

# Jimmy Nelson, Ph.D.

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## **ENERGY AND ENVIRONMENTAL ECONOMICS, INC.**

San Francisco, CA

*Associate Director*

Dr. Nelson joined E3 in 2016. He advises utilities, system operators, and state agencies on the operations, economics, and planning of electricity systems with large amounts of variable renewable energy resources. He currently leads E3's work supporting the California Public Utility Commission's integrated resource planning process and contributes extensively as a technical advisor to the CPUC's Modeling Advisory Group. He is also a project manager for E3's US government funded project (ARPA-E) that uses machine learning to determine operational flexibility needs. His study *Investigating the Economic Value of Flexible Solar Power Plant Operation* received Public Utility Fortnightly's Top Innovators Award in 2018. Prior to joining E3, Dr. Nelson received a Kendall Science Fellowship to work with the Union of Concerned Scientists. He earned his Ph.D. from the Energy and Resources Group at the University of California, Berkeley. Select E3 projects include:

- **Operational benefits of machine learning operational reserves, ARPA-E, 2020-2021.** Dr. Nelson leads efforts to qualify the operational cost savings and greenhouse gas reduction benefits of new methods to calculating system flexibility needs at high renewable penetrations. To simulate the benefits of near-real time reserve requirements derived from machine learning methods, he manages a team that runs a multi-stage production cost model of the California electricity system.
- **Investigating the Economic Value of Flexible Solar Power Plant Operation, First Solar, 2018.** Modeling four modes of solar plant operation on Tampa Electric Company's system, Dr. Nelson led a study demonstrating how system operators can maximize the value of solar plants as solar penetration increases. The study demonstrates that controlling the output of solar plants is essential at higher solar penetration levels, and that providing essential grid services can increase the economic value of solar plants.
- **Integrated Resource Planning (IRP) Implementation Support, California Public Utilities Commission, 2016 – Ongoing.** Dr. Nelson leads E3's CPUC IRP support work, conducting specialized analysis and engaging with CPUC staff and a broad range of stakeholders on the implementation of California's system-wide electricity plan. Using RESOLVE, E3's in-house capacity expansion model designed for use on high-penetration renewable systems, Dr. Nelson models least-cost resource portfolios for the electricity system consistent with California's long-term greenhouse gas reduction goals.
- **RESOLVE Model Development, 2016 – Ongoing.** Dr. Nelson leads the implementation of new RESOLVE model capabilities, including an effective load carrying capability surface for renewable generators, improved generator operational constraints, a greenhouse gas emissions limit, and energy sufficiency constraints.
- **BANC EIM Benefits Analysis, Balancing Area of Northern California, 2016.** Dr. Nelson was the technical lead on E3's study of the benefits to BANC members of participating in the Western Energy Imbalance Market. The E3 team worked closely with representatives from all BANC members to model the operations of their respective electric systems accurately using PLEXOS

production simulation software, providing a clear illustration of the EIM value proposition for each BANC member.

- **Energy Storage Benefits Analysis, Storage Developer, 2016.** Using the REFLEX production simulation model, Dr. Nelson quantified the production cost and renewable curtailment savings associated with developing a storage project in California.

### **UNION OF CONCERNED SCIENTISTS**

*Energy Modeling with Senior Energy Analyst Laura Wisland*

Oakland, CA  
2013 – 2015

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

- Production cost modeling using PLEXOS, REFLEX, and Excel VBA
- 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**

*Doctoral Research with Professor Daniel Kammen*

Berkeley, CA  
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”

- Electric power system planning using high spatial and temporal resolution computer modeling
- Renewable energy deployment, integration, economics, and public policy
- Linear programming, database management, and geospatial information systems

### **UNIVERSITY OF CALIFORNIA, BERKELEY, Department of Chemistry**

*Master’s Research with Professor A. Paul Alivisatos*

Berkeley, CA  
2006 – 2008

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

## Education

University of California, Berkeley

*Ph.D., Energy and Resources*

*Link Foundation Energy Fellowship*

Berkeley, CA  
2013  
2011 – 2013

University of California, Berkeley

*M.S., Chemistry*

Berkeley, CA  
2008

Haverford College

*B.S. with High Honors, Chemistry*

*American Chemical Society Philadelphia Chapter Undergraduate Award*

*American Chemical Society Division of Analytical Chemistry Undergraduate Award*

Haverford, PA  
2006  
2006  
2005

## Citizenship

United States

## Peer-Reviewed Publications

### Energy Analysis:

1. 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).
2. 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).
3. 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).
4. 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).
5. 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).
6. 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).
7. **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).

### Chemistry:

1. Thorkelsson, K.; **Nelson, J. H.**; Alivisatos, A. P.; Xu, T. "End-to-End Alignment of Nanorods in Thin Films." *Nano Letters*, 13 (10), pp. 4908-4913 (2013).
2. Bomm, J.; Büchtemann, A.; Fiore, A.; Manna, L.; **Nelson, J. H.**; Hill, D.; van Sark, W. G. J. H. M. "Fabrication and Spectroscopic Studies on Highly Luminescent CdSe/CdS Nanorod Polymer Composites." *Beilstein Journal of Nanotechnology*, 1, pp. 94-100 (2010).
3. Dukovic, G.; Merkle, M. G.; **Nelson, J. H.**; Hughes, S. M.; Alivisatos, A. P. "Photodeposition of Pt on Colloidal CdS and CdSe@CdS Semiconductor Nanostructures." *Advanced Materials*, 20, pp. 4306-4311 (2008).

4. Talapin, D. V.; **Nelson, J. H.**; Shevchenko, E. V.; Aloni, S.; Sadtler, B.; Alivisatos, A. P. "Seeded Growth of Highly Luminescent CdSe/CdS Nanoheterostructures with Rod and Tetrapod Morphologies." *Nano Letters*, 7 (10), pp. 2951-2959 (2007).
5. **Nelson, J. H.**; Johnston, A. R.; Narducci Sarjeant, A.; Norquist, A. "Composition Space Analysis of Templated Molybdates." *Solid State Sciences*, 9, pp. 472-484 (2007).
6. Lu, Y.; Choi, D.; **Nelson, J.**; Yang, O.; Parkinson, B. A. "Adsorption, Desorption and Sensitization of Low Index Anatase and Rutile Surfaces by the Ruthenium Complex Dye N3." *Journal of The Electrochemical Society*, 153 (8) pp. E131-E137 (2005).

## Reports and Book Chapters

1. Nelson, J. H.; Wisland, L. M. "Achieving 50 Percent Renewable Electricity in California." *Union of Concerned Scientists* (2015).
2. 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).
3. 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).
4. Tidwell, V.; Dale, L.; Franco, G.; Averyt, K.; Wei, M.; Kammen, D.; Nelson, J. H. "Energy Impacts." Chapter 12 in: *Assessment of Climate Change in the Southwest United States. Technical Report, U.S. National Climate Assessment*, [Garfin, G., Jardine, A., Merideth, R., Black M., Overpeck, J. (eds.)]. Tucson, AZ: Southwest Climate Alliance (2012).

## Selected Presentations

1. *Integrated Energy Policy Workshop, California Energy Commission, "Achieving 50 Percent Renewable Electricity in California," Sacramento, CA (07/24/2015).*
2. *Renewable Energy Markets Conference, "Renewable Ancillary Service Markets for California's Duck Curve," Sacramento, CA (12/03/2014).*
3. *Briefing to California Legislative Members and Staff on Renewable Energy, Hosted by the Union of Concerned Scientists, "Renewables and Aquatic Animals," Sacramento, CA (03/04/2014).*
4. *California Climate Policy Modeling Dialogue and Workshop, "Planning Power Systems with Deep Emission Reductions by 2050 Using the SWITCH Model," Davis, CA (12/16/2013).*
5. *Lead Commissioner Workshop on Evaluating Electricity Sector Needs in 2030, California Energy Commission, "Simultaneous Planning of Generation, Transmission, and Storage Capacity for 2030 and Beyond Using the SWITCH Model," Sacramento, CA (08/19/2013).*