

## The last will be first:

---

Will Mexico's unique market design avoid the growing pains experienced by U.S. energy and capacity markets?

October 31, 2017

## Rationale for the creation of electric markets in Mexico

---

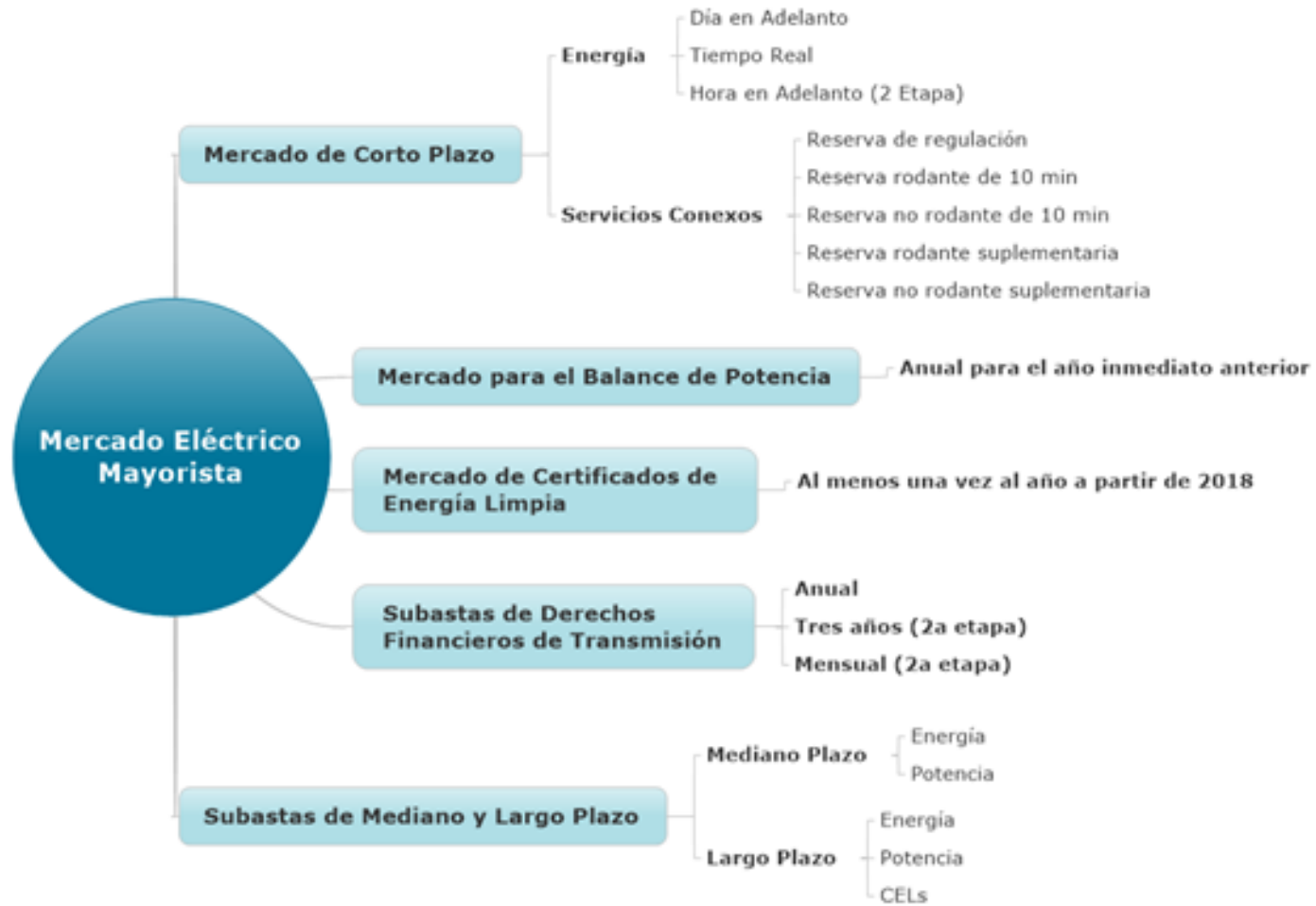
- Reduce the Government of Mexico's burden of financing the expansion the electric power system in a rapid economic growth environment
- Ensure the reliable delivery of electricity at the lowest cost to consumers
- Help meet GOM commitments to international GHG emission reduction treaties through an increased share of electricity generation using clean technologies (primarily renewable energy resources)
- Reduce/eliminate GOM subsidies to renewable electric generation

## Challenges faced in the design of the Mexican electric markets

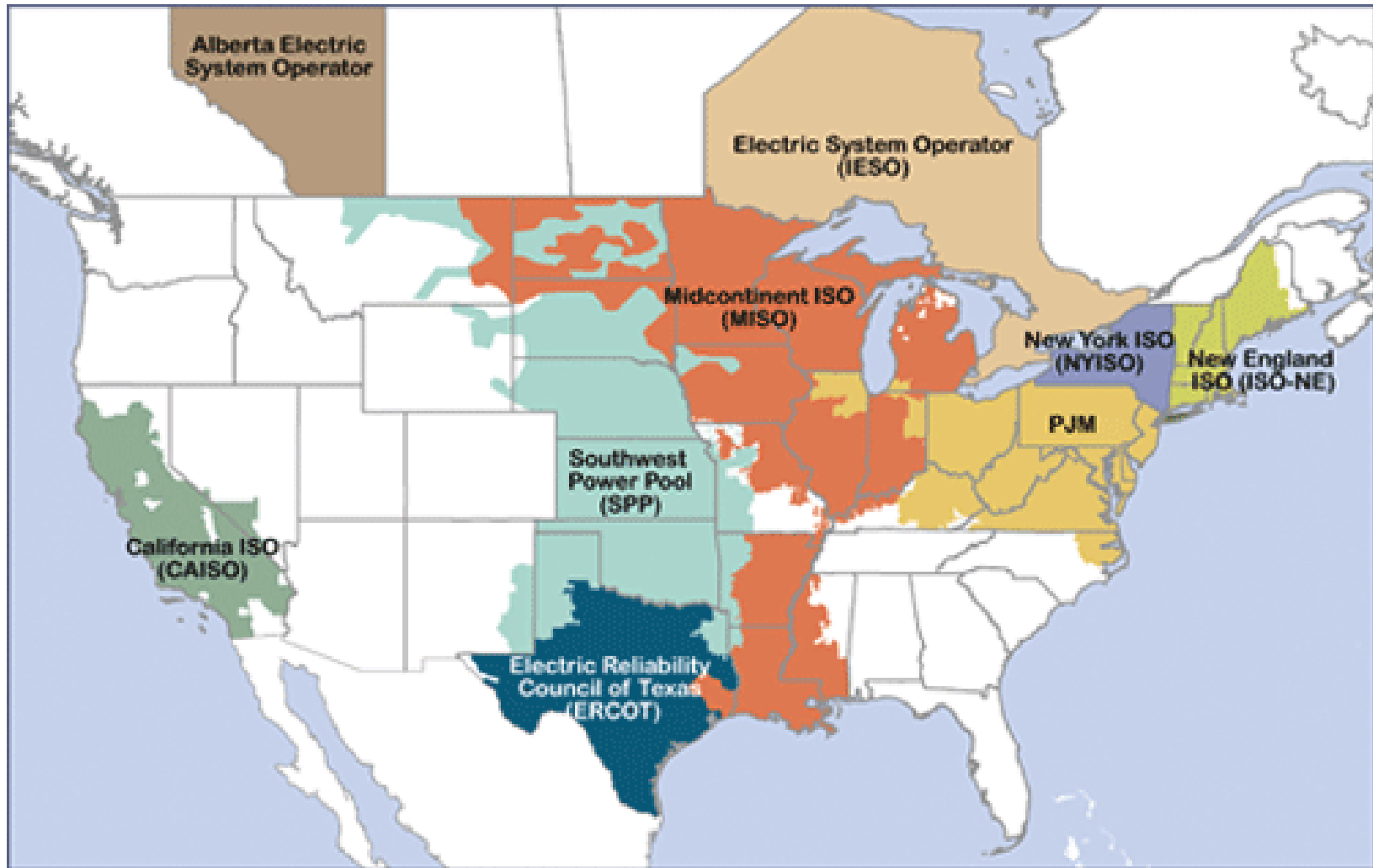
---

- Smooth transition from a GOM monopoly on generation, transmission, and distribution to competitive markets in a very short time
- Continue to reliably meet load as a growing share of policy-driven intermittent renewable generation comes on line which will eventually require market designs that incentivize:
  1. New resources entering the market to provide operational flexibility;
  2. Existing resources to upgrade their technology to offer additional flexibility capabilities if more flexibility capabilities are needed; and
  3. Flexible resources to offer those capabilities to the short-term energy and/or ancillary services market when flexibility is needed most
- Minimize unnecessary complexity and uncertainty of the regulatory structure to prevent discouraging private investors

# The MEM design benefits from earlier market experiences



# US and Canada ISOs



Source: FERC

## Current challenges faced by US electric systems

---

US markets are changing to adapt to a rapidly growing share of renewable resources that pose market design challenges:

- **Resource adequacy / mix challenges:** associated with ensuring markets attract enough capacity and flexibility with increasing zero variable cost generation depressing energy prices. Solution:
  - Sufficient capacity requirements – higher planning reserves
  - Sufficient flexibility requirements – flexible resource requirement
- **Operational challenges:** balancing supply and demand with highly variable renewable generation which requires energy and ancillary services in real time to balance demand and supply. Solution:
  - Strengthening scarcity pricing in energy and ancillary services (i.e., allowing prices to rise to attract resources that can generate (or interrupt) at high net peak load times)
  - Appropriate ancillary services design (e.g., fast-ramping products)

## Eastern ISO Capacity Markets – a work in progress

	PJM	NYISO	ISO-NE
<b>Construct</b>	3-year forward	Prompt, and monthly spot	3-year forward
<b>Pricing</b>	Sloped demand curve	Sloped demand curve	Sloped demand curve
<b>Pay-for-performance</b>	Yes Non-performance charges triggered by emergency actions Bonus if performance exceeds fleet average	No	Yes Non-performance charges triggered by operating reserve shortage

## MISO's Capacity Market is distinct from those of other ISOs

---

- MISO stands apart in two significant, and related, ways:
  1. 90% of load is served by traditionally-regulated, vertically-integrated utilities
  2. 10% of MISO system load is competitively provided through “retail access”
    - As a consequence, the capacity market was not designed to induce new generation investment
    - The MISO capacity market is an offer-based “prompt” (year ahead) market – with no sloped demand curve – that functions as balancing market for capacity



## Recent Key Issues in US Eastern ISOs

---

- Inducing improved capacity availability
  - Pay-for-performance (non-performance penalties)
- Price formation
  - Low, flat energy market prices (low demand growth, low natural gas prices, increased renewable generation)
  - Increased reliance on capacity market for generator net revenue: potential bias toward low capital cost resources
  - Increased dispatch of units at minimum output – such units generally cannot set energy clearing price
    - ◆ Results in muted price signals and high uplift costs
  - Lower incentives for units to reduce output to follow load
  - Ongoing FERC docket on price formation and initiatives at respective ISOs

## Need for Flexible Generation Incentives

---

- Incentivize flexible response generation to accommodate increased renewables
  - MISO Ramp Capability Product
  - NYISO
    - ◆ Multi-period pricing (similar to CAISO) – binding price for current period, advisory price for prompt period (within hour)
  - ISO-NE – currently considering approaches for ramp capability procurement and reimbursement
  - PJM – examining combination of pricing reforms and introduction of load-following product

## Mexico's design addresses key resource adequacy challenges

---

- Second phase of the short-term energy market – addition of hour-ahead market with free bids instead of cost-based bids (2018)
- Capacity requirements for all LSEs coupled to a capacity market conducive to least-cost reliable service through competition
- Frequency of auctions and diversity of contract length (long- and medium-term capacity auctions plus capacity balancing market)
- Long duration and enforceability of contracts (15-year duration coupled to performance guarantees)
- Indicative capacity and transmission expansion plan (provides information to investors re: location of demand growth and availability of transmission capacity)
- Ancillary services markets may need to reward flexibility as more intermittent resources come online

## How well will the Mexican market design work?

---

- Too early to tell
  - Success to be measured by ability to deliver reliable supply at least cost
  - Combined revenues from all markets should reflect value of investments needed to meet customer expectations for reliable electric service
  - Average 2017 LMPs in all regions of the SIN have been significantly higher than in 2016 – partly attributable to higher HH NG prices (as well as plant physical unavailability and transmission constraints)
  - First Capacity Balancing Market yielded relatively high prices, considering high reserve margins (due to impaired plant and natural gas availability)
  - Market monitor reports will, over time (several years), help explain the behavior of the market and provide guidance to fine tune design

## The new markets require well informed decision making

---

- Demand and fuel price forecasts for life of an asset
- LMP forecast for life of assets, beyond PRODESEN 15-yr horizon
- Identification and assessment of risks in energy, capacity and CEL contracts
- Evaluation of performance of wholesale markets
  - Expectations for market revenues
  - Monitoring ongoing and potential market modifications
- Assessment of policy and regulatory risk

# Q&A

---

# Services and Experience

---

**Mexico**

## Services - Mexico's electric power sector

---

Bates White's regulatory economics and technical experts have an unparalleled understanding of the Mexican electric power and natural gas infrastructure, markets and regulations, having served government and private sector clients since 2002. Our services to energy asset owners and investors include:

- Briefings on market structure/operations and legal/regulatory frameworks: Our descriptions of the market and regulatory constructs have been relied upon by developers and investors in the legacy and restructured energy markets.
- Electric and natural gas demand analyses: Our electric and natural gas demand forecasts have been used by project developers of power plants and pipelines and natural gas and other natural gas facilities in ascertaining the economic viability of their assets.
- Detailed forecasts of delivered fuel prices: Our analysts regularly produce price forecasts for all fuels used in the generation of electricity (coal, residual oil, distillate oil, natural gas) for specific locations and generating plants in Mexico.
- Electricity price and generation revenue forecasting: Our multi-area and nodal economic dispatch production cost models of the Mexican power system have been used to forecast the dispatch and revenue produced by generation assets under contract to CFE or operating under self-supply or other bilateral agreements.
- Due diligence for energy project finance: Our market and regulatory due diligence services have been relied upon in the acquisition and financing of numerous conventional and renewable energy generation projects. Many of these projects are in operation today.



## Conventional power generation experience - Mexico

---

Bates White has a well established track record of due diligence in non-recourse, project finance in México. Our experts led due diligence and prepared independent economic and market consultant reports for several fossil-fired and renewable generation projects in México, going back as early as the Altamira II natural gas combined-cycle independent power generators, and as recent as new combined-cycle power plants currently under development.

Specific conventional generation project market and regulatory due diligence experience:

- Economic and regulatory consultant for the financing of Altamira II natural gas, combined-cycle, independent power plant under contract with CFE.
- Economic and regulatory consultant for the acquisition of Norte III natural gas, combined-cycle, independent power plant under contract to CFE.
- Independent fuel price forecasts for several IPP and self-supply generation projects.
- Economic and regulatory consultant for the acquisition of a small hydro self-supply generation project.
- Preliminary risk assessment in the potential acquisition of a gas-fired IPP half-way through its PPA with CFE.
- Market analysis and transmission feasibility study for a US combined -cycle generation facility constructed in the U.S. to export to Mexican industrial customers.
- Developed model for the rolled-in methodology used to incorporate new pipelines into the national pipeline system regional tariffs – model used by the CRE in designing natural gas transportation tariffs.

# Renewable power generation experience - Mexico

---

- Wind facilities
  - Due diligence for financing over \$1 billion in wind projects in various wind basins in Mexico
  - Interconnection and transmission support to Baja California wind projects
  - US-Mexico environmental compliance analysis for Baja wind projects
- Other renewable energy facilities
  - Regulatory, market and economic due diligence in the development and acquisition of hydroelectric facility
  - Preliminary economic analysis in due diligence of acquisition of solar PV projects in Northern Mexico
- Implications for transmission development and system operation
  - Analysis of transmission feasibility for electricity imports from Texas to various regions in Mexico
- Mexico-U.S. Cross-border considerations
  - Supply and demand analysis for Baja California-California border region
  - Baja California renewable energy potential and related infrastructure needs analysis
  - Future NG and electric infrastructure needs analysis for BC-CA border region

# Analytical Tools

---

# Analytical Tools

---

## **Bates White uses state-of-the-art power system and electric market modeling tools:**

- PROMOD IV electric market model multiarea, transmission-constrained, chronological-dispatch, production costing model with hourly, economically optimized unit commitment. The model is capable of full nodal LMP forecasting in the US and Mexico. Mexico system database co-developed with ABB for use with PROMOD.
- PowerWorld Simulator power systems simulation package, capable of efficiently solving systems with up to 100,000 buses and an almost unlimited number of lines. It provides import/export capability to the some of the most common power flow formats.

## **Solar modeling:**

- NREL's Solar Advisory Model (SAM) and custom PV models co-developed with the University of Wisconsin-Madison. Used to assess the competitiveness of various PV plants vis-à-vis solar thermal generation facilities.

## **Expertise with VLDB (very large databases)**

- 3 instances of MS SQL Server housing > 20 TB of client data, with several databases containing > 1 billion rows of data.
- 1 instance of Oracle housing ~1 TB of client data.

## **Significant investment in tools/utilities:**

- 8 servers running MatLab, with Optimization, Distributed Computing, and Financial Toolboxes.
- Proprietary econometric tools implement econometric techniques developed and used by Bates White's world-renowned econometricians.
- Statistical analysis software: SAS, Stata, Eviews, Mathematica.
- MapInfo GIS expertise, including multicriteria site selection such as T&D, critical habitat, etc.

# **Bates White Energy Experts**

---

# Nicolás Puga, MSc

## Partner - Energy Practice Leader

---



- Over 30 years experience in the analysis of electric power and natural gas markets and as an advisor to generation and transmission project development. Mr. Puga has worked in most major organized energy markets in North America and South America as well as in Australia and the Philippines. In México, he has conducted due diligence in generation and transmission projects, led market studies for new natural gas franchises and pipelines, and advised government agencies on gas transportation tariffs and fuel procurement and risk management. Mr. Puga earned a MSc in Energy Engineering at the University of Arizona and a BSc in Electrical Engineering at the Universidad de Guanajuato, Salamanca, México.

- Developed zonal and nodal market price forecasting models of México's interconnected electric power grid using the using ABB's MarketPower and PROMOD IV simulation platforms for dispatch analysis and economic determination of long-term capacity additions. The models have been used in the independent market and economic analysis of several natural gas and renewable energy generating facilities, as well as in the economic analysis of US-México cross-border electricity trade.
- Conducted market and regulatory due diligence on the acquisition of a portfolio of greenfield hydroelectric and wind generation projects in various stages of development; including the feasibility of transmission access and the risk of security and social unrest. Evaluated the economic viability of the early development stage projects in the portfolio under restructured electric market conditions and the projects' competitiveness in future energy and clean energy certificate auctions.
- Conducted a valuation of a run-of-river hydroelectric facility under development in Mexico. The valuation considered the potential revenue from the sale of Clean Energy Certificates during the economic life of the project.
- Developed a comprehensive briefing on the laws, regulations and electric market rules for a Canadian generation project developer and operator considering entry into the Mexican market. The briefing explored available business opportunities and associated risks for bilaterally contracted and merchant generation projects.
- Conducted market and commercial due diligence in the acquisition of a large combined cycle facility under construction and advised investors on the risks in the existing long-term energy and capacity PPA with CFE.

# David W. DeRamus, PhD

## Partner

---



- Founding member of Bates White.
- Specializes in economic and financial analysis, quantitative modeling, pricing analysis, damages analysis, and valuation.

- Testifying and consulting expert in energy-related disputes, rule-making proceedings, market design proceedings, and market manipulation cases.
- Testified before federal and state regulators in numerous market-based rate proceedings and M&A applications in electric utility industry.
- Conducted several due diligence analyses evaluating potential risks associated with multi-billion dollar transactions in oil and manufacturing.
- On behalf of a major multinational company, submitted expert reports before the Mexican tax authority in international tax dispute.
- Served as expert witness in several US and international arbitration proceedings on economics of contracts, financial issues, and damages.

# Carolyn A. Berry, PhD

## Principal

---



- Over 20 years of experience in electric market design and operation, policy formation, and electric and natural gas regulatory issues. Dr. Berry has worked both at the Federal Energy Regulatory Commission during the formative years of U.S. electric market deregulation and inside a major U.S. regulated utility. After obtaining her PhD at Northwestern University in Evanston, IL, Dr. Berry taught economics at the Universitat Pompeu Fabra in Barcelona, Spain.

- On behalf of a group of investor-owned utilities and state agencies, led teams responsible for developing settlement valuations. Represented the parties in settlement negotiations requiring the development of creative approaches to issue resolution and consensus building.
- Served as expert witness in the California Energy Crisis proceedings where among other things testified on the subject of just and reasonable rates for electric energy and ancillary services sales in California centralized markets.
- Conducted analysis of market power and market manipulation in the California and WECC electric markets through bidding strategies, energy and transmission scheduling practices, and trading strategies. Submitted written testimony and testified at FERC hearings.
- For a U.S. client, analyzed the removal of electric transmission capacity in the Pacific Northwest from the California ISO-controlled grid. Identified various inefficiencies and gaming opportunities that arise when electric transmission is governed by different sets of rules.



## Collin Cain, MSc Principal



- Extensive experience in power market analysis, with applications in asset valuation, supply procurement, and investment due diligence. Development and application of market pricing and risk analysis models. Forensic analysis of the conduct and application of forecasts, market evaluation, and risk assessment by contract counterparties. RFP development, market design, and regulatory strategy.
- Recently evaluated the revenue models of gas fired, wind and hydroelectric projects in México to verify the proper representation of the terms of the project's sales contracts and its interconnection and transmission agreements.
- Valuations of all Central Maine Power power plants, supporting negotiated sale of generation assets to FPL. FPL Energy agreed to pay \$845 million for all of CMP's non-nuclear generating assets.
- Valuation analysis of qualifying facility (QF) hydro plants for New York State Electric & Gas Corporation (NYSEG), supporting settlement negotiations with plant owners.
- Testimony on behalf of Constellation Energy Commodities Group regarding the Illinois electricity supply auction. Analyzed the conduct, bidding behavior, and outcome of the auction, addressing auction structure, rules, and allegations of market manipulation.
- Development of RFP and evaluation procedures for the Ontario Ministry of Energy's 2500MW RFP. Directed the economic evaluation of generator proposals. Created analytical tools to evaluate aggregate costs, including transmission upgrade cost impacts, for every possible portfolio of submitted bids.

# Christopher Gulick, MBA

## Associate Advisor

---



- Specializes in fuel markets, with a focus on natural gas supply and transportation contracting, operations, and portfolio planning; market assessments; natural gas demand and price forecasting; developing and implementing fuel supply plans, contract compliance, and regulatory issues.
  - As a consulting and a testifying expert, Mr. Gulick has provided due diligence associated with fuel supply and transportation contracts; evaluated transactions in natural gas infrastructure and LNG facilities; developed fuel supplies for large end-users; and advised on contracting for fuel supplies, transportation, and storage.
- On behalf of a California regulator, evaluated the feasibility and transportation capacity of the natural gas infrastructure in northern Baja California (MX) and Arizona (US) to deliver gas into southern California (US).
  - In México, he co-led a team that provided advice to Comisión Federal de Electricidad, on integrating fuel (natural gas, oil, and coal) procurement and risk management functions.
  - Developed gas and oil price forecasts for use in developing forward power curves for valuation purposes in the financing of two major independent power producer generating facilities under contract to CFE.
  - Expert witness on behalf of an LNG supplier seeking a price adjustment under an LNG supply agreement. Analyses and testimony covered netback calculations, loss estimates, and the calculation of the embedded option value of the buyer's right to divert cargoes.

# Spencer S. Yang, PhD

## Principal

---



- Extensive experience in the analysis of energy markets, renewable energy investments, solar project development, market power, power systems and transmission networks, generation portfolios, and climate change.

- Serving as lead advisor to Korean IPPs on developing solar PV projects in the U.S.
- Provided consulting services to major Korean IPPs on forming solar project joint ventures, asset purchases and sales, land leases, permits, interconnections, power marketing, and PPA negotiations.
- Provided consulting services to the Korea Development Institute (KDI) on issues related to Korea's electricity market reform, transmission investment, and generation investment.
- Provided consulting services to California Energy Commission in developing the 33% renewable energy goals, market price referent (MPR), and feed-in tariff (FIT) mechanism.
- Testified on behalf of Maryland PUC Staff regarding potential market power issues associated with the proposed Exelon–Constellation merger
- Testified on behalf of the Virginia State Corporation Commission regarding the needs and alternatives to a proposed 500-kilovolt transmission line.
- Testified on behalf of Shell Trading regarding the proper quantification of import capability.

## Energy Practice contacts

---

Nicolás Puga, MSc  
Energy Practice Leader  
202.652.2184

Collin Cain, MSc  
Principal  
202.216.1156

Carolyn Berry, PhD  
Principal  
202. 846.6463

David DeRamus, PhD  
Managing Partner  
202.216.1154

Spencer Yang, PhD  
Principal  
202.747.2086