Jimmy Nelson, Ph.D.

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ENERGY AND ENVIRONMENTAL ECONOMICS, INC. Carrboro, NC
Director

Dr. Nelson advises utilities, system operators, and state agencies on the operations, economics, and planning of decarbonizing electricity systems. His technical expertise in electricity planning and dispatch optimization models helps clients to understand the impacts of higher levels of variable renewable energy resources on their systems. Dr. Nelson's work frequently focuses on the role of reliability in the context of resource planning and operations. In the planning context, he has led the development of dynamic capacity accreditation for renewable and storage resources in capacity expansion models. He also frequently advises clients on the modeling of operational reserves in production cost models. He has a long history supporting California Public Utilities Commission's integrated resource planning process and was E3's technical manager for the development of the CPUC's 2019-20 Reference System Plan. His study Investigating the Economic Value of Flexible Solar Power Plant Operation received the Public Utility Fortnightly's Top Innovators Award in 2018.

Prior to joining E3 in 2016, Dr. Nelson was a Kendall Science Fellow at the Union of Concerned Scientists and earned a Ph.D. from the Energy and Resources Group at the University of California, Berkeley. Dr. Nelson began his career in energy working to make solar panels cheaper when cost was one of the main barriers to adoption. More than a decade later, he is helping clients understand how to manage and use frequent surpluses of renewably sourced electricity.

Select E3 projects include:

- **Battery Flexibility Value**, **Confidential Utilities (2024)**. Led production simulation analysis to quantify the value of battery flexibility that is not captured in resource planning models.
- **Wind Integration Operational and Economic Analysis, Alaska Railbelt Utilities (2023-4).** Managed and led technical analysis for the Railbelt Utilities to understand the operational challenges that the Railbelt system will face with integrating large quantities of wind energy. E3 employed two-stage production simulation to study unit commitment and dispatch in the context of higher wind capacity. The study demonstrated that integrating higher levels of wind on the Railbelt is feasible, but may require significant changes in operational practices relative to present day.
    - **Silicon Valley Power (SVP), Integrated Resource Plan (2023).** Advised capacity expansion modeling in PLEXOS. SVP's IRP addressed rapidly growing load, which is seeing significant increase in large data center loads and is unique in California in needing to meet those loads in the near-term with clean energy resources. E3 applied a "marginal reliability need" approach, using marginal ELCC accreditation for all resource types, a novel approach to the IRP process that provided a more accurate long-term forecast.
    - **Day Ahead Market Cost Benefit Study (2022-2023).** Used Western Electricity Coordinating Council (WECC)-wide multi-stage production cost modeling to support a broader E3 cost-benefit analysis of day-ahead markets within WECC. The study focused on comparing CAISO's EDAM and

SPP's Markets+ day-ahead energy markets for a group of utilities. E3 used the PLEXOS model to simulate day-ahead scheduling and subsequent real-time dispatch across the WECC. Dr. Nelson lead the implementation of fast start pricing and the development of demand data for the model.

- **El Paso Electric, New Mexico and Texas All Source RFP Bid Evaluation (2022).** Developed a PLEXOS capacity expansion model, translated bids into PLEXOS inputs, and validated model-selected bids for an E3 project that evaluated bids received by El Paso Electric through two all-source RFPs, one for New Mexico and one for Texas.
- **New Brunswick Power Decarbonization Strategy (2021 -2023).** Modeled operational reserves for wind, performed production cost modeling, and supported portfolio development via capacity expansion in support of the development of New Brunswick Power's decarbonization strategy. The study illustrated the key role that renewables, particularly wind, and clean energy imports will play in supporting Net Zero in New Brunswick.
- **Analytical Integrated Resource Plan Support – Zero Carbon Analysis, NV Energy, 2021.** Led capacity expansion modeling using PLEXOS software to quantify the value of diverse renewable resources in helping NV Energy meet the state of Nevada's goal of 100 percent zero-carbon energy by 2050. Implemented an interdependent solar and storage resource adequacy contribution in expansion modeling.
- **Machine Learning Ramping Requirements, Advanced Research Projects Agency-Energy (ARPA-E), 2020-2021.** Co-managed a team that used machine learning to determine ramping requirements for the California Independent System Operator (CAISO) system. Led production simulation that quantified savings of new ramping requirements.
- **RESOLVE model product manager and developer, 2016-2021.** Contributed to the development and use of E3's RESOLVE model, an in-house capacity expansion model that adds capacity expansion logic to a simplified production simulation model to produce an optimal investment plan.
- **Integrated Resource Planning Implementation Support, California Public Utilities Commission, 2016-Present.** Contributes to E3's CPUC IRP support work, conducts specialized analysis and engages with CPUC staff and a broad range of stakeholders on the implementation of California's system-wide electricity plan. Using the RESOLVE model, E3 staff model least-cost resource portfolios for the electricity system consistent with the state of California's long-term greenhouse gas reduction goals.
- **Extended Day Ahead Market (EDAM) support, California Independent System Operator and EIM Entities, 2019.** Helped E3 staff calculate and validate reserve and balancing needs for 14 Western Interconnection balancing areas using E3's RESERVE model.
- **Investigating the Economic Value of Flexible Solar Power Plant Operation, First Solar, 2018.** Led a study finding that increasing the operational flexibility of solar plants could decrease dispatch costs, reduce solar curtailment, and reduce greenhouse gas emissions. The study explored four modes of solar plant operation on Tampa Electric Company's system and received the Public Utility Fortnightly Top Innovators Award.
- **Balancing Area of Northern California (BANC) Energy Imbalance Market (EIM) Benefits Analysis, BANC, 2016.** Technical lead on E3's study of the benefits to BANC members of participating in the Western EIM. The E3 team worked closely BANC members to model the operations of their respective electric systems using PLEXOS production simulation software, providing a clear illustration of the EIM value proposition for each BANC member.

UNION OF CONCERNED SCIENTISTS Oakland, CA
Energy Modeling with Senior Energy Analyst Laura Wisland 2013 – 2015

Project: Operational flexibility at high fractions of variable renewable energy in California

- Production cost modeling using the PLEXOS model
- Expert testimony and public comments on energy policy and planning
  - California Public Utilities Commission: Long Term Procurement Plan
  - California Independent System Operator: Frequency Response Stakeholder Process
- Kendall Postdoctoral Fellowship (2013 – 2014)

UNIVERSITY OF CALIFORNIA, BERKELEY, Energy Resources Group Berkeley, CA
Doctoral Research with Professor Daniel Kammen 2009 – 2013

Dissertation Title: "Scenarios for Deep Carbon Emission Reductions from Electricity by 2050 in Western North America Using the SWITCH Electric Power Sector Planning Model"

UNIVERSITY OF CALIFORNIA, BERKELEY, Department of Chemistry Berkeley, CA
Master's Research with Professor A. Paul Alivisatos 2006 – 2008

Project: Nanoparticle synthesis, characterization, and computer modeling for solar energy conversion

Education

University of California, Berkeley Berkeley, CA
Ph.D., Energy and Resources 2013
Link Foundation Energy Fellowship 2011 – 2013

University of California, Berkeley Berkeley, CA
M.S., Chemistry 2008

Haverford College Haverford, PA
B.S. with High Honors, Chemistry 2006

Peer-Reviewed Publications in Energy Analysis

1. *Sun, Y., Nelson, J. H., Stevens, J. C., Au, A. H., Venugopal, V., Gulian, C., Kasina, S., O'Neill, P., Yuan, M., & Olson, A. (2022). Machine learning derived dynamic operating reserve requirements in high-renewable power systems. Journal of Renewable and Sustainable Energy, 14(3), 036303.*

2. *He, G.; Avrin, A. P.; Nelson, J. H.; Johnston, J.; Mileva, A.; Tian, J.; Kammen, D. M. "SWITCH-China: a systems approach to decarbonizing China's power system." Environmental Science & Technology, 50 (11), pp. 5467-5473 (2016).*

3. *Mileva, A.; Johnston, J.; Nelson, J. H.; Kammen, D. M. "Power system balancing for deep decarbonization of the electricity sector." Applied Energy, 162, pp. 1001-1009 (2016).*

4. *Morrison, G. M.; Yeh, S.; Eggert, A. R.; Yang, C.; Nelson, J. H.; Greenblatt, J. B.; Isaac, R.; Jacobson, M. Z.; Johnston, J.; Kammen, D. M.; Mileva, A.; Moore, J.; Roland-Host, D. Wei, M.; Weyant, J. P.; Williams, J. H.; Williams, R.; Zapata, C. B. "Comparison of low-carbon pathways for California." Climatic Change, 131, pp. 545-557 (2015).*

5. *Sanchez, D.; Nelson, J. H.; Mileva, A.; Johnston, J.; Kammen, D. M. "Biomass Enables the Transition to a Carbon-negative Power System Across Western North America." Nature Climate Change, 5, pp. 230-234 (2015).*

6. *Mileva, A.; Nelson, J. H.; Johnston, J.; Kammen, D. M. "SunShot Solar Power Reduces Costs and Uncertainty in Future Low-Carbon Electricity Systems." Environmental Science & Technology, 47 (16), pp. 9053-9060 (2013).*

7. *Wei, M.; Nelson, J. H.; Greenblatt, J. B.; Mileva, A.; Johnston, J.; Ting, M.; Yang, C.; Jones, C.; McMahon, J. E.; Kammen, D. M. "Deep Carbon Reductions in California Require Electrification and Integration Across Economic Sectors." Environmental Research Letters, 8, 014038, (2013).*

8. *Nelson, J.; Johnston, J.; Mileva, A.; Fripp, M.; Hoffman, I.; Petros-Good, A.; Blanco, C.; Kammen, D. M. "High-Resolution Modeling of the Western North American Power System Demonstrates Low-Cost and Low-Carbon Futures." Energy Policy, 43, pp. 436-447 (2012).*

Reports

1. *Nelson, J. H.; Kasina, S.; Stevens, J.; Moore, J.; Olson, A.; Morjaria, M.; Smolenski, J.; Aponte, J. "Investigating the Economic Value of Flexible Solar Power Plant Operation." Energy and Environmental Economics, Inc. (2018).*

2. *Nelson, J. H.; Wisland, L. M. "Achieving 50 Percent Renewable Electricity in California." Union of Concerned Scientists (2015).*

3. *Nelson, J. H.; Mileva, A.; Johnston, J.; Kammen, D. M.; Wei, M.; Greenblatt, J. B. "Scenarios for Deep Carbon Emission Reductions by 2050 in Western North America using the SWITCH Electric Power Sector Planning Model." CEC-500-2014-109, California Energy Commission (2014).*

4. *Wei, M.; Nelson, J. H.; Ting, M.; Yang, C., Kammen, D. M.; Jones, C.; Mileva, A.; Johnston, J.; Bharvirkar, R.; Greenblatt, J. B.; McMahon, J. E. "California's Carbon Challenge: Scenarios for Achieving 80% Emissions Reduction in 2050." Tech. Rep. LBNL-5448E, Lawrence Berkeley National Laboratory (2012).*