

Curriculum vitæ de Mme Judy W. Chang

Principal

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Ms. Judy Chang is an energy economist and policy expert with a background in electrical engineering and over 16 years of experience in advising energy companies and project developers on regulatory and financial issues. Ms. Chang has submitted expert testimonies to the U.S. Federal Energy Regulatory Commission, U.S. state, and Canadian provincial regulatory authorities on topics related to transmission access, power market designs. and power purchase contract issues. She also has authored numerous reports and articles detailing the economic issues associated with system planning, including comparing the costs and benefits of transmission, and using a comprehensive perspective over the value of transmission beyond the traditional avoided cost views. In addition, she assists clients in comprehensive organizational strategic planning, asset valuation, finance, and regulatory policies.

Ms. Chang has presented at a variety of industry conferences and has advised clients on financial and policy issues related to the integration of renewable energy. She holds a Master's in Public Policy from Harvard Kennedy School, is Director of The Brattle Group, a Director of the Massachusetts Clean Energy Center, and the founding Executive Director of New England Women in Energy and the Environment.

AREAS OF EXPERTISE

- Transmission Planning, Tariff Design, and System Modeling
- Renewable Energy
- Energy and Environmental Policy
- Regulatory Policies and Market Design
- Strategic Planning for Energy Companies



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EXPERIENCE

Transmission Planning, Tariffs Design, and System Modeling Engagements

- Develop Process for Using Scenario-based Approach for Transmission Planning. For the Electric Reliability Council of Texas (ERCOT), developed and led ERCOT and stakeholder sessions in developing future scenarios appropriate for long-term transmission planning.
- Evaluation of Transmission Planning and Benefits Metrics. For The Electric Reliability Council of Texas (ERCOT), reviewed, assessed, and developed recommendations for: 1) improvements in planning process, 2) methods for evaluating the long-term costs and benefits, and 3) improvements in system simulations. These recommendations are used to develop an improved business case for transmission.
- **Transmission Planning and Benefits/Costs Analyses.** For WIRES, a trade group of transmission companies, authored a peer-reviewed whitepaper outlining the industry practices for methodologies for evaluating the benefits and costs of economic transmission projects; and present a scenario-based approach to transmission planning.
- Evaluation of Regulatory Risks Associated with a Transmission Company. For a consortium interested in transmission assets, assisted in evaluating the potential regulatory risks associated with the target company.
- Benchmarking of the Impact of Regulatory Processes on Transmission Costs. For an international transmission company, analyzed the potential impact of the differences associated with jurisdictional and regulatory process on transmission project costs.
- **Reactive Power Tariff.** For an industry customer that owns generators that deliver reactive power, conducted analyses to present the revenue requirements, and submitted expert report before the Federal Energy Regulatory Commission for approval.
- **Cost and Benefits Analysis of Regional Transmission Plans.** For an independent transmission company, performed a transmission planning process that started with proposing projects, to evaluating the various benefits associated with each proposed projects, through using metrics that apply to the regional projects.
- **Transmission Intertie Management.** For the Alberta Electric System Operator, presented written and oral evidence before the Alberta Utilities Commission regarding North American regulatory policies related to transmission path management.

- **Transmission Congestion Management.** For the Alberta Electric System Operator, evaluated the Alberta power system's historical and prospective congestion conditions and authored a report that explains how the Alberta energy market and congestion management system functions. The report presented an analysis of the risks associated proposed changes to the existing congestion management system.
- **Transmission Congestion Management.** For the Alberta Electric System Operator, assisted in presenting evidence before the Alberta Utilities Commission regarding the economic efficiencies associated various methods of managing transmission congestion in the context of the Alberta Electric Market Framework.
- **Transmission Tariff.** For an industrial customer, analyzed transmission pricing policies and submitted expert affidavit before the Kansas Corporation Commission regarding the pricing and payment for line extensions.
- **Transmission Tariff Compliance Analysis.** For a transmission owner, analyzed how a proposed approach for determining the available transfer capability on certain transmission interfaces may be compliant with FERC regulation
- **Transmission Tariff Compliance Analysis.** For a transmission owner, analyzed the procedures used in assessing system impact relating to point-to-point transmission service request from a large merchant generator. Provided support for expert witness in proceeding before the provincial regulator.
- Market Assessment for Transmission Business. For several parties interested in investing in transmission, developed an outlook of opportunities for transmission project investments across several North America markets.
- **Regional Market and Transmission Organization Analysis.** For the utility and industrial customers in the Maine, co-authored a report that discussed alternatives of transmission organization participation for the State of Maine and market design issues associated with the alternatives. This report also explained various methodologies of allocating New England's transmission costs and analyzed the cost implications of alternative allocations of investments.
- Economic Analysis of Reactive Power Procurement. For the government of Colombia, analyzed the effects of inadequate supply of reactive power, compiled an international comparison of how reactive power is managed on eight electric systems, proposed a regulatory framework for reactive power management and drafted market rules to be

implemented by the system administrators in Colombia to improve the supply and usage of reactive power and thereby improve the system reliability of the electricity network. Included in this engagement, the project team used a load-flow analysis to determine the optimal reactive power requirement for generators, distribution companies and transmission owners.

- Economic Analyses of Transmission Projects. For an independent transmission company, conducted the economic analyses associated with regional transmission projects. The results are used to support a proposed transfer of transmission assets from a vertically-integrated utility to an independent transmission company.
- Procurement Strategy and Market Modeling. For a utility fulfilling a state renewable resource requirement, Ms. Chang led a team to analyze the potential economic and system impact of entering into purchasing power contracts with several renewable resource developers. This engagement included performing a system impact analysis of the western part of the U.S. Such an analysis included performing a load flow analysis, estimating the locational marginal prices for the western system and evaluating the potential changes in transmission congestion resulting from purchasing power from the proposed renewable resources.
- Analysis of Impact of Locational Marginal Pricing. For a New England utility, performed detailed analyses of the potential impact of the change from zonal pricing to locational pricing and the utility's exposure to congestion charges as a result of the implementation of LMP. The analysis was performed using a Brattle in-house oligapolist model that simulated the bidding behaviors of power sellers in a market before and after the implementation of LMP. The results included a comparison of the financial impact of the transition to LMP-based market. Hourly prices were forecasted with the emphasis on the utility's relative congestion cost exposure under a zonal pricing versus a LMP regime. The result of the analysis was used to design the utility's congestion hedging strategies.
- **Regional Transmission Tariff Advisory.** For a market participant in the Midwest ISO and Pennsylvania-New Jersey-Maryland ("PJM") markets, evaluated various long-term transmission cost allocation designs while eliminating pancaked transmission costs between the two regional transmission organizations ("RTOs") and analyzed the potential customer impact of each design.



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Renewable Energy

- Evaluating the Implications of Economic Bidding on Renewable Energy Contracts. For a renewable energy project owner, evaluated the economic implications associated with bidding behavior of the off-taker on the renewable contract payments.
- Evaluation of Renewable Energy Contract Procurement. On behalf of Massachusetts Attorney General, assessed the renewable energy contract procurement process and results and testified before the Massachusetts Department of Public Utilities.
- Expert Witness in Wind Curtailment Arbitration. For a wind power plant owner, submitted expert report and delivered oral testimony before an Arbitration panel about the likely financial damages resulting from wind curtailment. The dispute was related to: a) the long-term power purchase contract between a utility and the wind farm owner, b) the responsibilities of the various parties for obtaining the appropriate transmission service and c) the use of power curves to estimate the expected wind power generation when facility was curtailed.
- Evaluation of the Potential Market Impact of Proposed Transmission on Wind Generation Investment. For a renewable energy developer, submitted expert testimony on the potential impact of certain proposed transmission configurations on the wholesale and retail market in Maine.
- Evaluation of the Cause and the Economic Implications of Wind Curtailment. For a wind generator, examined transmission tariff and operations documents of the grid operator to determine whether certain curtailments were warranted and if so, assess the economic implications of those curtailments.
- Assessment of Market Design Improvements for Interconnecting Wind Generators. For a large regional transmission organization, assessed the potential risks associated with existing procedures for interconnecting wind generators on wind generators with different types of interconnections agreements, and proposed recommendations for improvements to the RTO procedures.
- Analysis of Approaches to Integrating Wind Energy. For a grid operator, co-authored a report that presents the approaches used in various regional markets around the world to integrate wind resources. The analysis was conducted to assist the client in setting up its own policies and improve existing market rules.

- Evaluation of Renewable Energy Long-term Contract Procurement. For the Massachusetts' Attorney General's office, submitted expert witness testimony before the Massachusetts Department of Public Utilities, evaluating the renewable energy long-term contract resulting from the procurement process conducted by the three Massachusetts distribution utilities.
- Evaluation of Off-shore Wind Contract Terms. For the Massachusetts' Attorney General's office, submitted expert witness testimony before the Massachusetts Department of Public Utilities, comparing the proposed contract price and terms of the Cape Wind offshore wind project with the price and costs of other U.S.-based and European offshore wind projects. The testimony also estimated Cape Wind likely project costs and evaluated the potential ratepayer value of various proposed contract terms.
- **Transmission for Renewable Energy.** For a transmission-owning utility, developed future scenarios of renewable energy development across the Western Interconnect, and assisted in analyzing the energy and ancillary services market that ultimately drives the value of transmission under development.
- Wind Integration Analysis. For a utility in the West, assisted in developing an analytical method to evaluate the operational impact of various levels of wind penetration and estimate the potential need for and costs of ancillary services to help integrate variable generation resources. Our work involved developing an econometric method to estimate granular wind generation patterns in the utility' service territories.
- Regional Renewable Energy Analysis. For the State of Connecticut, Brattle consultants authored the state's 2009, 2010, 2012 Resource Plan report. This effort included providing a long-term view and detailed analysis of the resource potential in New England. Brattle staff also provided policy recommendations about the procurement of electric power resources for a 10-year horizon, after comparing the potential effects of future scenarios on various resource procurement possibilities. Also as a part of this effort, Brattle consultants analyzed the New England renewable energy market including a detailed evaluation of short-term and long-term supply and demand balance of renewable energy in the region, an examination of the supply potential in the region and the potential effect of transmission investment choices on renewable energy development in the region.
- **Regional Transmission and Renewable Development Analysis.** For a transmission company, evaluating the likely economic benefits of a transmission project proposal, including the amount and quality of renewable energy resources that the proposed transmission can help

support. Using Brattle's in-house regional generation expansion model, we estimated the likely carbon emissions savings from implementing a regional extra-high voltage transmission overlay and enabling the energy delivery from high-qualify wind resources located in remote regions.

- Renewable Integration Analysis and Model Development. For a utility in the West, assessed the potential compensating resource needs and costs associated with integrating intermittent resources into the regional system. Designed and managed the development of the first user-interactive evaluation tool to estimate the investment and operational cost associated with increasing regulation, load-following, day-ahead scheduling, and ramping services that will be needed with increasing intermittent resources that have generation output that can be unpredictable and variable in nature. The framework and mechanics of the model have been presented before the California Public Utility Commission's Stakeholder workshops, with results of scenarios discussed at various forums.
- Energy Storage Valuation. For a technology incubator in China, analyze the potential for energy storage to improve overall system efficiency. This engagement involved simulating the use of energy storage in the context of Chinese electricity system and estimating the value of storage used for serving peak load, providing frequency regulation service, and help integrate wind resources where generation and transmission infrastructure is limited.
- Assessment of the Impact of Adding Solar PV in New York and Texas Markets. For a trade association, estimated the wholesale market impact of adding a significant amount of solar PV in New York and Texas.
- Assessment of the Potential Impact of Import Tariff on Employment in the Solar PV Sector. For a trade association, analyzed the potential employment effects of imposing an import tariff on solar components from China into the U.S.
- Energy Storage Analysis. For a company interested in the opportunities of investment in storage, evaluated the potential costs and benefits of adding pumped hydro storage onto a regional grid, particularly in light of its ability to store renewable generation that are in excess of the amount the grid can absorb during low-load periods. Also assessed the potential impact of adding storage on the energy and capacity markets. The project involved evaluating the potential value of the "savings" associated with storing excess energy produced by wind in off-peak periods and estimating the likely optimal storage size in a particular transmission system.

- Energy Storage Valuation. For a technology incubator and national scientific research institute in China, analyzing the value of energy storage in the context of Chinese energy market. This analysis includes estimating the value of using storage to provide ancillary services in the Chinese energy market, as well as to shave peak demand. The results of the analysis are used to inform technology developers of the ideal cost point for energy storage in both grid-connected and other niche applications.
- Evaluation of the Impact of Renewable Energy Policy Change. For a renewable energy trade association, conducted a comprehensive economic impact analysis associated with potential changes to a state's Renewable Portfolio Standards (RPS) and authored a report. The report evaluated the potential impact of changing the RPS on the regional emissions, customers' retail rates, state's employment and macroeconomic activities, regional fuel diversity and transmission expansion.
- **Regional Job and Economic Development Assessment.** For a regional transmission organization, evaluated the potential job and economic impact associated with proposed transmission projects and the associated renewable energy development that will be enabled by proposed transmission expansions. Department of Energy's Job and Economic Development Impact model and IMPLAN were used to conduct the evaluations.
- Policy Analysis Relating to Community Wind Development. For a utility in the Midwest, provided an analysis of various financial structures, risks, and benefits for corporate- and community-based renewable projects. We also analyzed mechanisms available to policy makers to increase the local economic benefits of renewable development efforts.
- Analysis Climate Change Policies on Conventional Energy Resources. For a private equity company, analyzed and co-authored a presentation on the potential impact of proposed U.S. federal climate change policy on the short-term and long-term natural gas supply and demand balance and market dynamics. The presentation was used to inform client in making potential investment decisions.
- **Renewable Energy Financing.** For an international organization, managed and evaluated renewable energy investments in India, including the likely impact of transmission congestion and curtailment on the value of the investment. Responsible for negotiating potential financing arrangement for several Indian wind farms and created a pipeline of >10 renewable energy investment opportunities.
- **Renewable Energy Policy and Strategic Analysis.** For The Government of India, advised on how to strategically position a government-run lending institution in renewable energy.

- **Policy and Financial Analysis of Energy Efficiency Programs.** For several utilities in the U.S., led consulting and client internal teams in simulating the impact Energy Efficiency programs on company's financial performance. Advised client on DSM program parameters, avoided cost estimation, cost and benefit analyses, and regulatory strategies on shareholder incentives for utilities to expand DSM programs.
- **Pilot Lithium-Ion Storage Project.** For a utility in the western U.S., assisted in the development of implementation plan and metrics to be used in evaluating a pilot lithium-ion storage project to be used in integrating renewable energy on the transmission system.

Energy and Environmental Policy

- **Regional Greenhouse Gas Compliance Approach.** For a coal-owning utility considering options for complying with greenhouse gas (GHG) emissions regulation, developed a proposed regional approach to reducing GHG. Authored a discussion paper that describes the approach and the potential implementation challenges that must be resolved.
- Energy and Environmental Policy. For a regional government, examining and analyzing potential energy and environmental policies that can help reduce greenhouse gas emissions from the power sector.
- **Deregulation of Wholesale and Retail Power Markets.** For a Canadian utility, analyzed the international experiences in deregulating wholesale and retail power markets and analyze the potential desirable ingredients associated with deregulation.

Regulatory and Market Design Engagements

- **Regional Market Power Analysis.** Submitted expert testimony before Federal Energy Regulatory Commission (FERC) on behalf of an electricity supplier regarding the measures of generation market power in New England.
- Capacity Market Design Analysis. Several regions in the U.S. have begun to institute a mandatory locational installed capacity (ICAP) requirement for energy companies that serve retail customers. However, these locational ICAP requirements can significantly increase the market power of local generators located in transmission-constrained areas. For an electric utility in New England, analyzed the implications of instituting a locational Installed Capacity (ICAP) requirement on those who serve retail customers in the transmission-constrained zones.



- Capacity Market Design Analysis. The FERC has asked some RTOs to revise resource adequacy requirements in some regions. In early 2004, ISO-New England submitted a proposal for instituting a *locational* installed capacity requirement (ICAP) and for administering a locational ICAP market. For Northeast Utilities, Ms. Chang assessed the impact of ISO-NE's proposal on load-serving entities and filed written testimony before the FERC critiquing the ISO-NE's proposal.
- **Capacity Market Design Analysis.** For New York ISO ("NYISO"), performed a study on how the rule changes in generation capacity requirement might affect reliability of system. Conducted an economic analysis on how changes the requirements in the capacity market may affect the profitability of electric generation suppliers and load serving entities.
- **Congestion Pricing and Transmission Rights Analysis.** For a utility in the New England electricity market, evaluated the cost of congestion given the existing and proposed market rules on financial transmission rights, congestion cost allocation, and the market shares and the operational characteristics of the generators. With the results of the analysis, assisted top executives in making strategic investment decisions.
- **Transmission Congestion and Market Power Analysis.** For an electric utility, assess the pricing and market dynamics in the New England electricity market and diagnosed the potential for firms to offer generation resources at strategically designed prices and thereby exercise occasional market power. Assessed the impact of this strategic behavior.
- Stranded Cost Policy and Impact Analysis. For an Australian natural gas distribution company, conducted a report of stranded cost experiences and lessons from North America, focusing on the regulatory and economic progress of the natural gas and electricity industries. Studied historical events, regulatory decisions, and actions of the FERC and states, as well as the economic drivers of those decisions. Compared and contrasted multiple methods of calculating stranded costs and the financial implications of each.

Strategic Planning and Long-term Resource Planning

Scenario-based Strategic Planning and Developing Business Unit and Division Level Business Plans. For a utility, led the senior executive team in: a) evaluating the organizations strengths and weaknesses; b) its near-term and long-term risks and issues; c) develop industry scenarios; d) from the scenarios, develop robust corporate strategies; e) develop and prioritize strategic initiatives that support each strategy; f) develop vision and mission for the organization and obtain agreement throughout the organization; g) develop business unit plans and performance metrics to support each corporate strategic initiative;

h) develop resource needs and timelines associated with each business unit plan and help feed necessary information to the corporate budgeting process; i) develop an overall corporate communication plan; and j) develop progress tracking tool. This effort included working with the executive team of the organization, a separate operational and technical team, and leaders of each business unit and division in the organization through a set of facilitated workshops and meetings over one year. The final deliverable included a comprehensive strategic plan for the organization including documenting the process and the results of a scenario-based planning. The process also successfully set a new direction for the organization during one of the most financially and organizationally challenging time.

- **Resource Planning.** For a utility in the West, guided a group of cross-functional planning group in assessing future uncertainties, developing future scenarios, developed analytical frameworks and methodologies in analyzing future resource options. Recommendations included using scenario-based and stochastic approaches in analyzing the risks associated with short-term and long-term uncertainties in the market place on the value of the utility's future resources.
- **Strategic Planning.** For a utility in the Midwest, using previously developed scenarios, led senior executives in developing specific 10-year strategies to lead the organization through uncertain times. The assignment also involved working with various divisions within the organization to set up plans in support of the strategic direction that the organization has chosen to take. Also provided points-of-view on the global, national and regional power market trends.
- Strategic Planning. For a utility in the Midwest, led teams of senior staff, board of directors, and other important stakeholder teams to develop future energy market scenarios used to assess key strategic decisions that the utility must make over a ten-year horizon. This effort includes significant stakeholder and analytical processes, including guiding utility senior management in developing analytical tools to make decisions under significant regulatory and market uncertainties. For three long-range strategic business decisions, helped develop business options, assessed the risks and returns of each option and helped prioritize decisions. Delivered a summary report to the board of directors and senior management of the organization.
- Long-term Regional Planning. For a group of utilities in the Midwest, developed a longterm view on the supply and demand balance of generation and demand resources, including various levels of renewable energy deployment and a spectrum of retirement scenarios for

existing generation resources. The analyses and report incorporates the potential for various levels of energy efficiency and demand response adoption and examines the potential impact of plug-in hybrid electric vehicles. The report also synthesized the plans of individual utilities in the region, including various perspectives on the region's demand growth and supply options. The long-term projection scenarios will be used in developing transmission infrastructure for the region.

- **Regional Long-Range Strategy Planning.** For the State of Connecticut and the Connecticut utilities, develop a set of long-range scenarios of the New England renewable energy market, including a detailed evaluation of short-term and long-term supply and demand balance of renewable energy in the region. This effort involves multiple stakeholder meetings and working with a team of experts in developing long-range policy options based on market dynamics.
- Long-term Planning. For a utility facing significant market and regulatory uncertainties, led a group of senior operational team in developing future scenarios and setting resource strategies. The result of the planning sessions led to the utility revising and improving their planning approach.



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EXPERT TESTIMONIES AND REGULATORY FILINGS

Before the State of Maine Public Utilities Commission, Docket No. 2012-00589, Supplemental Testimony on behalf of Maine GenLead, LLC regarding Maine Public Utilities Commission Investigation into Reliability of Electric Service in Northern Maine, January 17, 2013 (with Johannes Pfeifenberger).

Before the Massachusetts Department of Public Utilities, Written and Oral Testimony in Response to the Petition of Unitil, National Grid, NSTAR, and Western Massachusetts Electric Company's Petition for approval of power purchase agreements, in Dockets D.P.U. 13-146, 13-147, 13-148, and 13-149.

Before the Federal Energy Regulatory Commission, Docket No. ER14-357-000, Affidavit in the matter of the proposed Rate Schedule FERC No. 1 for Reactive Supply and Voltage Control from Generation and Other Sources Service on behalf of Delaware City Refining LLC, November 2013.

Before the New York State Public Service Commission, Case 03-E-0188, on behalf of Brookfield Renewable Energy Group in the Proceeding on Motion of the Commission Regarding a Retail Renewable Portfolio Standard: 2013 Review of Energy Programs, October 28, 2013, (with Marc Chupka).

Before the State of Maine Public Utilities Commission, Docket No. 2012-00589, on behalf of Maine GenLead, LLC regarding Maine Public Utilities Commission Investigation into Reliability of Electric Service in Northern Maine, August 2, 2013 (with Johannes Pfeifenberger).

Before the Kansas Corporation Commission, Affidavit in Docket No. 13-MKEE-434-TAR and 13-SEPE-433-TAR in the Matter of the Application of Sunflower Electric Power Corporation and Mid-Kansas Electric Company, LLC to Approve Extraordinary Transmission Facility Extension Service Terms as an Appendix to their Open Access Transmission Tariff, March 15, 2013.

Before the Alberta Utilities Commission, Written and Oral Evidence in Proceeding ID No. 1633 in the Matter Of Objections To ISO Rules Section 203.6 – Available Transfer Capability and Transfer Path Management, September 20-21, 2012.

Before the American Arbitration Association Panel, Expert Report and Oral Testimony regarding estimated financial damage associated with breach of power purchase contract, August 2011.

Before the Massachusetts Department of Public Utilities, Testimony and Exhibits in Response to the Petition of Western Massachusetts Electric Company (WMECO), for approval of power purchase agreements between WMECO and one on-shore wind projects, D.P.U. 11-12, June 21, 2011, (with Jürgen Weiss).

Before the Massachusetts Department of Public Utilities, Testimony (Oral) in Response to NSTAR Electric Company's Petitions for Approval of a Purchase Power and Renewable Energy Certificate

Contract in accordance with the requirements of the Act Relative to Green Communities (St. 2008, c. 169, § 83) and the Request for Proposal Process approved by the Department of Public Utilities in D.P.U. 10-76, Dockets No. 11-05, 11-06 and 11-07, June 2011, (with Jürgen Weiss).

Before the Massachusetts Department of Public Utilities, Direct Prefiled Testimony in Response to NSTAR Electric Company's Petitions for Approval of a Purchase Power and Renewable Energy Certificate Contract in accordance with the requirements of the Act Relative to Green Communities Act (St. 2008, c. 169, § 83) and the Request for Proposal Process approved by the Department of Public Utilities in D.P.U. 10-76, Dockets No. 11-05, 11-06 and 11-07, May 27, 2011, (with Jürgen Weiss).

Before the Massachusetts Department of Public Utilities, Testimony (Oral) in Response to the Petition of Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid for approval by the Department of Public Utilities of amended power purchase agreements between National Grid and Cape Wind Associates, LLC., Docket No. 10-54, September, 2010, (with Jürgen Weiss).

Before the Massachusetts Department of Public Utilities, Direct Prefiled Testimony in Response to the Petition of Massachusetts Electric Company and Nantucket Electric Company d/b/a National Grid for approval by the Department of Public Utilities of amended power purchase agreements between National Grid and Cape Wind Associates, LLC., Docket No. 10-54, August 20, 2010, (with Jürgen Weiss).

Before the Federal Energy Regulatory Commission (FERC), Prepared Joint Direct Testimony on Behalf of the City of Vernon, California, in its Prepared Petition for Declaratory Order and Request for Waiver of Filing Fee of City of Vernon, California, Docket No. EL09-64-000, July 15, 2009, (with Philip Hanser).

Before the Federal Energy Regulatory Commission (FERC), Comment - "A Marginal - Value Approach to Pricing Reactive Power Services in Principles for Efficient and Reliable Reactive Power Supply and Consumption," Docket No. AD05-1-000, April 4, 2005, (with Martin Baughman and Philip Hanser).

Before the Federal Energy Regulatory Commission (FERC), Prepared Joint Affidavit with Philip Hanser on behalf of Northeast Utilities Service Company and affiliated companies' market-based rate authorization, Docket No. ER96-496-010, et al., September 27, 2004, Revised December 9, 2004.

Before the Federal Energy Regulatory Commission (FERC), Prepared Joint Affidavit with Philip Hanser, on behalf of Northeast Utilities, in Devon Power LLC, et al., Docket No. ER03-563-030, March 24, 2004.

PUBLICATIONS

"A Market-based Regional Approach to Valuing and Reducing Greenhouse Gas Emissions from Power Sector-An ISO-administered Carbon Price as a Compliance Option for EPA's Existing Source Rule." (with Jürgen Weiss and Yingxia Yang) April, 2014.

"Recommendations for Enhancing ERCOT's Long-Term Transmission Planning Process," (with Johannes Pfeifenberger, Samuel A. Newell, Toshiki (Bruce) Tsuchida, and John (Mike) Hagerty), prepared for The Electric Reliability Council of Texas (ERCOT), October 2013.

"The Benefits of Electric Transmission: Identifying and Analyzing the Value of Investments," (with Johannes Pfeifenberger and John Michael Hagerty), prepared for the Working Group for Investment in Reliable and Economic Electric Systems (WIRES), workproduct, July 2013.

"Bridging the Seams: Interregional Planning Under FERC Order 1000," (with Johannes Pfeifenberger and Delphine Hou), *Public Utilities Fortnightly*, November 2012.

"The Employment Impacts of Proposed Tariffs on Chinese Manufactured Photovoltaic Cells and Modules," prepared for Coalition for Affordable Solar Energy, (with Mark Berkman, Lisa Cameron), January 30, 2012.

"Plugging In — Can the Grid Handle the Coming Electric Vehicle Load?" (with Dean Murphy, Marc Chupka, and Onur Aydin), *Public Utilities Fortnightly*, June 2010.

"2010 Integrated Resource Plan for Connecticut," (with Samuel Newell, Dean Murphy, Marc Chupka, and Mariko Geronimo), workproduct, January 1, 2010.

"Assessment of a Maine ISA Structure as a Possible Alternative to ISO-NE Participation," (with Ken Belcher, Johannes P. Pfeifenberger, and Delphine Hou), workproduct, May 2009.

"Transmission Super Highways: Assessing the Potential Benefits of Extra-High-Voltage Transmission Overlays in the Midwest" (with Peter S. Fox-Penner, Delphine Hou, and Ryan Hledik), workproduct, March 2009.

"2009 Integrated Resource Plan for Connecticut," (with Onur Aydin, Marc Chupka, Mariko Geronimo, Dean M. Murphy, Samuel A. Newell, and Joseph B. Wharton), workproduct, January 1, 2009.

"LMPs/FTRs Alone Will Not Solve Transmission Problems Blackout Showed," (with Philip Hanser), *Natural Gas and Electricity*, Volume 20, Number 4, November 2003.

"Transmission Management in the Deregulated Electric Industry — A Case Study on Reactive Power," (with Frank C. Graves and Dean M. Murphy), *The Electricity Journal*, Volume 16, Issue 8, October, 2003.

"Competition in Gas Pipeline Markets: International Precedent for Regulatory Coverage Decisions," (with Paul Carpenter), Report to the National Competition Council of Australia, June 2000.

PRESENTATIONS

"A Market-based Regional Approach to Valuing and Reducing Greenhouse Gas Emissions from Power Sector," in multiple industry conferences and stakeholder meetings, April, 2014.

"Trends and Benefits of Transmission Investments: Identifying and Analyzing Value," (with Johannes Pfeifenberger and John Michael Hagerty), presented at the CEA Transmission Council, Ottawa, Ontario, September 26, 2013.

"Assessing and Understanding the Implications of Economics of Coal-Fired Plants," presented at the Alberta Power Symposium, Calgary, Alberta, September 26, 2013.

"The Benefits of Electric Transmission: Identifying and Analyzing the Value of Investments," (with Johannes Pfeifenberger and John Michael Hagerty), presented to the Working Group for Investment in Reliable and Economic Electric Systems (WIRES), July 31, 2013.

"Implications of the Increase in Wind Generation for Alberta's Market: Challenges of Renewable Integration," presented at 13th Annual Alberta Power Summit, Calgary, Alberta, November 28, 2012.

"Challenges of Renewable Integration: Comparison of Experiences," presented at Transmission Executive Forum West 2012, Meeting Public Policy Objectives through Transmission Investment, Del Mar / San Diego, California, October 22, 2012.

"Challenges of Renewable Integration: Comparison of Experiences," presented at 4th Annual Renewable Energy Technology Conference and Exhibition, Washington, D.C., October 18, 2012.

"Energy Supply and Demand - A Market Perspective," presented at EnergySMART 2012 Conference, Boston, October 3, 2012

"How Are Markets Adjusting to Large Amounts of Renewable Generation?" presented at 8th Annual Carnegie Mellon Conference on the Electricity Industry: Data-Driven Sustainable Energy System, (with Kamen Madjarov), March 14, 2012.

"Challenges of Renewable Integration – Comparison of Experiences," presented at IPPSA 18th Annual Conference: Around the Horn: Lessons Learned from Other Markets, Banff, Alberta, March 12, 2011.

"Quantifying The Economics and Market Demand for Energy Storage Technology Applications," presented at the Energy Storage Forum, Europe 2011, Paris, France, May 16, 2011.

"Policy Challenges Associated with Renewable Energy Integration," presented at 2011 MIT Energy Initiative Symposium, April 2011. Forthcoming in *2011 MIT Energy Initiative Symposium Proceeding on Managing Large-Scale Penetration of Intermittent Renewables.*

"Shareholder Incentives: Ratemaking Mechanisms for Sustainable Energy Efficiency Programs," presented at Law Seminar International Conference on: Electric Utility Rate Cases, Boston, Massachusetts, November 9, 2010.

"Renewable Integration: Quantifying the Effects of Variable Energy Resources," presented at Wind and Solar Integration Summit, Scottsdale, Arizona, January 24, 2011.

"Looking Forward: High Wind and Solar Penetration on the Grid," presented at the NARUC Renewable Energy Retreat, Riverside, California, October 7, 2010.

"Renewable Integration Model Presentation," presented at the California Public Utility Commission's Long-Term Procurement Plan Workshop," San Francisco, California, August 25, 2010.

"Renewable Energy Integration: Issues and Analyses," presented at the EUCI Conference on Renewable Energy Development and Transmission Expansion, Portland, Oregon, August 11, 2010.

"Renewable Integration Model and Analysis" (with Kamen Madjarov, Ross Baldick, Antonio Alvarez, and Philip Q Hanser), presented at the Transmission and Distribution Conference and Exposition, 2010 IEEE Power and Energy Society, April 2010.

"Renewables and Storage: Does Size Matter?" (with Jürgen Weiss), presented at the 15th Annual POWER Research Conference on Energy Research and Policy, University of California, Berkeley, March 18, 2010.

"Update on Renewable Energy Market Trends," presented at Seminar on Financing Clean Energy Projects under the Reinvestment Act of 2009, (organized by Environment Business Council of New England), June 11, 2009.

"International Renewable Energy Financing," presented at Euromoney's Renewable Energy Finance Forum, New Delhi, India, November 30, 2006.

"Wind Power Grid Integration: How to Evaluate Potential Grid Impact of Proposed Wind Projects," presented at Electric Power 2005 Conference, April 6, 2005.

"Transmission Management in the Deregulated Electric Industry — A Case Study on Reactive Power," presented at the Ancillary Services Conference, Denver, Colorado, October 9, 2003.

"Regulatory Design for Reactive Power and Voltage Support Services," presented to Comisión de Regulación de Energía y Gas, Bogotá, Colombia, December 2001.

"International Review of Reactive Power Management," presented to Comisión de Regulación de Energía y Gas, Bogotá, Colombia, May 4, 2001.

"Assessment of Energy Demand Growth and the Need for Peaking Plants," presented at the Merchant Plant Finance Conference, Atlanta, Georgia, September 14, 2000.

"Shortening the NYISO's Installed Capacity Procurement Period: Assessment of Reliability Impacts," presented to the New York ISO, May 2000.

"Electricity Price Forecasting with Imperfect Market Conditions," presented to the Electricity Market Pricing Conference, Denver, Colorado, August 9, 1999.