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## **Education**

- B.S., Electronics Engineering, Oregon State University, 1970  
*Major:* Computer Engineering  
*Honoraries:* Tau Beta Pi, Eta Kappa Nu engineering honor societies

## **License:**

- Professional Electrical Engineer, Oregon License #8580

## **Professional Employment History**

### ***Solar Consultant***

***February 1998 to present***

#### *Cascade Solar Consulting, LLC*

- Perform private solar consulting and program management work for multiple clients including utilities, private solar contractors, engineering/consulting firms, non-profit entities, local/state governments, and homeowners. Projects include solar PV system monitoring and analysis at four sites and project management of the Solar for Schools installations for Portland General Electric and Bonneville Environmental Foundation; and solar consultant to the City of Ashland, OR for procurement of 30kW of PV systems. Recent clients include the Energy Trust of Oregon, Portland State University, and ER Munch, Architect.

### ***Senior Analyst/Emerging Renewables***

***February, 1999 to 2002***

#### *RER Inc*

- Led projects and performed on-site verification, evaluation, analysis, and monitoring of solar photovoltaic and wind systems throughout California under the California Buydown Program. Verified a total of 55 systems through on-site visits and have installed 20 monitoring systems at selected PV/wind sites. Definition and concept development of projects and analysis and documentation of results were project elements in addition to on-site field work.

### ***Product Line Manager Earth Smart Products***

***September,  
1997 to February 1998***

#### *Enron/FirstPoint*

- Responsible for design and delivery of branded environmental utility products including Earth Smart Power (renewable, central generation), Earth Smart Homes, and Earth Smart Commercial Buildings.

**Analyst**

**1995-1997**

Product Development Department, Portland General Electric

- Designer of Earth Smart®/Commercial Buildings Program (1995-96). Responsible for initiating implementation of the program including selection of professional staff, development of marketing and communications plans, and developing all program procedures and processes.
- Principal investigator and developer of Earth Smart® brand Product Line concept (1996-1997), including expanding the brand to larger geographic area and expanding product line to include renewable electric power, environmental services, and land development services.

**Analyst III**

**1991-1995**

Market Development Department, Portland General Electric

- Principal designer and leader in the design/development of marketing offers. Responsible for developing technical and business product concepts, identifying and characterizing markets, defining market studies and analyzing studies' results, designing detailed processes and procedures, training implementation teams, developing performance indicators and market goals, defining and coordinating implementation of advertising and PR messages and media with PR team.
- Project Manager of Energy Efficiency R&D Projects. Responsible for conceptualizing and writing research plans, securing funding support, selecting and overseeing hardware and monitoring contractors, procuring necessary equipment, gathering, assembling, and analyzing data, and writing reports.
- PGE Corporate Electric Power Research Institute (EPRI) Coordinator (1991-1994) and Corporate R&D Coordinator (1992-1994). Responsible for coordinating and evaluating PGE R&D projects and funding sources
- Solar representative to PGE Renewables Working Group (1993) and Renewables RFP Evaluation Team (solar) (1993-4). Responsible for using renewables knowledge and understanding to design a renewables development plan for PGE. The second effort involved detailed evaluation of solar PV power plant proposals in response to PGE's Renewable Power RFP.

**Supervisor/Senior Project Manager**

**1989-1990**

Market Research and Development Department, Portland General Electric

- Senior Project Manager responsible for developing conservation marketing programs. Involved team leadership skills, creative skills used in conceptualizing innovative and attractive offers, knowledge of residential home heating and water heating technologies and markets, establishment of pricing and incentives, and evaluation of customer attitudes for message design.

**Supervisor**

**1986-1989**

Marketing Offer Design Department, Portland General Electric

- Supervised staff of four analysts responsible for developing marketing programs, involving coaching and team development skills, and other skills (noted above in 1989-90 section).

**Energy Application Specialist**

**1983-1986**

Conservation Services Department, Portland General Electric

- Renewable Resources Consultant for internal/external clients/customers. Responsible for maintaining professional-level knowledge of all renewable technologies. Provided effective personal consultations with customers, teaching skills utilized in classroom teaching, and effective public speaking skills utilized in providing public presentations on solar space and water heating (passive and active systems), photovoltaics, small scale hydro, and small scale wind generation.

**Energy Management Consultant/ Solar/Renewable Energy**

**1976-1983**

Conservation and Energy Management Department, Portland General Electric

- Expert/consultant/engineer to customers and company in renewable resource technologies and applications (see above). Was instrumental in instituting the Water Heater Incentive Program, which was the first utility program in the nation to offer incentives for solar water heating.

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**Relevant Experience And Skills**

**Monitoring and Evaluation**

**2000-2002** Manage project to install monitoring systems for 20 PV and wind systems in state of California. Project work included specification and selection of monitoring system, selection of monitoring sites, coordination with customer/clients and solar installers, actual installation at each site, and analysis and interpretation of the data received. Secondly, managed the procurement, installation and monitoring of two photovoltaic systems installed in high schools as part of PGE Solar for Schools program. Managed major residential PV system project, including design & installation of sophisticated datalogging, display and Web-accessible data system.

**1999-2000.** Verified, through on-site visits, that 55 PV systems installed under the California Buydown program were installed and operating consistent with the Program requirements. Documented and wrote analysis of findings.

**1999-2000.** Operate the Clackamas Community College Environmental Learning Center Portland Region Solar Radiation Monitoring Site as a Cascade Solar Consulting contract. The site provides precision solar radiation monitoring for Portland, OR geographic area. Contract includes monthly data analysis and reporting to sponsors and clients.

**1997-2000.** Managed the specification, purchase, installation, and acceptance of data acquisition systems for five grid-tie photovoltaic installations in Portland, OR area. Analyze and evaluate performance of the PV systems from the acquired data.

**1992-1994.** Specified, and managed installation of data acquisition systems for two commercial daylighting projects, analyzed and reported results based on data acquired.

### ***Solar and Photovoltaic Consultation and Engineering – Recent Project Experience***

**2001-2005.** Photovoltaic System Design, Consulting and Project Management Projects including:

5 kW residence on the Oregon Coast (Oceansolar.com): Designed PV module mounting layout and wiring design for unique multifaceted standing seam copper roof. Was co-designer of remainder of PV system. Designed and installed all photovoltaic monitoring sensors, loggers, and display capability.

2 kW Solar for School system on West Salem High School - Designed and managed the installation, including monitoring system design and installation for this school system.

5 kilowatt residence (Cannon Beach): Was solar photovoltaic consultant and designer for this PV system on curved bitumen “flat” roof. Homebuilder won national award “National Association of Home Builder's National "Green Builder of the Year" for overall project.

50 kW PV system for Winery (Stoller Winery) – Performed complete detailed design & specification of a 50 kW PV system to be installed on new winery building.

Photovoltaic consulting and instructor - In 2003-2005 I provided training for PV system inspectors, designers, and installers for Energy Trust of Oregon. I taught NEC Code training for Photovoltaic systems for City of Portland in May, 2004. I have provided analysis and evaluation of solar PV proposals for Energy Trust including detailed sun-tracking analysis.

Photovoltaic Consultant to Portland State University - Procurement of 25 kiloWatt flat rooftop Photovoltaic system for Cramer Hall. Wrote specification and technical portions of RFP and served as technical lead for PSU’s selection of installation contractor.

**2000.** Solar Photovoltaic Consultant to City of Ashland, OR for procurement of 30 kW PV systems installed on three buildings. Wrote technical requirements for City's RFP and was primary technical evaluator of proposals received. Performed initial evaluation of as-installed performance requirements.

**2000.** Named Program Manager for PGE Solar for Schools Program. Involved writing RFP for PV system suppliers, evaluating proposals and selecting winning bidder, and coordinating/assisting system supplier and installation team on installation of

two 2-kW PV systems and monitoring package. Coordinate with School Teams for participation in the program.

**1997-1998.** PGE Project manager for installation of four AC (integrated inverter) module systems. Managed specification and design of 4 kW grid-tie system completed December, 1998. Involved selecting and managing contractors, understanding technical specifications of PV equipment options, coordinating delivery of equipment, securing appropriate permits, and working with building owners for smooth installation. Served as engineering consultant to private solar contractor on one 3-kW residential grid-tie PV system.

**1996.** Coordinated PGE “interconnection team” inspection and test of customer-owned grid-tie PV system.

**1992.** Purchased and installed 1.5 kW grid-tie photovoltaic system on residence. Performed all electrical and structural design and installation labor for mounting the system on a home. Coordinated all code and permit related activities, coordinated with PGE on net metering. Secured time-of-day rate to enhance PV economics. [Personal project]

#### ***Technical Articles Published***

“PGE Solar Demonstration Projects – Technical Results.” U.S. Department of Energy Technical Results Conference, Denver, 1977

“PGE’s WHIP Program.” National Conference of American Solar Energy Society, Philadelphia, 1981

“Boleyn Solar Home – 10 Years Later.” National Conference of American Solar Energy Society, Portland, 1987

“Testing the Copper Cricket Solar Water Heating by an Electric Utility.” Co-author. International Solar Energy Society World Congress, Denver, 1991

“Product Concept and Field Test of Green Marketing Programs.” With Rick Weijo. ACEEE Summer Study, 1996

“California Buydown Program Phase I Performance Monitoring Results: Implications for PV Systems Purchasers” Principal author & presenter, National Conference of American Solar Energy Society, 2001

“Measured Output for Nineteen Residential PV Systems: Updated Analysis of Actual System Performance and Net Metering Impacts” Co-author with Kurt Scheuermann, Pat Lilly, and Sanford Miller, National Conference of American Solar Energy Society, 2002

#### **Other Relevant Experience/Skills**

Working and conversational knowledge of Spanish language.

