

ENERGY AND ENVIRONMENTAL ECONOMICS, INC.

San Francisco, CA

Director

Mr. Schlag leads E3's Resource Planning practice area. His principal area of expertise is electric integrated resource planning, with an emphasis on renewable integration, system flexibility needs, and resource adequacy. Mr. Schlag has led a number of E3's recent engagements to support utilities in their IRP analyses, including (1) Arizona Public Service, where E3 facilitated stakeholder workshops and provided independent modeling to provide stakeholders access to technical resources; (2) NV Energy, where E3 conducted a study of the effective load carrying capability (ELCC) of renewables and storage, supported by Mr. Schlag's expert testimony; and (3) Xcel Energy, where E3 was asked to provide an independent third-party study of Xcel's long-term plan to decarbonize its electricity supply, an analysis that supported Xcel's recent decisions to commit to early coal plant retirement and nuclear relicensing. Mr. Schlag holds a Master of Science in Civil and Environmental Engineering (Atmosphere and Energy) and a Bachelor of Science in Earth Systems, both from Stanford University.

Mr. Schlag's prior clients include the Balancing Authority of Northern California, Bonneville Power Administration, the California Public Utilities Commission, the California Independent System Operator, Los Angeles Department of Water and Power, Portland General Electric, Public Generating Pool, Seattle City Light, the Western Electricity Coordinating Council, and the Western Interstate Energy Board. Select E3 projects include:

- **Integrated Resource Planning Support, Arizona Public Service, 2019-2020.** Mr. Schlag led an engagement to provide strategic and technical support to APS culminating in the development of its 2020 Integrated Resource Plan. Mr. Schlag oversaw an effort to develop a simplified IRP portfolio model used to facilitate dialog with stakeholders through a series of workshops exploring the impacts of different potential future portfolios and ultimately presented key findings from the effort to the Arizona Corporation Commission.
- **SB100 Implementation Study, California Energy Commission, 2020.** Mr. Schlag contributed in an advisory capacity to the development of a study examining the investments needed to achieve a California's 100% goal for carbon-free power in 2050. The analysis builds off Mr. Schlag's prior experience working with California state agencies to develop an optimization-based approach to resource planning in the state using E3's RESOLVE model.
- **Upper Midwest Integrated Resource Plan Technical Support, Xcel Energy, 2018-2019.** Mr. Schlag led analysis of the impact of deep decarbonization scenarios on Xcel Energy's Upper Midwest System over the 2020-2034 planning period to support Xcel's IRP filing before the Minnesota Public Utilities Commission. Using E3's RESOLVE and RECAP models, Mr. Schlag identified optimal resource investment portfolios that met resource adequacy needs in the context of state and corporate long-term greenhouse gas reduction targets.
- **Integrated Resource Planning Support, Sacramento Municipal Utilities District, 2018.** In a project evaluating long-term clean energy and greenhouse gas reduction goals in the context of vehicle

and building electrification, Mr. Schlag customized E3's RESOLVE model to SMUD's system to develop optimal portfolios of renewable, conventional, and energy storage resources to meet SMUD's electric energy and reliability needs while achieving 90-100% carbon emissions reductions by 2040.

- **Integrated Resource Planning Implementation Support, California Public Utilities Commission, 2016-present.** Mr. Schlag worked closely with the CPUC in its rollout of a framework and process for integrated resource planning. Mr. Schlag helped design the analytical framework currently in use in the 2017 IRP and managed an E3 team working to develop a "Preferred System Plan"—an optimal resource portfolio consistent with the state of California's long-term greenhouse gas reduction goals—using RESOLVE, E3's in-house capacity expansion model designed for use on high-penetration renewable systems. Mr. Schlag continues to advise E3's team in an ongoing engagement to provide technical support to the IRP process.
- **Pacific Northwest Low Carbon Scenario Analysis, Public Generating Pool, 2017.** Mr. Schlag led a study examining the most effective policy mechanisms to facilitate greenhouse gas reductions in the electric sector in the Pacific Northwest. The study relied on E3's RESOLVE model to compare the relative impacts of expanded RPS goals, carbon caps, carbon taxes, and a prohibition on new gas generation, highlighting the different cost and emissions impacts of each on ratepayers in the Northwest.
- **100% Clean Energy Study, Los Angeles Department of Water and Power, 2017.** Working directly with LADWP staff, Mr. Schlag designed a work plan for LADWP's 100% Clean Energy Study to be executed over the next two to three years. This effort included scoping of a public outreach program, development of potential research partnerships, and preliminary data gathering and validation.
- **RPS Program Evaluation Support, CPUC, 2012-2017.** Mr. Schlag managed an E3 team including four subcontractors to provide multiple services to the CPUC over a five-year period. Foremost among these was the redesign, development, and maintenance of an updated RPS Calculator—tailored specifically to highlight renewable integration challenges at high penetrations—which was used as a key source of inputs in both the CAISO's Transmission Planning Process (TPP) and the CPUC's Long-Term Procurement Proceeding (LTPP). Additional support tasks included development and maintenance of a database of the renewable contracts of the three investor-owned utilities and an assessment of renewable cost, potential, and performance in California and throughout the Western U.S.
- **EIM Benefits Analysis, Northwestern Energy, 2016-2017.** Mr. Schlag led E3's study of the benefits to NWE of participating in the Western EIM. The E3 team worked closely NWE staff to model the effect of NWE's EIM participation on system operations using PLEXOS production simulation software, providing a clear illustration of the EIM value proposition.
- **EIM Benefits Analysis, Balancing Authority of Northern California, 2016.** Mr. Schlag led E3's study of the benefits to BANC members of participating in the Western EIM. 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.
- **EIM Benefits Analysis, Seattle City Light, 2016.** Mr. Schlag led the assessment of Seattle City Light's prospective benefits of participation in the Western EIM. E3's analysis for SCL was designed specifically to highlight the value of Seattle's flexible hydroelectric generation fleet in the EIM's 15- and 5-minute markets, using dispatch optimization software and historical market prices to quantify the value of arbitrage opportunities.
- **SB350 Regionalization Study, California Independent System Operator, 2015-2016.** Mr. Schlag contributed to E3's work as part of a consulting team studying the benefits of expanding the CAISO

to a broader regional entity in accordance with California's Senate Bill 350. Using RESOLVE, Nick helped to design the alternative portfolios used as the basis for identifying the potential infrastructure impacts (and associated fixed cost savings) of ISO expansion.

- **Western Interconnection Flexibility Assessment, WECC & WIEB, 2014-2016.** Working in partnership with the National Renewable Energy Laboratory, an E3 team managed by Mr. Schlag completed a thorough examination of the flexibility of the generation fleet of the Western Interconnection and its ability to integrate high penetrations of renewable generation. The study identified both operational challenges as well as institutional and physical solutions to facilitate renewable integration across the region.
- **Western Gas-Electric Study, WIEB, 2013-2014.** Mr. Schlag managed a two-phase study of gas-electric coordination in the Western Interconnection to investigate whether the natural gas infrastructure in the West would be sufficient to meet future needs of the electric sector, considering both the anticipated retirements of a sizeable portion of the Western coal fleet as well as the increasing penetrations of intermittent renewable resources.
- **Investigating a Higher Renewables Portfolio Standard for California, PG&E, SCE, SDG&E, LADWP & SMUD, 2013.** As part of the E3 team, Mr. Schlag helped to design and analyze a range of renewable portfolios to meet a 50% Renewables Portfolio Standard, using production simulation to evaluate integration challenges and calculating the corresponding rate impacts for California ratepayers.
- **PGE Low Carbon Portfolio Development, Portland General Electric, 2012.** Mr. Schlag worked with PGE staff and a group of environmental stakeholders to create a low carbon portfolio for analysis in PGE's 2012 Integrated Resource Plan. The portfolio was designed to include higher penetrations of renewable generation and accelerated achievement of efficiency goals.
- **Cost and Performance Review of Generation Technologies, WECC, 2012.** Mr. Schlag led E3's literature review of the cost and performance of new electric generation technologies, which culminated in a report to WECC staff with recommended assumptions for use in its 10- and 20-year study processes.

STANFORD UNIVERSITY

Teaching Assistant

Palo Alto, CA

2008-2009

- Assisted students with coursework in engineering classes related to energy efficiency, electric power, and meteorology; facilitated students' experiments in the Renewable Energy Laboratory

ROCKY MOUNTAIN INSTITUTE

MAP Sustainable Energy Fellow

Boulder, CO

Summer 2008

- Awarded three-month MAP Sustainable Energy Fellowship sponsored by MAP Royalty, Inc. to conduct research on the energy efficiency potential in residential, commercial, and industrial sectors of the United States as part of RMI's Next Generation Utilities project

STOCKHOLM ENVIRONMENT INSTITUTE

Donald Kennedy Environmental Fellow

Stockholm, Sweden

Summer 2007

- Awarded Donald Kennedy Environmental Fellowship through Stanford in Government to study benefits of clean cooking fuels in Sub-Saharan Africa, research that culminated with a working paper on the market barriers to clean cooking fuel adoption

Education

Stanford University
M.S., Atmosphere and Energy (Civil & Environmental Engineering) Palo Alto, CA
2009

Stanford University
B.A., Earth Systems (Energy Science and Technology) Palo Alto, CA
2008

Citizenship

United States

Expert Witness Testimony

1. *Public Utilities Commission of Nevada, 2020, testified on behalf of NV Energy in its Fourth Amendment to 2018 Joint Triennial Integrated Resource Plan proceeding regarding the effective load carrying capability (ELCC) of renewable and energy storage resources and the value of diverse renewable resources in helping NV Energy meet Nevada's goal of 100 percent zero-carbon energy by 2050*

Refereed Publications

1. Olson, A., C.K. Woo, N. Schlag and A. Ong (2016) "What Happens in California Does Not Always Stay in California: The Effect of California's Cap-and-Trade Program on Wholesale Electricity Prices in the Western Interconnection," *The Electricity Journal*, 29(7), 18-22.
2. A. Olson, E. Hart, J. Hargreaves, R. Jones, N. Schlag, G. Kwok, N. Ryan, R. Orans, R. Frowd, "Halfway There: Can California Achieve a 50% Renewable Grid?", *IEEE Power and Energy Magazine*, 13(4), 41-52.
3. Woo, C.K., H. Liu, F. Kahrl, N. Schlag, J. Moore, and A. Olson (2012) "Assessing the economic value of transmission in Alberta's restructured electricity market," *Electricity Journal*, 25(3): 68-80.