Appendix 1

STATE REPRESENTATIVE
48th DISTRICT
DEBORAH EDDY

State of Washington House of Representatives

RULES

TECHNOLOGY, ENERGY & COMMUNICATIONS
VICE CHAIR

TRANSPORTATION

ECOLOGY & PARKS

June 9, 2011

Jeffrey Goltz
Washington Utilities & Transportation Commission
P.O. Box 47250
1300 S. Evergreen Park DR SW
Olympia, WA 98504-7250

Dear Chairman Goltz:

I am writing to invite the Utilities and Transportation Commission (Commission) to contribute to an interim activity of the House Technology, Energy and Communications Committee (TEC Committee).

During the 2011 Interim, at the request of TEC Committee chair Rep. John McCoy, I am leading a project relating to distributed energy (DE). The purpose of the project is to identify and develop a set of policy actions to advance distributed energy in Washington, including potential legislation to encourage the growth of distributed energy in the state. Over the interim, I will be convening a focus group of state legislators to hear presentations and engage in discussions from different perspectives, including developers, utilities and stakeholder groups. We will conclude by developing a set of recommendations for presentation to the full TEC Committee. I expect one or more bills to develop from this work.

I would like to invite the Commission to assist in the DE project by conducting a study of distributed generation issues applicable to investor-owned electric utilities. Specifically, I foresee the Commission's study providing background information and detailed discussion to the TEC Committee and the Legislature of the available options to encourage the development of cost-effective distributed generation in areas served by investor-owned utilities, as well as the opportunities and challenges facing investor-owned utilities and their ratepayers in developing distributed generation in this state.

While the timeline for the DE project is still under development, I anticipate much of the work of the focus group to occur in the fall of this year. The Commission's insight into distributed energy would be an important contribution to the DE project.

Sincerely,

Deborah H. Eddy

Cc: Representative John McCoy

APPENDIX 2 – Workshop Participants and Commenters

Organizations Attending July 25, 2011, Workshop

Avista Utilities
Bonneville Power Administration
Cascade Power Group
CJ LLC
Clark Public Utilities
Climate Solutions
Colville Tribes
Foster Pepper PLLC
Grossman Services
Hydropower Reform Coalition
Interstate Renewable Energy Council
Island Community Solar
King County Department of Natural Resources and Parks
Northwest Clean Energy Application Center, US Department of Energy
Northwest SEED
NW Energy Coalition
PacifiCorp
Puget Sound Energy
Puresolar, Inc.
Renewable Northwest Project
Seattle City Light
Silicon Energy
Snohomish County Public Utility District No. 1
Staff, Washington State House of Representatives
Staff, Washington State Senate
Tacoma Public Utilities
Local Energy Alliance of Washington (WALEA)
Washington Environmental Council
Washington State Department of Commerce
Washington State Housing Finance Commission

Organizations Submitting Comments on or after July 15, 2011

Avista Utilities
Cascade Community Wind Company
Cascade Power Group
David Paul Rosen & Associates
eFormative Options
Farm Power Northwest
Hydropower Reform Coalition
Interstate Renewable Energy Council
King County Department of Natural Resources and Parks
Local Energy Alliance of Washington
Northwest Clean Energy Application Center, US Department of Energy
NW Energy Coalition
PacifiCorp
Puget Sound Energy
Renewable Northwest Project
Seattle Steam Company
Snohomish County Public Utility District No. 1
Washington State Department of Ecology
Washington State Housing Finance Commission

Organizations Submitting Comments on August 8, 2011

Avista Utilities
Cascade Power Group
Hydropower Reform Coalition
Keyes & Fox, LLP
Local Energy Alliance of Washington
NW Energy Coalition
PacifiCorp
Renewable Northwest Project
Seattle City Light
Snohomish County Public Utility District No. 1
Northwest Clean Energy Application Center, US Department of Energy

Appendix 3: Distributed Solar

1. Resource Description, Distribution, and Potential

There are two general categories of technologies that make use of solar energy; active, electricity-producing photovoltaic panels (PV), and a variety of "passive," non-electricity-producing technologies and design strategies in buildings. The latter category includes design features such as building orientation to take advantage of (or avoid) the sun's rays at different angles through the year, passive ventilation strategies and solar water heaters.

While electricity-producing technologies like PV fit more comfortably in the category of "renewables" under state law, passive solar technologies directly reduce the need for additional energy inputs, such as with solar hot water heaters that displace electricity or natural gas for all or a portion of the total energy required to heat water, and are therefore categorized as energy efficiency measures. Because of these different categorizations, different policies and incentives have been adopted for the two types of solar technologies.

The greatest solar resources in the United States are in the Southwest states, in southern California, southern Nevada, Arizona, New Mexico, and the western part of Texas. Western Washington's solar resource is more limited, but Eastern Washington's annual solar resource is stronger than much of the northern and eastern regions of the country.[1] The relatively limited sunshine in Western Washington does not preclude electricity production from PV, water heating, or space conditioning using solar power, but the energy-per-dollar cost of the installed solar technology will be lower in Western Washington than in Eastern Washington.

Currently, Washington's three electric IOUs have varying amounts of distributed solar projects within their service territories. Avista Utilities (Avista) states that it has 76 distributed solar PV systems within its Washington territory, with a total generation capacity of 333 kW.[2] PacifiCorp states that it has 260 kW of solar PV capacity in net-metering applications in Washington.[3]

The present projected potential of solar technologies in Washington varies greatly, with the potential for thermal hot water heaters far outstripping that of PV. In PacifiCorp's Washington service territory, for example, the company calculated in its 2011 IRP that the potential installed capacity for PV by 2030 is 2.4 MW. For solar hot water heaters, this potential is 25.8 MW over

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[1] National Renewable Energy Laboratory. "Photovoltaic Solar Resource: United States - Spain - Germany." Map. *www.nrel.gov/gis/mapsearch/*. (Accessed August 24, 2011). Germany." Map. *www.nrel.gov/gis/mapsearch/*. (Accessed August 24, 2011).

[2] Comments of Avista at 2 (July 15, 2011).

[3] Comments of PacifiCorp at 1 (July 15, 2011).

the same time period.[4] The projected potential for PV is limited by its higher cost per MWh. In Puget Sound Energy's (PSE) 2011 IRP, the company states that it did not include several renewable resource technologies in its modeling, including solar PV, because these technologies "are not capable of producing power on a scale and at a cost that would make sense for PSE customers."[5]

2. Benefits and Challenges of Distributed Solar Generation

Because of the modular sizing of PV systems, PV can be distributed on residential housing or in relatively larger single location such as a 300 kW installation on a warehouse. This feature provides the potential for PV to match the load of the distribution system. This is also true of passive solar design in buildings and for solar thermal hot water applications. However, incentives and other supportive policies do not require that the developer affirmatively demonstrate that the location of the deployment of solar energy matches the needs of the distribution area. At this stage of solar development, such a requirement is not necessary and would be unduly burdensome, but if more widespread deployment occurs, consideration of the specific needs and impacts on the affected distribution area will be necessary to realize the available benefits to the distribution system.

Avista states that typical PV production profiles tend to coincide with system loads and reinforce local distribution circuits, but larger systems could cause operational problems during times of light load, or the farther away systems are installed from loads.[6] PSE states that distributed systems may cause problems in areas where local substations are already close to full capacity.[7] PacifiCorp states that integrating the "sheer volume of distributed projects amplifies the impacts on [PacifiCorp]," when compared to integration of utility-scale projects.[8]

Stakeholders report that the cost for purchasing PV equipment represents about half the total cost of the distributed generation facility, with the other half going toward installation.[9] Local Energy Alliance of Washington (WALEA), for example, stated that the per-unit cost of an installed PV system ranges from $8 to $9 per watt (without accounting for subsidies or other incentives), with

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[4] Comments of PacifiCorp at 2 (July 15, 2011).

[5] Puget Sound Energy, *2011 Integrated Resource Plan,* at 5-11 (May 30, 2011). Other technologies not included in the company's IRP modeling were geothermal, tidal, and long-haul wind outside the Pacific Northwest.

[6] Comments of Avista at 12 (July 15, 2011).

[7] Comments of Puget Sound Energy at 10 (July 15, 2011).

[8] Comments of PacifiCorp at 11 (July 15, 2011).

[9] Comments of Avista at 11 (July 15, 2011); Comments of Puget Sound Energy at 10 (July 15, 2011).

$4 to $5 representing the cost of the solar panels.[10] Avista reported that a "typical distributed solar system ranges from $4,000 to $6,000 per installed kW," which equates to $4 to $6 per watt,[11] while NW Energy Coalition (NWEC) stated that the average cost for an installed residential system in the second quarter of 2011 was $6,300 per kW in Oregon, but because system costs are falling, "many residential and commercial systems are now being priced at closer to $5.00/watt."[12]

Roughly defining "utility-scale" as systems larger than five MW, distributed residential and commercial solar PV applications generally cost more than utility-scale applications because the utility would be able to take advantage of economies of scale in purchasing and installation costs, and would have lower per kW interconnection costs. Avista estimated the costs of utility-scale PV projects in a range of $2,000 to $3,000 per installed kilowatt for multi-megawatt projects.[13] NWEC estimated the cost difference between residential/small commercial-scale and utility-scale projects, excluding the panels themselves, at $1-2 per watt (or $1,000-$2,000 per kW).[14]

NWEC commented that aggregating geographically diverse solar PV systems offers "considerable reductions in variability."[15] WALEA also noted that variability is mitigated by geographical distribution if installations are integrated region-wide.[16]

3. Stakeholder Perspectives and Policy Options

A variety of subsidies and incentives to encourage the manufacture and use of solar PV currently exist in Washington. These include net metering, cost recovery mechanisms and tax incentives discussed in Sections II and III of the report. Some stakeholders comment that current incentive levels are too high to justify on the basis of cost-effectiveness while other stakeholders assert that the incentives are insufficient to encourage further growth of distributed solar.

For example, Avista states that because the costs of PV installation are falling, and because electricity costs in the Pacific Northwest are relatively low, economic justification for subsidizing solar energy is difficult. The company notes that utility-scale solar installations are not competitive with wind resources, which is why solar is not included in its 2011 integrated resource plan. It further notes that while state and federal incentives help make solar energy

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[10] Comments of the Local Energy Alliance of Washington at 11 (July 15, 2011).

[11] Comments of Avista at 11 (July 15, 2011).

[12] Comments of the Northwest Energy Coalition and Renewable Northwest Project at 9 (July 15, 2011).

[13] Comments of Avista at 12 (July 15, 2011).

[14] Comments of the Northwest Energy Coalition and Renewable Northwest Project at 10 (July 15, 2011).

[15] *Id.*

[16] Comments of the Local Energy Alliance of Washington at 11 (July 15, 2011).

more attractive to consumers, customers may still be "reluctant to make the initial capital investment."[17]

PSE addresses a central issue in the discussion of increasing distributed generation in Washington, which is defining the specific goals that the incentives and subsidies are designed to support. PSE said, "if the intent is to encourage local manufacturing, it . . . would be more effective [for an incentive to be] structured as a direct incentive to the in-state manufacturer," rather than to the end user, because the retail price of systems manufactured in the state tends to be higher, "such that much of the incentive value is lost." Further, PSE states that many of the jobs created by growth of the distributed solar market occur on the installation side, and that "it may be more effective to target incentives at appropriate technologies, regardless of manufacturing location."[18] PSE asserts that if the goal of an incentive or subsidy is to increase local investment in distributed generation, extending and increasing state incentives would be beneficial because short-term incentives create market and investment inefficiencies, while incentives that are stable in the long term provides investor confidence.[19]

The Washington State Housing Finance Commission (WSHFC) comments that Washington's incentives for solar PV are inadequate to support timely payback for installations in multi-family housing, commercial, industrial, or municipal buildings, and are only financially feasible for single-family home installations using solar panels manufactured in-state. WSHFC states further that community solar projects on public buildings are difficult to develop within the current provisions on a broad scale.[20]

NWEC argues that state incentives and the federal investment tax credit are still necessary to drive development of solar resources in Washington, in part because the state as a whole has the poorest solar resource in the United States after Alaska and some of the lowest electric prices in the country, which makes competition with conventional energy sources difficult for solar energy. It notes that Germany has a poorer solar resource than Washington, "and has by far the greatest amount of solar PV installed than anywhere else in the world."[21]

WALEA stated that incentive levels are "sufficient or even generous," but that restructuring incentive programs "could make conditions more favorable for solar with the same or a lower

[17] Comments of Avista at 13 (July 15, 2011).

[18] Comments of Puget Sound Energy at 11 (July 15, 2011).

[19] *Id.*

[20] Comments of the Washington State Housing Finance Commission at 3 (July 15, 2011).

[21] Comments of the Northwest Energy Coalition and Renewable Northwest Project at 12 (July 15, 2011). We note that Germany also has very high rates for electricity.

incentive level." WALEA also advocated for allowing community net metering to decrease costs to implementing community solar projects.[22]

The primary challenge to increasing the level of distributed photovoltaic systems is the higher cost of PV panels and the higher installation costs of distributed PV per installed kW compared to utility scale PV. Given these higher costs, it is likely that near term development of solar energy will remain dependent on continued subsidies.

As we discuss in Section III of the report, if further use of other non-state funded financial incentives is implemented, such as net-metering and feed-in tariffs, it is likely that ratepayers would pay higher electric rates to support the cost of these incentives. In the short-term, while individual consumers, communities or commercial entities may seek to install distributed PV to reduce their electric bills, distributed PV may not be the most cost-effective renewable resource for investor-owned utilities to pursue.

If the Legislature chooses to explore new or expanded financial incentives for solar resources, subsidies could be targeted to encourage cost-saving efficiencies in installation costs, which is one cost element that disadvantages distributed PV relative to utility scale PV. Similar challenges face solar water heating technologies. If subsidies are developed to promote distributed PV, similar subsidies for solar water heaters might be considered based on their potential as a cost-effective solar energy technology.

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[22] Comments of the Local Energy Alliance of Washington at 12 (July 15, 2011).

Appendix 4: Distributed Wind

1. Resource Description, Distribution, and Potential

Washington is one of the leading states in total installed wind capacity, with 2,104 MW installed by the end of 2010.[23] Many of the best wind sites are located along the Columbia River on Washington's southern border, and in the southeastern and central parts of the state.[24] The vast majority of wind resource development is utility-scale, with only 355 kW of the state's total installed wind capacity is generated by distributed (under 100 kW capacity) wind projects.[25]

Smaller wind systems can be generally grouped into three sizes: "micro-turbines," of less than 1 kW and mounted on roof tops or set at ground level, mid-sized turbines with nameplate capacities of 1.8 kW to 10 kW on towers reaching heights of 60 to 140 feet,[26] and larger turbines with nameplate capacities ranging from 20 kW to over 100 kW also on towers 60 to 140 feet tall.[27]

2. Benefits and Challenges of Distributed Wind Generation

Distributed wind provides electricity with no greenhouse gas or other air pollutant emissions. Like other technologies used for net-metering, distributed wind can offset on-site demand and avoid distribution losses. Though Washington has some distributed wind projects currently, several factors may limit the potential for distributed wind projects.

Distributed wind generation poses siting challenges including land use and aesthetics issues. Small wind installations face various local ordinances and various zoning requirements that can

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[23] American Wind Energy Association, "2010 US Wind Industry Annual Market Report: Rankings," at 1 (May 2011). Accessed September 27, 2011. <http://www.awea.org/learnabout/publications/factsheets/upload/2010-Annual-Market-Report-Rankings-Fact-Sheet-May-2011.pdf>

[24] See "Renewable Energy Atlas of the West: The Washington State Edition," at 7.

[25] eFormative Options, LLC, "Policy & Market Trends: Improving Small Wind's Bottom Line," (June 2011, accessed September 28, 2011). <http://www.eformativeoptions.com/dwpolicytool/PtP_AWEA_Poster-handout.pdf>

[26] American Wind Energy Association, "In the Public Interest: How and Why to Permit for Small Wind Systems," at 2 (September 2008).

[27] American Wind Energy Association, "Policies to Promote Small Wind Turbines," at 1 (accessed September 28, 2011)., http://www.awea.org/learnabout/smallwind/upload/Policies_to_Promote_Small_Wind_Turbines.pdf>

affect developers' abilities to obtain building permits. Some jurisdictions limit installations of turbines beyond a certain size.[28]

Distributed wind also faces economic challenges. Capital costs for residential distributed wind turbines range from approximately $2,500 to $3,500 per kW.[29] Total installed costs (including the power generation module and other equipment, installation, engineering fees, and owner costs) for a typical 10 kW wind turbine are approximately $3,000 per kW.[30]

3. Stakeholder Perspectives and Policy Options

The Local Energy Alliance of Washington (WALEA) comments that in rural areas, distribution capacity constrains wind development.[31] On the other hand, investor-owned utilities (IOUs) comment that the current distribution system can accommodate distributed wind generators, as long as development does not occur in areas with low loads or where other variable distributed generation projects already exist.[32] Puget Sound Energy (PSE) states that modeling the distribution system will help identify the impacts of distributed wind generation and identify distribution system constraints, if any.[33]

With regard to subsidies or incentives to encourage distributed wind, Avista Utilities (Avista) comments that one mechanism that does not require public resources or cause a cost-shift among utility customers is the incentive embodied in the Energy Independence Act (RCW 19.285). The company states that even though utilities may count, for compliance with the RPS, distributed generation at double the value of the resources' outputs, this multiplier does not encourage much acquisition of distributed generation, which indicates that the multiplier is not adequate to compensate for the difference between the costs of larger systems and the higher costs of distributed generation. Avista encourages the UTC to identify a multiplier that would, "level the

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[28] For example, Cascade Community Wind commented that Kittitas County does not have a process by which to issue permits for turbines over 100 kW capacity. See Comments of Cascade Community Wind Company at 2 (July 15, 2011).

[29] California Energy Commission, "Distributed Energy Resource Guide; Economics of owning and operating DER Technologies." (Accessed September 29, 2011). http://www.energy.ca.gov/distgen/economics/capital.html.

[30] *Id.*

[31] Comments of the Local Energy Alliance of Washington at 12 (July 15, 2011).

[32] See Comments of Avista at 14 (July 15, 2011); Comments of Puget Sound Energy at 12 (July 15, 2011).

[33] Comments of Puget Sound Energy at 12 (July 15, 2011).

compliance value of distributed generation technologies with that of commercial wind resources."[34]

The comments of the Washington Housing Finance Commission note that distributed solar PV is not cost-effective in most circumstances with the current financing incentives, and that the "lack of realistic and usable financing incentives . . . would similarly affect distributed wind."[35]

To address the challenge of high upfront costs for distributed wind, Cascade Community Wind Company (CCWC) recommends allowing community net-metering, in which subscribers would pool their resources to provide a third party with the necessary upfront capital in exchange for power from a central project. CCWC argues that this arrangement would allow customers to construct larger, more efficient, well-sited, and professionally-managed systems.[36] CCWC also advocates for expanding the Washington production incentive to include community wind projects in addition to community solar projects, and to increase the $5,000 incentive per project to $5,000 per participant.[37]

eFormative Options offeres another alternative to address the challenge of up-front costs, suggesting that the state's existing performance-based incentive could be supplemented with a program that would provide partial payments to developers of distributed wind projects, which would be calculated by estimating production ahead of time by using certified power curves and wind map calculations.[38]

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[34] Comments of Avista at 16 (July 15, 2011).

[35] Comments of the Washington Housing Finance Commission at 4 (July 15, 2011).

[36] Comments of Cascade Community Wind Company at 2 (July 15, 2011).

[37] *Id.*

[38] Comments of eFormative Options, LLC at 2 (July 15, 2011).

Appendix 5: Distributed Hydrokinetic

1. Resource Description, Distribution, and Potential

Hydroelectric power is the primary source of electricity in Washington: 67 percent of electric generation in Washington is from hydropower, most of which is generated from conventional utility-scale hydroelectric facilities.[39] Hydroelectric power may be generated from conventional generation from dams as well as through hydrokinetic generation from ocean waves or from currents in canals, rivers, and tide channels. Virtually all of the conventional hydroelectric generation is from utility scale or large facilities with a generating capacity of over 100 megawatts. Hydroelectric generation on a smaller scale is described as "small," "mini" and "micro hydro," depending on the generating capacity of the facility.[40]

As discussed in Section II of the report, water, wave, ocean and tidal power are included in the definition of "renewable resource" in the Energy Independence Act (EIA).[41] In order to qualify for multiple renewable energy credits under the EIA, a hydroelectric resource must be an "eligible resource" under the EIA, and under five-MW generating capacity.[42] However, the definition of an "eligible renewable" under the Act excludes certain hydroelectric facilities. The definition includes:

> (a) Electricity from a generation facility powered by a renewable resource ***other than fresh water*** that commences operation after March 31, 1999, where: (i) the facility is located in the Pacific Northwest; or (ii) the electricity from the facility is delivered into Washington state on a real-time basis without shaping, storage, or integration services; or
>
> (b) Incremental electricity produced as a result of efficiency improvements completed after March 31, 1999, to hydroelectric generation projects owned by a qualifying utility and located in the Pacific Northwest or to hydroelectric generation in irrigation pipes and canals located in the Pacific Northwest, where the additional generation in either case does not result in new water diversions or impoundments.[43]

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[39] The Renewable Energy Atlas, Washington State Edition, www.EnergyAtlas.org, at 5.

[40] Small hydro is generally described as a facility with a generating capacity of between 1 to 30 megawatts (MW), while mini hydro facilities have a capacity of 100 to 1000 kW, and micro hydro facilities have a capacity of less than 100 kW. See www.microhydropower.net/size.php.

[41] RCW 285.030(18)(a),(f).

[42] RCW 19.285.030(9).

[43] RCW 19.285.030(1)(a) and (b).

Thus, only wave, ocean, and tidal generation resources that are less than five MW of generation capacity qualify as distributed generation under the EIA. Electricity from incremental efficiency improvements of less than five MW on fresh water generation facilities do not count as distributed generation under the EIA.

PacifiCorp currently has five small distributed hydropower facilities in Washington with a total capacity of 24 MW, while Avista Utilities (Avista) has three distributed hydropower facilities with a total capacity of 3 MW.[44] There is some potential for additional distributed conventional hydropower generation in Washington though incremental improvements to existing facilities or development of facilities in small rivers, streams and irrigation canals. The 2007 Washington State Resource Assessment Report finds that more than 2500 MW of additional electricity could be generated from existing facilities through efficiencies or adding hydropower to non-power dams.[45] The Local Energy Alliance of Washington (WALEA) claims that the distributed hydrokinetic energy from run-of-stream projects, irrigation channel, hydro and dam improvement projects has the potential to provide hundreds of megawatts of electricity in Washington.[46] However, in its 2011 integrated resource plan, PacifiCorp estimates only an additional .3 MW of distributed hydropower by 2030 from micro turbines.[47] Avista does not project many future distributed hydropower projects, noting that hydroelectric sites in Eastern Washington are limited.[48] Puget Sound Energy (PSE) notes that the potential for micro hydropower is limited, but may make sense for "unique or one-off applications of a particular customer."[49] The difference between the estimates in the 2007 Report and the utilities' integrated resource plans may be the result of the least cost test the utilities apply to hydropower generation.

The greatest potential for additional hydroelectric generation in Washington and the United States is from hydrokinetic power from the motion of the ocean, waves and tidal currents, which some estimate could provide up to 10 percent of the country's electricity.[50] While WALEA asserts that hundreds of megawatts of energy may be generated from distributed ocean energy,

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[44] Comments of PacifiCorp at 1, App. B (July 15, 2011); Comments of Avista at 2 (July 15, 2011). PSE filed comments but did not identify its current level of small or distributed hydropower in Washington.

[45] Comment s of Hydropower Reform Coalition at 4 (July 15, 2011).

[46] Comments of the Local Energy Alliance of Washington at 1 (July 15, 2011).

[47] Comments of PacifiCorp at 2 (July 15, 2011).

[48] Comments of Avista at 3 (July 15, 2011).

[49] Comments of Puget Sound Energy at 12 (July 15, 2011).

[50] Bedard, Roger, et al., *North American Ocean Energy Status*, EPRI, March 2007 at 2; *see also Hydrokinetic Electric Power Generation*, Pew Center on Global Climate Change, http://www.pewclimate.org/print/technology/factsheet/Hydrokinetic; Hotokainen, Rob, *Will ocean's tides supply endless electricity?*, Tacoma News Tribune, August 9, 2011.

ocean energy is still a developing technology and hydrokinetic power is mostly viable at the small commercial or utility scale.[51] There is currently one hydrokinetic project underway in Washington: the Snohomish County Public Utility District No. 1 (SnoPUD) tidal power pilot project in Admiralty Inlet has the potential for generating 1.7 million MW of electricity per year (194 aMW).[52] Tacoma Power initiated and then put on hold a pilot project in the Tacoma Narrows that had a projected generating potential of .9 million Megawatts per year (102 aMW).[53] While utilities in Oregon and the Oregon Wave Energy Trust, a non-profit organization, are pursuing wave energy in the state of Oregon, there are no pending proposals for wave energy generation in Washington.[54]

2. Benefits and Challenges of Distributed Hydropower Generation

The greatest benefit of distributed hydropower is that it does not rely on fossil fuels to generate electricity, avoiding greenhouse gas emissions and other air pollution.[55] Distributed conventional hydropower uses a reliable and well developed technology, and depending on the source, can provide continuous, rather than intermittent, power. If the source is dependent on seasonal precipitation, snow melt or irrigation, the output will vary over the year and total output from will vary from year to year. If the source of water is tidal it will be intermittent *but very* predictable, unlike other intermittent renewables such as wind and solar.

Despite these benefits, there are a number of challenges facing the development of distributed hydropower. Regulatory challenges include determining whether fresh water hydro projects qualify as an "eligible renewable" under the EIA, the five-MW limit for distributed generation, federal and state laws and regulations and the resulting licensing and permitting requirements, tribal treaty rights, potential environmental impacts, financial considerations and the intermittent nature of hydropower generation. For some types of hydro power, the technology is not yet commercially available. The technology for hydropower from run-of-stream, irrigation canals, and dam improvements is well established, while the technology for hydrokinetic power generation is still in the early stages of commercial development.

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[51] Comments of Local Energy Alliance of Washington at 1 (July 15, 2011); *see also* Thresher, Robert, *The United States Marine Hydrokinetic Renewable Energy Technology Roadmap*, National Renewable Energy Laboratory, April 13, 2010, at 4-6.

[52] *North American Ocean Energy Status*, at 2; Comments of Snohomish PUD at 4 (July 15, 2011); *see also* Hotokainen.

[53] *Id.*

[54] Anderson, Steven, *Wave Power Hits Oregon: Catching Ocean Swells for Predictable Power*, Green Utility, Public Utilities Fortnightly, April 15, 2011; *see also* Oregon Wave Energy Trust, *Wave Energy Development in Oregon: Issues & Limitations, Preferred Practices & Policy Considerations*, prepared by Pacific Energy Ventures, Sept. 2009.

[55] Comments of the Washington State Department of Ecology at 2 (July 21, 2011).

The primary challenge for development of distributed conventional hydropower and hydrokinetic power generation is the number and complexity of federal and state law and regulations, including environmental laws and regulations.[56] Marine hydrokinetic projects require a license from FERC under the Federal Power Act, as well as other regulatory approvals.[57] Several state and federal agencies have jurisdiction over waterways, as well as the intercontinental shelf and tidal lands, requiring multiple licenses and permits before development may begin.[58] SnoPUD comments that a more efficient permitting process must be established to promote the development of hydrokinetic resources.[59]

Further, power generation from flowing fresh water in fish-bearing streams poses unique uncertainties. A number of tribes have treaty fishing rights in Puget Sound, rivers in Washington and ocean waters off the Washington coast from Grays Harbor northward. In 2001, 21 treaty Indian Tribes and the United States sued the State of Washington, alleging that fish passage barrier culverts under state highways and roads violate treaty fishing rights. The Court entered a partial ruling in favor of the Tribes in 2007, and held a trial on the remaining issues in 2009, but the Court has not yet issued a final decision.[60] The tribes have recently prepared a paper concerning impacts on salmon habitats, and the tribes' efforts to reduce those impacts.[61] While some argue that hydropower has a low environmental impact, the tribes and others, such as the Hydropower Reform Coalition argue that hydropower has significant environmental impacts and that new construction should be avoided.[62]

Current hydrokinetic (ocean, wave and tide) power generation technology appears to be best suited for small commercial or utility scale production, not smaller scale distributed generation.

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[56] *North American Ocean Energy Status*, at 7.

[57] *See* 16 U.S.C. § 817; *Finavera Renewables Ocean Energy, Ltd.*, 121 FERC ¶ 61,288 (Dec. 21, 2007) (Order Issuing Conditioned Original License for Makah Bay Offshore Wave Pilot Project), 127 FERC ¶ 62,054 (April 21, 2009) (Order Accepting Surrender of License).

[58] *North American Ocean Energy Status*, at 7; Oregon Wave Energy Trust, *Wave Energy Development in Oregon: Licensing and Permitting Requirements*, prepared by Pacific Energy Ventures, July 2009; *see also* Comments of Avista at 15 (July 15, 2011); Comments of Snohomish PUD at 3 (July 15, 2011).

[59] Comments of Snohomish PUD at 3 (July 15, 2011).

[60] *United States v. Washington*, Civil No. 70-9213, Subproceeding 01-1, Order on Cross Motions for Summary Judgment (W.D. Wash., Aug. 23, 2007). *See generally* Conference of Western Attorneys General, *American Indian Law Deskbook* 411-14 (Clay R. Smith, et al., eds., 4th ed. 2008 & Supp. 2011). RCW 77.15.320 makes it unlawful to maintain a dam or other stream obstruction without provision for fish passage.

[61] *See Treaty Rights At Risk: Ongoing Habitat Loss, the Decline of the Salmon Resource and Recommendations for Changes*, A Report from the Treaty Indian Tribes in Western Washington, July 14, 2011, available at http://nwifc.org/downloads/whitepaper628finalpdf.pdf.

[62] Comments of the Hydropower Reform Coalition at 3-4 (July 15, 2011).

The facilities would likely meet the five MW limit for distributed generation as a prototype or pilot project, but will likely not be commercially viable unless they are developed as a small commercial or utility scale project.[63] Further, due to the restrictions under treaties, laws and rules governing use of the intercontinental shelf and tidal lands, individuals are not likely to adopt hydrokinetic power for the purpose of distributed generation. Despite the potential for hydrokinetic power generation in Washington, it is still an emerging technology that some compare to wind power generation technology 20 years ago.[64]

Fresh-water small scale or micro hydropower that involves "low-head" technologies, i.e., river or irrigation flows of with a vertical drop of 20 meters or less, use conventional hydropower turbine technology.[65] Such technologies are well developed and established in the market. Such small or micro hydropower facilities would likely meet the five-MW distributed generation requirement, but may not meet the restrictions under the EIA to qualify as an "eligible resource."

Developers of hydropower facilities, whether conventional or hydrokinetic, also will need to overcome certain financial barriers. Avista notes that power from micro hydro generation facilities is costly ($147.87/MWh), making the technology economically unviable.[66] Promoters of hydrokinetic power argue that there is a lack of research and development funding from the federal government, as well as the lack of a level playing field with other renewable energy resources for tax credits and other financial incentives.[67]

Finally, like many renewables, hydropower generation is generally intermittent due to the varying nature of water movement. As a result, utilities do not see that hydropower provides sufficient value as a peaking resource.[68] The Local Energy Alliance and the Department of Ecology see value in hydrokinetic wave or tidal power as a base-load resource, in particular for serving local load.[69] Hydropower from run-of-the-river or irrigation canals will vary depending

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[63] Thresher, Robert, *The United States Marine Hydrokinetic Renewable Energy Technology Roadmap*, National Renewable Energy Laboratory, April 13, 2010, at 4-6.

[64] *North American Ocean Energy Status*, at 6; see also *The United States Marine Hydrokinetic Renewable Energy Technology Roadmap*, at 3.

[65] Donalek, Peter, J., *Update on Small Hydro Technologies, and Distributed Generation Including Run-of-River Plants*, IEEE, 2008; see also Oliver, Gordon, *Ridgefield firm gets hydropower boost*, the Columbian, February 1, 2011; Berg, Sven, *Irrigators Look to Hydropower for Revenue: Selling electricity can help lower costs for Idaho farmers*, Idaho Statesman, July 30, 2011.

[66] Comments of Avista at 14 (July 15, 2011).

[67] *North American Ocean Energy Status*, at 7-8.

[68] Comments of Puget Sound Energy at 5 (July 15, 2011); Comments of Avista at 7 (July 15, 2011).

[69] Comments of the Washington State Department of Ecology at 2 (July 21, 2011); Comments of the Local Energy Alliance of Washington at 6 (July 15, 2011).

on the flow in the river or canal. Some hydrokinetic generation, such as tidal power that would generate power regularly based on the movement of the tide, may be more predictable, but may still not correspond to the utility's peak load. Wave generation may require more constant and large waves for continuous generation, which may not be as predictable as tidal but may be more predictable than wind is now.[70]

3. Stakeholder Perspectives and Policy Options

Taken as a whole, it does not appear that development of distributed hydropower will result in significant generation capacity. Ocean, wave and tidal power generation show the most potential for electric generation capacity, but are not well suited for distributed generation and are not yet commercially-available technologies. The technology for conventional distributed hydropower is well developed, but there are limitations under the EIA, state and federal regulations, licensing and permitting, and financial barriers to pursuing this distributed resource. Considering these challenges and the limited potential for generation capacity from such resources, distributed hydropower appears to be a resource that is best used for "unique or one-off applications" as PSE notes in its comments.[71]

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[70] *Hydrokinetic Electric Power Generation, at 1; North American Ocean Energy Status*, at 2.

[71] Comments of Puget Sound Energy at 12 (July 15, 2011).

Appendix 6: Distributed Biomass and Biodigesters

1. Resource Description, Distribution, and Potential

Biomass and biodigester facilities have limited but measurable potential to contribute to electricity production in the state of Washington. Biomass energy is the heat combustion of plant material to produce electricity, sometimes in conjunction with waste heat recovery or use. In Washington, the viable fuel source for biomass facilities is considered to be woody materials.[72] The 20-year horizon of generation sources analyzed in the Northwest Power and Conservation Council's 6th Power Plan does not include field waste as a fuel source in its economic modeling of biomass facilities.[73]

Biodigesters break down organic matter anaerobically (i.e., in an oxygen starved environment) to produce methane (natural gas) and environmentally neutral organic residue for amending soils on the farms or for retail sale.[74] The primary application of biodigesters has been to manage the manure and waste water from dairy farms.

There are six existing biodigester plants in Washington that are all on dairies totaling 3.4 MW of installed capacity.[75] The Yakima and greater Grant, Benton, Franklin and Adams County areas have a potential for 40 MW of installed capacity based on using only the waste generated from dairies, while Bellingham County has a potential of 10 MW of installed capacity based on the same assumptions. However, because of the large initial cost of building a biodigester facility and the fuel transport costs, only larger diaries with approximately 500 or more producing cows are generally considered to have the economic potential to develop biodigester facilities.[76] The 6th Power Plan projects 17 MW of installed capacity for manure biodigesters in Washington over the next 20 years.[77] This consideration reduces the Yakima area potential to 20 MW and the Bellingham area to 6-7 MW. However, efforts to overcome the transportation costs of fuel between small dairies and the potential availability of energy rich food wastes may support the deployment of biodigester facilities supported by a collection of smaller dairies.

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[72] Northwest Power and Conservation Council, 6th Power Plan, at I-29-32.

[73] *Id.*

[74] The other chemical digestion method, a cellulosic process that breaks down strongly bonded lignocellulose molecules in wood fibers or straw is not near economic viability for electricity production and is not considered in this report.

[75] David Paul Rosen & Associates, *Anaerobic Biodigester Financial Feasibility Assessment*, Washington State Housing Finance Commission (August 5, 2011).

[76] Northwest Power and Conservation Council, 6th Power Plan, at I-23-26.

[77] Northwest Power and Conservation Council, 6th Power Plan, at I-26.

The geographic location of biomass plants, in contrast to biodigesters, is decentralized. Because biomass plants need to be located near large forests that are under continuous timber management and harvest, and transportation costs can be high, biomass facilities are expected to be distributed in regions across the state with large forests.[78]

The consistent availability of biomass fuel from timber management and harvest, as well as the effect of timber harvest and management levels on price volatility of biomass fuel, are the critical economic factors affecting biomass plants. Biomass plants are expected to be in the 15-MW capacity size due to optimum economies of scale.[79] The size of the plant will match the scale of an existing site's facility where the plant is co-located, and will match the volume of steadily available biomass fuel.[80]

2. *Benefits and Challenges of Distributed Biomass and Biodigester Generation*

Biomass and biodigester technologies offer a substantial benefit in providing baseload power that qualifies as an eligible renewable resource under statute. Biodigesters also offer benefits extending beyond the electric system, such as reduced greenhouse gas emissions from manure or reduced nutrient discharges into waterways.[81]

Development of these resources is geographically constrained. Biomass is limited by the economics of transport and the production of woody debris fuel as a result of timber management and production. Biodigesters are geographically limited to locations with large dairies or large sources of compostable green materials that typically come from segregated municipal waste streams of larger urban areas. The generation potential from biodigester resources is further limited by the economic hurdle of the up-front capital cost of the facilities and fuel transportation costs. In most cases, biodigester facilities require at least a single large source of fuel to support facility development.

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[78] *Id.* The Washington Department of Natural Resources will issue its 2011 Statewide All-Lands Forest Biomass Supply Assessment this fall. *See* Washington Department of Natural Resources, "July 2011 Update and Progress Report on the State of Washington Forest Biomass Assessment," at 41 (July 11, 2011).

[79] Northwest Power and Conservation Council, 6th Power Plan, at I-29.

[80] *Id.* One example is the biomass plant in Darrington. The Department of Natural Resources (DNR) has conducted a forest biomass initiative under legislation enacted in 2009 and 2010. 2009 Wash. Laws. Ch. 163; 2010 Wash. Laws ch. 126. Reports and other information about forest biomass potential are available on the DNR website at: http://www.dnr.wa.gov/ResearchScience/Topics/OtherConservationInformation/Pages/em_biomass.aspx.

[81] Natural Resources Defense Council, "Renewable Energy for America: Biogas Energy," accessed October 5, 2011. http://www.nrdc.org/energy/renewables/biogas.asp.

The Bellingham dairies are almost completely within Puget Sound Energy's (PSE's) service territory and the majority of the Yakima dairies are within PacifiCorp's territory. The potential for generation from biodigester facilities only meets a fraction of investor-owned utility (IOU) requirements for additional capacity. For example, PSE's 2011 Integrated Resource Plan (IRP) identifies a need for 917 MW of installed capacity for 2011.[82] PacifiCorp's 2011 IRP calls for the acquisition of 1,250 MW of installed capacity in the next three years.[83]

An additional factor in determining generation potential for biodigesters is the addition of organic food materials, including pre or post-consumer food waste, which greatly increases the methane production, and thereby, the electricity production. The potential average electrical production is more difficult to predict with the addition of food waste. The higher average electric output enabled by the addition of food waste makes biodigesters more attractive to utilities, because utilities are seeking baseload renewable resources with consistent and predicable production profiles to contribute to meeting peak resource needs.[84] The higher average output also increases the developers' total revenue from sales of electricity. All the operating dairy digesters in Washington indicate revenue from "tipping" fees they charge for taking pre-consumer food wastes.

Biomass and biodigesters face some regulatory issues as well. Biomass and biodigesters are qualified generators under the federal Public Utilities Regulatory Policies Act (PURPA). Under PURPA, an investor-owned utility is required to make an offer to purchase the electric output of the generator at the utility's avoid cost. Thus, the requirement to purchase provides the biomass and biodigester-based generators a guaranteed market for their electricity.

Developers of biodigesters seek long-term cash streams for their electric output as a means of securing financing and project viability during the development phase of their projects. While there is evidence dairies may need lower-interest loans to overcome the upfront capital costs of their projects, there is also clear evidence that the income stream from the sale of electricity is a critical component in the project financing.[85]

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[82] Puget Sound Energy, *2011 Integrated Resource Plan*, Docket UE-100961, Figure 1-1 at 3 (May 30, 2011).

[83] PacifiCorp, *2011 Integrated Resource Plan*, Docket UE-100514, at 259 (March 31, 2011).

[84] "Geothermal is heavily exploited, particularly in the near term, due to favorable baseload economics…state renewable energy targets…" *Id.* at 208.

[85] David Paul Rosen & Associates, *Anaerobic Biodigester Financial Feasibility Assessment,* Washington State Housing Finance Commission (August 5, 2011).

3. *Stakeholder Perspectives and Policy Options*

Stakeholders identify a number of challenges to developing biomass and biodigester facilities and offered corresponding options for policy changes to address them. Most of the challenges to developing these resources are addressed in the main body of this report and fall generally into three categories: changes to definitions in the EIA, clarification of issues stemming from PURPA, and issues related to financing.

With regard to the EIA, PSE notes that, "[b]iogases, produced from biomass either through anaerobic digestion or gasification, are not deemed resources under the RPS; however, they should be given the same value as landfill gas under RCW 19.285.030."[86] The Northwest Clean Energy Application Center also advocates for changing the definition of "bioenergy" under the EIA to include food waste and green waste, also referred to as yard waste.[87]

The Washington State Housing Finance Commission comments that contract lengths for purchase power agreements between generators and utilities can be challenging for developers seeking financing.[88] Under IOU tariffs, dairy digesters qualify for published PURPA rates. However, contract lengths under IOU tariffs vary considerably. PSE's contract length extends for 10 years and PacifiCorp's contract only extends for five years. UTC rules governing these standard offer contracts do not establish a length for such contracts.

Section III of the report discusses more fully the issues of changes to definitions in the EIA and the contract length for standard offer contracts under PURPA, as these issues have potential effects on technologies beyond biomass and biodigester facilities.

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[86] Comments of Puget Sound Energy at 13 (July 15, 2011).

[87] Comments of Northwest Clean Energy Application Center at 2 (July 15, 2011).

[88] Comments of Washington State Housing Finance Commission at 4 (July 15, 2011).

Appendix 7: Distributed Geothermal

1. Resource Description, Distribution, and Potential

Geothermal energy is energy generated within the earth that conducts from the core toward the surface. Some geothermal electricity generation facilities take advantage of high temperature sites close the surface of the earth that occur along fault lines. Other technologies involve deep drilling to access more remote high heat sources, while others take advantage of lower temperatures closer to the surface.

There are some high-temperature (above 212 degrees F), close-to-surface geothermal sites in Washington, mainly along the eastern side of the Cascade Range that could be developed for electricity production of up to 300 MW,[89] as well as for district heating and direct-use applications.[90]

Low- to moderate-temperature (below 212 degree F) resources may also have some potential for power generation, and direct-use applications. Similarly, ambient ground temperature lends itself well to direct use through technologies such as ground source heat pumps (GSHPs) for space conditioning and water heating applications. [91]

Investor-owned utilities in Washington are not developing geothermal projects. PacifiCorp conducted a study to explore options for developing geothermal resources in its service territory in 2010. The study identified eight geothermal resource areas that met PacifiCorp's criteria for commercial viability, but none of the sites selected for in-depth review were located in Washington.[92]

2. Benefits and Challenges of Distributed Geothermal Generation

Geothermal energy offers significant benefits, including providing base-load power with very low greenhouse emissions. However, many factors limit the use of geothermal energy for electricity production at the distributed, under five-MW level in Washington. The initial capital

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[89] US Department of Energy, Energy Efficiency and Renewable Energy, *Geothermal Technologies Program: Washington,* at 1 (February 2005).

[90] Sjoding, Dave, Erin Hamernyik, and David Norman. *Washington Geothermal Energy Status and Roadmap,* Second Working Draft, Washington State University Extension Energy Program, at 3 (May 25, 2009).

[91] Sjoding, Dave, Erin Hamernyik, and David Norman. *Washington Geothermal Energy Status and Roadmap,* Second Working Draft, Washington State University Extension Energy Program, at 3 (May 25, 2009).

[92] PacifiCorp, *Power Generation, Geothermal Resource Study,* at 3-5 (August 2010).

costs can be quite high, ranging from $1,600 to more than $5,000 per kW of capacity.[93] Permitting and siting can be complex because many potential sites in Washington are located on sensitive or protected lands.[94] While geothermal resources are the private property of the holder of the title to the surface land above the resource,[95] groundwater is a public resource.[96] With limited exceptions, any withdrawal of hot groundwater requires a water withdrawal permit from the Department of Ecology.[97]

3. Stakeholder Perspectives and Policy Options

Many different technologies make use of the earth's heat, but there are few technologies that lend themselves to electricity production from geothermal energy at the distributed scale for individual or small groups of consumer-generators. Very few participants in this inquiry offered comments on development of distributed geothermal resources and none suggested changes to current incentives or regulatory structures for distributed geothermal. Given the narrow use of this resource, policies to promote the use of distributed geothermal energy may be better targeted toward direct-use measures such as ground source heat pumps for residential, commercial, and industrial buildings and other heating processes.

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[93] "Geothermal Energy." *Pew Center on Global Climate Change* (accessed September 23, 2011). http://www.pewclimate.org.

[94] For example, many sites with geothermal potential are located on National Forest Service lands in the Mount Baker-Snoqualmie National Forest and the Gifford Pinchot National Forest, and have been closed to geothermal leasing. *See* Sjoding et al, *Washington Geothermal Energy Status and Roadmap, Second Working Draft*, Washington State University Extension Energy Program, at 8 (May 25, 2009).

[95] RCW 78.60.040; see RCW 78.60.030(1) (definition of "geothermal resources").

[96] RCW 90.03.010; RCW 90.44.040; *see* Wash. Const. art. XXI, § 1.

[97] RCW 90.44.050.

Appendix 8: Useful Articles and Sources on Distributed Generation

Electric Generation

- Northwest Power and Conservation Council. *Sixth Power Plan.* 2010. <http://www.nwcouncil.org/energy/powerplan/6/default.htm>.

Distributed Generation

- "Distributed Energy Resources Guide: Economics -- Capital and Installation Costs." *California Energy Commission Home Page.* <http://www.energy.ca.gov/distgen/economics/capital.html>.
- Lovins, Amory. *Small Is Profitable.* Rocky Mountain Institute, 2002.
- *Renewable Energy Atlas, Washington State Edition.* 2002. <www.energyatlas.org>.
- The Network for New Energy Choices. *Freeing the Grid: Best Practices in State Net Metering Policies and Interconnection Procedures.* 2010. <http://www.newenergychoices.org/uploads/FreeingTheGrid2010.pdf>.
- Schwartz, Lisa. *Distributed Generation in Oregon: Overview, Regulatory Barriers and Recommendations.* Oregon Public Utilities Commission, 2005.

Distributed Solar

- National Renewable Energy Laboratory. *Guide to Community Solar: Utility, Private and Non-Profit Project Development.* U.S. Department of Energy, 2010.
- "Washington Incentives/Policies for Renewables & Efficiency." Database of State Incentives for Renewables and Efficiency. <http://dsireusa.org/incentives/index.cfm?getRE=1?re=undefined&ee=1&spv=0&st=0&srp=1&state=WA>.

Distributed Wind

- eFormative Options, LLC. *Distributed Wind Policy Comparison Tool.* <http://www.eformativeoptions.com/dwpolicytool/>.
- eFormative Options, LLC. *Small Wind Policy and Market Trends: Growth Impacts from U.S. Incentives.* Presentation. 2010. <http://www.eformativeoptions.com/docs/RhoadsWeaver-Policy-2010-12-8.pdf>.

- *In the Public Interest: How and Why to Permit for Small Wind Systems. A Guide for State and Local Governments*. American Wind Energy Association, 2008. <http://www.awea.org/_cs_upload/issues/3482_1.pdf>.

Distributed Hydroelectric and Hydrokinetic

- Donalek, Peter J. *Update on Small Hydro Technologies, and Distributed Generation Including Run-of-River Plants*. IEEE, 2008.
- "Hydrokinetic Electric Power Generation." *Pew Center on Global Climate Change*. <http://www.pewclimate.org/print/technology/factsheet/Hydrokinetic>.
- Thresher, Robert. *The United States Marine Hydrokinetic Renewable Energy Technology Roadmap*. National Renewable Energy Laboratory, 2010.

Distributed Biomass and Biodigestion

- David Paul Rosen & Associates. *Anaerobic Biodigester Financial Feasibility Assessment*. Washington State Housing Finance Commission, 2011.
- "Renewable Energy for America: Biogas." *Natural Resources Defense Council*. <http://www.nrdc.org/energy/renewables/biogas.asp>.

Geothermal

- *Geothermal Technologies Program: Washington*. U.S. Department of Energy, Energy Efficiency and Renewable Energy, 2005.
- Pew Center on Global Climate Change. *Geothermal Energy*. <www.pewclimate.org>.
- Sjoding, Dave, Erin Hamernyik, and David Norman. *Washington Geothermal Energy Status and Roadmap, Second Working Draft*. Washington State University Extension Energy Program, 2009.

Financial Incentives

- Dann, Christopher, Sartaz Ahmed, and Owen Ward. "Renewables at a Crossroads: Investment Opportunities in an Evolving Environment." *Public Utilities Fortnightly* June 2011.
- Joint Legislative Audit & Review Committee (JLARC). *011 Tax Preference Performance Reviews, Preliminary Report*. State of Washington, 2011. <http://www.leg.wa.gov/JLARC/AuditAndStudyReports/2011/Documents/2011TaxPreferencesPreliminary.pdf>.

- "Renewable Energy Prices in State-Level Feed-in Tariffs: Federal Law Constraints and Possible Solutions." National Renewable Energy Laboratory, 2010. <http://www.nrel.gov/docs/fy10osti/47408.pdf>.
- *State Clean Energy Policies Analysis (SCEPA): State Tax Incentives*. Rep. National Renewable Energy Laboratory, 2009. <http://www.nrel.gov/docs/fy10osti/46567.pdf>.