R&D Projects Scheduled for 2011

Project Title (Requested Projects include Multi Year)	2011 Approved Projects
Distributed Resources Process & Reporting Improvements Description: With all the new requirements placed on Distributed Resources (Solar Initiative, Feed-In Tariff, Demand Response Controls, WREGIS), PGE needs to modify and automate its work processes to remain at near existing staffing levels. An example of updating and automation would be linking our GenOnSys system with our Maximo Maintenance system so that when a particular type of alarm came into GenOnSys, it would automatically generate a work order. This project will also help automate PGE's feeder queue for tracking solar projects, small power projects and DSG as well as establish a standard system for providing information to the Protection Department for customers wanting to interconnect with PGE on distribution feeders. Benefit: This project will determine whether a proposed automated solution is cost effective. It will provide improved response to alarms at Distributed Resources sites, reducing system outages and improving availability. The project allows PGE greater flexibility in responding to customer needs when interconnecting with distribution feeders. Risks of Non-Participation: DSG labor costs will increase due to current manual processes and potential inappropriate customer charges for feeder upgrades could be levied on the wrong customers.	$150,000
Demand Response Com Model Description: For this project, the use of an integrator like Factory IQ will model the newly approved Schedule 77 Demand Response tariff following the communication standard 61850-7-420. This standard has elements developed for distributed generation but not demand response and is one of the cornerstone standards being reviewed by NIST as a potential smart grid interoperability requirement. The project would research the Demand Response requirements and formulate a communications model (Com Model) that can be implemented in our GenOnSys software that's used for controlling our generators, only this will monitor and control our load reductions for Schedule 77 and our RFP winner for commercial demand response. Benefit: By creating a standardized model for Demand Response, PGE will benefit from both the labor associated with bringing a new Demand Response client into the program as well as setting standards for information transmission related to Demand Response. Risks of Non-Participation: Costs associated with each new Demand Response installation will be variable as well as the data and requirements for each Demand Response customer will also vary.	$50,000
Firm Load Reduction Technology Demonstration Description: PGE is proposing collaboration with a provider of control equipment targeting commercial building lighting and HVAC to demonstrate automatic peak load reduction. The funds will be used to purchase the control equipment and communications equipment to test the capacity impact of automatically and seamlessly reducing load during critical system peaks. Testing includes sending signals to control systems, receiving acknowledgement of the signal, monitoring the automatic reduction of load without human intervention, and observing immediate feedback to system operations of the amount of reduction. The impact on automated notification systems, collection of usage determinants, billing and customer satisfaction will also be examined for any system changes that will be required for full scale implementation of Auto Demand Response (DR). This research and partnership supports PGE representations made as part of the OPUC AMI filing - to implement firm peak load reductions. Benefit: Approving this request will help offset some equipment cost for PGE participants. It is expected that PGE funds will be supplemented with the provider's installation services and software hosting. Results will be used in integrated resource planning, Distributed Resources Command Center (DRCC) development, cost	$150,000

effective demand response capability, and power operations. Risks of Non-Participation: Benefits in this specific application will quantified against market pricing and the cost of building a peaking plant for a limited number of hours of operation.	
Relay Control Equipment for Residential Direct Load Control Description: PGE is required by the conditions to the AMI order to conduct direct load control among our customers. PGE's IRP reflects 25 MW of capacity can be attained from residential customers. OPUC commissioners are particularly interested in an air conditioning pilot and water heat pilot. A critical component of direct load control for air conditioning is a programmable communicating thermostat (PCT) and control relays for water heating control. A demonstration of the cost effectiveness of direct load control on these two appliances is essential to gaining cost recovery and to expanding the program quickly enough to acquire 25 MW in two years. Equipment and installation costs for each technology are approximately $200 each. PGE is planning a small scale test of approximately 500 customers in each technology. Benefit: Approving this request will expedite the initiation of the research and results. Benefits in this specific application will be quantified against market pricing and the cost of building a peaking plant for a limited number of hours of operation. Risks of Non-Participation: PGE's timing of implementing Demand Response is subject to monitoring by the OPUC and subsequent decisions as to under whose purview DR should reside.	$100,000
EPRI Target P75.002 Mercury & Integrated Environmental Control Technology Development Description: Provides access to EPRI's evaluations of mercury capture technologies. This program is a sub-program of EPRI Target 75 which was fully funded for 2009. For 2010, we are only requesting funding for one of the three parts of Target 75 ($73,095 for P75.002). Benefit: This investigation would benefit Boardman. EPRI has also been instrumental in the development and evaluation of mercury control technologies. In 2008, EPRI co-funded the mercury testing performed at Boardman, saving PGE and its co-owners over $90,000. Risks of Non-Participation: Possible lost opportunity to significantly reduce the capital and/or operating costs for the Boardman mercury controls installation if emerging mercury control systems prove to be technically feasible and commercially available over the next year for U.S. applications.	$73,095
[1]Geologic Sequestration of CO2 in Columbia River Group Basalts Description: PGE has been a member of the Big Sky Carbon Sequestration Partnership since its 2004 inception. PGE's thermal power plants emit carbon dioxide (CO2). The Boardman coal plant emits around 5 million tons per year while the natural gas turbine plants emit less. To address imminent regulation of CO2 emissions in response to global climate The Partnership is one of seven federally funded, regional efforts to characterize and demonstrate the potential for CO2 sequestration especially in geologic formations. The focus of the Big Sky work has been sequestration in Columbia River Basalts. These 10,000 feet thick basalt overlay much of the Pacific Northwest. All of PGE's thermal plants sit on these basalts layers. A unique quality of basalt (a calcium, magnesium or iron silicate SiO2) is that it is very reactive with carbonic acid such as forms when CO2 is dissolved in water. Thus, if CO2 is injected into basalt not only is there the potential for pore space storage of CO2 as a gas but, when combined with pore space water, forms carbonic acid. Because of this, CO2 can then also displace the silicate yielding a "scale" or solid carbonate. In effect, the gaseous CO2 is transformed into a solid mineral, i.e., a rock. This geochemistry is well known and well demonstrated in lab and bench scales under expected injection pressure and temperature at depth.	$10,000

[1] R&D project brought forward from 2010 continuing through 2011.

Benefit: Over the past five years, Big Sky has located a test location for injection of CO2 in a supercritical liquid phase. A test well has been drilled and characterization work is nearly complete. The location is at the Boise, Inc. pulp and paper mill in Wallula, WA nearby the Port of Walla Walla. Injection of CO2 is now planned for 2nd quarter, 2010. Risk of Non-Participation: PGE would not be seen as being serious in addressing this important issue (applicable to both gas and coal fired stations).	
OSU – Carbon Balance for Capture of Flue Gas Greenhouse Gasses by Microalgae Description: PGE and Oregon State University (OSU) project: The overall goal of this study is to perform a fundamental engineering analysis on the use of algae to capture CO_2 from flue gas and process the captured carbon into lipids which can be converted into biodiesel, with specific focus on the carbon balance for the process. This information can then be used by PGE to assess the technical and economic feasibility of using algae to reduce carbon emissions from coal and gas-fired power plants. Benefit: Global climate change is an important environmental and societal issue that is being addressed in various ways including federal and state legislation limiting carbon dioxide emissions and carbon cap and trade programs. Involvement in sustainable solutions that can address multiple goals of producing biofuels while sequestering carbon dioxide will be a step towards reducing effective carbon dioxide emissions. Production of algae biodiesel utilizing flue gases from fossil fueled power plants is a sustainable renewable alternative to achieve energy security. Growing lipid-rich algae using power plant flue gases thus achieves the twin goals of providing a renewable biofuels while reducing environmental impact. Risk of Non-Participation: Investigating methods to sequester carbon dioxide will help in formulating strategies to limit carbon dioxide emissions and meet any future regulations. With imminent regulation of carbon emissions – PGE seeks to at least bound, technically and economically – any opportunity to mitigate this risk.	$5,000
[2]**Agronomy, Acceptability & Potential for Growing Giant Cane (Arundo donax) in E. Oregon** Description: It has been PGE's experience and that of its industry that fuel cycles based on biomass for power generation are defeated by unreliable production capability and or high fuel transportation costs. Transportation costs have usually been the dominant issue. PGE has become aware of and has done preliminary research on the possibility of growing Giant Cane (*Arundo donax*) near the Boardman plant as a renewable "closed loop biomass" fuel. U/W and WSU have test grown this extraordinarily productive plant in Washington's Yakima Valley for the last 6 years and have just planted 30 additional acres to test cropping and harvesting techniques. The harvested material will serve as feedstock to NW pulp/paper mills. It remains to understand whether *Arundo donax* or other 'opportunity fuel', biomass sources nearby to Boardman can either be grown or collected (or both) in sufficient quantity to be torrefied (charred) in Oregon. Once torrefied, the fuel can be stored with less concern for moisture uptake or biological degradation (e.g., mold). The ability to stockpile torrefied fuel also mitigates concerns around: • Winterkill of Arundo • Having sufficient land to produce an energy crop like Arundo • Less irrigation water due to drought or other natural events • Limited throughput of a torrefaction facility If *Arundo* proves to be the viable choice and passes muster with regard to regulatory permitting, social and agricultural acceptance and overall sustainability – PGE's initial review suggests that it can meet critical acceptance criteria as a coal substitute. Benefit: Arundo, in a torrefied form can be used to displace a portion of the coal burned at Boardman. In this	$114,000

[2] R&D project brought forward from 2010 continuing through 2011

event, it helps PGE lower its overall carbon emission footprint; adds flexibility in addressing its RPS commitment and finally can potentially lessen, if not obviate significantly, the cost of some of the capital upgrades currently envisioned for Boardman as part of the 2009 IRP. Risk of Non-Participation: Carbon emissions from burning coal exclusively at Boardman become a limiting and decisive factor. Using torrefied (charred) Arundo offers the only near term (within 5 years) of delivering a competent and cost-effective solution to the CO2 emission issue now confronting PGE's Boardman coal plant.	
Home Energy Management Description: This project with Intel and Battelle demonstrates the viability of implementing demand response utilizing equipment that can be purchased and supported via the mass-market electronics retail channel. Intel has developed a microprocessor to be embedded in video-oriented, consumer electronics (i.e. TVs, DVD players, etc.) The chip comes complete with an open-protocol, operating system. Intel's goal is to make all home-video products Internet ready. From a customer perspective, the customer sets up price and comfort preferences via the user interface on the TV. The customer does this setup one time for each appliance they add to the system. Then, an always-on portion of the Intel platform monitors prices from PGE, as required, via the Internet and sends control commands at the appropriate times to execute the customer's comfort and cost savings directives. The always-on Intel platform communicates to each appliance through WiFi or other in-home communication protocol. Benefit: Customers get the benefit of equipment sold and supported in a competitive and familiar environment. Familiarity and ease of installation will make demand response acceptable to a larger audience. Risk of Non-Participation: The Intel/Battelle model reflects the logical end state of demand response systems where innovation is driven by third parties using open platforms. In this model PGE merely provides price signals on the Internet. By not participating and proving the validity of this platform we risk much higher expenses and loss of first mover advantage in the future for equipment and maintenance of demand response equipment.	$75,000
OSU Wave Energy Research – Wave Energy Linear Generators Description: Provide support for the continued expansion of resource evaluations being used to assess renewable energy (e.g., wave, wind) potential in the Pacific Northwest. OSU's research demonstrates a compelling case for renewable energy technologies. Advanced renewable energy research may provide the benefit of encouraging new project development in Oregon. This would allow increased diversity in PGE's renewable resources portfolio. Benefit: As a result of Oregon Legislature passing a Renewable Portfolio Standard (RPS) in 2007 and in support of PGE's Integrated Resource Plan (IRP); PGE will be actively pursuing significant new renewable resources to satisfy forecast load growth ~200MWa. Today's research on advanced renewable technologies will provide important options. In order to evaluate effectively wave energy generation options, PGE must expand its knowledge base. Support of OSU's research and development of Oregon wave energy should provide significant benefit in accomplishing this goal. Risk of Non-Participation: A decision to withhold funding for the OSU wave energy program could compromise its effectiveness and the benefits it could provide, from a resource development perspective. PGE may lose the opportunity to provide input and assist in directing how this renewable resource is developed to maximize benefit to our customers	$5,000
Short-term Energy Storage Devices with Local Network Systems Description: Past PGE research began an exploration of the opportunities for local energy storage devices that could be supportive of local network systems. This effort remains focused on community scale renewable and or coupled with highly efficient community scale opportunities such as groundwater heat exchange. Benefit: As a matter of "scale matching" it is likely that limited energy storage is a much better economic application with small community energy networks than with the much, larger overall electrical grid. In some	$10,000

respects, a variation of this is being investigated now for wind power energy storage where storage supports just the peaks and valleys of wind vs. lots of wind and no wind. There is a significant difference in this approach. This project extends the thinking to small neighborhoods or communities where energy use is reasonably matched to a limited, but well stored energy supply. Risk of Non-Participation: We ignore the scale benefits of this above approach and make the potentially erroneous "one size fits all", business as usual approach to meeting small community energy needs.	
Optimizing Biglow Canyon Wind Farm Description: PGE is building the Biglow Canyon Wind Farm in three phases to provide approximately 450 MW of electric power to its customers. This development also provides a unique laboratory for many wind energy studies since the wind farm is equipped with a Supervisory Control and Data Acquisition (SCADA) system. The SCADA provides a wealth of data that can improve the project's energy output with the following objectives: 1. Determining which turbines may be underperforming for various reasons 2. Minimizing unplanned failures 3. Help in providing effective preventative maintenance 4. Determining if other turbine sites may exist in the project development area and 5. Improve energy forecasts with complimentary meteorological measurements While the data provided by the SCADA to address these areas is readily available, many times this vast amount of data is ignored or not fully used by wind farm operators. Benefit: As first priorities, PGE wishes to maximize the output from our project area and to minimize operational costs. OSU's Energy Resource Research Laboratory (ERRL) will provide optimization of the PGE Biglow Canyon Wind Farm focused, initially on using the SCADA system data to address Items #1 thru #4, above. Objectives #1 through #3 identified for maximizing project output - such as investigation of individual turbine under-performance, etc. will be the focus of the first year's work scope. These will culminate in two Tasks: • Development of testing of methodologies, and, • Data processing programs to allow wind farm operators to routinely process, in a meaningful way, the large amount of SCADA system data Risk of Non-Participation: Carbon emissions will be under increasing public scrutiny. Participating in carbon cap and trade programs will represent an additional operational expense for generating electricity from coal/natural gas. Renewable power resources such as wind farms will represent a large portion of the solution (that is also mandated by public policy); they are, however also intermittent power generating resources. The large capital expense of a wind farm must be accompanied by real efforts to maximize the output – especially in making every attempt to minimize or otherwise offset intermittency to the extent possible.	$10,000
Miscellaneous small projects awaiting PGE R&D funding approval	$8,305
PGE R&D Projects Approved for 2011	**760,000**[3]

[3] For 2011, PGE is forecasting approximately $760,000 in R&D Expense, but has approved only $751,695 as of 2-16-2010.