoy asked what median we are matching. Kujala answered that the input forecast from Aurora match the 50% of each period.

Morrissey asked if the y axis is real. Kujala said yes. Adams asked if the data are the prices the algorithm sees. Kujala stated that is the range of the futures before we put in the independent factors. Adams asked if the prices are scaled. Kujala state these come out of the algorithm and there is a location shift to median. McCoy asked where the locational shift takes place. Kujala answered in the model. McCoy asked if the locational shift is jumpy or smooth. Kujala answered that it depends on what you select noting that the proportional jump logic was very severe. McCoy asked why jumps are always up. Kujala stated that is the model I was handed.

McCoy stated that if you own something it can only go to 0 but if you sold it it could go to infinity. Kujala stated that is lognormal distribution of prices.

Adams brought up the solar panels in California and asked how the model would capture that. Kujala stated that should be captured in Aurora.

Morrissey asked if the Dependent Price Distribution [slide 11] includes carbon. Kujala said carbon is set to 0 and it's hydro, gas and load. McCoy asked about the scale on the graph. Kujala said it's dollars per MWh.

Litchfield noted a pattern at quarter 3 and 60. Kujala said it could be forecast shapes or jumps. He noted that there's a quarterly shape as well as seasonal components.

Morrissey asked if using the high gas prices pulls prices up [slide 13] Kujala answered that we are well synchronized between the medium and high forecast from the natural gas committee and not the medium low forecast. Morrissey stated that if you ran it again on medium/low the prices would be lower on average. Kujala stated that is was different.

Litchfield asked if there was probability estimates of the high. Kujala stated that he was given 85% from Massoud.

Adams brought up California scenario and asked about treating a load forecast driven by different scenarios. Kujala thought that was a good idea. Adams suggested a no coal scenario or others. Kujala reminded him that all of the loads are a frozen efficiency meaning they are prior to conservation. Adams said these are concepts to be debated but not inside this model.

Morrissey asked if conservation in the load would pull prices down. Kujala said it may. Morrissey said that 6000 MW of conservation is a demand suppressant. Kujala said we will see what runs we have to do after we get initial outputs. Geiselman went back to gas price distribution asking if he ran the new distribution factors by the committees. She suggested a new approach. Kujala stated that the committee might be lost in the statistics and that's why the SAAC is looking at it.

Geiselman wondered what the documentation would look like in the final report. Kujala explained his methodology.

Slide 18 Annual Factor Natural Gas Price Example

Litchfield noted that the jump didn't change the range but added volatility. Kujala stated it's symmetric but it will increase the range. Litchfield asked if this is seasonal. Kujala stated yes it's the seasonal factor.

McCoy stated that the Estimating Seasonality [slide 22] makes sense and is easy to accept. Morrissey asked to see the jump factor. Kujala stated it will come later.

Morrissey asked if the electricity price with no jumps [slide 29] was incorporated with a dependent price distribution. Kujala answered no. McCoy suggested there were 6 jumps [slide 30]. Kujala said it should be 10 and some are small and some are large.

Litchfield asked about the median adjustment. Kujala opened the model.

Lunch

Adams asked for a discussion on NPV. Kujala stated he will give a high level view. Litchfield agreed that there may be a communication problem with the words Net Present Value being used.

Morrissey asked about 672 as the set of hours. Kujala stated that he copied it from the last model. Kalich stated that it's 28 days. He then asked where the O&M costs are. Kujala said they come up later.

Litchfield asked how does a load play into this. Kujala said that given a price it will dispatch thermals. Abadi said that Aurora will have it.

Ollis stated that the electrons have to go somewhere. Kujala said there is a price in the model that sets a starting price. If it results in a dispatch within your

bandwidth you are generating more or less. This model is not about my resource serving my load.

Litchfield stated he understood then asked about a balancing authority meeting load and then exporting. He stated that meeting load will take a high percentage of resource and the boundary and there is an underlying load shape. Kujala stated that when that load comes in there is a price and it tells me the dispatch first and I compare it to the load. The buckets are either heavy or light.

Ollis explained the issue a different way.

Litchfield stated that he is still struggling with using this model for resource acquisitions. Some acquisitions are peaking and he doesn't see how you get that out of the capacity distribution. Kujala stated that dispatch has nothing to do with when you need peaking resource. The dispatch is how the dispatch acts once you have it.

Kujala explained the three reasons for buying: economics, reliability or Renewable Portfolio Standards. Ollis explained the difference between purchasing for economics and purchasing for adequacy. Abadi asked if building for economics has nothing to do with this. Kujala stated that it's projected. Abadi then asked if the power prices used here come from Aurora. Kujala stated that they come from futures and Aurora is the middle ground. Abadi then asked what the thermal build in Aurora. Kujala answered in the past it was the long term extension and gas plants. Abadi pointed out a discrepancy and asked how it will be reconciled. Kujala answered that it's not a large issue in the model.

Adams said this is the cost of operating the system in this quarter and the future but where does it check to see if you've met load. Kujala stated that is an iterative process. Kujala discussed the penalty for load shedding.

Abadi asked for discussion before diving into a compartment. Kujala said the model is very transparent. Adams asked if there was an easy way to track the number of load shedding periods. Kujala said yes.

Litchfield asked where Kujala got the numbers for Slide 44. Kujala said he inherited them.

Litchfield asked if Slide 46 is a run with uncertainty. Kujala said yes and individual games could be different. Ollis asked if this is new generation that the model would choose. Adams stated that the reason it looks odd is because it has average hydro. Kujala said over generating. Abadi asked what the loads are. Kujala said average loads and average generation.

Kujala explained why there would be over generation. He stated, with heavy caveats that right now it's building more for adequacy than economics. Adams was surprised.

Adams asked for statistics for what's triggering the builds. Kujala stated he will as they come out.

Adams asked if what comes out of the math is the variable costs [slide 47]. Kujala explained how you capture revenue from market sales.

Litchfield stated that it makes him nervous to say that the more energy efficiency we do the more money we make. He said this bothers him about NPV. Kujala suggested moving conservation in and the effect on NPV for the next meeting. Adams asked what [Slide 47] the difference between load shedding and generation curtailment. Kujala explained that if you don't put a penalty on these things you could end up with things on the efficient frontier that do not make sense.

Adams asked if the resource adequacy penalty is in the model. Kujala said yes and explained further. Adams asked for a real world example. Kujala said the

optioning structure makes more sense with big shafts. He explained the difference between a hard constraint and a penalty. Kujala said he expected to see less curtailment.

Litchfield asked for a future meeting to look at optioning logic and model set up and what “gets you the dots.” Kujala stated he is waiting for the right inputs and will have them next time. Litchfield the concepts are more important than the numbers.

Kujala drew attention to Slide 52 which has the web interface. Kalich asked about fixed O&M versus variable. Kujala answered that the regional cost is added to the NPV. The idea is not to underrepresent the price paid. He also said that it’s a broader definition of fixed O&M.

Kujala ended the meeting.

Attendees on site

Ben Kujala	NPCC
John Ollis	NPCC
Ehud Abadi	BPA
Jim Litchfield	consultant to Idaho
Dick Adams	PNUCC
Tomas Morrissey	PNUCC
Michael McCoy	PSRI/Becker Capital
Tom Chisholm	USACE

Attendees via Go-To-Meeting

Tom Coatney	BPA
Diane Broad	ODOE
Elizabeth Osborne	NPCC
Susan Fisher	
Jimmy Lindsay	PGE
Clint Kalich	Avista

Michael Linn

Mark Dyson

Michael Deen

Rick Sterling

Shirley Lindstrom

Sibyl Geiselman

RMI

PPC

Idaho PUC

NPCC

EWEB