

METIN CELEBI

Principal

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Dr. Metin Celebi provides expertise in electricity markets, resource planning, and analysis of environmental and climate policy. He has consulted and testified primarily in the areas of economic viability of coal-fired and nuclear power plants, wholesale power pricing and market design, and has experience in developing and analyzing federal/state climate policies, environmental regulations, LMP modeling, generation plant valuation, cost allocation, and competitive implications of mergers. His recent engagements include economic viability assessments for coal plants, estimating above-market costs of U.S. DOE's proposed payments to merchant generation plants, impacts of implementing marginal losses in the ERCOT market, economic damages in energy contracts, impacts of retiring coal plants on power markets, and cost/benefit assessment of RTO membership to electric utilities. Dr. Celebi has also experience in the estimation and implementation of marginal costs in ratemaking for electric utilities.

Dr. Celebi provided expert testimony in cases involving impacts of mandates to install emission control equipment on economic viability of a coal plant in Missouri and the owner's revenue requirements, economic viability of a coal plant in Kentucky, the wholesale power prices in Arizona, long-term power contract dispute in California, impact of coal plant retirements on wholesale energy prices in MISO, LMP spikes in PJM, and allocation of certain ancillary services costs among market participants in ERCOT.

EDUCATION

Dr. Celebi holds a Ph.D. in Economics from Boston College in the field of industrial organization and applied econometrics. His Ph.D. dissertation thesis explored the incentives of transmission owners to provide transmission capacity and reliability in deregulated electricity markets, and characterized the optimal regulation of capacity and reliability in an incomplete information setting. He received his Master in Economics from Bilkent University in Ankara, Turkey, and a B.S. in Industrial Engineering from Middle East Technical University (METU) in Ankara, Turkey.

AREAS OF EXPERTISE

- Coal Plant Economics – Viability, Retirements and Market Impacts
- Resource Planning for Electric Utilities
- Environmental and Climate Policies - Design and Implications
- Wholesale Electric Market Analysis and Asset Valuation
- Energy Litigation

- Retail Electric Rates - Cost Estimation and Recovery

EXPERIENCE

COAL PLANT ECONOMICS – VIABILITY, RETIREMENTS AND MARKET IMPACTS

- For a municipal electric utility in the MISO market region, evaluated the economic viability of an existing coal plant against the projected wholesale power prices in MISO. By using an in-house plant dispatch and commitment modeling tool, estimated the future annual capacity factor and variable costs of operating the plant, and compared the plant's avoidable future costs against the projected market prices of energy and capacity for the plant. Developed scenarios for future market prices by considering the key uncertainties such as natural gas prices and potential implementation of a CO₂ emissions prices. Estimated the savings from a potential early retirement of the coal plant.
- For an investor-owned electric utility in the MISO market region, assessed the potential for economic early retirement of a coal-fired plant under several scenarios including potential future requirements for retrofitting the plant with SO₂ emissions control equipment and future wholesale power market conditions. Estimated the likely impact of retrofits and early retirement on the utility's revenue requirements and retail rates.
- For an electric utility considering an early retirement for one of its coal plants, provided regulatory support to describe the changing economic viability of the existing coal plants in the U.S. wholesale power markets over the last decade. Conducted research on regulatory decisions in various state jurisdictions on recovery of past investments at retiring generation plants, and explained the perverse incentives on retirement decisions that would be created by disallowing prudently incurred past investments.
- For a merchant generation company in PJM, assessed the potential impacts of coal plant retirements on future likely range of energy prices under key uncertainties for market fundamentals. In addition, the project team evaluated whether the recent price spikes under the extreme weather and system conditions can be repeated in the future with increasing reliance on gas-fired generation plants.
- For an electric utility in Wisconsin, provided expert testimony on the likely changes in energy and capacity prices as a result of projected coal plant retirements and environmental retrofits in the MISO region. The analysis included a transparent model to estimate the impacts of retirements and retrofits on the regional supply curve, and the impacts of nationwide coal

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retirements on natural gas prices. Reviewed the projected reserve margins in the MISO region with and without the coal retirements to evaluate the likely changes in capacity prices in the MISO region after 2016.

- Conducted a screening analysis of coal-fired units in the United States for producer of a fuel that could be an alternative to burning coal in generating units in order to avoid or mitigate future compliance requirements with environmental regulations. The analysis compared the projected costs for each unit under the coal-fired operations (including the retrofit cost of environmental control equipment) against the costs under operations with the alternative fuel and the costs of replacement with a new gas-fired unit.
- For American Coal Ash Association, conducted annual surveys for the production and use of coal combustion residuals in the U.S. The Brattle team designed and implemented the survey that is circulated to coal generation plant operators, and supplemented that information with Brattle's assessment of key market trends in the power industry. The results of the survey are published each year for consumption by energy and environmental agencies and industry analysts.
- For an investor, assessed the economic viability of selected merchant and regulated coal plants in the Midwest. The analysis focused on estimates of projected net revenues for merchant plants, and cost of continued operations of the regulated coal plants against replacement power costs. In addition, estimated the projected capacity factor and coal use by each plant under selected future gas and CO₂ price sensitivities.
- Managed a case regarding the estimation of cost and performance benchmarks for two coal-fired generation plants in the Eastern U.S. We assessed their performance and cost by comparing them with similar coal plants in the country with respect to various performance metrics (heat rate, availability, forced outage rate, etc.) and cost metrics (fuel cost, maintenance costs, capital expenditure). We identified the strong and the weak points, by using various definitions of total costs and key performance metrics, and we analyzed the tradeoff between good performance and high costs among peer group plants.

RESOURCE PLANNING FOR ELECTRIC UTILITIES

- For a large Midwest utility serving electric and gas, assessed current and likely future industry developments with potential to create opportunities and risks for the regulated and nonregulated operations of the company. The key developments included emerging EPA air quality, water and ash regulations for power plants, potential climate policies, macroeconomic

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recovery, and smart grid technologies. In addition, conducted a thorough comparison of the risks and cost of capital associated with regulated and unregulated businesses, including behind-the-meter renewable generation. Presented the findings of these assessments to the Board of Directors.

- Assisted a municipal electric utility in developing a least-cost strategy to comply with the environmental regulations. Developed a screening tool to compare the economics of environmental retrofits against alternatives such as replacement with a new gas-fired combined cycle or relying on market purchases of energy and capacity to meet the retail load obligations. Presented the results of the economic analysis and potential hedging strategies to the executive management.
- Co-authored a chapter of a recent EPRI report on decision-making complexities and factors in utility resource planning and environmental compliance investment decisions. The chapter described how various metrics of cost and performance are used by power industry planners and executive decision makers, what some of the limitations of those metrics and modeling techniques are, and how this problem and modeling complexity may alter the type and timing of technology preferences. Some of the complexities are illustrated with a couple of examples on retire/retrofit choices for coal plants to comply with the environmental regulations and on decision-making for Carbon Capture and Sequestration (CCS) investment under CO₂ price volatility.
- Assisted an electric utility in the Midwest in their resource planning. Developed environmental regulation scenarios with the executives and experts at the utility, and assisted in modeling and reviewing the implications of regulatory and market scenarios on the least-cost strategy subject to meeting load, renewable energy standards, and capital constraints. The strategy options included retrofitting the coal-fired generation plants with necessary control equipment, retirement of coal-fired units and replacement with gas-fired units. Presented the results to the utility executives.
- Assisted an electric utility in developing an Integrated Resource Plan under potential climate policy scenarios. The plan was developed by reviewing and choosing the best mix of supply-side alternatives and demand-side programs that would achieve the joint objectives of minimizing cost and mitigating CO₂ footprint subject to meeting the utility's obligation to serve its customers. The supply-side options included combinations of conventional generation technologies, renewables and low-CO₂ fossil-fired generation, and new transmission investment.

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- For a large independent generation company, led a team to assess the reasonableness of the evaluation procedures and criteria used by an electric utility in the Southern U.S. in its RFP to acquire new generation assets and PPAs. The team reviewed the RFP requirements and the workpapers supporting the RFP results in a short period of time to identify the questionable assumptions and criteria used by the electric utility, and quantified the impacts of these on the relative costs of bids.
- For EPRI, analyzed and reviewed the major drivers of generation technology choice in various countries and regions around the world. Although the availability and degree of access to fuels is a common driver, other factors such as capital cost, attitude towards nuclear technology and renewables, constraints on carbon-intensive technologies, and degree of economic development play varying degrees of roles in the choice of generation fuels and technologies in each country.

ENVIRONMENTAL AND CLIMATE POLICIES - DESIGN AND IMPLICATIONS

- For a merchant generation owner in New England, managed a team to conduct an economic study on the potential cost and emission impacts of making the existing clean energy generators eligible under an expanded Clean Energy Standard (CES) program in Massachusetts. Under the existing CES program, commercial operating date requirements limit eligibility to clean energy generators commencing operation after 2010. The study concluded that retaining existing clean generation that came online prior to 2010 under the CES program would reduce GHG emissions in Massachusetts and New England, and would reduce system production and customer costs.
- For a power industry association, co-authored a study to assess the carbon emission impacts of premature nuclear retirements. The study concluded that the vulnerability of some nuclear power plants to premature retirement could create a major threat to the attainment of desired CO₂ reduction. The analysis found that the retirement of a 1,000 megawatt nuclear plant could increase CO₂ emissions in the range of 4.1 to 6.7 million tons per year, or 0.52-0.84 tons per MWh of nuclear generation lost, depending on the region in which the nuclear retirement occurs. In addition, the increased level of CO₂ emissions arising from a premature nuclear retirement is not confined to the state in which the unit resides. In fact, in most cases the majority of this increase will occur outside the state, and a significant amount of the

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emissions increase will occur in states beyond those adjacent to the state experiencing the retirement.

- For an industry association, co-authored a study to analyze the potential implications for competitive wholesale electricity markets if new gas-fired combined cycle (CC) plants are not covered under the Clean Power Plan's (CPP) mass-based state implementation plans (SIPs). The authors found that if state implementation plans exclude new gas CC plants, the electric sector could fall short of the carbon dioxide (CO₂) reduction goals set by the CPP, while incurring higher system costs per ton of CO₂ avoided. In addition, Brattle simulations illustrated that excluding new gas CCs from the emissions cap would introduce a discrepancy in the economics facing new and existing gas CCs that are identical in all respects other than their in-service dates. New CCs would earn greater profits in the energy market because they would be compensated as if they were entirely non-emitting plants.
- For a power industry association, conducted analysis of EPA's proposed rule for regulating CO₂ from existing sources under Section 111(d) of the Clean Air Act, focusing on potential economic impact to hydropower. Summarized key aspects of the rule, and assessed how the compliance options for states could differ from the BSER options in setting the target rates, and how states can utilize hydropower (existing or new) as a compliance option under the rule.
- For a western electric utility, evaluated the EPA's development of CO₂ rate targets in Arizona and assessed the reasonableness of projected pace and level of emission reductions. Conducted a detailed assessment of the assumptions and modeling approach in EPA's IPM simulations, and identified areas of improvements. Prepared a whitepaper to summarize the findings to be filed as part of the utility's comments to EPA.
- For an electric utility in the western U.S., conducted a study to assess reliability and supply-chain implications of compliance with EPA's Regional Haze Rule. Regional Haze Rule aims to reduce haze-forming pollution (primarily due to emissions of particulate matter and its precursors SO₂ and NO_x) that reduces visibility in parks and wilderness areas, especially in the Western U.S. We assessed the impact of outages at coal units to tie-in the environmental retrofit equipment on available resources to meet the utility's load obligations in the future. In addition, we compared the historical retrofits on coal units in the region against projected retrofits to comply with Regional Haze Rule.

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- Co-authored a study commissioned by the Midwest Independent Transmission System Operator (MISO), evaluated the feasibility of the large number of simultaneous environmental retrofits and new generation that may be needed for coal plants to comply with the EPA's Mercury and Air Toxics Standards (MATS) rule. The study found that compliance with the MATS rule poses significant challenges. The study took into account the historical level of actual retrofits and new generation construction, typical timelines to complete various types of projects, potential bottlenecks in specialized types of labor, and the required planned outages in coal plants to install and test the environment control equipment.
- Co-authored studies that analyze the economics of retirement decisions for each coal plant operating in the United States under the proposed and emerging EPA air quality and water regulations, taking into account the predicted profitability and cost of replacement power for both regulated and unregulated plants. The regulations are expected to force coal plants to decide between retiring versus installing expensive control equipment to reduce emissions of SO₂, NO_x, particulates, and hazardous air pollutants such as mercury, as well as cooling towers to reduce the use of cooling water.
- For a natural gas producer, analyzed the potential for change in natural gas demand as a result of the Waxman-Markey climate policy proposal. Using scenarios for new renewable capacity and price of natural gas relative to coal, analyzed effects of CO₂ prices on dispatch switching from coal-fired to gas-fired generation plants in various ISO regions, as well as on demand for gas in non-electric sectors.
- Assisted an electric utility in understanding the implications of the Waxman-Markey climate policy proposal on its renewable generation portfolio and its electricity sales to other regions. Our team identified opportunities and risks for specific renewable technologies due to provisions in the bill imposing renewable portfolio standards for electric utilities.
- For electric utility companies in the Eastern U.S., analyzed the potential effects of existing and developing environmental legislation and regulation on the existing generation fleet. The assignment included reviewing and summarizing the regulations by pollutant, identifying the specific generation plants that these regulations could affect, and estimating economics of retirement for each plant under a regulatory scenario.
- Conducted screening analyses for electric utilities to assess their exposure to allowance costs in the near term and long term due to recent cap and trade climate policy proposals. Under alternative assumptions to comply with the regulations (from complete reliance on allowance

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purchases to reducing emissions to meet the economy-wide targets), estimated the potential cost of the policy net of free allowances under the proposal using various CO₂ price scenarios.

- For an electric utility, assisted in evaluating expected natural gas prices under potential CO₂ prices due to proposed federal climate policies in the U.S. The analysis included modeling of changes in demand for natural gas in electric and non-electric sectors as a result of potential CO₂ prices, as well as feedback effects due to dispatch switching from coal-fired generation plants to gas-fired generation plants in electric sector.
- Helped a large energy company evaluate the implications of several climate policy options on U.S. CO₂ emissions from electric and transportation sectors, and consumption and prices of electricity, natural gas, and coal. The analysis focused primarily on long-term implications for future generation capacity mix, and provided insights about the feedback effects between fuel prices, electricity prices, and electricity consumption.

WHOLESALE ELECTRIC MARKET ANALYSIS AND ASSET VALUATION

- For a group of market participants in Texas, managed a team to estimate the impacts of implementing marginal losses in the ERCOT market on system production costs, transmission losses, LMPs, load payments, and generator revenues. The Brattle team simulated the ERCOT power system using the PSO software, and calibrated the model to recent generation and load patterns. The study results were made public in a proceeding before the Texas Public Utility Commission.
- For a large group of generation owners and trade groups, conducted a study to estimate the above-market payments to certain merchant generation plants with 90-day fuel supply under the U.S. DOE's proposed payments. While the DOE's rationale for the proposed payments was to improve the resilient operations of the power system, the study concluded that 1) there is no evidence supporting the premise that 90 days of on-site fuel at individual power generating plants would improve the resilience of the grid in the regions where the rule would apply, and that 2) implementing the proposed rule would undermine core market principles and diminish some of the most important advantages of competitive wholesale power markets.
- For a developer of biogas power plant, submitted expert testimony on outlook on projected long-term wholesale power prices in Arizona. Reviewed forward market prices for near term deliveries as of the execution date of a contract with the supplier of waste feedstock, and

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summarized the industry expectations for the timing of the need and cost to build new generation in the region.

- For a developer of solar PV generation plants, conducted research and analyses to identify potential opportunities for renewables to be offered to electric utilities as qualifying facilities (QFs) under the Public Utilities Regulatory Policies Act (PURPA). Summarized the states with the largest penetration of renewable QFs and most favorable contract/pricing terms, and presented the likely outlook on avoided cost rates by region.
- For an investment firm, evaluated the projected net margins from energy and capacity markets in the Northeast for a new gas-fired generation plant. Assessed the key market drivers and risk factors associated with the plant's future performance, and conducted analyses to assess the implications for the asset's market value.
- For an independent power producer, analyzed the market trends in California power markets and explore potential value drivers of the client's existing gas-fired combined-cycle plant in California. The Brattle team simulated the long-term wholesale energy prices in Southern California region, and developed a modeling tool to analyze the projected capacity payments for existing resources under the California's local resource adequacy construct.
- Assisted an electric utility in performing a valuation of a coal-fired unit. Managed the analysis to model the projected revenues from energy and capacity markets, as well as to project variable and fixed operating costs and environmental compliance costs in the future. Various market and regulatory scenarios are considered and presented to the client.
- For an investor, performed a valuation analysis of a potential new gas combustion turbine (CT) in Texas. Developed scenarios for future energy-only and capacity markets, estimated regional reserve margins under a few load growth scenarios. In addition to estimating annual energy margins using a virtual commitment and dispatch model, estimated the projected run-hours for the new CT.
- For an investor, co-authored a valuation analysis of a large gas-fired cogeneration facility in the Midwest. In addition to projecting energy and capacity prices in the region under the key uncertainties on gas prices, coal plant retirements, and renewable generation additions, the study analyzed the projected revenues under the existing long-term sale contracts to provide energy and steam.

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- Co-lead of team to assist a municipal electric utility in the Midwest to sell a portion of its share of energy and capacity from a new coal plant. The Brattle team acted as the Sale Advisor to design the sale process, solicit bids, prepare informational documents, and evaluate the bids.
- For a Regional Transmission Organization (RTO) in the Midwest U.S., estimated the future costs and benefits from an electric utility joining that RTO as a member, compared to stand-alone and an alternative RTO membership. The analysis included impact on production cost savings, existing transmission constraints and interconnection capacities, wholesale trading activity, load diversity benefits, generation investment savings, and allocation of transmission costs and revenues.
- For a power plant developer, estimated the market potential for new wind, solar and gas peaking plants in the Eastern Interconnection. The Brattle team worked in close coordination with the client to develop and refine assumptions and scenarios on future fuel prices, capital costs of new plants, federal tax credits as well as federal climate policy. Economic potential for new generation alternatives is estimated by using Brattle's in-house simulation model Xpand, which optimizes plant dispatch as well as generation entry and retirements in order to meet future electric demand and reserve margin requirements.
- For an electric cooperative in the Midwest, conducted studies to evaluate the impact of planned new wind and gas combined-cycle units at alternative locations on the nodal energy prices and net revenues for generation fleet owned by the cooperative. Provided analytical support to assess likely allocations of auction revenue rights for hedging congestion.
- For a large merchant generation company in PJM, assessed the likely causes of high energy prices during the polar vortex events. Analyzed the impact of each driver on market prices, and conducted simulations to evaluate the likely market prices in the future under similar weather conditions and sensitivities for coal plant retirements, increased penetration of demand-resources, and expected gas prices.
- For a large coal company, assisted in designing and evaluating innovative coal supply contracts with power plants. The project team developed a customized tool to simulate the regional energy and capacity prices in the eastern power markets, and evaluated the profitability of various types of supply contracts from the perspective of the coal company and the power plant. In addition, the Brattle team identified coal-fired power plants that could be potential candidates to benefit from signing innovative coal supply contracts.

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- For a group of electric utilities in the Midwest, led a team to assess the energy-related costs and benefits of joining an RTO. Using a nodal pricing simulation software, the team estimated the net costs to customers of the utilities with respect to energy, congestion, marginal losses, and allocation of financial transmission rights and loss refunds under each configuration (stand-alone and RTO membership).
- For clients in PJM, Dr. Celebi examined the variability of historical congestion patterns to help assess the reasonableness of the utilities' FTR/ARR acquisition strategies.
- Provided consulting services on the impact of moving into a Locational Marginal Price (LMP) market design for a client in WECC. In addition to quantifying the expected congestion cost exposure under LMP market design, examined the impacts of potential mitigating solutions on the cost exposure and on the client's ability to hedge these costs through acquisition of financial instruments.
- Estimated the economic benefits of a proposed power plant in California. The project included an analysis of benefits from reduced market-clearing prices, avoided/deferred transmission upgrades, and reliability improvements.
- For an independent power producer, assessed the competitive offer price for its planned gas-fired generation unit in the PJM capacity market. Under key scenarios reflecting uncertainty in market fundamentals and in reasonable modeling assumptions, estimated the net cost of new entry (Net CONE) for the generation plant using plant-specific cost and performance information supplemented by publicly available estimates for generic plants. The key modeling assumptions driving the range of results were the appropriate methodology to levelize overnight capital costs and the appropriate time period over which the costs of the generation plant would be recovered in the PJM markets.
- Assisted an energy company to understand the fundamentals of the PJM capacity markets to inform the company's bidding strategy in the capacity auctions. Conducted a training session to go over the auction clearing mechanism, simulation of the market-clearing prices and quantities and alternative methodologies to project future market supply curves.
- For an energy trading company in Western U.S., assessed the CAISO's historical calculations of nodal energy prices at specific locations. The focus of the assessment was to understand the impact of modeling differences between day-ahead energy markets and annual Congestion Revenue Rights (CRRs) auctions on the nodal energy prices at those locations. The findings of this assessment were used to support a complaint at FERC.

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- For a transmission owner in Canada, assessed whether the proposed procedures to coordinate the Available Transmission Capacity (ATC) on its interfaces with neighboring systems are consistent with the FERC requirements and the practices of U.S. counterparts. ATC coordination is required under FERC Order 890 in order to ensure that ATCs are calculated in a consistent manner by transmission providers and transmission service is provided in a non-discriminatory manner.
- For a Regional Transmission Operator (RTO) in Eastern U.S., assisted in the preparation two expert reports regarding an alleged manipulation of market credit rules through its trading activity in the FTR markets. The analysis involved a review of the trading activity and an assessment of risks assumed by the trader through a review of historical congestion prices.
- Submitted a rebuttal and surrebuttal testimony jointly before the Pennsylvania Public Utilities Commission on the causes of an episode of high locational marginal prices (LMPs) experienced by a small electric utility in PJM wholesale energy markets. Using data on potential causes of high congestion and detailed market simulation modeling, identified several causes including increased virtual bidding activity, reduced transmission capability, and changes to physical characteristics of certain transmission assets.
- For an electric utility considering joining an RTO, managed transmission flow analyses of generation and load deliverability, as well as LMP market simulations to assess the effects of the company's move on prices in its service territory.
- Co-authored a report reviewing the results and the performance of the ISO-NE Forward Capacity Market (FCM) auctions conducted for the 2010/2011 and 2011/2012 commitment periods.
- Submitted affidavit at the Public Utilities Commission of Texas (PUCT) regarding a proposed rule to allocate costs of procuring replacement reserves to market participants in ERCOT.
- Analyzed the economic and network impacts of a utility signing renewable energy contracts with several potential renewable generation projects. Using market simulation tools such as MarketSym™ and Powerworld™, simulated an entire reliability council to assess whether each of the potential renewable generation projects would cause additional transmission constraints, and estimated the impacts of these projects on LMPs across the region.
- Assisted an electric utility before the energy regulator in Quebec, Regie De L'Energie, involving third-party access to an electric transmission system owned and operated by another company.

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- Assisted numerous clients in examining the potential for exercise of horizontal and vertical market power under FERC's market power tests as a result of asset acquisitions, mergers, and as part of periodical market-based rate (MBR) filings.
- Helped a client assess the potential liability and market impacts associated with offering the output of an out-of-service generation unit to the ISO-NE markets.
- Led the efforts to prepare a report assessing the implications of the Open Access Transmission Tariff (OATT) filed by Midwest ISO on market efficiency and gaming opportunities.
- Contributed to The Brattle Group's investigation of the California power crisis on issues involving physical or economic withholding and manipulative gaming strategies such as double-selling, circular scheduling, wheel-out, simulation of real-time energy, and ancillary services markets.
- Estimated the potential for the exercise of market power in a load pocket in the Northeast U.S. power markets. The study simulated strategic behavior in order to assess the price risk for a distribution company due to congested transmission facilities.

ENERGY LITIGATION

- In an international arbitration dispute involving a coal mine in South America, co-managed a team to support expert report on the economic damages associated with a change in royalty structure. The analysis included the impact of royalty terms on the incentives for increasing mine production and on royalty payments to the government, under base outlook and sensitivities for projected international coal prices, mine cost structure, and discount rates.
- In a coal bankruptcy case regarding the qualification of a coal supply contract under the safe harbor provisions in the U.S. Bankruptcy Code, assisted an electric utility to evaluate the effectiveness of a long-term coal supply agreement as a hedge against regional fuel and power prices, including alternative coal prices and the more volatile prices of natural gas and wholesale power.
- In a large litigation case before FERC, provided testimony on the economic burden imposed by the prices in two long-term contracts that California Department of Water Resources (CDWR) signed with Shell and Iberdrola during the California energy crisis. Estimated the "down the line" economic burden by comparing the payments under the contracts to prices in comparable contracts and market prices after the end of the dysfunction. Assessed whether the

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contract prices could be explained by the expected future market fundamentals in the California power markets by using DAYZER market simulation software for the near-term and expected cost of installing and operating a new generation unit for the long-term.

- For estimating breach-of-contract damages, managed the team to support expert testimony in a high-profile international arbitration case. Brattle team built and ran simulation models to forecast power prices and GHG allowance prices in California and the rest of Western states through 2050, accounting for very short-term operational effects as well as long-term capacity expansion needs. The simulation models covered all of the states in the full Western Electricity Coordination Council (WECC) region to capture California's dependency on imports from other areas and changes in price and availability of these imports over time. The modeling team evaluated the impact of GHG policies, RPS policies, changes in load forecasts, changes in hydro conditions, and changes in natural gas prices over time on the power and GHG allowance prices. The simulation models were benchmarked against historical unit dispatch and near term power price forwards to replicate actual market operations and expectations. The Brattle team used the resulting range of power price forecasts under expected range of future market conditions to estimate damages, including an options framework to simulate plant operations and show the threshold conditions for economic shutdown.
- In a New Source Review (NSR) litigation case, analyzed whether the repairs conducted in several coal-fired generation plants should have been expected to result in significant increases in emissions of certain pollutants. The major disagreements were on the choice of baseline emissions and the level of expected impact from the repairs.
- In several NSR cases, estimated the amount of potential increases in emissions of SO₂ and NO_x as a result of repairs and replacements of various equipment in coal-fired generation plants. The analyses focused on potential increases in emissions due to avoided outage hours or increased output due to improved relative efficiency of the plants compared to the rest of the generation facilities in the system.
- For a group of municipal electric utilities in Massachusetts buying energy from a generating facility under a long-term contract, assisted in evaluating their net benefits from requesting must-run operation of the facility relative to the operations chosen by the seller. The engagement also included a comparison of municipal utilities and investor-owned utilities with respect to their incentives under the Massachusetts Electric Restructuring Act to buy out their power purchase contracts.

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- Helped a client in the Western U.S. in a litigation case involving allegations of market power and market dysfunction affecting the prices and other terms of various long-term electricity purchase and sale contracts.
- Managed several cases related to estimation of damages resulting from early termination of power contracts.

RETAIL ELECTRIC RATES - COST ESTIMATION AND RECOVERY

- For a university and a new hospital in Pennsylvania, conducted economic due diligence studies on the potential cost savings from installing an on-site combined heat and power (CHP) facility that would offset the power and heating needs. Reviewed the key drivers of the potential cost savings including net metering revenues from excess generation output from the CHP plant, reduction in cost of purchasing grid power, and future market prices for power and fuels. Presented the findings to the executive teams and provided analytical support in contract negotiations.
- For an investor in distributed gas-fired generation assets in Texas, conducted a study on future savings in transmission and distribution service costs, and potential market penetration of distributed energy resources. The Brattle team reviewed key aspects of the wholesale market structure that directly impact the long term stability of the transmission tariff rate, and identified potential risks and mitigating factors associated with possible changes to the design of the market.
- For a retail electric provider in ERCOT, analyzed the costs and savings in its contract with a large customer to provide various services.
- In a merger involving two electric companies in the Eastern U.S., analyzed the impacts of the merger on competition in retail electricity markets. Both companies owned electric distribution companies, transmission assets, generation resources, and retail electricity providers in several states. The analysis involved assessment of whether the increased market share in wholesale energy markets affects retail competition, number of suppliers in retail electricity markets, ease of entry and exit to provide electricity to retail customers directly or through Default Service (DS) procurements, and potential for abusing affiliate relationships with the electric distribution company to favor the retail electricity provider affiliate.

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- For an association of suite meter providers in Canada, analyzed whether the incumbent electric utility has been cross-subsidizing the provision of suite meters to its residential customers at the expense of its other customers. The analysis involved a comparison of the estimated fully-allocated costs of providing suite meters to the net revenues from these customers under the regulated retail rates under alternative assumptions on the costs of meters and types of suite meter installations.
- Prepared a Marginal Cost Study for an integrated electric utility in an RTO-region in U.S. The study estimated the incremental costs to the utility of serving additional demand and customers by time period, sub-region, and customer class.
- For a large electric customer of a utility in Western U.S., assisted in evaluating the utility's proposed rate design. Specifically, provided an assessment of alternative methods to classify generation costs (as demand, energy, or customer-related) and to allocate the fixed costs among customer classes. The analysis also included an assessment of the treatment of the costs and revenues associated with off-system sales in determining the revenues to be recovered from various customer classes.
- For an electric customer in U.S., analyzed whether a proposed change in rates by the electric utility would result in just and reasonable rates for transmission-level and station-service customers. The resulting testimony assessed whether the proposed rates were consistent with fundamental principles of ratemaking such as cost causation and rate stability, and compared the proposed rate design to the rate options provided by utilities in other jurisdictions for transmission-level and station-service customers. The parties settled the case with reduced rates for the client based on the lower cost of serving transmission-level customers relative to distribution-level customers.
- For an electric utility planning to install smart meters and in-home displays in the Eastern U.S., assisted in estimating the likely benefits to retail customers and to the utility. The quantified benefits to the utility company mostly came from reduced costs of meter reading and outage managements, whereas the customer benefits came from reduced costs of energy, capacity, and carbon emissions as a result of reduced peak load and annual energy consumption.
- Co-managed a case regarding a Texas electric utility company auctioning off its generation assets in order to determine its stranded costs. The project team assessed whether the market value of the utility's jointly-owned generation assets was depressed due to the rights of first

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refusal (ROFR) provisions attached to these assets, and whether the utility company failed to take commercially reasonable steps to mitigate its stranded costs.

- Helped a client analyze the cost of providing ancillary services (reserves, regulation, voltage support, etc.) from its hydroelectric generation facilities. The analysis required special emphasis to deal with the implications of separating cost of energy and ancillary services on the electricity rates of different customer types.

ADDITIONAL EXPERIENCE

- Before joining The Brattle Group, Dr. Celebi worked as an economic consultant for London Economics Inc. He designed a simulation model of the wholesale power market in the market area served by the New York Independent System Operator (NYISO).
- Ph.D. thesis on the regulation of investment in reliability and capacity of power transmission networks. Dr. Celebi illustrated that the structure of incentives to provide transmission capacity under a particular reward mechanism changes drastically when transmission reliability is also a choice variable to the owner. He particularly found that the well-known result of under-investment in capacity does not necessarily hold in this new environment. Therefore, Dr. Celebi characterized the optimal regulation of a line owner under incomplete information using line reliability as another choice variable.
- Dr. Celebi taught Microeconomics and Macroeconomics for one year at Boston College. He has also worked as a Teaching Assistant for a graduate-level Game Theory course, and for a number of undergraduate level courses.
- Dr. Celebi also attended the Summer School in Economic Theory on Auctions and Market Design (Hebrew University).

ACADEMIC HONORS AND FELLOWSHIPS

- Summer dissertation award in 1999, Graduate School of Arts and Sciences, Boston College
- Summer dissertation award in 1998, H. Michael Mann Fund, Boston College
- Scholarship from Yasar Holding Company, 1991-1993
- Tuition scholarship and stipend from the Turkish Ministry of Education towards the completion of B.Sc. Degree in Industrial Engineering, 1988-1993

TESTIMONY

Before the Public Service Commission of Kentucky, Prepared Direct Testimony on behalf of Big Rivers Electric Corporation re: economic viability of Station Two coal plant, May 1, 2018.

Before the United States District Court Eastern District of Missouri Eastern Division, Expert Report on behalf of Ameren Missouri re: impacts of proposed mandates to install emission control equipment at Rush Island coal plant on revenue requirements and economic viability of the plant, Case No. 4:11 CV77 RWS, April 23, 2018 and April 27, 2018.

Before the Superior Court of the State of Arizona, Expert Report on behalf of Vieste SPE, LLC and Vieste Energy LLC re: projected long-term wholesale power prices in Arizona, January 30, 2017 and February 21, 2017.

Before Federal Energy Regulatory Commission, Prepared Direct Testimony on Behalf of the California Parties re: economic burden imposed by the prices in two long-term contracts that California Department of Water Resources (CDWR) signed with Shell and Iberdrola during the California energy crisis.

Before the Public Service Commission of Wisconsin, Pre-filed Rebuttal and Surrebuttal Testimony on behalf of Wisconsin Public Service Corporation re: the impacts of pending coal plant retirements and environmental retrofits on energy and capacity prices in the MISO region, December 14, 2012 and January 11, 2013.

Before the District of Columbia Office of Tax and Revenue, Affidavit on behalf of Pepco Energy Services re: categorization of electricity as a tangible property versus a service for determining the eligibility of electricity sales for exemption from sales tax, July 15, 2011.

Before the Pennsylvania Public Utilities Commission, Docket No. P-2008-2020257, Rebuttal and Surrebuttal Testimony on behalf of Pennsylvania Electric Company re: causes and pricing of transmission congestion in Wellsboro area in PJM, January 16, 2009, March 10, 2009 (with P. Hanser).

Before the Public Utilities Commission of Texas, Docket 33416, Affidavit supporting Constellation New Energy's Request for Expedited Hearing re: allocation of replacement reserve costs in ERCOT, November 8, 2006.

PUBLICATIONS

“The Brattle Group's Notes on the Affordable Clean Energy Rule”, by Metin Celebi, David Luke Oates, Michael Hagerty, Yingxia Yang, and Marc Chupka, August 23, 2018.

“The Cost of Preventing Baseload Retirements: A Preliminary Examination of the DOE Memorandum”, by Metin Celebi, Richard Sweet, Kelly Oh, and Marc Chupka, prepared for Advanced Energy Economy (AEE), American Petroleum Institute (API), American Wind Energy Association (AWEA), Electricity Consumers Resource Council (ELCON), Electric Power Supply Association (EPSA), and Natural Gas Supply Association (NGSA), July 19, 2018.

“New Technologies and Old Issues under PURPA”, by Robert S. Mudge, Metin Celebi, Marc Chupka, and Peter Cahill, published in the February 2018 issue of Norton Rose Fulbright's Project Finance NewsWire, February 26, 2018.

“The Future of Cap-and-Trade Program in California: Will Low GHG Prices Last Forever?”, by Yingxia Yang, Michael Hagerty, Ashley Palmarozzo, Hannah Sheffield, Metin Celebi, Marc Chupka, and Frank C. Graves, December 5, 2017.

“Comments on Expanding CES Eligibility to Existing Nuclear Units”, by Onur Aydin, Metin Celebi, David Luke Oates, Tony Lee, and Kelly Oh, Prepared for NextEra Energy Resources, and presented to the Massachusetts Department of Environmental Protection in response to the proposed Clean Energy Standard-Existing (CES-E), November 30, 2017.

“The Future of the U.S. Coal Generation Fleet”, by Metin Celebi, Marc Chupka, Dean M. Murphy, Samuel A. Newell, and Ira H. Shavel, published in the Fall 2017 newsletter for the ABA Antitrust Section, Transportation and Energy Industries Committee, November 30, 2017.

“Evaluation of the DOE's Proposed Grid Resiliency Pricing Rule”, by Metin Celebi, Judy Chang, Marc Chupka, Samuel A. Newell, and Ira H. Shavel, prepared for NextEra Energy, Inc., October 26, 2017.

“Impacts of Marginal Loss Implementation in ERCOT”, by Metin Celebi, Toshiki Bruce Tsuchida, Rebecca Carroll, Colin McIntyre, and Ariel Kaluzhny, prepared for Ad Hoc Group, including Vistra Energy, The Wind Coalition, and First Solar, October 11, 2017.

“Nuclear Retirement Effects on CO₂ Emissions: Preserving a Critical Clean Resource”, by Metin Celebi, Marc Chupka, Frank Graves, Dean Murphy, and Ioanna Karkatsouli, December 2016.

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“Covering New Gas-Fired Combined Cycle Plants under the Clean Power Plan: Implications for Economic Efficiency and Wholesale Electricity Markets”, by Judy Chang, Kathleen Spees, Metin Celebi, and Tony Lee, November 2016.

“The Clean Power Plan: Focus on Implementation and Compliance”, by Marc Chupka, Metin Celebi, Judy Chang, Ira H. Shavel, Kathleen Spees, Jürgen Weiss, Pearl Donohoo-Vallett, Michael Hagerty, and Michael A. Kline, Brattle Policy Brief, January 2016.

“EPA’s Proposed Clean Power Plan: Implications for States and the Electricity Industry,” by Metin Celebi, Kathleen Spees, J. Michael Hagerty, Samuel A. Newell, Dean Murphy, Marc Chupka, Jürgen Weiss, Judy Chang, and Ira Shavel, Brattle Policy Brief, June 2014.

“Coal Plant Retirements: Feedback Effects on Wholesale Electricity Prices”, by Onur Aydin, Frank C. Graves, and Metin Celebi, November 2013.

"Potential Coal Plant Retirements: 2012 Update," by Metin Celebi, Frank C. Graves, and Charles Russell, The Brattle Group, Inc., October 2012.

“Supply Chain and Outage Analysis of MISO Coal Retrofits for MATS,” with Kathleen Spees, Quincy Liao, and Steve Eisenhart, May 2012.

“State Regulatory Hurdles to Utility Environmental Compliance,” with Philip Q Hanser and Bin Zhou, Electricity Journal, April 2012.

“Potential Coal Plant Retirements in U.S. and Impact on Gas Demand,” presented at CERI Conference in Calgary, Alberta, February 27, 2012.

“Decision Complexities in Utility Resource Planning and Environmental Compliance Investment”, with Frank Graves, chapter in EPRI report “The Market Backdrop to U.S. Power Generation Coal Technology Goal-Setting and Learning”, September 2011.

“Marginal Cost Analysis in Evolving Power Markets: The Foundation of Innovative Pricing, Energy Efficiency Programs, and Net Metering Rates”, with Philip Q Hanser, Brattle Group Energy Newsletter, Issue 2, 2010.

“Virtual Bidding: The Good, the Bad, and the Ugly – Experience of RTOs with Virtual Bidding and Implications for Market Participants' Hedging Congestion Costs,” with Attila Hajos and Philip Q Hanser, Electricity Journal, June 2010.

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"Can the U.S. Congressional Ethanol Mandate be Met?", with Evan Cohen, Michael I. Cragg, David Hutchings, and Minal Shankar, Brattle Group Discussion Paper, May 2010.

"Prospects for Natural Gas Under Climate Policy Legislation: Will There be a Boom in Gas Demand?" with Steven H. Levine, Frank C. Graves, Brattle Group Discussion Paper, March 2010.

"Internal Market Monitoring Unit Review of the Forward capacity Market Auction Results and Design Elements," with Dave Laplante, Hung-po Chao, Sam Newell, and Attila Hajos, June 5, 2009 (filed at FERC by ISO-NE on the same date).

"CO₂ Price Volatility: Consequences and Cures," with Frank Graves, Brattle Group Discussion Paper, January 2009.

A Lexicon entry for "A Theory of Incentives in Procurement and Regulation - Laffont&Tirole" in Lexikon der Okonomischen Werke, with Richard Arnott, (2006).

Contributing author of the Energy Bar Association Antitrust Committee's Report on 2005 Antitrust Development.

"The CAISO's Physical Validation Settlement Service: A Useful Tool for All LMP-Based Markets," with Philip Q. Hanser, Jared S. des Rosiers, and Joseph B. Wharton, Electricity Journal, October 2005.

"The Design of Tests for Horizontal Market Power in Market-Based Rate Proceedings," with James Bohn and Philip Hanser, Electricity Journal, May 2002.

"Financial Transmission Rights: Implementation Issues," with Philip Hanser, Working Paper, February 2002.

"An Analysis of Incentives and Regulation in Providing Capacity and Reliability in Power Transmission Networks," Unpublished Ph.D. Thesis, Boston College, September 2000.

PRESENTATIONS

"Future of Coal: Clean Power Plan, Market Drivers, and Other Regulations", by Metin Celebi, presented at the American Coal Ash Association's (ACAA) 2017 Winter Membership Meeting, January 25, 2017.

"CO₂ Regulations and Coal", by Metin Celebi, presented at Energy Bar Association's (EBA) Energizer, "Ongoing Climate Imperative", November 10, 2016.

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“Update on Clean Imperative and Sectoral Responses in the US Power Industry”, by Robert S. Mudge, Metin Celebi, Susan Nickey, Allyson Umberger Browne, and Elias B. Hinckley, presented at the American Bar Association (ABA) Business Law Section's Annual Meeting, September 8, 2016.

“The Clean Power Plan: Retirements and Reliability”, by Metin Celebi, presented at the Wisconsin Energy Institute 2015 Energy Summit, Madison, WI, October 2015.

“The Clean Power Plan: Retirements and Reliability”, by Metin Celebi, Michael Hagerty, Yingxia Yang, and Nicole Irwin, EUCI Conference, Houston, TX, April 1, 2015.

“Hydropower and the EPA Section 111(d) Proposal”, by Marc Chupka, Metin Celebi, and Kathleen Spees, Presented at the National Hydropower Association, August 12, 2014.

“Coal Plant Retirements and Market Impacts,” presented at the Wärtsilä Flexible Power Symposium, February 5, 2014.

"U.S. Coal Plant Retirements: Outlook and Implications," presented at the Coaltrans West Coast Conference, Las Vegas, June 14, 2013.

"U.S. Coal Plant Retirements: Outlook and Implications," by Metin Celebi, The Brattle Group, Inc., presented at the West LegalEd Center CLE Webcast, January 24, 2013.

“Environmental Retrofits: Costs and Supply Chain Constraints,” presented at MISO Annual Stakeholders’ Meeting in Indiana, June 2012.

“Potential Coal Plant Retirements and Retrofits Under Emerging Environmental Regulations,” presented during the annual meeting of Minnesota Rural Electric Association (MREA), August 10, 2011.

“Potential Coal Plant Retirements in ERCOT Under Emerging Environmental Regulations,” with Frank Graves, presented before Public Utility Commission of Texas, at Workshop on Potential Environmental Regulations and Resource Adequacy, June 22, 2011.

“The Regulatory Landscape for Coal-Fired Power: EPA Rules and Implications,” with Frank Graves and Marc Chupka, presented at EUCI Conference in Miami, Florida, January 24, 2011.

“Potential Coal Plant Retirements under Emerging Environmental Regulations,” with Frank Graves, Gunjan Bathla, and Lucas Bressan, presented at EUCI Webinar on December 8, 2010.

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“Financial Instruments in Power Markets: Virtual Bids and FTRs,” with Attila Hajos and Philip Q Hanser, presented at EUCI Conference in Washington, DC, July 19, 2010.

“Marginal Cost Studies in Ratemaking and Implications of Federal Climate Policy,” presented by Dr. Metin Celebi as an invited speaker at Southeastern Electric Exchange Rates and Regulation Section Meeting, Charleston, South Carolina, October 28, 2009.

“CO₂ Price Volatility Delays Clean Generation Investment,” presented by Dr. Metin Celebi at Law Seminars International’s Renewable Energy in New England conference as an invited speaker, Boston, June 25, 2009.

“What to Expect from Electric Power and Transport Sectors in Response to U.S. Climate Policy,” presented by Dr. Metin Celebi at Rutgers University Center for Research in Regulated Industries, January 18, 2008.

"Financial Transmission Rights: Necessary or Burdensome?," by Dr. Metin Celebi and Philip Q Hanser, IAEE Conference, Potsdam, June 7, 2006.

“Regulation of Transmission Investment and Reliability in Power Networks,” Presented to the METU International Conference in Economics V, September 2001, Ankara, Turkey.