Planning and Innovation Division Responses to Joint Oversight Committee Follow-up Questions from April 25, 2016 Presentation

1. **How does each program funded by the energy supplier assessment benefit the energy suppliers?** ***This will be addressed at the July meeting when the agency budget is discussed.***

2. **What is the unsubsidized return on investment from solar projects, particularly on 1.5% requirement? Who is making these decisions? Who decides feasibility of 1.5% projects?**

   ODOE does not collect data that would allow us to calculate the return on investment for each 1.5% Green Energy Technology project. However, public bodies that implement GET projects are asked to report data from which ODOE can calculate simple payback periods. For the 45 projects reported through 2015, the simple payback reported ranges from 5.4 years to 142.2 years, with an average payback period of 52.6 years. The payback figures are not adjusted for any incentives received because public bodies are not required to report that information to ODOE.

   Under ORS 279C.527, public bodies subject to the 1.5% for Green Energy Technology requirement are responsible for determining if the 1.5% investment will be made at the construction site or an off-site location, or if it will be deferred for a future construction project. The statute authorizes public bodies to make the 1.5% investment off-site if that is more cost-effective than on-site. The statute allows a public body to defer the investment if the public body determines that green energy technology is not "appropriate" either on-site or off-site.

   To reach that decision, OAR 330-135-0052 requires the public body to consult with a technical review panel that includes ODOE, a representative of the public body, a representative of the green energy technology industry, and an engineer or architect. However, after receiving the panel's recommendation, the public body is solely responsible for making the final determination.

   The statute is designed to showcase emerging renewable technologies on public buildings and does not require these projects to be cost-effective; the statute uses cost-effectiveness only to compare the option of making the investment on-site or off-site. OAR 330-135-0015 provides a definition of cost-effectiveness for this purpose. The statue does not establish conditions for determining if a project is appropriate, but OAR 330-135-0045 includes optional considerations for public bodies, including whether the solar or geothermal resource meets minimum performance standards, whether the green energy technology would interfere with the character of a building listed in the National Register of Historic Places, and whether the green energy technology would create security risks for staff or inhabitants of the building.

   ODOE's role in the 1.5% for Green Energy Technology program is to establish rules to implement the statute, reach out to inform public bodies of their statutory requirements under the program, provide technical advice to public bodies subject to the program, and collect and compile information to report to the legislative assembly.

3. **Does the .07% solar contribution to state energy resources include behind the meter?**

   This value does not include most of the behind the meter solar installations in Oregon. The exceptions are systems installed under the Pilot Volumetric Incentive Rate (VIR) program and energy generated from net metered systems in excess of the annual on-site loads. Oregon net metering regulations require that net excess generation at the end of a net metering term be donated to low-income assistance programs. This excess generation is reported by utilities as contributing to retail load and is therefore included in the 0.07% value.

   Behind the meter solar installations may be viewed as load reduction or generation resources. By the end of 2013, approximately 44MWdc of net metered PV systems had been installed in Oregon. This includes almost 800 commercial installations and more than 5,800 residential installations. The estimated annual output of these systems is 45,000 MWh, or a little less than 0.1 percent of annual statewide retail load. If all net metered PV systems were included, the percentage of Oregon's retail electric load in 2014 would increase from 0.07 percent to approximately 0.17 percent. It is also worth noting that the electric energy resource mix is based on 2014 retail electricity sales, so only projects installed by the end of 2013 are counted in the analysis. Projects installed from 2014 to date will be included in future resource mix calculations.

4. **What is ODOE doing to enhance the use of CNG in transportation? How many fueling stations has the department supported?**

   ODOE has a long history of supporting natural gas projects in the transportation sector. In 1991, Oregon established incentives for alternative fuel vehicles and fueling infrastructure within the Business Energy Tax Credit (BETC) program. The BETC program sunset in 2011 and was replaced by the Energy Incentive Program (EIP) for Alternative Fuel Infrastructure (House Bill 3672 (2011)). Alternative fuel vehicles were added to the program as of January 1, 2015. The program will sunset at the end of 2017.

   The EIP program has issued 19 preliminary certificates for CNG fueling stations, of which seven projects have received final tax credit certificates. An additional application is in technical review and pending preliminary certification. The program has issued five preliminary certificates for CNG fleets; four are for new vehicles and one is for the conversion of existing vehicles to run on CNG. The preliminary certificates for CNG fleets cover 31 new CNG vehicles and two conversion vehicles.

   ODOE worked with NW Natural and the Columbia Willamette Clean Cities Coalition to form the Oregon Natural Gas Vehicle Working Group, which released the Oregon Natural Gas Transportation Fuel Information paper in 2014 (the group is currently working on an updated version). This paper was used by ODOT to inform their federally-funded incentive program for CNG fueling projects and used by the Oregon Public Utility Commission to inform rulemaking for SB 844, which enables a natural gas utility to propose projects that reduce GHG emissions such as CNG transportation projects.

ODOE works with fleet managers across the state to analyze natural gas use. Currently, ODOE is working with the cities of Corvallis and Bend to determine if their fleets can use natural gas. ODOE is also advising the City of Portland on a proposed renewable natural gas project.

The Bend-La Pine School District project mentioned during the hearing was actually a Liquid Petroleum Gas (LPG) or propane project. This has been a successful project for the district; ODOE provided incentives for both vehicles and fueling infrastructure. ODOE has worked with several fleets such as Benton County and Willamette Valley Transport to adopt propane.

5. **Who tracks the subsidies that accrue to one project?** ***This will be addressed at the June meeting when the energy development services programs are discussed.***

6. **The expenditure values don't true up with the FTEs shown. Please explain.**

   The presentation and handouts included *actual* expenditures for three biennia (2011-2013, 2013-2015 and projected 2015-2017) and currently *budgeted* FTE (personal services) levels. Actual expenditures for personal services are generally lower than budgeted due to vacancies, which may give an appearance of a low expenditure to FTE ratio.

   The budgeted FTEs represent the staffing level the Planning and Innovation Division has allocated for each of the programs and activities going forward. In some cases, the planned FTEs for individual programs or activities are higher or lower than recent actual FTEs because the division plans to increase or decrease resources devoted to that program or activity. This could give the appearance of a low or high expenditure to FTE ratio.

   Expenditures include costs other than personal services. For instance, the 2015-2017 projected actual expenditures for the division's Renewable Energy Project Support work include a NW Solar Communities grant for PowerClerk software implementation, and expenditures for Combined Heat and Power work include a US Department of Energy grant. In addition, programs with a greater number of rural stakeholders, such as Renewable Energy Project Support and Reducing Solar Energy Costs, may involve greater than average travel costs for department staff. These factors could give an appearance of a higher expenditure to FTE ratio.

   Finally, ODOE's accounting system tracks expenditures for the Planning and Innovation Division in seven broad categories, so the breakouts provided in the presentation and handouts for the Division's 21 programs and activities are approximate. While the total expenditures for all of the programs and activities is accurate, the expenditure to FTE ratio may not be reliable for programs and activities with low FTE levels.

7. How does the ACEEE scorecard make any difference?

The ACEEE scorecard is the best source of information for benchmarking Oregon's energy efficiency programs against other states. In addition to an overall state rank, the scorecard provides detailed comparisons of state government efficiency programs, building codes, combined heat and power policies, utility-implemented efficiency programs, transportation efficiency programs, and state appliance standards. These comparisons help policymakers identify areas where efficiency gains can be made and locate states with the best programs to evaluate. This benefits Oregon and all other states by enabling states to efficiently share information and leverage each other's programs.

In addition, the overall ranking makes a difference to grant funders and energy efficiency providers who are considering making investments in Oregon. Oregon's consistently high ranking is of interest to other states that seek to partner with a recognized energy efficiency leader in seeking grants for innovative projects.

ODOE's investment of resources to develop the scorecard is very low – less than a tenth of an FTE annually. In addition to submitting the agency's own data, ODOE ensures that data covering energy efficiency programs implemented by all other Oregon entities is submitted and accurately reflected in ACEEE's database. This not only ensures that Oregon's data is accurate, but is also an opportunity for a holistic look at Oregon's energy efficiency programs to identify any gaps or opportunities.

8. Is Washington data on "resource counts" compatible with Oregon data?

Oregon and Washington work together on the electricity resource mix to ensure that the data for unspecified or spot market purchases is compatible and comprehensive. The electricity resource mix for any given electric company includes information about the company's own generating resources and specific wholesale purchases, where the resources used to generate the electricity are known, as well as information about unspecified or spot market purchases, where the resource mix must be calculated based on resources not specifically claimed by any utility. The resource mix for the unspecified portion is calculated at a regional level given the interconnected nature of the electric grid. Since this calculation is the same for states in the Northwest, Oregon and Washington do the analysis together to reduce cost and ensure that the data is compatible. The Oregon Public Utility Commission requires investor owned utilities to report their electricity resource mix to their customers, and the utilities rely on the analysis developed by the two states to meet this obligation.

9. (a) Is ODOE looking at the cost of renewables in terms of the need to have standby power (ex., natural gas plant) to supplement?

ODOE views the cost of "standby power" and other options for increasing system flexibility to be a central consideration in evaluating how to meet statutory requirements to integrate higher levels of variable renewables in the electric grid. The term "standby power" is shorthand for generation capacity held in reserve to provide real-time services to the grid to balance generation and load. These services are typically provided by power plants that run for many hours of the year, not a plant that is standing by waiting to be turned on.

It is true that increased system flexibility is needed as more wind and solar generation is added, as these resources are inherently variable in nature. One option for providing increased system flexibility is the use of generation reserves, where generators increase or decrease output as needed over a given time period. The costs and contracting mechanisms for providing flexibility through generation reserves are well-understood, and ODOE uses them as a benchmark for other flexibility options. Other emerging options include demand response, energy storage and balancing over a wider geographic area.

Flexibility may be needed over short time periods, from just a few seconds to a few minutes, due to gusting winds or scattered cloud cover over a solar generating facility. Flexibility over the course of an hour or two is needed if predicted power output from wind and solar is different than actual output, or if load during the same period is different than the prediction. In special circumstances, system flexibility may be needed over long time periods, meaning many hours to weeks. The northwest has experienced this need when hydro generation is high in the spring and wind power output is also high. California utilities predict that as solar generation increases, there could be more solar than needed in the mid-day and possible curtailment as a result.

In addition to the use of generation reserves, there are other sources of flexibility in the system that are currently not widely utilized in Oregon. Demand response, in which users adjust their energy usage during peak periods, can provide fast-acting flexibility. Recent investments by the northwest utilities in smart meters and smart grid technologies will serve to facilitate demand response and coordinate generation and load. In other regions of the country, demand response is cost-competitive at present with natural gas plants in providing a flexible resource.

Looking to the future, a variety of energy storage options are promising, but they must come down in cost and provide the right service to meet the need. How much energy can be stored, how long it is stored, and how quickly it can be discharged must be matched to the flexibility need. Another source of flexibility is sharing the responsibility for balancing wind and solar with our neighbors. The Energy Imbalance Market, which has been in operation between PacifiCorp and California Independent System Operator (CAISO) since November 2014, has provided enhanced flexibility in the sub-hourly timeframe at lower cost to PacifiCorp customers.

(b) What is the duration of the energy storage pilot with EWEB?

The EWEB Grid Edge Demonstration will involve energy storage installed at three sites: the utility's operations center, a municipal water pumping station, and a mission-critical communications tower. The total for all three installations will be a battery capacity of 500 kW and 903 kWh. This is the energy equivalent of maximum power output from the battery systems for 1 hour and 48 minutes. If the power output required is less than maximum, the energy stored can be discharged over a longer time period.

Each of the demonstration sites will also include solar PV and diesel generators. With the combination of these three resources, EWEB plans to explore the optimal charge/discharge cycles for the battery and the most efficient use of fuel for the generators.

(c) Is agency tracking research on battery alternatives?

Through regular contact with utility operations staff, ongoing exchanges with National Laboratory researchers, and attendance at energy storage conferences, ODOE keeps abreast of technology developments in energy storage. Many exciting new areas are being explored. Technologies follow a path of maturation from the basic proof of concept, to research and development in the lab, to manufacturing, to demonstration and finally to commercialization.

During the hearing, committee members asked about graphene technology. Graphene has the potential to increase the performance of lithium-ion batteries by providing a better anode material as compared to graphite. Although laboratory results are encouraging, and battery performance improvements can be seen, this technology is in the early research and development stage. According to researchers at Sandia National Laboratory, graphene batteries are currently at the stage of research for practical applications.

(d) In response to a number of questions, the agency stated it would provide information on energy storage options.

There are many different ways to store energy, and the technology used needs to match the need for energy. The presentation covered needs for utilities, grid operators and customers, all of which are different in terms of how much energy they have to store, how long they have to store it for, how quickly it needs to be available and other factors. As described above, energy storage can help integrate renewable energy over a variety of time scales. Although battery storage is getting a lot of media attention and R&D funding, there are a variety of energy storage options being tracked by ODOE that have both near and long-term potential benefits to the electric grid and its consumers.

In addition to traditional chemical batteries, other potential methods of storage, using different kinds of energy, are shown, in the chart below. These include converting electricity to chemicals such as hydrogen, converting electricity to gravitational energy such as pumped hydro or rail storage, converting electricity to thermal energy such as hot water, and converting electricity into motion energy, such as flywheels. Many of these technologies are currently being explored for use in Oregon as they could be a good match for the energy storage needs of particular utilities and different subsets of their industrial, agricultural and residential customers.

Potential energy Potential energy is stored energy and the energy of position. There are several forms of potential energy.	Kinetic energy Kinetic energy is the motion of waves, electrons, atoms, molecules, substances, and objects.
Chemical energy is energy stored in the bonds of atoms and molecules. Batteries, biomass, petroleum, natural gas, and coal are examples of stored chemical energy. Chemical energy is converted to thermal energy when people burn wood in a fireplace or burn gasoline in a car's engine. **Mechanical energy** is energy stored in objects by tension. Compressed springs and stretched rubber bands are examples of stored mechanical energy. **Nuclear energy** is energy stored in the nucleus of an atom—the energy that holds the nucleus together. Large amounts of energy can be released when the nuclei are combined or split apart. **Gravitational energy** is energy stored in an object's height. The higher and heavier the object, the more gravitational energy is stored. When a person rides a bicycle down a steep hill and picks up speed, the gravitational energy is being converted to motion energy. Hydropower is another example of gravitational energy, where gravity forces water down through a hydroelectric turbine to produce electricity.	**Radiant energy** is electromagnetic energy that travels in transverse waves. Radiant energy includes visible light, x-rays, gamma rays, and radio waves. Light is one type of radiant energy. Sunshine is radiant energy, which provides the fuel and warmth that make life on earth possible. **Thermal energy**, or heat, is the vibration and movement of the atoms and molecules within substances. As an object is heated up, its atoms and molecules move and collide faster. Geothermal energy is the thermal energy in the earth. **Motion energy** is energy stored in the movement of objects. The faster they move, the more energy is stored. It takes energy to get an object moving, and energy is released when an object slows down. Wind is an example of motion energy. A dramatic example of motion is a car crash, when the car comes to a total stop and releases all its motion energy at once in an uncontrolled instant. **Sound** is the movement of energy through substances in longitudinal (compression/rarefaction) waves. Sound is produced when a force causes an object or substance to vibrate. The energy is transferred through the substance in a wave. Typically, the energy in sound is smaller than other forms of energy. **Electrical energy** is delivered by tiny charged particles called electrons, typically moving through a wire. Lightning is an example of electrical energy in nature.

Source: http://www.eia.gov/KIDS/energy.cfm?page=about_forms_of_energy-basics

10. How are appliance standards enforced?

Manufacturers are responsible for providing only compliant products to Oregon consumers. Under OAR 330-092-0025, manufacturers report compliance by registering a product on the

Multi-State Compliance system website (www.appliance-standards.org). ODOE subscribes to this database, which is hosted and maintained by the California Energy Commission (CEC).

By aligning Oregon's appliance standards with California's standards, Oregon is able to leverage California's compliance tools and manufacturer outreach. In addition, this approach makes it easier for manufacturers to comply with a west coast market's needs and reduces chance of non-compliant products entering the distribution network.

For products sold into Oregon by online and mail-order retailers, those retailers specify in the product description that non-complying products "cannot be shipped to California or Oregon." The California Energy Commission has the authority and budget to perform in-field compliance verification in the California market. The CEC notifies ODOE if retailers – especially those with locations in Oregon – are not complying. To date, no violations have been shared.

11. Where does Oregon ranks in per capita GHG emissions among the 50 states?

Oregon is 40th in per capita emissions, including all emissions produced within Oregon's borders (10 states and the District of Columbia have lower per capita emission rates than Oregon). However, this figure does not take into account the carbon emissions Oregonians are responsible for due to our demand for and consumption of imported electricity or other goods and services that are produced out-of-state.

12. (a) On alternative transportation fuels: A statement was made in the presentation that "many alternative fuels can be manufactured in state." Provide the quantity on a percentage basis that is being made in state and the relative costs and comparable life cycle.

In 2005 petroleum (gasoline & diesel) accounted for 98.4% of the fuel consumed in the transportation sector. Only 1.6% was alternative fuels, consisting mostly of ethanol seasonally for oxygenation purposes, and none of this fuel was produced in-state. In 2014, petroleum accounted for 90.98% of the fuel consumed, with alternatives now taking a 9.02% share of the market. Pacific Ethanol in Boardman Oregon produces 40 million gallons of ethanol per year, accounting for 27% of the ethanol consumed in the state. SeQuential Pacific Biodiesel produces over 6 million gallons per year, accounting for 18% of the biodiesel consumed in-state.

Ethanol from the Midwest has a 30.6% greenhouse gas emission (GHG) reduction compared to gasoline. The ethanol produced at the Pacific Ethanol facility in Boardman Oregon has a 35.8% reduction in GHG emissions. Biodiesel produced in the Midwest from soy has a 42.7% reduction in GHG emissions compared to diesel fuel. Biodiesel produced at the SeQuential Pacific plant in Salem Oregon from used cooking oil has an 82.2% reduction in GHG emissions compared to diesel.

The fuels produced in-state are cost competitive with fuels produced out of state. Prices are not typically set by the business producing the fuel, but rather by the market for the fuel in the region. Biofuels currently are more expensive than petroleum fuel due to low petroleum prices; however, at times of high petroleum prices, biofuels have been less expensive than their petroleum counterparts. Several variables affect fuel prices, but typically biofuel prices have been less volatile then petroleum fuel prices. Because the biofuels produced in-state have lower GHG emissions, they have added value to markets that have low-carbon fuel programs such as California, Oregon, and British Columbia.

(b) On bringing down soft solar costs: Provide a trajectory of when ODOE believes solar will be competitive with natural gas with a lowering of soft costs (unsubsidized).

ODOE is not able to provide a trajectory of when solar will reach price parity with conventional grid power because there are many variables that will affect this timeline. Variables with large impact include:

- Future wholesale energy costs
- Future solar project costs
- Local solar resources

For example, a solar project in Redmond will generate 30% to 35% more energy annually than a similar system installed in Portland. Similarly, solar projects installed in a hydro-dominated BPA utility service territory may face different economics than a project in a utility service territory that relies heavily on coal or natural gas generation facilities.

In the presentation, ODOE staff referenced a National Renewable Energy Lab (NREL) report entitled "Grid Parity for Residential Photovoltaics in the United States: Key Drivers and Sensitivities" which found Oregon to be one of the last states to reach solar grid parity primarily due to low regional energy costs and low solar resources. The following table is an excerpt from that report:

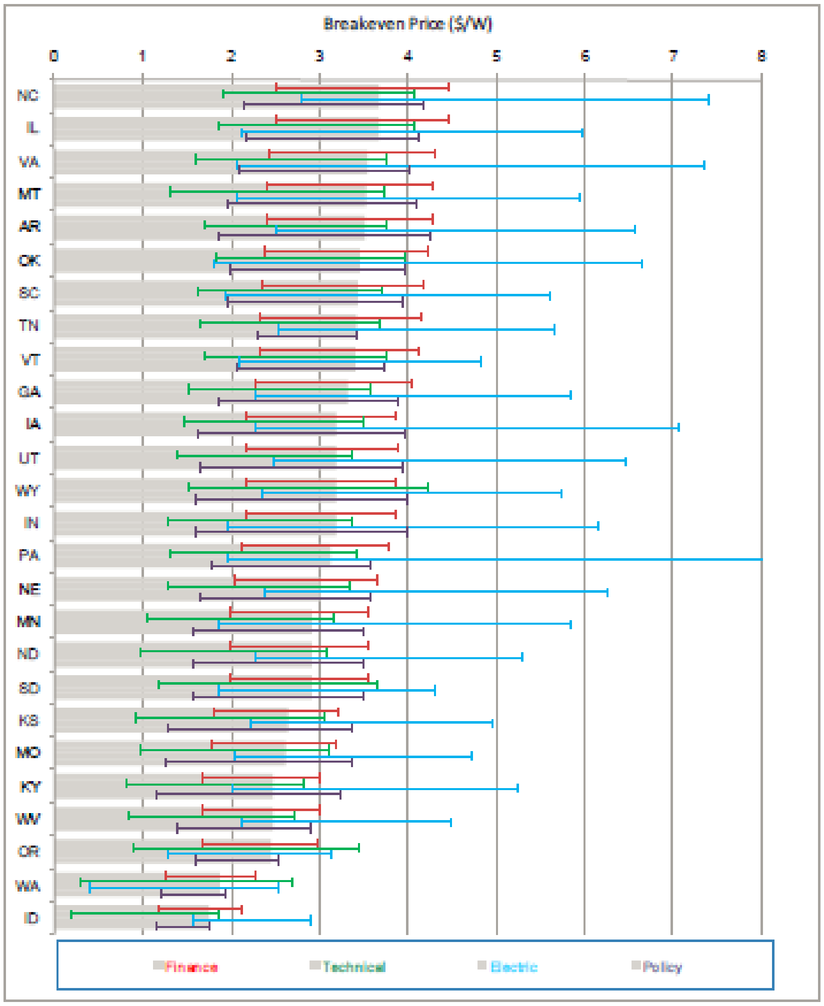

Fig. 3b. Range of PV break-even costs in the 2015 scenarios: Bottom 26 region

This table demonstrates the break-even costs necessary for solar to compete with conventional grid electricity. In the table, Oregon, Washington and Idaho rank lowest, with a conservative estimate of costs below $1.00 per watt ranging to about $3.00 per watt for solar to break even with conventional grid power. To date in 2016, the average cost of direct purchase residential solar projects in the Residential Energy Tax Credit program is about $4.34 per watt. In the past year, about 45 residential projects were installed below $3.25 per watt. It is expected that utility scale projects in the 2MW to 10MW range will be installed as low as $2.00 per watt.

Solar projects continue to have high capital costs; however, they are expected to generate energy for at least 25 years. Calculating the levelized Cost of Energy (LCOE) is a useful way to quantify solar energy costs. LCOE calculations take the total lifetime costs of a solar project divided by the projected lifetime energy production. At $3.00 per watt, solar projects in Eastern Oregon have an LCOE of about $0.10 per kWh.