Comments to the Northwest Power and Conservation Council regarding Seventh Power Plan: Quantifiable Environmental Costs and Benefits
by
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1. Residual environmental effects beyond regulatory control

1a. Should the council also consider, in crafting the methodology, the residual effects that a resource might have on the environment after compliance with environmental regulations?

Yes. The issue paper states "Congress adopted these provisions at a time when natural resource policy was awash in considerations about the need to internalize environmental externalities when possible, to capture better the true cost to society of resource choices." This need to internalize environmental externalities is now greater than ever. Regulation invariably lags behind scientific knowledge and in this day-and-age of partisan politics our legislative bodies seem largely paralyzed and unable to act even on well-established science to enact basic provisions to protect our climate, our ocean, and our fresh water supplies. The Northwest Power and Conservation Council has the ability and the obligation to create a Seventh Plan that in every way possible takes into account current scientific understanding of the dire threats to the climate from greenhouse gas emissions, the threat to our oceans from acidification by carbon dioxide emissions, and the threat to our freshwater supplies by irresponsible and unnecessary pollution and through usage for thermal electrical production.

The urgency of the climate issue cannot be overstated. Because of the nonlinear effects of system dynamics, decisions made now will have far more profound effects than any decisions we can make in the decades to come. As elevated global temperatures melt Arctic sea ice, the reflectivity of Arctic regions is decreased[1], allowing for yet further global absorption of heat from the sun[2]. The Arctic tundra is laden with frozen methane, a potent greenhouse gas. Melting of Arctic ice and release of these huge methane reserves is not something that our children's children will be able to reverse. Not for any price.

The links between water and energy are profound. It has been reported that almost 50% of the fresh water pumped in the US is pumped in the service of thermal electrical production.[3] Much of the NWPCC four state region is arid and susceptible to drought, particularly as the effects of climate change become increasingly manifest in our region.[4]

As stated above, regulations invariably lag knowledge. Moreover, regulations are invariably a political compromise that also reflects the needs and desires of the polluting interests. For these two reasons, compliance with existing regulations will inevitably allow damaging externalities that the Council is

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[1] Polar ice caps have a high albedo and reflect about 70%. Deserts reflect about 40%. Oceans reflect about 10%. Riihelä, A. (2013, August 8). Nature Climate Change: Three-decade decline in reflectivity of Arctic sea ice. Finnish Meteorological Institute. Retrieved from http://en.ilmatieteenlaitos.fi/press-release/1200826
[2] Riihelä, A. (2013, August 8). Nature Climate Change: Three-decade decline in reflectivity of Arctic sea ice. Finnish Meteorological Institute. Retrieved from http://en.ilmatieteenlaitos.fi/press-release/1200826
[3] Lovins, A. (2011) *Reinventing Fire: Bold Business Solutions for the New Energy Era*. White River Junction, Vt.: Chelsea Green Pub.
[4] Natural Resources Defense Council. *Climate Change, Water, and Risk: Current Water Demands Are Not Sustainable*. (2010). Retrieved from http://www.nrdc.org/globalWarming/watersustainability/index.asp.

obligated to take into account either by monetizing the effects to the best of its ability or, as it has done in the past, by setting out-and-out prohibitions on certain practices within "protected areas".[5]

1b Are there reasonable methods for quantifying the costs of such effects?

Yes. There are methods to at least begin to put values on the currently externalized negative impacts of generating energy for human use. We suggest employing a life cycle assessment approach supported by appropriate expert input. Such an endeavor might proceed as follows:

1. NWPCC staff sets up a preliminary matrix of impacts (see example, Table 1 below).
2. The Council creates an advisory group to inform the process and refine matrix, perhaps the Externalized Costs Advisory Committee (ECAC)
3. The Council solicits public input on:
    a. Breadth and depth of matrix,
    b. Which cells should be assessed quantitatively, and
    c. Issues of concern in cells of note.
4. Advisory group is expanded as needed to include appropriate skills and knowledge
5. Staff works with advisory committee to refine matrix and quantify impacts in cells that rise to a significant level of externalized costs
6. Costs may be determined either as funds needed to restore system to its pre-activity state or, where this is impossible, as funds needed to make up for the loss or damage to natural systems.
7. NWPCC should keep in mind its precedent of outright prohibition of hydroelectric generation in areas that are of high natural importance and apply this principle of outright prohibition of damaging activities to areas of particular sensitivity to disruption, pollution, or water withdrawal.
8. In making its assessments of the impacts, the Council should include full consideration of expected climate patterns for the region, especially with regard to temperature and precipitation.

We note that the externalized costs for electricity production through the burning of coal have been studied at some length. A good starting point in refining a methodology for coal in the west and for other resource uses would be the full study from the Annals of the New York Academy of Sciences ,[6] summarized by the Harvard Medical School, Center for Health and the Global Environment [7].

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[5] "The Council designated certain river reaches in the basin as "protected areas," where the Council believes hydro development would have unacceptable risks of loss to fish and wildlife species of concern, their productive capacity, or their habitat . . . In essence, Protected Areas are places where fish and wildlife values are judged to outweigh the value of electricity those areas could generate." Paquet, P. (2010 September) Northwest Power and Conservation Council. Presentation retrieved from http://www.nwhydro.org/events_committees/Docs/2010_Low_Impact_Hydro/LIHW%20-%20NWPCC%20-%20Paquet.pdf.

[6] Epstein, P. R., Buonocore, J. J., Eckerle, K., Hendryx, M., Stout III, B. M., Heinberg, R., Clapp, R. W., May, B., Reinhart, N. L., Ahern, M. M., Doshi, S. K. and Glustrom, L. (2011), Full cost accounting for the life cycle of coal. Annals of the New York Academy of Sciences, 1219: 73–98. doi: 10.1111/j.1749-6632.2010.05890.xhttp://onlinelibrary.wiley.com/doi/10.1111/j.1749-6632.2010.05890.x/full.

[7] Harvard School of Public Health. (2011). *Mining Coal, Mounting Costs: The Life Cycle Consequences of Coal*. Retrieved from http://www.oregonrenewables.com/Assets/Reports/Mining_Coal_Mounting_Costs.pdf

Ongoing Activities and Processes	Impacts										
	Water			Air				Land		Human Communities Impacts	Natural Communities Impacts
	Usage	Pollution		Pollution				Pollution	Disruption		
		Organic	Metals	Green House Gases (GHG)	CO2 (Ocean Acidification)	Other Organics (Dioxins, PAHs, etc)	Metals	OrganicsMetals	Disruption, Earthquake etc	Pollution, Noise, Dust, Viewscape, etc	Pollution, Loss of Habitat, Loss of Species, etc
Electricity from Natural Gas											
Resource Extraction	x	x	x	x	x			x	x	x	x
Resource Transport				x	x					x	
Resource Storage				x							
Power Plant Operation	x			x	x	x					
Electricity from Coal											
Resource Extraction	x	x	x	x	x			x	x	x	x
Resource Transport		x	x	x	x						
Resource Storage		x	x								
Power Plant Operation	x	?	?	x	x	x	x			x	
Electricity from Biomass											
Resource Extraction		x		x	x				x	x	x
Resource Transport				x	x					x	x
Resource Storage											
Power Plant Operation	x			x	x	x	x			x	
Electricity from Wind											
Power Plant Operation										x	x
Electricity from Solar											
Power Plant Operation										x	x
Electricity from Geothermal											
Power Plant Operation	x			x	x						

Table 1. Example of how an impact matrix might be constructed and populated. Some cells will be of extreme relevance; others not at all. Cells of real, but minor-and-difficult to measure impact may be earmarked for future consideration.

“Carbon”

The Council’s methodology issue paper appropriately highlights carbon emissions. We would like to take this opportunity to differentiate between different types of “carbon” emissions to be considered so as all may be appropriately dealt with in the Council’s methodology.

Greenhouse gases (GHG) typically include carbon dioxide, methane, nitrous oxide, and, less important for energy production activities, fluorinated gases. These gases, along with water vapor, all play a significant role in causing climate change. In the Council’s Methodology, each gas should be considered separately as their sources and potency as a GHG vary.[8] Of particular importance are the potencies of methane and nitrous oxide. Fugitive emissions of methane during the extraction, transport, and storage of natural gas can be a huge source of GHG potency[9] It has recently been shown though studies from space that these fugitive emissions are likely about 5 times larger than previously estimated.[10] This issue should be addressed aggressively in the NWPCC’s work.

Carbon dioxide emissions cause ocean acidification by equilibration of prevailing atmospheric CO_2 levels with carbonic acid in the ocen. In estimating the Social Cost of Carbon, the EPA methodology does not take into account this effect of carbon emissions.[11] The financial impacts of ocean acidification will vary regionally, both because of variations in acidity due to upwelling patterns and because of varying commercial uses of the ocean.[12] Given the importance of coastal fisheries within the NWPCC region, aggressive estimation of direct costs of ocean acidification, current and future, should be made. Already oyster fisheries are having to import “seed” from Hawaii (as native water is now too acidic for growth of oysters from eggs) and buffer water for their growth.[13]

The Water Nexus

Energy and water are intricately connected, with traditional energy production highly dependent on large quantities of water resources.[14] [15] Moreover, water shortages are becoming profound across the globe. Witness as an example the extreme shortage of water in Sao Paulo, Brazil, where the city reservoir is

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[8] US Environmental Protection Agency. (2014) *Climate Change Indicators in the United States*. Retrieved from http://www.epa.gov/climate/climatechange/science/indicators/ghg/index.html.

[9] DeGraw, J., English, F., Eatherington, F., Gleichman, T., Heiken, D., Lawrence, R., Matthews, N. & Serres, D. (2014) Summary of Recent Science: Climate Impacts of Natural Gas Production and LNG Export . Sierra Club, et. al. Retrieved from http://www.oregonrenewables.com/Publications/Climate-Impacts-of-Natural-Gas-Production-and-LNG-Export.pdf

[10] Miller, S. M, et al, (October 2013) *Anthropogenic emissions of methane in the United States,* Proceedings of the National Academy of Sciences. vol. 110 no. 50. Retrieved from http://www.pnas.org/content/110/50/20018.full

[11] Howard, P. (2014) OMITTED DAMAGES: What’s Missing From the Social Cost of Carbon. The Cost of Carbon Project (A joint project of the Environmental Defense Fund, the Institute for Policy Integrity, and the Natural Resources Defense Council) Retrieved from http://costofcarbon.org/files/Omitted_Damages_Whats_Missing_From_the_Social_Cost_of_Carbon.pdf

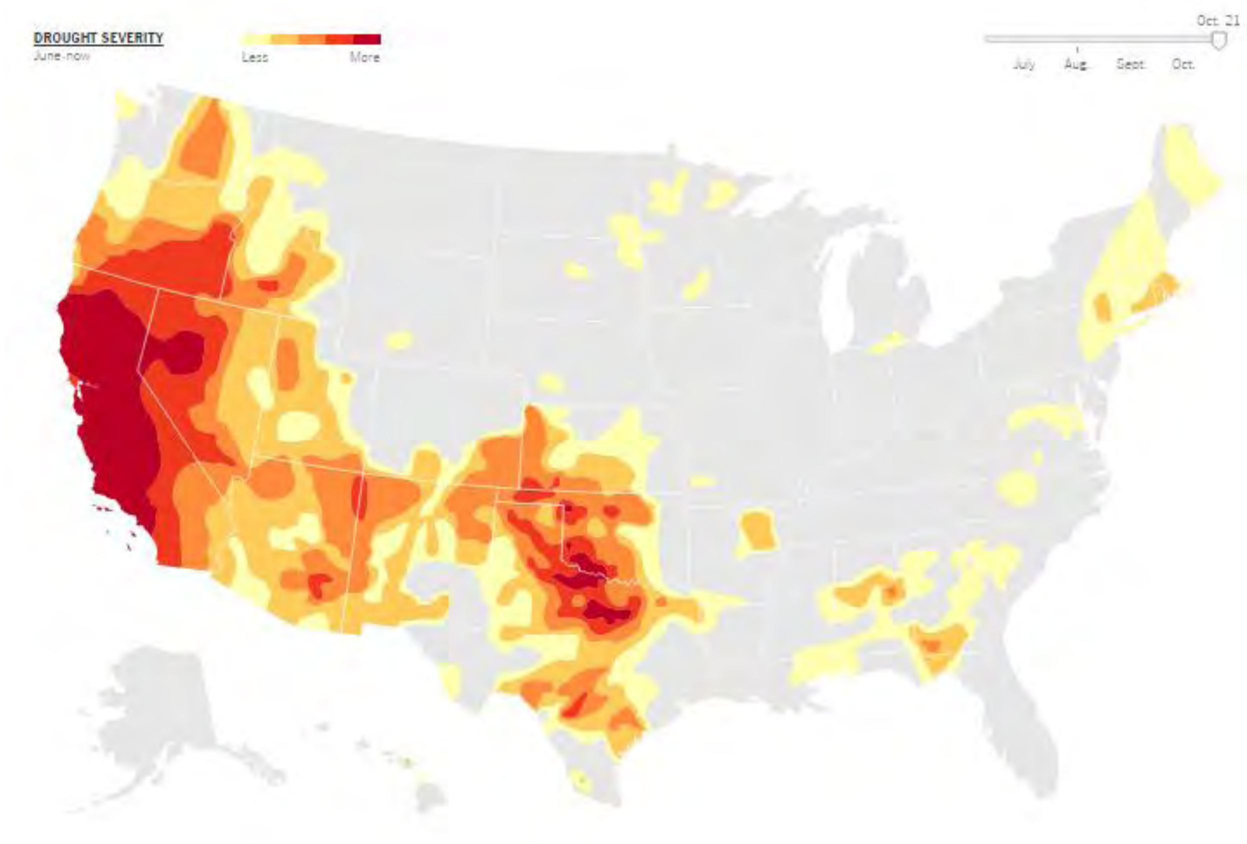
[12] Winner, C. The Socioeconomic Costs of Ocean Acidification: Seawater's lower pH will affect food supplies, pocketbooks, and lifestyles. Oceanus Magazine, Vol. 50. #2, Fall 2013. Retrieved from https://www.whoi.edu/oceanus/feature/the-socioeconomic-costs-of-ocean-acidification.

[13] Virj, A. (2014, July 21). The great American oyster collapse. Al Jazeera. Retrieved from http://www.aljazeera.com/indepth/features/2014/07/great-american-oyster-collapse-2014720132433957401.html

[14] Witkin. J. (2013, Octeober 8). In a Hot, Thirsty Energy Business, Water Is Prized. *New York Times*. Retrieved from http://www.nytimes.com/2013/10/09/business/energy-environment/in-a-hot-thirsty-energy-business-water-is-prized.html?_r=0

[15] Union of Concerned Scientists. (2013, July) *Water Smart Power: Strengthening the U.S. Electricity System in a Warming World*. Retrieved from http://www.ucsusa.org/clean_energy/our-energy-choices/energy-and-water-use/water-smart-power.html#.VFFamoc988E

down to 4% capacity and residences have been without water for days or weeks.[16] Worse still is the town of Porterville, CA where residents have been without running water for more than five months, with no change in sight.[17] Parts of our Northwest region are also highly drought susceptible. Below is a snapshot denoting drought severity last week throughout the US.[18]



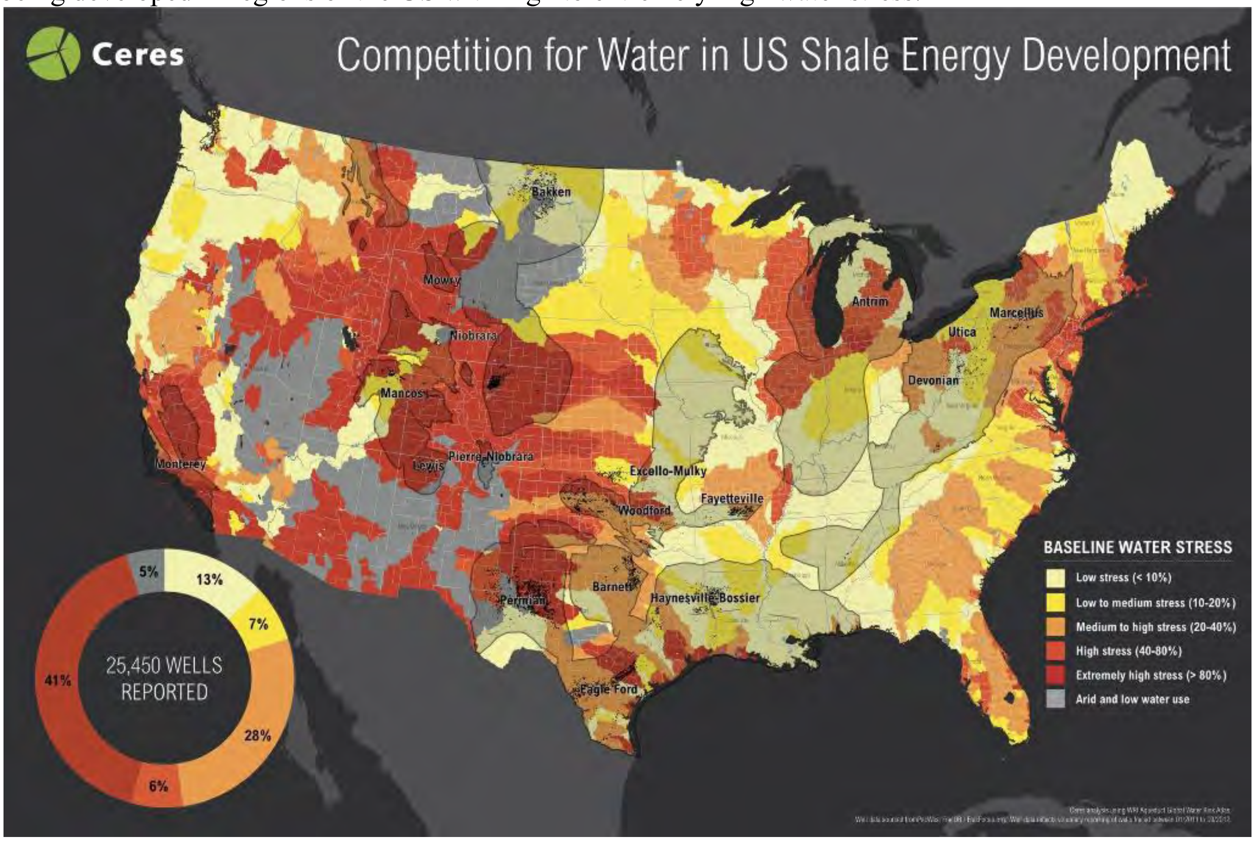
Droughts appear to be intensifying over much of the West and Southwest as a result of global warming. Over the past decade, droughts in some regions have rivaled the epic dry spells of the 1930s and 1950s. **About 30 percent of the contiguous United States was in at least a moderate drought as of October 21.**

Water quantity: Thermoelectric power plants use vast quantities of fresh water. Steam driven turbines need pristine water to turn into steam (often taken from groundwater) and huge quantities of water to cool

[16] Elizondo, G. (2014, October 18) Water crisis squeezes Sao Paulo state. *Al Jazeera*. Retrieved from http://www.aljazeera.com/news/americas/2014/10/water-crisis-squeezes-brazil-sao-paulo-state-20141017215812595820.html.
[17] Medina, J. (2014, October 2). With Dry Taps and Toilets, California Drought Turns Desperate. *New York Times*. Retrieved from http://www.nytimes.com/2014/10/03/us/california-drought-tulare-county.html?_r=0.
[18] Bostick, M., Quealy, K. (2014, September 8). The Upshot: Mapping Drought in the Spread Of Drought across the US. *New York Times*. Retrieved from http://www.nytimes.com/interactive/2014/upshot/mapping-the-spread-of-drought-across-the-us.html?abt=0002&abg=0.

the steam so that it condenses back to water, creating the backpressure to turn the turbine. It is estimated that nearly 50% of the water pumped in the US is pumped for thermoelectric power generation.[19]

Vast quantities of water are used in fracking, and while the exact quantities are difficult to know, estimates are available.[20] The map below shows that nearly half of all US shale gas and oil wells are being developed in regions of the US with high to extremely high water stress.[21]



In situations where water is withdrawn from aquifers, the Council should closely assess the actual long term value of that water to the region in light of future climate scenarios and drought uncertainty. In areas with slow aquifer recharge rates, the real costs associated with that usage must be estimated as the cost to bring in water from the closest area with abundant (naturally renewed) and pristine sources. The standard for determining when externalized costs have been fully accounted for is to ask whether existing resources are being left fully intact for future generations. Application of this standard to our nation's aquifers is long overdue.

[19] Lovins, A. (2011) *Reinventing Fire: Bold Business Solutions for the New Energy Era*. White River Junction, Vt.: Chelsea Green Pub.
[20] 2013 *Gone for Good Fracking and Water Loss in the West*. Western Organization of Resource Councils. Retrieved from http://worc.org/userfiles/file/Oil%20Gas%20Coalbed%20Methane/Hydraulic%20Fracturing/Gone_for_Good.pdf
[21] Gleick, P. (2013, June 27). The Growing Evidence of the Threat of Fracking to the Nations Groundwater. *Science Blogs.* Retrieved from http://scienceblogs.com/significantfigures/index.php/2013/06/27/the-growing-evidence-of-the-threat-of-fracking-to-the-nations-groundwater/

Water that is taken from surface water bodies and evaporated should be valued for its loss from other services (agricultural, industrial, human communities, natural communities) and valued as a cost in its contribution in the atmosphere as a GHG. About 2% of the water used in a thermoelectric power plant is evaporated.[22]

Water Temperature: The temperature of cooling-water discharged from power plants is regulated. However, thermoelectric power plants throughout the country are increasingly facing: a) warmer intake-water temperatures that are less effective in cooling; b) ambient air temperature that make it difficult to cool water sufficiently to meet discharge temperature regulations; and c) the release of warm effluent into water bodies that are already facing intense temperature-stress because of global warming. These issues have caused plants to slow or shut down during heat waves or to be granted exceptions from the Federal Clean Water Act temperature allowances. The US Department of Energy report entitled *U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather* addresses all these issues and gives examples of costs that have been incurred in order to comply with existing regulations.[23] A methodology for further valuing the cost of allowed and emergency warm water discharges could be developed by the appropriate experts on the Externalized Costs Advisory Committee created to give advice on this work.

Water Quality: The recent bonanza of natural gas extraction through fracking has been largely unregulated with respect to use of chemicals in the fracking water.[24] [25] After use, the fracking liquid is often disposed of illegally.[26] Groundwater systems that were thought to be hydraulically separate from the fracked system have turn out not to be[27], and methane and other hydrocarbons show up in drinking water wells in close proximity to fracking operations.[28] [29] A good survey of natural gas extraction pollution issues is presented by the Western Organization of Resource Councils.[30]

In situations where groundwater is polluted, the Council should look at the cost of remediation of the groundwater affected, if indeed full remediation is possible. In situations where full remediation is not possible, the cost of the pollution impact should be calculated as if that water had been lost from the

[22] Lovins, A. (2011) *Reinventing Fire: Bold Business Solutions for the New Energy Era*. White River Junction, Vt.: Chelsea Green Pub.
[23] US Department of Energy. (July 2013) U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather. Retrieved from http://energy.gov/sites/prod/files/2013/07/f2/20130716-Energy%20Sector%20Vulnerabilities%20Report.pdf.
[24] US Department of Energy. (2013, July) U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather. Retrieved from http://energy.gov/sites/prod/files/2013/07/f2/20130716-Energy%20Sector%20Vulnerabilities%20Report.pdf.

[25] Valentine, K. (October 24, 2014) Companies Are Fracking With Harmful Chemicals Through Regulatory Loophole. Climate Progess. Retrieved from http://thinkprogress.org/climate/2014/10/24/3584055/fracking-with-benzene/
[26] Kretzmann, H. (2014, October 6) Documents Reveal Billions of Gallons of Oil Industry Wastewater Illegally Injected Into Central California Aquifers. Center for Biological Diversity. Retrieved from http://www.biologicaldiversity.org/news/press_releases/2014/fracking-10-06-2014.html
[27] Warner, N. R. et al. (May 10, 2012) *Geochemical evidence for possible natural migration of Marcellus Formation brine to shallow aquifers in Pennsylvania* Proceedings of the National Academy of Sciences. Vol. 109 no. 30. Retrieved from http://www.pnas.org/content/109/30/11961.abstract
[28] Osborn, SG et al. (2011) *Methane contamination of drinking water accompanying gas-well drilling and hydraulic fracturing.* Proceedings of the National Academy of Sciences, U.S.A. 108:8172-8176 retrieved from http://sites.biology.duke.edu/jackson/pnas2011.html
[29] Jackson, R. B. et al, (June 2013) *Increased stray gas abundance in a subset of drinking water wells near Marcellus shale gas extraction.* Proceedings of the National Academy of Sciences. vol. 110 no. 28. Retrieved from http://www.pnas.org/content/110/28/11250.abstract
[30] Trechock, M. et al, (2013) *Watered Down: Oil & Gas Waste Production & Oversight in the West*, Western Organization of Resource Councils. Retrieved from http://worc.org/userfiles/file/waterreddown.pdf

system and therefore must be piped in from the closest area with abundant (naturally renewed) and pristine sources.

As stated earlier, the Council has in the past created "protected areas" where specific forms of energy production activities are off limits[31]. It seems that similar decisions would be appropriate to prohibit fracking and/or water cooled thermoelectric power production in areas that are drought susceptible and/or have limited and precious groundwater resources.

2. Environmental effects of resources not yet subject to regulatory control, especially carbon dioxide emissions

We have partially addressed this issue in Section 1. A recap and a few additional thoughts follow:

Water: Fresh water has been largely undervalued in the drier regions of our country leading to severe and unsustainable draw-downs of many aquifers[32] [33]and careless pollution of others. Calculating the costs of water loss and pollution from energy production activities should be a high priority for the Council's efforts.

Methane: We stress that special attention should be given to methane emissions during extraction, transport, and storage of natural gas since their potency as a green house gas is so great. Unless methane emissions are properly accounted for, the GHG benefits of transitioning from coal to natural gas will be vastly over stated.[34]

Carbon Dioxide as an Acid: The effects of ocean acidification must be taken into account separately from the social cost of carbon since it is not included in the EPA's methodology for the social cost of carbon.

"Social Cost of Carbon" (SCC) versus Compliance with 111(b) and 111(d)

The EPA Social Cost of Carbon aims to account for the externalized costs of GHG emissions. While an incomplete and imperfect analysis, it is a good start and the results are worth using. However, as seen in Table 2 below, the SCC is extremely sensitive to the discount rate used in its calculation.

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[31] "The Council designated certain river reaches in the basin as "protected areas," where the Council believes hydro development would have unacceptable risks of loss to fish and wildlife species of concern, their productive capacity, or their habitat . . . In essence, Protected Areas are places where fish and wildlife values are judged to outweigh the value of electricity those areas could generate." Paquet, P. (2010 September) Northwest Power and Conservation Council. Presentation retrieved from http://www.nwhydro.org/events_committees/Docs/2010_Low_Impact_Hydro/LIHW%20-%20NWPCC%20-%20Paquet.pdf.
[32] Braxton Little, J. (2009, March 1). The Ogallala Aquifer: Saving a Vital U.S. Water Source. Scientific American. Retrieved from http://www.scientificamerican.com/article/the-ogallala-aquifer/.
[33] US Geological Service. (2014) Groundwater Depletion. Retrieved from http://water.usgs.gov/edu/gwdepletion.html.
[34] DeGraw, J., English, F., Eatherington, F., Gleichman, T., Heiken, D., Lawrence, R., Matthews, N. & Serres, D. (2014) Summary of Recent Science: Climate Impacts of Natural Gas Production and LNG Export . Sierra Club, et. al. Retrieved from http://www.oregonrenewables.com/Publications/Climate-Impacts-of-Natural-Gas-Production-and-LNG-Export.pdf

Revised Social Cost of CO_2, 2010 – 2050 (in 2007 dollars per metric ton of CO_2)

Discount Rate Year	5.0% Avg	3.0% Avg	2.5% Avg	3.0% 95th
2010	11	33	52	90
2015	12	38	58	109
2020	12	43	65	129
2025	14	48	70	144
2030	16	52	76	159
2035	19	57	81	176
2040	21	62	87	192
2045	24	66	92	206
2050	27	71	98	221

Table 2. Revised Social Cost of Carbon[35]

The question is, "What discount rate should be used when looking at costs to future generations?" Strong arguments have been made that in matters of social costs in general[36] and in the matter of the Social Cost of Carbon in particular, **a very low or possibly negative discount rate is appropriate.** Laurie Johnson's blog,[37] which summarizes her paper in the Journal of Environmental Studies and Sciences,[38] provides an excellent summary of the compelling arguments against using a discount rate as high as 2.5%. We ask that you please read her summary in lieu of us repeating the arguments here.

New Electrical Generation Facilities: Use SCC with low discount rate, not 111(b)

The cost of the SCC with the arguably excessively high discount rate of 2.5% is still on the order of $60 per ton CO_2, which amounts to about 3 cents/kWh for natural gas powered electricity.[39] Accounting for a conservative social cost of carbon alone may effectively close the gap between the current levelized costs of new natural gas generators versus utility scale solar and wind.[40] New natural gas generation is certainly not cost competitive when adding the damages from fracking, fugitive emissions, ocean acidification, and other harms to be captured in the impact matrix. This makes 111(b) something of a moot point. New natural gas facilities should not be part of future plans.

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[35] Interagency Working Group on Social Cost of Carbon, United States Government. (2013, May) *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis*. Retrieved from http://www.whitehouse.gov/sites/default/files/omb/inforeg/social_cost_of_carbon_for_ria_2013_update.pdf.

[36] Woolfe, Tim, et al. *BENEFIT-COST ANALYSIS FOR DISTRIBUTED ENERGY RESOURCES: A framework for including all relevant costs and benefits.* Chapter 6. Discount Rates. Prepared for the Advanced Energy Economy Institute. September 22, 2014

[37] Johnson, L. (2012, September 17) *New study (part 1 of 2): Fed underestimate cost of carbon pollution, low balling climate change's impact on our children and our grandchildren.* Blog Post. http://switchboard.nrdc.org/blogs/ljohnson/co2pollutioncost_part1.html.

[38] Johnson, L. T. and Hope, C. (2012, September) The social cost of carbon in U.S. regulatory impact analyses: an introduction and critique. Journal of Environmental Studies and Sciences. Volume 2, Issue 3, pp 205-221

[39] 2011 IPCC aggregated results of the available literature

http://en.wikipedia.org/wiki/Life-cycle_greenhouse-gas_emissions_of_energy_sources

[40] See work of the NWPCC Generating Resources Advisory Committee.

One might assume that new natural gas plants will be required for integration of renewables. At a recent tour of the PGE Microgrid Pilot in Salem, Oregon, OREP visitors were informed that while the pilot was expensive because it was the first of its kind, the project has been highly successful at arbitrage and integrating solar, and similar projects could be constructed that would be expected to be just about cost effective now.[41] Cost effective electric storage is around the corner for our region, and as will be discussed below, demand response is a largely as yet untapped resource.

Old Electrical Generation Facilities: Calculate actual cost of externalities using SCC and other matrix impacts; calculate maximum timeline for compliance using robust implementation of 111(d).

For the purpose of truly weighing the costs and benefits of various energy scenarios, including the full externalized cost of each scenario is ultimately more meaningful than including the arbitrary compliance cost toward a particular regulation. Thus the SCC plus additional costs from the impact matrix should be used to weigh resources to set the long term plan for the region.

That said, we don't expect all fossil energy production in the region to stop overnight. Understanding the ramifications of 111(d) is likely to give guidance to the short term planning process. Given that the immediacy of the climate crisis requires quick action independent of any particular regulation, it behooves the Council to anticipate that the law will be confirmed in its most robust form and include this scenario as its base case.

3. Quantifiable environmental benefits

We see several opportunities for quantifiable benefits from energy strategies. They are as follows:

Demand response offers both balancing services to the grid and in the positive benefit side, can be used to avoid curtailment of existing and future renewable infrastructure, specifically wind turbines. Expansion of a demand response from home water heaters, for example, could soak up excess generation on windy spring nights when streamflow is high and the wind turbines are asked to curtail. This situation may become more and more frequent as more wind capacity is built out and as the spring high waters are likely come earlier in the year and more intensely. Electric car batteries with smart chargers could serve the same function. The council should explore and promote demand response aggressively.

Battery storage offers the same benefits outlined above for demand reponse, which is effectively a form of storage. As mentioned earlier, the PGE Microgrid Pilot shows the promise of this techonolgy both in integrating renewables and in earning money for through arbitrage.

Farm Biogas

Farm biogas is a limited but important resource for the region. Biogas can be cleaned and used as gas or immediately burned to generate onsite electricity. Farm biogas fits in the "additional benefits" bin because it reduces the amount of methane, a potent GHG, that escapes into the atmosphere. The Climate

[41] Kevin Whitener, PGE Staff, Salem, OR. October 10, 2014.

Trust[42] already buys offsets from a number of certified farm biogas facilities in the region. This is a very worthwhile area to focus some attention.

DG Solar for Disaster Resiliency

Chris Robertson of Chris Robertson Associates has submitted articulate comments to the NWPCC entirely dedicated to this subject. We concur with his suggestions and further ponder equipping some resiliency centers with battery backup so as to create tiny, self-islanding microgrids that could provide limited, but available, power day and night for medical, communications, and other essential services.

4. Environmental effects of new renewable resources

The National Academy of Sciences recently published an analysis that "indicates that the large-scale implementation of wind, PV, and CSP has the potential to reduce pollution-related environmental impacts of electricity production, such as GHG emissions, freshwater ecotoxicity, eutrophication, and particulate-matter exposure. The pollution caused by higher material requirements of those technologies is small compared with the direct emissions of fossil fuel-power plants."[43] We therefore think it unnecessary to consider the construction phase of renewable infrastructure in the Council's analysis.

We suggest that the Council include renewable resources in the impact matrix and use the expertise of the Externalities Advisory Committee to assess what if any of the environmental impacts of each technology is of sufficient concern to warrant monetization.

We thank the Council for the opportunity to provide input in this important matter,

Sincerely,

Kathleen Newman and Ray Neff
Oregonians for Renewable Energy Progress

Dated this day the 31st of October, 2014.

[42] www.climatetrust.org
[43] Hertwich, Edgar G. et al, *Integrated life-cycle assessment of electricity-supply scenarios confirms global environmental benefit of low-carbon technologie,* Proceedings of the National Academy of Sciences, Sept 3, 2014. http://www.pnas.org/content/early/2014/10/02/1312753111.full.pdf+html?sid=387bb6e2-0e99-42b4-869b-30931a9963db