

**ENERGY AND ENVIRONMENTAL ECONOMICS, INC.**  
*Managing Partner*

San Francisco, CA

Dr. Orans founded Energy and Environmental Economics (E3) in 1989. An economist and engineer, he has focused throughout his career on the challenges facing the electricity industry. He is a trusted advisor to a broad range of clients that have included government agencies, utilities, system operators, regulators, independent power producers, energy technology companies, public interest organizations, and investors. He has led E3 teams on numerous high-impact and high-profile projects that have required both rigorous technical analysis and the ability to effectively distill actionable insights to help E3's clients make informed decisions as they develop innovative projects, programs or policies.

Dr. Orans' pioneering work in utility planning has centered on the design and use of area and time-specific (ATS) marginal costs for both pricing and evaluation of grid infrastructure alternatives. This seminal work has led to detailed area costing applications in pricing, marketing and planning for many utilities throughout North America. He is an expert in designing wholesale transmission tariffs and has served as an expert witness in regulatory proceedings on retail rate design and wholesale transmission pricing, including that of Canada's three largest utilities -- BC Hydro, TransEnergie and Ontario Power Generation.

In a recent forward-looking study, Dr. Orans provided his expertise to California's energy and environmental regulators in evaluating the operational challenges, feasibility and cost consequences of a higher Renewables Portfolio Standard (RPS) in California by 2030<sup>1</sup>. This assessment included technical input from the California Independent System Operator (CAISO) as well as independent reviews from a distinguished four-member advisory panel. The study utilized E3's first-in-class Renewable Energy Flexibility (REFLEX) model. Additionally, in consultation with advisors to California's Governor and principals and staff from the energy agencies and the CAISO, E3 has developed a set of technology deployment scenarios that meet California's goal of reducing Greenhouse gas (GHG) emissions to 80% below 1990 levels by 2050<sup>2</sup>, using E3's California PATHWAYS model -- an infrastructure-based GHG and cost analysis tool that captures the interactions among the buildings, industry, transportation, and electricity sectors of the entire California economy, which becomes increasingly important in a low carbon future.

E3, in collaboration with Lawrence Berkeley National Laboratory (LBNL) and Pacific Northwest National Laboratory (PNNL) has also conducted research for a recently published report *Pathways to Deep Decarbonization in the United States*<sup>3</sup> for the Deep Decarbonization Pathways Project (DDPP) -- an initiative led by the Sustainable Development Solutions Network (SDSN) and the Institute for Sustainable Development and International Relations (IDDRI). The DDPP is a collaborative global initiative to explore

---

<sup>1</sup> <https://www.ethree.com/projects/modeling-californias-50-percent-renewables-portfolio-standard/>

<sup>2</sup> [https://ethree.com/public\\_projects/energy\\_principals\\_study.php](https://ethree.com/public_projects/energy_principals_study.php)

<sup>3</sup> [http://unsdsn.org/wp-content/uploads/2014/09/US\\_DDPP\\_Report\\_Final.pdf](http://unsdsn.org/wp-content/uploads/2014/09/US_DDPP_Report_Final.pdf)

how individual countries can reduce energy-related CO2 emissions through a transformation of energy systems, a transition referred to by the DDPP as “deep decarbonization.”

Dr. Orans is a respected thought leader who is often asked to share his expertise and vision for the energy industry. He regularly publishes in refereed journals and has taught a graduate course on electric utility planning at Stanford University. He received his Ph.D. in Civil Engineering from Stanford University and his B.A. in Economics from the University of California at Berkeley.

**DEPARTMENT OF ENERGY**  
**NATIONAL RENEWABLE ENERGY LABORATORY**  
**ELECTRIC POWER RESEARCH INSTITUTE**  
*Lead Consultant*

Washington, DC  
1992 – 1993

Dr. Orans developed new models to evaluate small-scale generation and DSM placed optimally in utility transmission and distribution systems.

**PACIFIC GAS & ELECTRIC COMPANY**  
*Research and Development Department*

San Francisco, CA  
1989 – 1991

Dr. Orans developed an economic evaluation method for distributed generation alternatives. The new approach shows that targeted, circuit-specific, localized generation packages or targeted DSM can in some cases be less costly than larger generation alternatives. He also developed the evaluation methodology that led to PG&E’s installation of a 500kW photovoltaic (PV) facility at their Kerman substation. This is the only PV plant ever designed to defer the need for distribution capacity.

**ELECTRIC POWER RESEARCH INSTITUTE**  
*Consultant*

Palo Alto, CA  
1988 – 1992

Dr. Orans developed the first formal economic model capable of integrating DSM into a transmission and distribution plan; the case study plan was used by PG&E for a \$16 million pilot project that was featured on national television.

**DEPARTMENT OF ENERGY**  
*Lead Consultant*

Washington, DC  
1989 – 1990

Dr. Orans was the lead consultant on a cooperative research and development project with the People's Republic of China. The final product was a book on lessons learned from electric utility costing and planning in the United States.

**PACIFIC GAS & ELECTRIC COMPANY**  
*Corporate Planning Department*

San Francisco, CA  
1989 – 1992

Dr. Orans was the lead consultant on a joint EPRI and PG&E research project to develop geographic differences in PG&E's cost-of-service for use in the evaluation of capital projects. Developed shared savings DSM incentive mechanisms for utilities in California.

## **PACIFIC GAS & ELECTRIC COMPANY**

*Rate Department Economist*

San Francisco, CA

1981 – 1985

As an economist at PG&E, Dr. Orans was responsible for the technical quality of testimony for all electric rate design filings. He was also responsible for research on customers' behavioral response to conservation and load management programs. The research led to the design and implementation of the first and largest residential time-of-use program in California and a variety of innovative pricing and DSM programs.

## Education

Stanford University

*Ph.D. in Civil Engineering*

Palo Alto, CA

Stanford University

*M.S. in Civil Engineering*

Palo Alto, CA

University of California

*B.A. in Economics*

Berkeley, CA

## Citizenship

United States

## Refereed Papers

1. Orans, R., Kahrl, F., and Aas, D., (2017) "Envisioning the Electric Utility in 2030: "Fat" or "Skinny"? *Public Utility Fortnightly*, (Forthcoming in first Quarter of 2017)
2. Li, M., R. Orans, J. Kahn-Lang and C.K. Woo (2014) "Are Residential Customers Price-responsive to an Inclining Block Rate? Evidence from British Columbia, Canada," *The Electricity Journal*, 27(1), 85-92.
3. Orans, R., A. Olson, J. Moore, J. Hargreaves, R. Jones, G. Kwok, F. Kahrl and C.K. Woo (2013) "Energy Imbalance Market Benefits in the West: A Case Study of PacifiCorp and CAISO," *The Electricity Journal*, 26(5), 26-36.
4. Woo, C.K., I. Horowitz, B. Horii, R. Orans, and J. Zarnikau (2012) "Blowing in the wind: Vanishing payoffs of a tolling agreement for natural-gas-fired generation of electricity in Texas," *The Energy Journal*, 33:1, 207-229.

5. Mahone, A., B. Haley, R. Orans, J. Williams (2011) "Electric Vehicles and Gas-Fired Power: A Strategic Approach to Mitigating Rate Increases and Greenhouse Price Risk," *Public Utilities Fortnightly* (Dec 2011) 42-50, available at: [http://www.fortnightly.com/exclusive.cfm?o\\_id=918](http://www.fortnightly.com/exclusive.cfm?o_id=918)
6. Alagappan, L., R. Orans, and C.K. Woo (2011) "What Drives Renewable Energy Development?" *Energy Policy*, 39: 5099-5104.
7. R. Orans, F. Pearl, A. Mahone (2010), "A Modest Proposal: After Cap and Trade", *Brookings Institute*
8. Orans, R., C.K. Woo, B. Horii, M. Chait and A. DeBenedictis (2010) "Electricity Pricing for Conservation and Load Shifting," *Electricity Journal*, 23:3, 7-14.
9. Olson A., R. Orans, D. Allen, J. Moore, and C.K. Woo (2009) "Renewable Portfolio Standards, Greenhouse Gas Reduction, and Long-line Transmission Investments in the WECC," *Electricity Journal*, 22:9, 38-46
10. Orans, R., M. King, C.K. Woo and W. Morrow (2009) "Inclining for the Climate: GHG Reduction via Residential Electricity Ratemaking," *Public Utilities Fortnightly*, 147:5, 40-45.
11. Woo, C.K., E. Kollman, R. Orans, S. Price and B. Horii (2008) "Now that California Has AMI, What Can the State Do with It?" *Energy Policy*, 36, 1366-74.
12. Orans, R., S. Price, J. Williams, C.K. Woo and J. Moore (2007) "A Northern California - British Columbia Partnership for Renewable Energy" *Energy Policy*, 35:8, 3979-3983.
13. Lusztig, C., P. Feldberg, R. Orans and A. Olson (2006) "A Survey of Transmission Tariffs in North America," *Energy-The International Journal*, 31, 1017-1039.
14. Woo, C.K., A. Olson and R. Orans (2004), "Benchmarking the Price Reasonableness of an Electricity Tolling Agreement," *Electricity Journal*, 17:5, 65-75.
15. Orans, R., Woo, C.K., Clayton, W. (2004)"Benchmarking the Price Reasonableness of a Long-Term Electricity Contract," *Energy Law Journal*, 25: 2, 357-383.
16. Orans, R., Olson, A., Opatrny, C., (2003) "Market Power Mitigation and Energy Limited Resources," *Electricity Journal*, 16:2, 20-31.
17. Woo, C.K., D. Lloyd-Zannetti, R. Orans, B. Horii and G. Heffner (1995) "Marginal Capacity Costs of Electricity Distribution and Demand for Distributed Generation," *The Energy Journal*, 16:2, 111-130.
18. Pupp, R., C.K.Woo, R. Orans, B. Horii, and G. Heffner (1995), "Load Research and Integrated Local T&D Planning," *Energy - The International Journal*, 20:2, 89-94.
19. Chow, R.F., Horii, B., Orans, R. et. al. (1995), *Local Integrated Resource Planning of a Large Load Supply System*, Canadian Electrical Association.

20. Feinstein, C., Orans, R. (1995) "The Distributed Utility Concept," *The Annual Energy Review*, 1988.
21. Woo, C.K., R. Orans, B. Horii and P. Chow (1995), "Pareto-Superior Time-of-Use Rate Options for Industrial Firms," *Economics Letters*, 49, 267-272.
22. Woo, C.K., B. Hobbs, Orans, R. Pupp and B. Horii (1994), "Emission Costs, Customer Bypass and Efficient Pricing of Electricity," *Energy Journal*, 15:3, 43-54.
23. Orans, R., C.K. Woo, R. Pupp and I. Horowitz (1994), "Demand Side Management and Electric Power Exchange," *Resource and Energy Economics*, 16, 243-254.
24. Woo, C.K., R. Orans, B. Horii, R. Pupp and G. Heffner (1994), "Area- and Time-Specific Marginal Capacity Costs of Electricity Distribution," *Energy - The International Journal*, 19:12, 1213-1218.
25. Orans, R., C.K. Woo and B. Horii (1994), "Targeting Demand Side Management for Electricity Transmission and Distribution Benefits," *Managerial and Decision Economics*, 15, 169-175.
26. Orans, R., C.K. Woo and R.L. Pupp (1994), "Demand Side Management and Electric Power Exchange," *Energy - The International Journal*, 19:1, 63-66.
27. Orans, R., Seeto, D., and Fairchild, W., (1985), "The Evolution of TOU Rates," Pergamon Press.

## Research Reports

1. R. Orans, Woo, C.K., Lakshmi Alagappan, M. Madrigal, *Creating Renewable Energy Ready Transmission Networks*, World Bank, September, 2010
2. CPUC Staff, Olson, A., Orans, R., *33% Renewables Portfolio Standard Implementation Analysis Preliminary Results*, California, June, 2009.
3. Orans, R., Olson, A., *Load-Resource Balance in the Western Interconnection: Towards 2020*, Western Electricity Industry Leaders Group, September, 2008.
4. Orans, R., Olson, A., *Integrated Resource Plan for Lower Valley Energy*, December, 2004.
5. Orans, R., Woo C.K., and Olsen, Arne, *Stepped Rates Report*, prepared for BC Hydro and filed with the BCUC, May, 2003.
6. Woo, C.K. and R. Orans (1996) *Transmission: Spot Price, Reliability Differentiation and Investment*, report submitted to Ontario Hydro.
7. Orans, R., Woo, C.K., and B. Horii (1995), *Impact of Market Structure and Pricing Options on Customers' Bills*, Report submitted to B.C. Hydro.
8. Horii, B., Orans, R., Woo, C.K., (1994) *Marginal Cost Disaggregation Study*, Report submitted to PSI Energy.

9. Woo, C.K., L. Woo and R. Orans (1995), *Rationing and Area-Specific Generation Costs*, Report submitted to Pacific Gas and Electric Company.
10. Orans, R., Woo, C.K., and C. Greenwell (1994), *Designing Profitable Rate Options Using Area- and Time-Specific Costs*, Report No. TR-104375, Electric Power Research Institute.
11. Singer, J., Orans, R., *Energy Efficiency Lending, A Business Opportunity for Fannie Mae*, Report submitted to Fannie Mae.
12. Orans, R., Feinstein, C. et. al., (1993), *Distributed Utility Valuation Study*, submitted to the Electric Power Research Institute, the National Renewable Energy Laboratory, and PG&E.
13. Orans, R., Pupp, R., (1993), *Menomonee Falls Case Study*, Submitted to Wisconsin Electric Power Corporation.
14. Orans, R. and C.K. Woo (1992), *Marginal Cost Disaggregation Study*, Report submitted to Wisconsin Electric Power Corporation.
15. Orans, R., C.K. Woo, J.N. Swisher, B. Wiersma and B. Horii (1992), *Targeting DSM for Transmission and Distribution Benefits: A Case Study of PG&E's Delta District*, Report No. TR-100487, Electric Power Research Institute.
16. Orans, R., Swisher, J., Duane, T., (1989), *Lessons Learned from U.S. Electric Utilities*, Prepared for the Department of Energy for the People's Republic of China.
17. Orans, R., *Area-Specific Marginal Costing for Electric Utilities: A Case Study of Transmission and Distribution Costs (1989) PhD Thesis*, Stanford University.
18. Orans, R., (1987) *The Risk of Sales Forecasts: Controllable through Indexation and Careful Disaggregation*, Submitted to Stanford University and Pacific Gas and Electric Company.
19. C.K. Woo, and R. Orans (1983), *Transferability of Other Utilities' Time of Use Experiments to PG&E's Service Schedule D-7*, Pacific Gas and Electric Company Reports filed with the California Public Utilities Commission.

## Conference Papers

1. Orans, R., "Getting to 2050, Pathways to Deep Reductions in GHG Emissions," CFA Society Presentation, October 25, 2011, San Francisco, CA.
2. Orans, R., "Renewable Resource Opportunities in the West," Law Seminars International, British Columbia, August 2010.
3. Orans, R., "California's 33% RPS Implementation Plan," Law Seminars International, San Francisco, September, 2009.

4. Orans, R., "Comparable Treatment of Resource Options," FERC Technical Conference, Phoenix, AZ., September, 2009.
5. Orans, R., "A GHG Compliant World in 2050," Law Seminars International, San Francisco, September, 2008.
6. Orans, R., "Gaps in State Energy Policy Coordination, A View from the Cheap Seats" Napa California, CFEE, September, 2007.
7. Orans, R. Evaluating Generating Resources based on an Equivalent Reliability Methodology, 2nd Annual Resource Planning Symposium, January, 2004, Vancouver, Canada.
8. Martin, J., Orans, R., Knapp, K., "DG Economics and Distribution Rate Design" (2000), Western Electric Power Institute, Distributed Generation and the Utility Distribution System Conference, March 22-23, Reno, NV.
9. Orans, R. (1997), "Getting the Transmission Prices Right," Facilitating Cross Border Trade, New Mexico.
10. Orans, R. (1997), "Deregulation on the Mainland, What is Happening and What is Not, PCEA Conference, Hawaii.
11. Swisher, J., Orans, R., (1995), "A New Utility DSM Strategy Using Intensive Campaigns Based on Area Specific Costs," ECEEE 1995 Summer Study.
12. Orans, R., Greenwell, C., (1995), "Designing Profitable Rate Options Using Area and Time-Specific Costs," Prepared for EPRI, Annual DSM Review, Dallas, Texas.
13. Orans, R, Integrated Local Area Planning, (1995), Prepared for NELPA and presented in Calgary.
14. Orans, R., Local Area Planning for Profit, "Annual Review of Distributed Resource Studies," Prepared for EPRI, Lake George, New York.
15. Orans, R., C.K. Woo, B. Horii and R. Pupp, (1994), "Estimation and Applications of Area- and Time-Specific Marginal Capacity Costs," Proceedings: 1994 Innovative Electricity Pricing, (February 9-11, Tampa, Florida) Electric Research Power Institute, Report TR-103629, 306-315.
16. Heffner, G., R. Orans, C.K. Woo, B. Horii and R. Pupp (1993) "Estimating Area Load and DSM Impact by Customer Class and End-Use," Western Load Research Association Conference, September 22-24, San Diego, California; and Electric Power Research Institute CEED Conference, October 27-29, St. Louis, Missouri.