OREGON'S ENERGY TRUST AND U.S. ENERGY PATTERNS

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1. United States Patterns of Renewable Energy and Efficiency

The United States of America is heavily dependent on fossil fuels. The country has vast reserves of coal, and most of our natural gas comes from reserves within our borders. Although our oil reserves are still producing, they are dwindling and most of our oil is now imported. In contrast, our use of renewable energy is quite small, as shown in Fig. 1. However, this very small contribution of solar energy illustrates only our metered use; thus, solar water heating, off-grid photovoltaics (PV), passive solar heating, daylight, clotheslines and all other direct (non-electrical) uses of solar energy are excluded. Similarly, direct use of wood for heating and cooking is excluded.

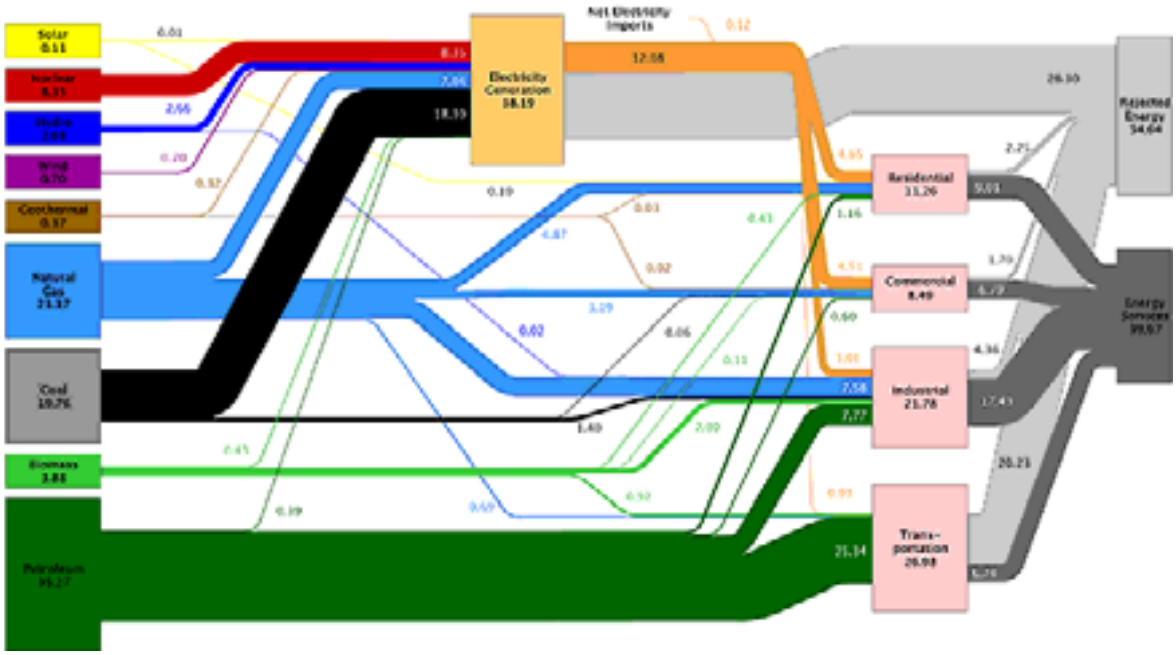

Fig.1. Metered Energy Use in the United States of America, 2009. Courtesy Lawrence Livermore National Laboratory.

The United States of America has not established national energy standards, either for energy efficiency (EE) or for renewable energy (RE). In the absence of such guidelines, many individual states have proceeded to establish standards, and national non-governmental organizations (NGO) have established ranking systems in efforts to reward the more successful states, and to challenge those states that lag behind.

Figure 2 shows national patterns for energy efficiency in 2010, as ranked by the American Council for an Energy Efficient Economy (ACEEE). A remarkable pattern of EE success emerges along the U.S. Pacific coast and Southwest, the Northeast and mid-Atlantic, and the upper Midwest. A lack of enthusiasm is evident through the central Plains states, and the Southeast. In general, states with more Democrats have relatively more EE development, those with more Republicans have less. Further, Democrats largely accept climate change as being influenced by fossil fuel consumption, while Republicans largely deny this link. Thus, alternatives to fossil fuels, such as EE and RE, are more attractive to Democrats. This becomes evident in Figure 3.

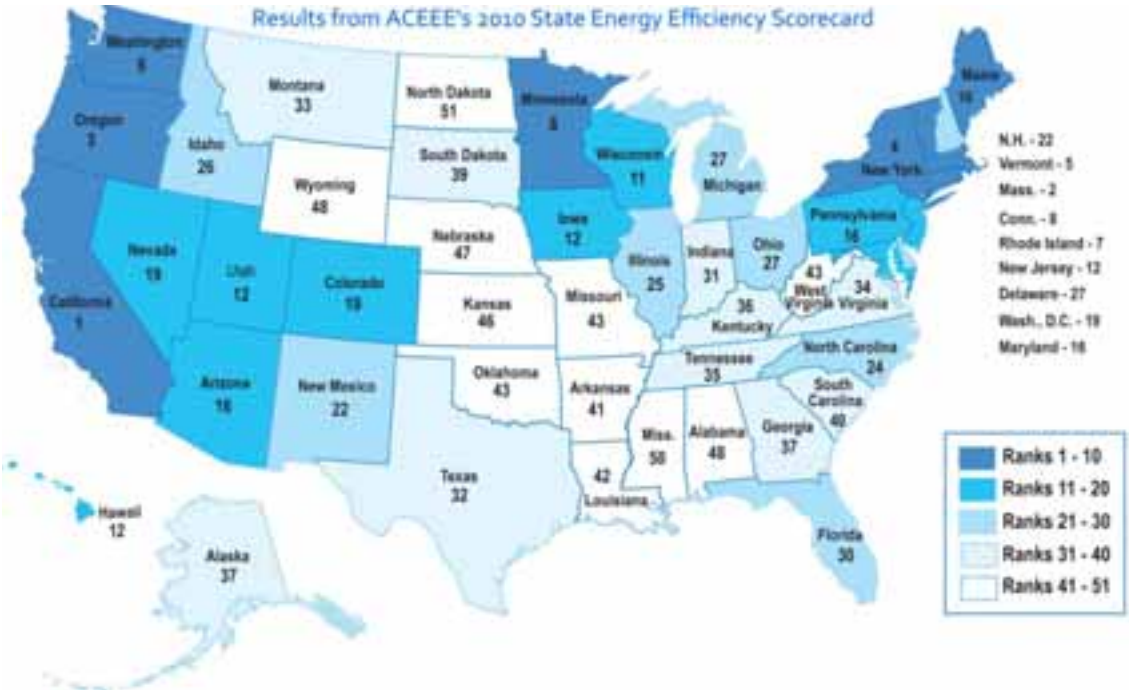

Fig. 2. Energy Efficiency State Rankings, 2010. Courtesy of the American Council for an Energy Efficient Economy.

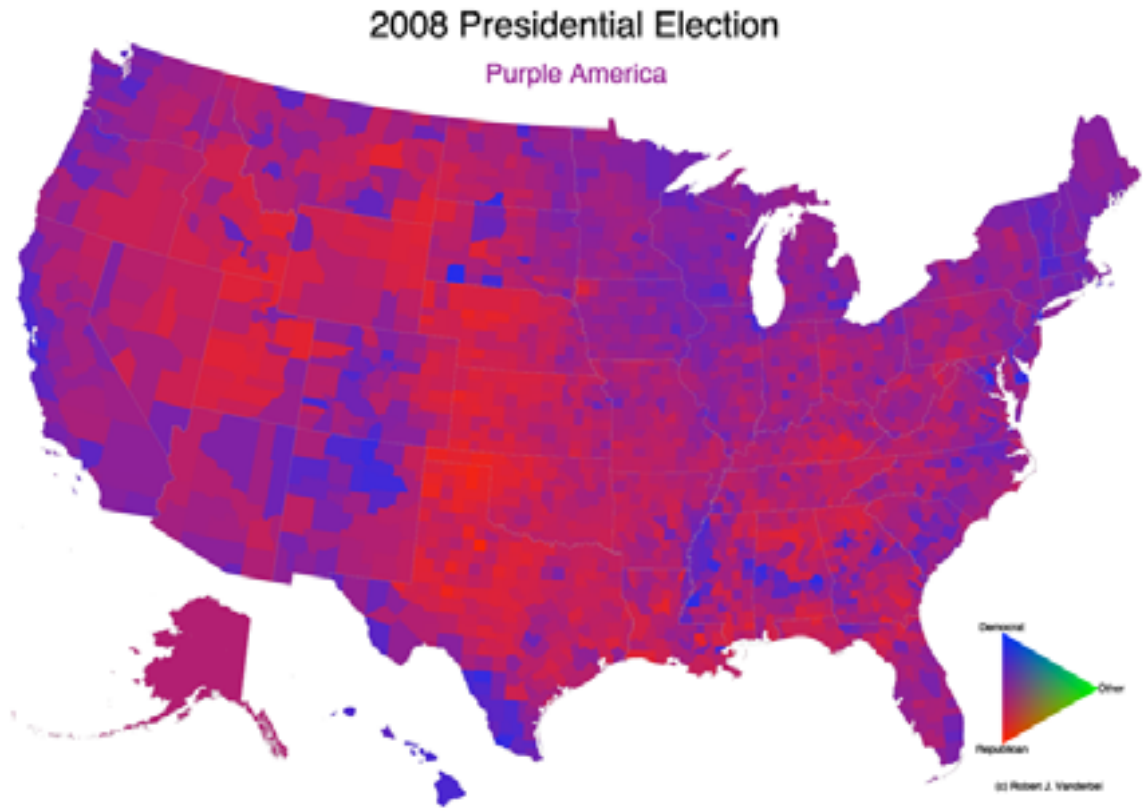

Fig. 3. Voting by County in the United States Presidential Election of 2008. Red indicates support for George W. Bush, blue for Barack Obama. Courtesy of Robert J. Vanderbei, Princeton University.

In Figure 3, the 2008 presidential election pattern of Republican [red] and Democrat [blue] voting reveals similar regional differences. The issues of the 2008 Presidential Election are far more complex than attitudes about energy; there are strong ethnic voting patterns for Obama in the otherwise Republican south (the Black vote) and in areas of Texas and New Mexico (the Hispanic vote). Although the map may appear to be largely "red," the rural counties of the US tend to vote Republican, and are far larger in area than the urban areas. Most urban areas tend to vote Democratic.

In Figure 4, the states are ranked by their success in renewable energy development. This is the result of ranking such indicators as successful technology, policy, and capital investment. Again, the patterns of strength in the U.S. Pacific coast and Southwest, the Northeast and mid-Atlantic, and the upper Midwest are apparent. "Clean energy" includes renewable energy sources such as solar photovoltaic, solar concentrating, wind, and biomass generation of electricity.

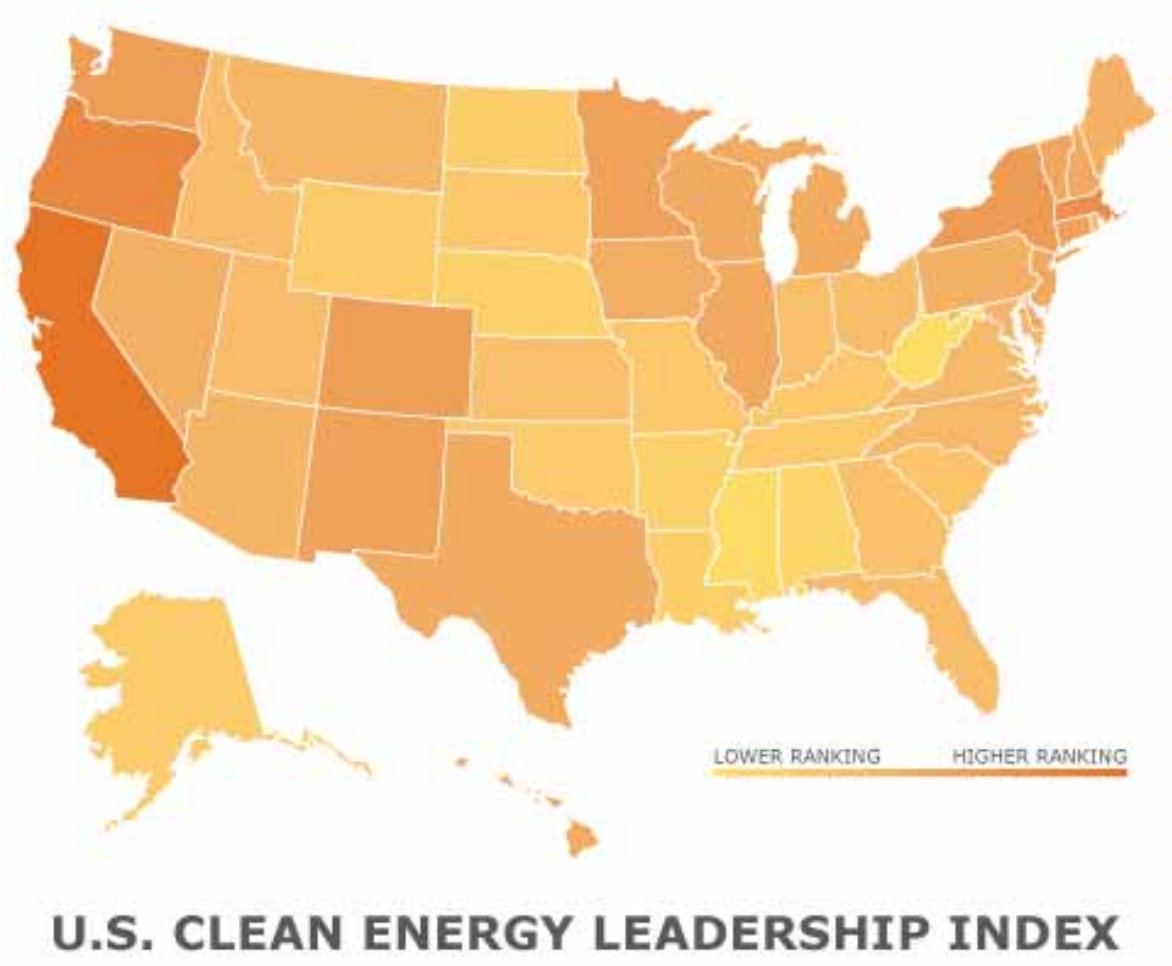

Fig. 4. The U.S. Clean Energy Leadership Index. Courtesy of Clean Edge, Inc.

2. Oregon's Energy Trust

2.1 Oregon's Energy Attitudes

Oregon, on the Pacific coast in the US Pacific Northwest, has a rather small population, slightly more than 1 percent of the US total. In area, Oregon has almost 3 percent of the US total; it is the 9th largest state in area.

The maps in Figures 2 and 4 show that Oregon ranks highly in both energy efficiency and renewable energy programs. This seems very surprising in that Oregon is famous among states for its cloudy and cool winter, and for very low electricity rates. Neither clouds nor cheap power would reinforce a culture of energy efficiency or investments in solar energy. The low electricity rates are due to the regional Bonneville Power Administration that distributes hydropower from large dams in the Columbia River basin. Oregon also has

considerable geographic diversity, from seacoast through rain forest, inland valleys, Cascade Mountains and high-elevation desert. The result is an array of renewable energy opportunities: wind, wave, hydro, biomass (lumber and agriculture), geothermal, and solar (especially in the high but sparsely populated desert regions).

Two of the strongest influences on EE and RE have been the Oregon Department of Energy and the Energy Trust of Oregon. The Department of Energy administers both a Business Energy Tax Credit and a Residential Energy Tax Credit. There are also incentive funds for industry to locate in Oregon, and Solar World took advantage of Oregon's incentives and credits to build what was at the time the world's largest PV manufacturing plant near Portland. Oregon produced almost one-quarter of the PV modules made in the U.S. in 2010. Oregon recently instituted a very limited Volumetric Incentive Rate (feed-in tariff), as an experimental program also administered by the Oregon Department of Energy.

2.2 Energy Trust of Oregon History

The Energy Trust of Oregon (ETO) began its programs in 2002, but with resistance from Republicans in the state legislature. The ETO is a non-profit organization, supervised by the Oregon Public Utility Commission. The funds come largely from a surcharge on the electric bills of the two major investor-owned electric utilities, PacifiCorp and Portland General Electric. These two serve about two-thirds of Oregon's population. This surcharge is 2.46 percent of their total billings. Initially this amounted to some $45 million annually. Of that amount, 77 percent was spent on energy efficiency projects and the remaining 23 percent went toward generation of electricity from renewable sources. ETO was given 10 years of life, and set ambitious goals: by "sunset" in 2012, achieve energy efficiency equivalent to 300 megawatts; and help Oregon to install 450 MW of renewable energy sources.

Impressed by the electricity savings, in 2003 Oregon's largest natural gas utility, Northwest Natural, asked the Oregon Public Utilities Commission to decouple their rates from profits, while giving ETO 1.5 percent of their residential and commercial billings for energy efficiency investments. This ringing endorsement of ETO's work, barely a year into operations, enabled ETO to be fuel-neutral in the efficiency programs.

After the 2006 elections Democrats controlled both houses of the Oregon legislature, and they enacted an ambitious renewable portfolio standard (RPS) of 25 percent of Oregon's electricity by 2025. The Legislature also extended ETO's life to 2025, and mandated additional funds for energy efficiency. The RPS required utilities to fund wind farms and certain other renewables without ETO help. ETO renewable funds, undiminished, are now capped at 20 MW per installation.

Today, 90 percent of ETO funds are dedicated to EE projects, and about 10% to RE projects. The ETO budget for 2011 is US$ 130,900,000 for EE, and US$ 15,300,000 for RE. The goals have been revised for 2014 targets for EE of 479 aMW electricity and 34.7 MTherms (3.66 TJoule) natural gas; and for RE, 124 aMW. At the close of 2010, 57% of the EE electric, 51% of the EE gas, and 82% of the RE goal had been met.

The U.S. Energy Information Agency lists the U.S. average rate for electricity in February 2011 as 11.2 US¢/KWh residential, 10.11 US¢/KWh commercial. In contrast, Oregon's February 2011 average rate was 9.39 US¢/KWh residential, 8.34 US¢/KWh commercial. Despite these relatively low rates, Oregon scores as third best of the 50 states and District of Columbia, as rated by the ACEEE in 2010 (Fig. 2).

2.3 Energy Trust RE Programs

Two basic types of RE are the continuous (24 hour/7 days) and the intermittent. Continuous sources with ETO investment include hydropower, biopower, and geothermal energy. Intermittent sources include wind and solar. Because of its constant supply, 24/7 sources are favored by utilities. But when intermittent sources provide the most power during periods of peak demand, such as solar on very hot days, they also draw favor from utilities.

Due largely to a national emphasis on wind power, and aided by its relatively low cost, utility-scale wind has dominated the ETO investments in RE, as shown in Figure 5. The details of ETO installations in intermittent sources (wind and solar) are shown in Table1, and in 24/7 sources in Table 2. Table 1 includes solar hot water, funded separately from solar electric programs. Utility-scale wind, at 91.1 aMW, has been installed mostly in the Columbia River gorge. Because ETO can no longer invest in utility-scale wind, a different pattern of RE is now evident in Figure 6. For the definition of aMW, see equation 1.

$$aMW = \frac{\text{MWh annual}}{8760h}$$

(eq.1)

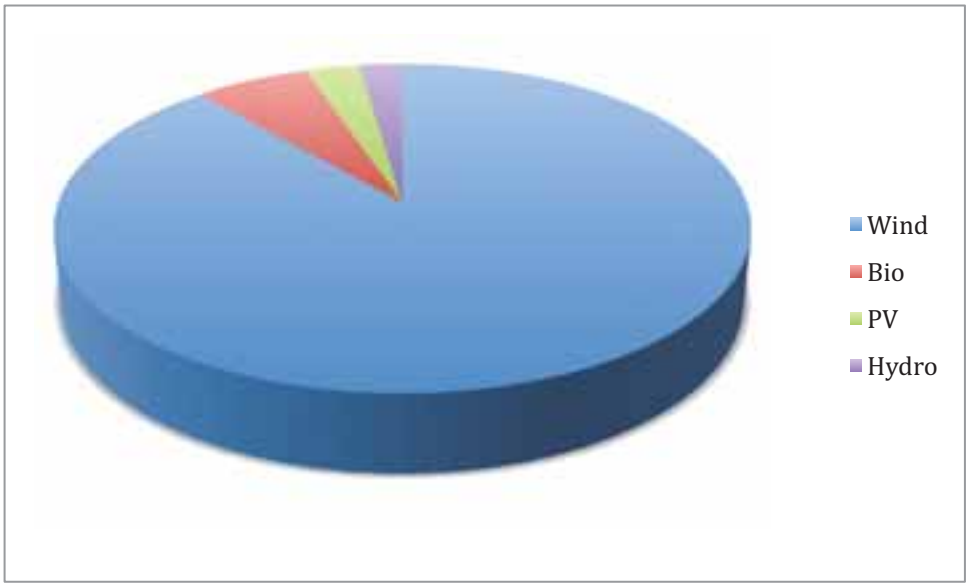

Figure 5. RE Installed aMW, through 2010. This is a total of 103 aMW, and does not include solar hot water.

Tab. 1 Intermittent Renewable Energy Investments

Year	PV aMW	Solar HW aMW	Solar HW KTherm (GJoule)	Wind Utility aMW	Wind Small aMW
02	0.002				
03	0.043			14.25	
04	0.079	0.008	10.27 (1,083)		0.005
05	0.049	0.019	19.13 (2,018)		0.001
06	0.089	0.028	30.96 (3,266)		0.001
07	0.153	0.050	35.51 (3,746)	46.774	
08	0.508	0.048	27.69 (2,921)	30.1	0.004
09	0.764	0.046	35.36 (3,730)		0.018
10	1.291	0.029	23.87 (2,518)		0.021
Total	2.987	0.229	183.093 (19,316)	91.124	0.049

Investments in continuous renewable energy are shown in Table 2. The ETO has supported more than 6 aMW of hydro on high desert irrigation district pipelines, more than 2 aMW of biopower on wastewater treatment plants, lumber mills and agriculture, and a small 0.086 aMW geothermal installation. ETO must await the advent of commercial operations for wave energy, as ETO is not funded for research and development, except for market transformation funding.

Tab. 2. Continuous (24 hr/7 day) Renewable Energy Investments, aMW

Year	Hydro (Irrigation Districts)	Biopower (Wood, Farm, Waste Water)	Geothermal
02-04			
05		0.406	
06		1.908	
07			
08	0.003	2.688	
09	0.468	1.388	
10	1.893		0.086
Total	2.364	6.39	0.086

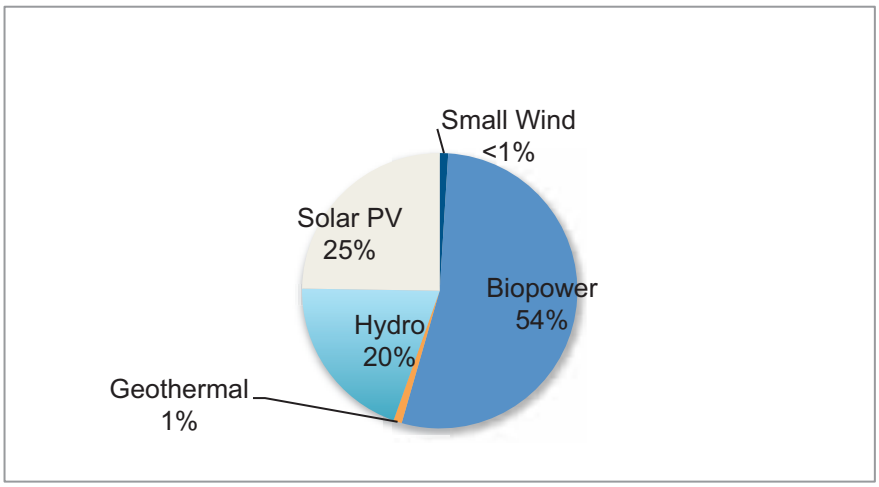

Figure 6. ETO Projects of less than 20 MW each, through 2010.

Figure 6 summarizes the ETO's small-scale (each <20 MW) projects installed, through 2010. Oregon is relatively rich in agriculture and forest sources of biomass, and relatively high annual rainfall supports hydropower. But that rainfall diminishes insolation, and many are surprised by Oregon's solar PV and hot water investments.

Oregon's "cloudy" reputation probably amuses Northern Europeans, as one of our least-insolated locations on Oregon's Pacific coast has about the same yearly average insolation as does Germany. As cloudy as Oregon is by reputation, and as cheap its electricity, the ETO has now supported installation of more than 20 MW of PV, in more than 2700 projects during the first 9 years of operations. This 20 MW capacity represents 3 aMW in Oregon's climate.

Our PV program consists mostly of incentives based on the kW capacity of the system installed. For our other RE programs, we offer early stage technical assistance for feasibility studies, grant writing, permitting, interconnection, and financing, in addition to incentives.

2.4 Future RE Investments

The recent downturn in the US economy has affected Oregon as well. The legislature has already sharply curtailed the Business Energy Tax Credits, and Residential Energy Tax Credits will be limited beginning in 2012. Because the ETO depends upon these tax credits to supplement its investments, future RE installations are expected to be much more limited.

The ETO could choose to continue to support all the current RE programs, each at a reduced level. Or it could choose to concentrate on one or two programs, to maximize installed MW capacity and/or aMW production. The latter is not my personal choice, because of the diversity of Oregon's RE sources. For example, the ETO has not even begun to invest in wave energy. Oregon and Washington State have the strongest waves of the US Pacific coast. With a market already established for our RE industries, the ETO will be reluctant to abandon any of them for the sake of a few.

For the United States, the immediate energy future is clouded. We continue to see Democrats favoring RE and EE, while Republicans favor drilling for gas and oil, mining coal, and supporting nuclear energy. The Republicans have denigrated the issue of climate change, and no legislation limiting carbon emissions is currently under discussion. This situation is likely to continue until we have decided the 2012 Presidential and Congressional elections.

3. References

Lawrence Livermore National Laboratory, US Energy Flowchart (accessed August, 2011): https://flowcharts.llnl.gov/

American Council for an Energy Efficient Economy, Report Card of the States (accessed August, 2011): http://www.aceee.org/node/820

Purple America, US Voting Patterns (accessed August, 2011):
http://www.princeton.edu/~rvdb/JAVA/election2008/

Clean Edge, The Leadership Index (accessed August, 2011):
http://www.cleanedge.com/leadership/

Energy Trust of Oregon (accessed August, 2011):
http://energytrust.org/

U.S. Energy Information Agency, Electricity Rates (accessed August, 2011):
http://www.eia.gov/cneaf/electricity/epm/table5_6_a.html