Northwest **Power** and **Conservation** Council

September 6, 2017

MEMORANDUM

TO: Council Members

FROM: Mark Walker

SUBJECT: Presentation by Steve Wright, General Manager of Chelan PUD

This is the third in a series of presentations to the Council emanating from Chair Lorenzen's desire to seek high-level input from knowledgeable utility executives and regulators on the challenges and key issues facing the electric utility industry.

Steve Wright was named General Manager of Chelan PUD in September 2013 after twelve years of service as the BPA Administrator. As General Manager of Chelan, he has led the development of a community based strategic plan finalized in April 2015. Steve is committed to an open dialogue with customers, employees, and the utility's many business partners about the priorities of Chelan PUD. In a 2016 survey, 93 percent of customers indicated they were either very satisfied or satisfied with their Chelan PUD service.

Mr. Wright's presentation will focus on ways in which utilities, from a policy perspective, can address greenhouse gas emissions reductions. He believes that this is the primary issue confronting the electric utility industry today, surpassing even the need to employ least cost planning to reliably meet load.

851 S.W. Sixth Avenue, Suite 1100
Portland, Oregon 97204-1348
www.nwcouncil.org

Steve Crow
Executive Director

503-222-5161
800-452-5161
Fax: 503-820-2370

Northwest **Power** and **Conservation** Council

September 11, 2017

Remarks by Steve Wright
Council Meeting
Spokane, Washington

Lorenzen: The next item on the agenda will be very interesting. We'll hear from Steve Wright to tell us what it's like on the outside versus being on the inside. And, Mark, it's almost as if our speaker does not need an introduction, but I'll give you the honor.

Walker: Thank you Mr. Chair. I'm delighted to be the one to introduce Steve Wright. I've known Steve Wright for over 30 years and this is the first time I've had the opportunity to do this. There are lots of things I'd like to tell you about Steve; I'm going to keep quiet about most of it. I will say that to the relief of most of the region and myself included, he's a much better utility manager than he is a golfer. But I just thought I'd give, Steve has been involved in these issues for many, many years, and in terms of institutional memory and involvement, it is more than anyone recently on the public power side.

So I just thought I'd give you a quick rundown of the major issues that he's been involved with for the past two decades: Starting in 1995 with the Bonneville financial crisis that required Congress to basically pass legislation to help Bonneville survive; the downturn when gas prices plummeted and Bonneville customers were leaving the system, Steve ran the Bonneville office in Washington and was the main instigator to solve that issue. He was at Bonneville for the 1996-1997 comprehensive review.

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He became acting administrator I think in November of 2000 right when the west coast energy crisis hit and he saw Bonneville through that, and the whole region, through that major issue. He was present, of course, for the regional dialogue which led to tiered rates and the eventual signing of long-term contracts in 2008 to ensure the stability of Bonneville over that time. And one of the issues that probably took more time than anything else for him was the 2008 Biological Opinion negotiations, and then again he had a major issue in 2010-2011 with the first west coast wind energy oversupply event. So Steve has been around a long time. He's really responsible for the stability of the system over that period of time to a great degree, and I'm delighted to have him here today.

Lorenzen: Steve, thank you for coming.

Wright: Thank you so much, Mr. Chair and Members of the Council. It's great to be before you again. It has been quite a few years, although I have met with the Council many times. I think I first met with the Council in 1982, so it has been many decades that I've been involved with Council activities.

I was a bit surprised to receive the invitation. I've come to understand that it has something to do with what was described as experience. And I think experience is in quotation marks, and it usually is a euphemism meaning you've gotten old. But then I look back in my files and I found the real reason that I was invited today was a document that was presented to me by the Council in January of 2013 signed by one Bill Bradbury as the then Council chairman, which made me an honorary Council Member with all the rights and privileges pertaining thereto, and I thought it might be important just to describe the rights that I have here today, or at least was granted by a former Council. It includes the right through the unique perspective of my crystal ball to evaluate, prognosticate, predict, forecast or simply guess about future Northwest energy issues and communicate said evaluation, prognostications, predictions, forecasts and guesses to the Council; and the right to whine, complain, criticize, question, deride, openly humiliate or even from time to time compliment members of the Council. So we'll find out whether I take advantage of that opportunity here today during the course of the presentation I'm going to provide to you.

I've discovered that when I talk about things that I do best when I talk about the things that I've been thinking about a lot. And so for the last couple of

years I've been thinking a lot about a few things that I'm just going to share with you and you'll decide whether they are important or not from there.

I've tried to put them in the context of hopefully sage advice, and the sage advice really starts with everything that you need to know you learned in kindergarten. So a few themes generally for this discussion.

Number 1, exercise and eat your vegetables. And by that I mean be prepared.

Do things the right way and good outcomes will result.

Don't take your loved ones for granted, and treasure what they do right.

Kobe Bryant said when he retired they asked him what thing he wish he would have done more of, and he said, "I wish I would have stretched more", and I always thought that was good advice for all of us, that we should always try to stretch more; and do the right thing for society. I think that is the goal and the mission of the Northwest Power Act that the Council tries to follow.

I've got three major themes that I want to talk about today of big things that I've been thinking about for the last few years.

The first has to do with least-cost planning and greenhouse gas emissions. My very first job working at the Bonneville Power Administration was developing the conservation supply curves. I was working with the retired and appropriately renowned Tom Eckman at the Council. He was doing supply curves for the Council and I was doing them for the Bonneville Power Administration. We were trying to figure out how you build supply curves to feed least-cost planning models, which hadn't even been developed at that point. The beauty of the Northwest Power Act I think is the least-cost planning approach. It is the fundamental thing that has worked now for 35 years. It is a timeless methodology for assessing planning decisions that is flexible for technology evolution, price movements, innovation, and all the other different kinds of things that happen in power planning and that you have to take into account and that you actually don't know how they will change through time.

Least-cost to society planning is a little bit like exercising and eating your vegetables. It is the hard work of preparation that pays off when difficult

decisions need to be made. It is the right process and if used correctly it leads to better public policy decisions. The framers of the Northwest Power Act did not necessarily expect the outcome of cancelling nuclear power plants to come out of the Northwest Power Act and yet within five years that is what happened. And it happened because of least-cost planning. If they would have chosen a generation portfolio, they would have gotten it wrong. What they did is they created a methodology for making good decisions that was timeless. It also now allows us to consider the value of rapidly declining prices for wind, solar, natural gas and other types of resources. It brought together our environmental and economic objectives that have broad support across the political spectrum.

So what can we learn from that? What can we learn from the way that the Power Act was put together? The most significant change happening in the electric industry is that we are moving away from least-cost planning to reliably meeting load. Inexorably I would say moving away from that. Many of us grew up with keeping rates low as the most important objective for electric utility systems. Today we are driven by goals for achieving greenhouse gas emissions reductions. Various governmental policies exemplify the shift, limitations on use of fossil fuels, renewable portfolio standards, carbon emission limitations, carbon pricing regimes, all in pursuit of the worthy goal toward making a contribution toward GHG emissions reductions, either directly or indirectly. Our approach though to reducing greenhouse gas emissions is occurring in a rather haphazard manner. It's not driven by a least-cost planning process. We need an analytical approach to least-cost planning for greenhouse gas emissions reductions. Governor Inslee's 2015 Carbon Emissions Reductions Task Force (CERT) called for the development of such a tool. But candidly not much resulted from that. So a few years ago at Chelan [PUD] we tried to take a shot at this, what I would call the kindergarten level approach to the least-cost planning for greenhouse gas emissions, mainly to try to pique people's interests and say wouldn't this be useful to do this kind of work? That work was completed last year, the Public Generating Pool is now pursuing an advancement of that and we hope to have some additional results later this year.

Developing a cross-sector beyond electric perspective on a least-cost approach to GHG emissions reduction would be a substantial benefit to the legislative and regulatory debates that occur, because it would give you a framework that you could understand and think about. So if I choose this,

what are the impacts, economic and environmental, compared against that alternative? And that again is the beauty of least-cost planning.

But I'm going to warn you, this is what we learned in going through this. This is really hard work. It was really hard work to figure out how to do least-cost power planning. And it turns out least-cost planning for GHG emissions is even harder than doing least-cost power planning. And why is that? A couple of examples for greenhouse gas emissions reductions, the analysis has to include interactions between sectors, like electricity to transportation, or to buildings, and we are not very good at understanding or even having the core data that is necessary in order to make those tradeoffs. There also are really substantial regional differences, so the greenhouse gas emissions profile for the Northwest is very different from the greenhouse gas emissions profile for the Midwest, and consequently the answers that you get in terms of what's the least-cost path are very different between the regions. So you can't do the big national study that would answer all these questions for us. That has to be done at the regional level.

And I will tell you that this approach will not answer all the policy questions, because one of the things that we are struggling with is we're really trying to solve for two objective functions, and my math-major friends would say it's nearly impossible to solve an equation with two objective functions that you are trying to solve for. So the difficulty here is that we're trying to solve for least cost for meeting load reliably and least cost for greenhouse gas emissions. But if we understood where the overlap is between those two, then we would be in a much better position to be able to pick the low-hanging fruit that achieves both our economic and environmental objectives.

So, I just come back to - do the right analysis and good policy decisions will follow.

Maybe the Council would be a good place for thinking about this kind of work, least-cost planning work. I would just say that my experience is that the Council has done a truly excellent job with its power plans, and I commend you for the work that went into a really fine Seventh Power Plan. I thought it was really well done. It took on some very difficult issues and handled them well.

The work in the Seventh Power Plan and the appendices that analyzes greenhouse gas emissions is a sound foundation for considering least-cost approaches. So there is some really valuable work that I found that has helped us in terms of our own thinking about how to approach this issue.

The problem with respect to the Council taking this on is that the Council's funding is from BPA ratepayers and candidly they alone should not support this effort, because it's a much bigger effort than just Bonneville preference customers. So all I can say is it would be a stretch for the Council to take this on.

By the way, from the work that we have done which admittedly is imperfect, so I'll just say that right up front, we're quite humble about the work we have done so far, energy efficiency and hydropower are the two strategies that accomplish both objectives of reliably meeting load and achieving greenhouse gas emissions reductions at least cost. And there is an overlap between those in which there is a funding stream that is not showing up for energy efficiency and hydropower, and that's a bit of a problem in terms of achieving GHG emissions reductions goals. And I'd also say it is hard to imagine a least-cost path to deep de-carbonization that does not involve substantial efforts to electrify vehicles and buildings. When you walk through the math of what it takes to get to a 50 or an 80 percent reduction in GHG emissions from the 1990 levels, it's very difficult to see a way to get there without going after some of the tough choices with respect to switching from fuel use that is currently being utilized.

So it is going to impact future power plans, whether we like it or not, because there will be a huge electricity component that is embedded in this kind of analysis.

The second key thing I'd like to talk about is the need for hydropower renewal in the policy arena. We in the Northwest have a really special relationship to hydropower because it is our dominant resource and the foundation of our low rates, high reliability and clean air. I think because the public understands the role that hydropower plays in the Northwest, the most common question that I get from the public is "So why is it that hydro is not considered renewable in the policy arena?" Renewable portfolio standards were designed in legislative arenas to provide more of a foothold in the marketplace for non-hydro renewables, so there's a logic to why it happened the way that it happened. But as we get to higher levels of non-hydro renewable standards, we need to recognize and even treasure the

positive value that hydropower brings to the market. So I believe that at this point in history hydropower is being taken for granted in the public policy world. What is it that causes me to worry about that? For example, expanding renewable portfolio standards and zero emission standards as exemplified by the (14:20) legislation that was going through the California legislature this year, which we chose to get actively involved in – the first time we've ever chosen to go in and the first time I've actually been down in the California legislature in all the years we've worked with California. Moving to a 60 percent renewable portfolio standard does not include hydropower, and a 40 percent zero emission standard that specifically excluded imports of hydropower from the Northwest essentially meant that there was no place for hydropower in that equation. We did a study, working with E3, and showed that roughly about 5 percent of California's load is currently served by Northwest hydropower and it produces huge, like 6 to 7 million tons of greenhouse gas emissions reductions as well as substantial in the hundreds of millions of dollars a year savings for consumers. And then there are opportunities for expansion as we move into the solar surpluses and think about how the system can operate and the synergies that could operate between Northwest hydropower and oversupply of solar in California. That provision has been removed from the legislation; it was removed in August or late July, from that bill, and as of today it is still out although the bill isn't done. So we are pleased that some progress has been made there but we are worried about how things will be treated in the future.

Second, additionality principles. If you are not tracking this, I don't know if you are, there are a significant number of big commercial customers who are now looking to leave their load-serving entity and want to acquire renewable resources to serve their load. And principles are being created by a variety of different groups as to what criteria should be used. One of the principles has to do with something called "additionality." It means that you have to bring something new to the table; you have to build a new resource in order to be able to meet these criteria. And those criteria currently exclude hydropower. So again we've got another piece of the market that is being walled off from hydropower, which would be very unfortunate. Working with my friend Ralph Cavanagh from NRDC on this in terms of defining some additional criteria that could be added to those additionality principles.

Tax credit policy: so production tax credit, investment tax credit, basically don't provide benefits to hydropower.

Research and development policy: If you look at the federal research and development activities, a very small fraction goes toward hydropower.

And of course probably the best example of hydro relicensing. It takes ten years to relicense a hydro project; it takes a couple of years to license just about any other generating project of any other kind across the country.

So these policies poorly reflect the importance of hydropower to meeting our environmental and economic objectives which of course were all about low-cost, emissions-free and reliability, and hydropower does that.

I want to focus for just a moment on the reliability benefits of hydropower which I think are not well understood. The public is demanding greater reliability as we move to a digital economy. They want more and more; they are not satisfied when we have outages because it shuts down their businesses, it shuts down their homes. If one thinks about the services necessary to assure a reliable power system, they include the following services: so you have to have energy, you have to produce kilowatt hours; you have to produce peak capacity, the ability to produce at the key moment when you are short of all other resources. In this brave new world that we're operating in, you have to have flexible capacity to support variable energy resources; you have to have regulation which is the ability to respond at the four-second level, you have to have spinning and non-spinning reserve which is four-second to ten-minute responses to big generator outages that occur on the system, and beyond ten minutes, how you would deal with that; you have to have Blackstar capability, the ability to be able to, if you have a big outage, you have to have some generation that doesn't require being heated up in order to start getting everything else working; and you need inertia because when you have a big disturbance on the system, you get big oscillations; big oscillations if you don't dampen them turn into cascading outages. What dampens oscillations? Big rotating mass; What's the big rotating mass in the West? The large hydro turbines that sit on the Columbia and the Snake rivers primarily.

So if you think about all of those services that are needed for reliability, there is only one generating resource available today that does all of them well. It doesn't matter what we're talking about. None of the other generating resources do that well, except for hydropower. So it is something that I think is really fundamentally misunderstood in the public policy world with respect to hydropower is that it is being somewhat

forgotten or ignored today. It is built, it runs, we don't need to think about it very much. But things are changing. Hydro needs reinvestment. This system was built primarily between 1930 and 1975. So it is an aging resource; it needs substantial reinvestment. Refurbishment decisions are very expensive and when you are making a refurbishment decision, you are comparing against market prices.

So I'm just going to give you an example from my utility. So we operate Rock Island Dam, the first dam that was built on the Columbia River. It started operating in 1931. Just to give you an idea of how good the engineering actually was, we have cracks in the turbine blades, and it turns out we're going to have to replace the entire turbine units. These are the original turbines from 1931, they have been operating for 85 years. So we are just reaching that point where stuff, even though there was tremendous engineering, we are reaching that point where things have to be fixed. When you do the analysis, there are three values to electricity that you compare against, and this by the way applies to energy efficiency as well. So it's energy, capacity and carbon. And all three are currently undervalued in the marketplace. So in energy the markets are doing a fantastic job of creating efficiency, but the production and investment tax credits confound the market. You know this, you've seen the examples of negative prices. What we are seeing is increasing amounts of negative prices as we put more variable energy resources to rely on production investment tax credits. I would refer you to the good work of E3 and Energy GPS who have really done an excellent job of documenting the coming supply expansion and the resulting impact on both hourly surpluses and deficits coming in the next decade, and the resulting decline in prices that are likely to occur, on average across time primarily because we're going to have more hours of negative prices.

This negative pricing phenomena will change as the tax credits roll off, but given current tax credit policy it's going to be a decade or more before that happens.

In the capacity world, the electricity markets around the country and the West do a poor job (21:09) of valuing capacity, swinging between over- and under-valuing because of a lack of storage. Currently we are in a period of under valuing. Mark mentioned that I got to be in charge during the west coast energy crisis, so I remember really well what it was like to be in a period when we had prices that were too low that led to substantial under-investment. Current market prices provide generally inadequate revenue to

support investment in new or refurbished capacity for peak or for flexibility purposes. Assuring adequate flexible capacity is the biggest concern for me as the marketplace evolves in terms of being able to maintain reliability and avoid price excursions. Even back in 2008 we saw this problem coming for variable energy resources. Of course Tom Karier was a co-sponsor of the wind integration work that the Council and Bonneville did back then and we began to think through what does it mean to add all these variable energy resources? So we've seen this coming for a while, and yet what we didn't really anticipate was how quick it was going to come. There is an incredible rapid acceleration in addition of variable energy resources across the West, particularly solar, and this is a radical change to system operations.

There is a reason the duck curve shows up in every conference that you go to around electricity in the west coast these days, and it's because the operation turns historical operation practice upside down on its head. I remember really clearly the day in 2013 when I first saw the duck curve. I went home that night and I laid in bed and stared at the ceiling for hours thinking this changes everything I know about the way the system operates, because the whole system is built around the idea that light load hour is at night and heavy load hour is the day and this flips that upside down.

There is a risk for reliability, particularly on addressing the duck's neck, the period when you have the evening up-ramp. And the real question is will we have adequate flexibility and can we put it in place quickly enough to be able to address that period? There was a recent surge – the August heat wave that came through, there was a big surge in prices on the duck's neck, prices in the high hundreds of dollars per megawatt hour. The first time we've seen that in many, many years. And I do worry that it will be a precursor of future challenges. The California ISO in May laid out a paper that identified near- and long-term challenges associated with dealing with the ramp. They did an excellent job. But it didn't provide any long-term solutions, beyond about four years. It left the question open as to how this problem is going to be solved. If it's going to be new capacity of some kind we need to be moving in terms of trying to figure out where that's going to come from.

So we really need policies that assure adequate investments in flexible capacity.

The third value stream is carbon. The California cap and trade is the only market in the west that we have some way to be able to look at what the prices are there. Prices are less than $15 a metric ton, have been for many years, and that number is too low to achieve anything approaching the meaningful reductions to achieve anything like the 50 to 80 percent levels of reductions that are called for below the 1990 levels. We know this and I say this with some amount of confidence because of the work we've done trying to understand least-cost approaches to greenhouse gas emissions reductions. We've tried to put the array of options and say how much do each of one of them cost per metric ton, and again, it's not a very sophisticated analysis but it gives us broad looks at where the cost streams are. And when you look at that you say boy, $15 a metric ton isn't going to make very much difference here in terms of the types of reductions that are being called for in the public policy arena. If greenhouse gas reduction policies are going to be pursued - if that is the public policy - then the pricing policy should probably be a regional approach as a means to achieving least cost, and if pricing is going to be used, creating larger, more liquid markets would promote economic efficiency.

So if you start with those two policy precursors and I know that not everybody does, but if you start from there, I would say consideration should be given to creating expansion of the California cap and trade program to other western states because that gives you the bigger, more liquid market in a way to achieve least cost.

I know that sometimes when we talk about this, people say well low prices sounds really good to most consumers and if they can be sustained it is great. It's a wonderful thing for consumers. But if it leads to under-investments the consequences can be severe. The most scarring event of my career was the West Coast energy crisis. I think back on everything and all of the things I was involved in, that six-month period when we went through the crisis was the hardest, most difficult and most important time. I got to see the impacts on people up-close and personal and I have the stories to tell about being pilloried and picketed during that period, personally. About the families, school board members, business owners and farmers in great distress and sometimes tears at public meetings, begging for someone to do something to provide relief to the extraordinary prices. And when you're in that moment, there is not very much you can do. What needed to happen was more action in advance of that moment. We knew that we were at risk of having this happen. We had plenty of studies in the late 1990s that told us we had a resource adequacy problem.

We were unable to act on it. Being short on supply is expensive and very, very destabilizing. And planning should be calling attention to this risk.

The primary impact on wholesale power markets today is driven by policy making in the state of California. That's why personally we're spending a lot of time in California. California is just a big share of the western power market, and when they make decisions, it moves everything. We in the Northwest have this attraction/repulsion to California in the electricity arena. We have wanted to be close but not too close to California since the development of the interties. We want to take advantage of the synergies between our two regions which have produced billions of dollars of benefits for both California and the Northwest, but we don't want them to take our lowest-cost resources or have their policies negatively impact us as happened in the energy crisis. We should be thinking today about what we want our future relationship with California to be. It's a critical question that should be answered by policy makers with some foresight and the will to drive to conclusions that are, I would argue, driven by least-cost to society principles and combined with a fair sharing of costs and benefits between the regions.

Simply put, from where we are today and the things that are being discussed in the California legislature, we have three options, and we'll either choose them consciously or unconsciously. First, the status quo. The system can operate the way it does today with the southern and northern intertie operating limits; the second is we can create more connection between the Northwest and California; more integration, more connection with California. We provide a lot of fuel displacement today where we go in and we displace natural gas plants. As you have a solar surplus there will be a lot of opportunity to provide more balancing services and large hydro is the natural complement to building solar surpluses in California.

But we may choose an alternative path which is less integration between the Northwest and California and again, we see this in some of the legislative initiatives going on in California. The proposals on generation portfolio standards that limit imports would take us in the opposite direction towards less reliance on each other towards trying to create value for consumers in both regions.

At Chelan I'll just say we very carefully watch and engage in these California issues, including the things like the size of the renewable

portfolio standards, what generating resources qualify as renewable, whether you have resource adequacy requirements, what's the cap and trade policy which results in a carbon price, what's the governance structure for the Cal ISO and whether it will become more regional or more focused on California and service California constituencies. All of these are significant issues that will have a big impact on generation and transmission investments and the physical operation of the western electric system, and ultimately these decisions will have a substantial impact on what the rates and system reliability will be in the Pacific Northwest in the next decade.

We recently worked with E3 to produce the study of the current and potential benefits from Northwest hydroelectric transactions and we'd be happy to share that with you if you have an interest in it.

Ultimately what we hope is that this will, this conversation could evolve into a broader discussion about how we work together to meet our environmental objectives and economic objectives in both California and the Northwest.

Okay, final theme. One that I'm not as close to today, but I was close to for many years and that's the question of can we have hydropower and salmon? So I think the answer is yes. I've believed that for my entire career. I know that the Council has believed that for a long time, too.

The improvements in survival over the last 30 years are well documented. We know that we've made a big difference in terms of salmon survival, but I see our region revisiting a fairly fundamental issue that was at the core of the debate in the last decade. The choice between whether to invest in significant increases in spill versus habitat restoration. This is not a debate that's unfamiliar to the Council. You've watched it as well for a long time. There are some who view habitat restoration biological benefits as not reasonably certain to occur even when there is a commitment to a financial investment. It is true that there is more data on in-river mainstem survival than there is on habitat restoration. Tom Karier knows all too well because of all of his years tracking the research and development dollars that Columbia River salmon are among the most studied species in the world due to hydropower dollars that were historically focused on mainstem conditions, but just because we have more data on mainstem in-river survival should not diminish our evaluation of the potential biological

benefits of off-mainstem habitat restoration where the research is catching up.

Here's one thing we know for certain. There are 11 million people that live in the Pacific Northwest today. There were 1 million people that lived here at the turn of the last century. The habitat has been altered and it has been altered in a lot more places than in the mainstem of the Columbia and the Snake. The hydro system is the primary funding source for addressing the degradation to habitat caused by humans that is going on in the Northwest. Just my view, it would be a mistake to claim no reasonable certainty for biological benefit of that habitat restoration because if we go down that path it would be very tempting to severely limit and cause a lack of justification for funding for habitat restoration. So I just think it would be a mistake to further degrade the output of the hydro system that is a necessary component of achieving a least-cost societal approach to greenhouse gas emissions reductions when there is a viable alternative like habitat restoration available on the table today.

So, I'm going to wrap this up and just say based on the stuff I've been thinking about for the last few years and, again, that's just limited to the things I'm thinking about, the best advice for policy makers I could give is prepare for the future, accept what I think has become obvious, at least in the west coast states, that greenhouse gas emissions reduction policy will drive electricity policy. Whether you like it or not, it's just the facts on the ground today that it does drive electricity policy. Develop the analytical tools and strategies to define least-cost approaches that seek to simultaneously achieve our economic and environmental, particularly our greenhouse gas emissions reductions goals; support strategies based on that analysis that create adequate compensation to promote investment to ensure we can reliably meet load, avoid rate excursions and achieve our greenhouse gas emissions reductions targets; pursue technology-neutral analysis and policies that allow for innovation and evolution because we are not good at predicting the future. That's probably my number one learning from the last 35 years. Engage in inter-regional discussions with the intention of supporting least-cost strategies to consumers that allocate benefits so everyone wins; and treasure the output of the hydropower system and support strategies that protect salmonids at the same time.

Lorenzen: Steve, it's stunning to hear your thoughts on the energy and hydropower, and particularly what I find most interesting is the concept of using least-cost planning for reduction of greenhouse gases. I think that's

something that we as a society have not embraced yet, and I think it's something that would be incredibly beneficial in order to marshal our resources in a way that also accomplishes what from a societal standpoint we consider an extremely worthwhile goal. And my pitch always is that money is a scarce commodity and that when you devote it in a way that doesn't make sense in a least-cost way there is a downside to that, and that it also eliminates the opportunity to do other good societal things. It is wonderful to hear you talk about that and to summarize it so succinctly. Tom.

Karier: Thank you Mr. Chairman. And thanks, Steve, for the comments. We've had a series of presentations; we've invited leaders in the Northwest with experience through a lot of these events, and it's very helpful for us to hear those observations.

I was thinking about that in the beginning of your talk you talked about results of a study that showed energy efficiency and hydropower as being two of the major valuable resources going forward. And then you talked about a lot of the problems. And as you were talking about it, I was thinking well, those are two of the major solutions to these problems and in a way that's not one or the other, but together. And we're not making more hydropower generally but we can in a way through energy efficiency. It frees up hydropower to be used for more things. Like many of the problems that you're talking about, capacity, flexibility, all of those things, and the problem, so the fundamental problem from an economic point of view is that it is undervalued. People aren't valuing that freed-up hydropower that can provide all those resources and help solve the duck curve, help solve all these other issues. And energy efficiency where in the region is always struggling. Many utilities are saying why should we do it if we only save $20 a megawatt hour in the energy market? Somehow we have to figure out how to sell that hydropower services at a rate that is commensurate with the value it's providing, and at the same time avoid some of the new gas plants that are being proposed that are going to operate 5 or 10 percent of the time. They are extraordinarily expensive and again, this freed-up hydropower can replace that. So our markets aren't working, the signals aren't working, but I think at Bonneville and maybe at Chelan where you have hydropower and energy efficiency opportunities, maybe there are ways to figure out contracts and ways to sell that hydropower at a reasonable price. Is that something that's possible?

Wright: Absolutely. Yeah. So again it is a problem, while a lot of my talk focused on hydropower, you heard the words energy efficiency a few times because I do believe that energy efficiency is part of the solution. And, again, least-cost approach both for meeting load as the 7th Power Plan again reiterates and our own work with respect to looking at greenhouse gas emissions reductions, energy efficiency is a key component that wins in almost any scenario. It is one that works. Just to give you an example of some of the thinking that we're doing and I'll come back to the work that we're doing with NRDC on the additionality principles, one of the criteria that we are asking folks to consider is one where those who want additionality would support investment in energy efficiency that would then free up hydropower that they could be delivered to them. So why not make an investment that goes beyond what would be cost effective for the electric system, but if one took into account the cost of carbon, would be a cost-effective investment, and then that does free up hydropower as you say and ultimately these businesses need kilowatt hours delivered to them. They can't operate on air. So use hydropower to be delivered to them that would be freed up. So yes, and that's just one of many ways that we can make the connections between these resources.

Lorenzen: Steve, what do you consider the greatest impediments to being able to monetize the value of the hydro system in terms of flexibility, frequency support, all those other benefits that come from it? What are the barriers?

Wright: well, number one is that we as a country have not really figured capacity markets. There are complaints about capacity markets in every market, whether it's PJM, MISO or ERCOT, we find it very difficult to successfully operate capacity markets. And there is a nascent and very not-well-formed capacity market in California and people are caught between operating in organized markets and bilateral markets. So number one is the structure of markets. Can we find a way to actually put them together that will compensate all these various reliability services that are necessary in order to make it work? There is some progress being made, FERC has put in place policies with respect to frequency regulation, there is a frequency regulation market today; we are selling into that market today. Bonneville is selling into that market today. Those markets didn't exist even two years ago so we're making some pretty good progress there.

But there's also a psychological problem beyond the markets. This is very similar to what happened in 1999 as we approached the west coast energy crisis, which is when you have a big surplus of energy and people can buy a strip of energy for five years at a really low price, then it is very tempting to say I'm going to do something that's going to lower my rates today and I'm going to be a hero in my community by lowering rates today. But if you rely on that market and then it turns out that it's short and you don't have the capacity, it takes a while to build the capacity to make it happen. That's where you get the big price spikes. And so it takes some planning regime on top of that to call to the attention that in fact there is a need to take action early and to avoid the siren song of the short-term energy prices.

Personally, I'm a fan of moving toward some sort of resource adequacy standard. I think that resource adequacy standards are part of the deal, If you are a load serving entity. That we all work together and we make sure that we are going to be adequate as a whole to make sure that there is enough supply and demand to avoid those kinds of price excursions. But it is very difficult to figure out how to put those in place. What's the regulatory regime to make it work, and so I'm not going to say it's easy, but something that moves us in a direction of making sure we have adequate planning and then some mechanism that causes us to actually act on that planning is where we need to move to.

Lorenzen: Thank you. Questions? Bill.

Booth: Thank you, Steve, good to see you again. I thought your comments were very, very well framed and formed and one of my concerns as well is the issue of adequacy of the system. I noticed that the Department of Energy seems to be heading towards a concern in that arena also. One of the first initiatives of the new Department of Energy was this pretty extensive white paper on adequacy and capacity that's just been published. It focused more on reserves and fuel on site and so forth, and of course to me, very supportive after looking at it, very, very supportive of the hydro system. I don't know if you've reviewed that.

Wright: I have and there is some very good language in there with respect to hydro.

Booth: So I'm just wondering if with that new initiative coming out of Washington from the Department of Energy if you might see an opportunity for Northwest hydropower folks such as yourself who are the experts, I

would say in the country, to work with the department in trying to address some of these issues that we have along the lines of subsidies and so forth for variable resources. It may take some national policy on looking at it as you do rather than a quick, easy fix. What does this mean for the longer term? I just wonder if you've given that any thought and if you see any opportunity there for maybe some national leadership now on this matter.

Wright: Electricity policy in our country has always been somewhat confused as to whether it operates at the federal level, the state level or the regional level. And there are elements of all three. The prerogatives of the states and the feds are jealously guarded by whoever happens to be sitting in those positions. So the fact of the matter is it is going to take action at all three levels in order to be successful in addressing the issues there.

There are actions again which the Federal Energy Regulatory Commission can take through the organized markets and I will come back to frequency regulation as an example. We do see some progress there that is good and helpful. There is a development of a resource adequacy standard in the California ISO market which I think has potential and again, if you go back to the paper that the Cal ISO produced in the so-called FRACMOO, the flexible resource adequacy must offer obligation process, it actually is fairly important in terms of saying we need to find some ways to be able to address these issues of making sure that we have flexible capacity on the system.

So what it unfortunately takes is I would love to be able to tell you that there are a couple of key points in the process and if you just touch those it's going to work. Unfortunately, it's bigger than that. And just the way that electricity policies have evolved in our country, there are many different points in this process that we're going to need to address in order to be able to get to the key thing which the Department of Energy report is addressing, which is price formation. How do we get adequate prices to make sure that we will have the capacity that we need? I'm not candidly a fan of the term "baseload capacity" anymore because I think that with all of the variable resources that operate in our system we have to have flexible capacity. I'm more concerned with that. But it really doesn't matter what your term is. They are both going at the same issue which is how do you get price formation in the market that will then attract investment? So last year just at Chelan we filed in 40 different regulatory proceedings because there is policy going on all over the place that impacts the prices in the western power market. And candidly, we're not that big an entity. It is hard

for us to support that so we're trying to figure out how we can try to move the ball in a lot of different arenas.

Lorenzen: Anything further? Steve, thank you so much.

Wright: Thank you for having me. I really appreciate it. It's a pleasure. I guess I have to find out whether I exercised any of my rights and privileges at some point. I'll get a grade later from you all.