Dr. Kai Van Horn

SENIOR CONSULTANT

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Dr. Kai Van Horn is a Senior Consultant at The Brattle Group with expertise leveraging electricity system modeling, analysis, and visualization to illuminate and navigate the opportunities and challenges presented by the energy transition.

He has worked with market participants, market operators, utilities, and an array of other stakeholders on a diverse range of consulting engagements focused on topics ranging from energy and capacity market design, transmission and generation planning, and the modeling and analysis of financial transmission rights, to carbon pricing issues, on and offshore renewables integration, and transmission benefits analysis.

Dr. Van Horn has nearly a decade of experience analyzing wholesale market designs, planning, and operations via the development of large-scale power system models in commercially available software packages, as well as custom-built simulation and analysis platforms. In that time, he as led numerous teams in the deployment of such models, and worked with clients to develop new modeling approaches that meet the evolving needs of the energy transition.

AREAS OF EXPERTISE

- Electricity Market Modeling
- Electric Transmission
- Renewable & Alternative Energy
- Resource Planning
- Market Design

EDUCATION

- **University of Illinois at Urbana-Champaign**
  PhD and MS in Electrical Engineering, Power Systems focus
- **Purdue University**
  BS in Multidisciplinary Engineering

PROFESSIONAL EXPERIENCE

- **The Brattle Group (2023–Present)**
  Senior Consultant (2023–Present)
- **National Grid (2019–2023)**
  Manager (2021–2023)
  Principal Analyst (2020–2021)
  Lead Analyst (2019–2020)
- **The Brattle Group (2013–2019)**
  Associate (2015–2019)
  Summer Associate (2013–2015)

SELECTED CONSULTING EXPERIENCE

WHOLESALE POWER MARKET DESIGN AND ANALYSIS

- Ontario Capacity Market Design. For the Independent Electricity System Operator of Ontario (IESO), advised and closely worked with IESO staff on the design of a proposed forward capacity market for Ontario. Specifically, worked with IESO staff to develop an understanding of locational issues in capacity market design, how such issues are addressed in other jurisdictions, and to effectively translate those experiences into the Ontario context.
- Facilitate Market Participation Workshop: For the Independent Electricity System Operator of Ontario (IESO), worked with IESO staff to develop workshop materials for their Non-Emitting Resources Subcommittee workshop on barriers to participation in the wholesale markets. Facilitated workshop consisting of guided small and large group discussion and summarized key outcomes and takeaways for IESO.
- CAISO EIM GHG Import Accounting Analysis. For the California Independent System Operator (CAISO), worked with ISO staff to assess the impacts of proposed market design

changes to the treatment of carbon charges on imports in the Energy Imbalance Market (EIM). Built a detailed model of the EIM market and studied the impacts on California and WECC-wide emissions of the proposed import emissions pricing options. Developed a concise presentation of results and delivered it to CAISO stakeholders.

- Strategic Market Planning. For a U.S. RTO, collaborated with strategic planning staff to create executive-level presentation materials that explore potential electricity sector futures and the ramifications for the RTO's markets and future market design/products. With presentation materials, facilitated workshops with senior executives and board members to provoke discussion on the trajectory of the electricity sector and how the RTO and RTO markets can continue to create value for stakeholders and society under a variety of future scenarios.
- Day-ahead market design and market power mitigation. For the Public Utilities Office of Western Australia, analyzed the existing design of their day-ahead market with regard to its effectiveness in providing liquid, competitive hedging opportunities to market participants, and facilitating market power mitigation.

WHOLESALE ELECTRICITY MARKET ANALYSIS AND MODELING

- Congestion Revenue Rights (CRR) Portfolio Analysis. For a California utility, developed nodal model of the WECC to forecast congestion patterns and three-part locational marginal prices in CAISO for the following year for a number of scenarios and market conditions, e.g., low/high hydro, low/high load. Additionally, developed tool to replicate CAISO's CRR Simultaneous Feasibility Test to assess scarcity of individual CRRs in the annual allocation process, and develop portfolio recommendations.
- California SB350 Regional ISO Study. For the CAISO, developed nodal model of the WECC to study the impacts of expanding the footprint of the ISO to include additional balancing authorities in the WECC. Studied 2020 and 2030 timeframes taking into account renewable and GHG policy changes, e.g. RPS, AB32, for a number of renewable capacity build-out scenarios to assess economic and environmental benefits of regionalization.
- Analyzing the Value of Flexible Generation. For a municipal utility, evaluated the potential ERCOT day-ahead and real-time market energy and ancillary service revenue streams for an investment in natural gas-fired reciprocating engines. Constructed a price-taker model of the ERCOT markets (using PSO) to simulate hypothetical historical revenues and costs, as well as forecast future revenues and costs, under a variety of, natural gas, energy, and AS price assumptions.

- Transmission Benefit-Cost Analysis. For a transmission developer in the west, developed benefits-cost case for transmission project to support filings before public commissions. To do so, developed nodal model of the WECC and studied benefits of the proposed project under various future scenarios using in-house enhanced modeling techniques to capture bilateral scheduling friction. Deployed commission-approved methodologies to calculate ratepayer benefits and project costs. Supported writing of technical reports and testimony.
- Enhanced Transmission Planning Modeling Demonstration. For LS Power, supported client in providing comments to the CAISO on deficiencies in the modeling that supports the CAISO's transmission planning. To do so, developed model that demonstrated the deficiencies, and illustrated an approach to correcting them. Created presentation summarizing results, which was submitted to CAISO with written comments.

RENEWABLE RESOURCE INTEGRATION

- Renewable Integration Study. For a Midwestern utility in MISO, studied the resource adequacy and operational impacts on the utility of increasing renewables shares in the local zone and MISO-wide. Build a zonal model of MISO capturing both day-ahead and real-time markets (using PSO) to simulate the impacts of forecast uncertainty on markets and operational needs. Also developed chronological resource adequacy model to estimate the loss-of-load expectation associated with the future resource portfolios considering different levels of reliance on zonal imports for capacity. Worked with the utility IRP team to leverage study findings in the IRP process. Presented study findings to senior executives.
- Renewable Integration in Aruba. For Aruba Utilities, studied the utility's additional real-time operational needs, including operating reserves, when integrating wind and solar generation constituting nearly 50% penetration. Additionally, built a detailed model of the Aruba system to analyze the benefits of various investments, such as flywheel energy storage and compressed-air energy storage, for integrating proposed wind and solar while maintaining existing levels of reliability.
- Renewable Integration on an Island. For an island utility, provided technical and economic analysis of tradeoffs between installing reciprocating engines and battery/solar installations in an island power system with high renewable penetration. Built production cost models to analyze operational impacts and costs of various resource configurations and future renewable resource development scenarios. Provided concise presentations summarizing key study outcomes.

OTHER ENGAGEMENTS

- Reactive Revenue Requirement Filing Support. For a generation owner operating in PJM, constructed a model to calculate cost-based revenue requirement associated with the provision of reactive power. Additionally, prepared testimony to support the client's FERC filing for reactive compensation and provided technical support during settlement hearings at the FERC.
- Reactive Revenue Requirement Settlement Support. For a generation owner operating in PJM, provided technical and regulatory expertise to client in settlement proceedings at FERC. Supported client by reviewing data request responses, building revenue requirement models and analyzes probable settlement outcomes, presenting supporting technical analyses to FERC Staff, and providing technical support in settlement conferences.

ARTICLES & PUBLICATIONS

- "The Value of Transmission for Diversifying Uncertain Renewable Generation through the Transmission System" with Johannes Pfeifenberger and Pablo Ruiz (September 2020)
- "Market Power Mitigation Mechanisms for the Wholesale Electricity Market in Western Australia" with Sam Newell, Toby Brown, and others, (November 2016)
- "Senate Bill 350 Study: The Impacts of a Regional ISO-Operated Power Market on California" with Johannes Pfeifenberger, Judy Chang, and others (July 2016)
- "Measurement-Based Security-Constrained Real-Time Economic Dispatch" with Alejandro Dominguez-Garcia and Peter Sauer, *IEEE Transactions on Power Systems* (September 2016)
- "The Repurposed Distribution Utility: Roadmaps to Getting There" with Phil Hanser, *Future of Utilities—Utilities of the Future* (March 2016)
- "Sensitivity-Based Line Outage Angle Factors" with Alejandro Dominguez-Garcia and Peter Sauer, *Proceedings of the 47th North American Power Symposium* (September 2015)
- "Measurement-Based Real-Time Economic Dispatch" with Alejandro Dominguez-Garcia and Peter Sauer, *Proceedings of the IEEE PES General Meeting* (July 2015)
- "A Network-Inclusive, Optimization-Based Approach to Power System Flexibility Evaluation" *Proceedings of the 46th North American Power Symposium* (September 2014)
- "The Evolution of the Electric Distribution Utility" with Phil Hanser, *Distributed Generation and its Implication for the Utility Industry* (July 2014)
- "Fixing FERC's Order No. 745" with Isaac Castillo, *The Electricity Journal* (October 2013)

PRESENTATIONS & SPEAKING ENGAGEMENTS

- "The Value of Diversifying Uncertain Renewable Generation through the Transmission System," UIUC Power Group Seminar (April 17, 2023)
- "Burning Questions: Hydrogen's role in & impacts on the Northeast electric power sector," ESIG Fall Technical Meeting (October 25, 2022)
- "Co-optimizing Planning of Generation and Transmission," ESIG Fall Technical Workshop (October 25, 2022)
- "It's All About the Timing: Modeling Energy Storage in Non-Chronological Capacity Expansion," ESIG Spring Technical Workshop (March 23, 2022)
- "Co-optimizing Planning of Generation & Transmission," FERC Technical Conference on Increasing Market and Planning Efficiency Through Improved Software (June 23, 2021)
- "The Value of Diversifying Uncertain Renewable Generation through the Transmission System," BU ISE Fall Webinar Series (October 14, 2020)
- "Sensitivity-Based Line Outage Angle Factors" (leading co-author), in Proceedings of the 47th North American Power Symposium, Charlotte, NC, Sept. 2015.
- "Measurement-Based Real-Time Economic Dispatch" (leading co-author), in Proceedings of the IEEE PES General Meeting, Denver, CO, July. 2015.
- "A Network-Inclusive, Optimization-Based Approach to Power System Flexibility Evaluation," in Proceedings of the 46th North American Power Symposium, Pullman, WA, Sept. 2014.

PROFESSIONAL ASSOCIATIONS & MEMBERSHIPS

2010-Present Institute of Electrical and Electronics Engineers (IEEE)
2010-Present IEEE Power and Energy Society (PES)