



# Nebraska Renewable Energy Export (LB 1115) Study

## PRESENTED TO

Nebraska Power Review Board

## PREPARED BY

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THE **Brattle** GROUP

# Presentation Agenda

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**Scope and Approach**

**Key Findings**

**Challenges to Increasing Renewable Energy Exports**

**Options for Legislature to Consider**

**Impacts on Electricity Rates and Economic Benefits**

# Renewable Energy Export Study Scope

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**We completed the Nebraska Renewable Energy Export Study in response to LB 1115 (2014) and the associated Power Review Board RFP (RFP NPRB-1115)**

**Based on LB 1115 and the RFP, the scope of the study was to:**

- Review state, regional, and national transmission infrastructure and policy;
- Identify future needs for transmission infrastructure and policy;
- Assess market availability, opportunities, and barriers to the construction of renewable generation facilities in Nebraska primarily designed for export
- Analyze the implications on the rates and service to Nebraska's electricity consumers and utilities

**The RFP requested that we consider a potential range of 5,000 to 10,000 MW of renewable generation capacity in Nebraska intended for export**

**As instructed by the RFP, we did not complete detailed modeling of the power system in Nebraska and the surrounding states**

## Scope and Approach

# Study Approach

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### **Our approach for completing the study included the following steps:**

- We reviewed transmission planning processes utilized for expanding the grid and the capabilities of the existing transmission system in and around Nebraska
- We analyzed supply and demand balances for renewable generation in the region with a particular emphasis on the competitive landscape in and around Nebraska
- We researched policies and financial incentives for renewable generation development in neighboring states
- We interviewed stakeholders in the LB 1115 Working Group, including individuals representing developers of wind generation and transmission projects, the Nebraska public power utilities, environmental regulatory agencies, and the Southwest Power Pool (SPP)
- We focused on wind generation capacity as the primary renewable resource in Nebraska for export due to the high quality of the resource in the state

## Key Findings

# Transmission Capacity Available

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**We find that the Nebraska transmission system will allow for at least an additional 2,000 MW of renewable resources to be added to the system but likely will require significant upgrades to achieve 5,000 – 10,000 MW**

- Several hundred MWs of renewable capacity can likely be added before transmission constraints significantly limit new capacity
- Transmission projects already approved or under construction (e.g., “R-Plan” and Neligh-Hoskins 345 kV lines) will increase available capacity by 2016 – 2018
- We estimate that the transmission upgrades will allow for at least 2,000 MW of new wind capacity, but could potentially accommodate up to 4,000 MW
- We find limited transmission to export wind from Nebraska to outside of SPP and to move power from western Nebraska to the rest of the Western Interconnection
- We estimate the total investment in transmission infrastructure would likely range from \$1.5 billion to \$4.0 billion (assuming needed for >2,000 MW of new wind)
- A significant portion will likely be borne by Nebraska ratepayers, depending on whether new lines are developed through regional processes or other options
- Some of the costs will be offset by the benefits of reduced congestion that also increase the value of all off-system power sales by Nebraska electric suppliers

## Key Findings

# Market Demand and Competitive Landscape

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**The broader regional market for additional renewable generation is currently saturated but a new wave of development would likely occur if the economic opportunities present themselves**

- There is limited remaining demand for meeting existing RPS mandates and targets in the region around Nebraska and the expiration of the federal production tax credit (PTC) increases the price at which wind generation can sign energy contracts
- Future demand likely to be driven by higher electricity prices, plant retirements, implementation of more stringent environmental regulations (e.g., Clean Power Plan), renewal of the federal PTC, and/or additional state mandates

**Nebraska renewable power exports face substantial competition from neighboring states**

- Small differences in the relative economics (e.g., tax incentives and energy prices) can significantly affect where renewable capacity is developed
- Developers are less familiar with regulatory requirements in Nebraska due to limited previous development experience and additional approvals not required in other states

# Challenges to Increasing Renewable Exports

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**There are several market and regulatory challenges that limit the expansion in Nebraska of renewable generation capacity including:**

1. Long-term Transmission Constraints
2. Limited Near-term and Uncertain Long-term Demand for Renewable Energy
3. Less Attractive Economics Compared to the most attractive Neighboring State
4. Greater Perceived Risks Compared to Neighboring States

**To be prepared to meet the next wave of demand for renewable energy, Nebraska will need to directly address these challenges while understanding that they are likely to occur over different time periods**

- *Near-term:* Economic disadvantages and the perceived permitting and regulatory risks relative to neighboring states
- *Longer-term:* Limited transmission capacity after exhausting the additional interconnection capabilities and congestion relief provided by already-approved new transmission projects

## Challenges to Increasing Renewable Energy Exports

# Challenge #1: Transmission Constraints

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**Transmission upgrades will be required to achieve 5,000 – 10,000 MW of wind capacity**

### **Brief summary of transmission planning by SPP:**

- SPP plans transmission on a portfolio basis through a series of studies called the Integrated Transmission Plan (ITP), which covers near-term, 10-year, and 20-year horizons
- SPP planning processes are multi-state, multi-stakeholder processes that are often contentious, create planning and cost allocation risks, and require 3–8 years to build new lines
- Transmission upgrades are initially justified in the ITP to meet reliability, economic, or policy needs, but the complete portfolio is approved based on region-wide economic benefits
- Cost allocation for approved transmission facilities depends on voltage level through SPP highway/byway methodology with projects >300kV allocated regionally
- Transmission costs are directly assigned to generators and/or off-takers if needs are identified through Generation Interconnection and Transmission Service Requests with transmission associated with designated wind network resources allocated 2/3<sup>rd</sup> regionally
- Nebraska utilities can “sponsor” self-funded transmission projects that would largely bypass SPP’s planning and cost allocation processes

**Expanding transmission to the west will likely be costly as there is limited transmission between interconnections and significant constraints exist to the rest of WECC**

**Few effective and actionable planning processes currently exist for transmission upgrades across regional boundaries; awaiting interregional FERC approval**



# Challenge #2: Uncertain and Limited Demand

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**Beyond RPS mandates/targets, wind generation can be attractive for development if their costs are competitive with energy market prices and new conventional generation sources (e.g., gas CC)**

- Wind Levelized Cost of Energy w/o PTC = \$45 – 60/MWh
- New Gas CC Levelized Cost of Energy = \$50 – 65/MWh

**We find that it is likely that significant new demand for renewable generation resources will arise if and when:**

- Significant load growth continues to reemerge in and around Nebraska
- A substantial amount of existing generation retires due to the high costs of environmental retrofits and/or low wholesale power prices
- Natural gas price increases result in higher wholesale electricity prices
- Environmental regulations around fossil-fueled generation resources, such as EPA's proposed Clean Power Plan, become more stringent over time, which in turn increases electricity prices, particularly if a cost was placed on carbon emissions

### Challenge #3: Less Attractive Economics

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The regional market for developing wind resources is very competitive such that small differences in costs lead to significant differences in development

**Developing wind generation in Nebraska has been less economically attractive than the most desirable neighboring state due to:**

- *Additional Tax Incentives:* While we estimate the tax incentives available in Nebraska to be equivalent to those in Kansas, we find that additional tax incentives in Oklahoma put Nebraska at an economic disadvantage of approximately \$3 per MWh of wind energy produced
- *Higher Energy Prices:* Wholesale power market have been (and are projected to be) lower in Nebraska than other regions in SPP with high quality wind resources, especially southern SPP, by \$5 – 10/MWh. In addition, Nebraska prices are slightly less than in Kansas and neighboring regions within MISO

**All other factors being equal, more attractive financial incentives and higher wholesale power prices in other states provide a \$5 – 10/MWh economic disadvantage for developing wind in Nebraska**

### **Challenge #4: Greater Perceived Risks**

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**Compared to other states that have had significant renewable generation built over the past decade primarily to meet RPS targets in their state, developers:**

- Have limited experience of developing renewable generation in Nebraska
- Perceive that developing wind projects in Nebraska is more risky than in some neighboring states

**Nebraska is the only state in the region to require special regulatory approval, such as through the Certified Renewable Export Facility (CREF) process**

- Most states require approval of offtake contracts if the local utility is the purchaser, but no special approval needed for exporting power out of the state
- No developer has completed the CREF process yet; thus perceived risky
- Developers generally very positive in their feedback on working experience with PRB

**We find that other permitting requirements in Nebraska are no more difficult than in neighboring states; but developers have limited experience with them**

# Options for Nebraska Legislature to Consider

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**We find that there could be significant future demand for renewable energy exports, creating a new wave of development**

**We provide the Legislature four options to consider for overcoming the existing challenges to development in Nebraska**

1. Develop a State-Wide Transmission Strategy
2. Provide Additional Tax Incentives
3. Simplify the CREF Process
4. Create a State Function to Promote Nebraska Renewables

## Option #1: Develop Transmission Strategy

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Despite the significant upgrades currently in development, we find that Nebraska must start now in setting its transmission strategy due to long lead time to identify, approved, and build transmission

A transmission infrastructure strategy that offers the lowest cost to ratepayers would most likely be a combination of the following:

- *Pursue transmission infrastructure development through SPP:* Continue working through SPP process to take advantage of regional cost allocation
- *Evaluate and reduce barriers related to SPP GI and TSRs:* Explore opportunities to group future requests to achieve more cost-effective scale
- *Explore state-sponsored “gathering facilities”:* Such transmission facilities would connect most attractive regions for wind generation with SPP backbone; will require up-front funding by Nebraska ratepayers
- *Explore developing transmission interties to market outside of SPP:* Develop projects that directly connect wind generation with markets to the west and east and not SPP (also requires up-front funding)

## Option #2: Provide Additional Tax Incentives

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**We estimate that additional incentives to overcome the combined economic disadvantage faced by developers in Nebraska would be \$5 – 10/MWh**

**There are several tax-related incentives Nebraska could provide to make development in the state more attractive:**

- *Eliminate Nameplate Capacity Tax*: Provides \$1/MWh of incentives
- *Provide state-level Production Tax Credit*: Set at desired incentive level
- *Provide state-level Investment Tax Credit*: ITC of 9 – 18% expected to provide \$5 – 10/MWh of incentives on a levelized basis

**We find the elimination of the Nameplate Capacity Tax and the ITC to be the most effective option for attracting development while limiting impact on ratepayers**

## Options for Nebraska Legislature to Consider

# Option #3: Simplify CREF Process

To reduce perceived and actual risks in Nebraska for approval of wind generation, we provide two options for simplifying the CREF process

Requirement	Current Process	Option A	Option B
Demonstrate identifiable and quantifiable public benefits			
Demonstrate intent to sign a PPA with a purchaser outside NE for at least 90% of output for 10 years or more			
Offer NE suppliers an option to purchase up to 10% of output			
Demonstrate facility will not have a materially detrimental effect on the state's retail electric rates			
Demonstrate executed agreements for generation interconnection and transmission service with appropriate transmission provider			
No demonstration (from third-parties) of substantial risk of creating stranded assets owned by NE consumer-owned electric utilities			
Applied for and is actively pursuing required approvals from other federal, state or local entities, including all environmental permits			
Demonstrate that applicant and interconnecting transmission owner have a joint transmission development agreement			
Agrees to reimburse electric suppliers for transmission costs not otherwise covered			
Submit a decommissioning plan			
Must meet CREF definition, including having a PPA for at least 90% of output for 10 years or more			

## **Option #4: Create Function to Promote Nebraska**

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**Similar to entities in neighboring states such as Wyoming, Kansas, and South Dakota, Nebraska may want to set up a function that helps the state promote and achieve its policy goals**

**Some potential objectives of the new function could include:**

- Reaching out to developers and potential customers to promote Nebraska as an attractive location for development and is “open for business”
- Guiding interested developers through the development process
- Streamlining processes necessary for developing wind generation and transmission, including support for siting and environmental analysis
- Communicating with landowners to raise awareness of objectives
- Monitoring market conditions for renewable energy
- Contributing to state transmission strategy

**The added function would need the active and credible support of key policy makers to be effective in completing its objectives**



# Impact on Electricity Rates

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**We estimate transmission investment of \$1.5 – 4.0 billion to support 5,000 to 10,000 MW of new renewable resources in the state**

- The amount paid by Nebraska ratepayers depends on the approach taken and the timing when the investment is necessary (may not be required until at least 2022)
- We estimate that a single year \$1 billion investment through SPP ITP in a 345 kV project would increase Nebraska rate by 0.7%; the impact would be significantly higher (3 – 5%) if investment is in lower voltage “gathering facilities”

**Additional wind generation may reduce wholesale prices and increase rates**

- Nebraska utilities are net sellers into the wholesale market such that their off-system sales revenues decrease when energy prices decrease
- Specific impact requires detailed modeling and can be overcome by transmission
- If average prices are reduced by \$5/MWh, we estimate rates will increase by 2%

**Wind generation may increase SPP’s balancing costs for providing additional back up capacity to respond to intermittent generation**

- Estimated additional balancing cost range from \$2 – 10/MWh of wind generation
- Impact on ratepayers depends on the actual need and how costs are spread across SPP; also may provide additional revenues to Nebraska generation that can respond

# Impact on State Economic Development

We estimated economic benefits of wind and transmission development in Nebraska from increased employment, economic activity, and property taxes

- *Wind Benefits:* Accrue over construction and 20-year operating period
- *Transmission Benefits:* Assume additional transmission is needed beyond 2,000 MW and estimate economic development benefits only during construction period

We find the following economic benefits of 5,000 – 10,000 MW of wind generation development in Nebraska:

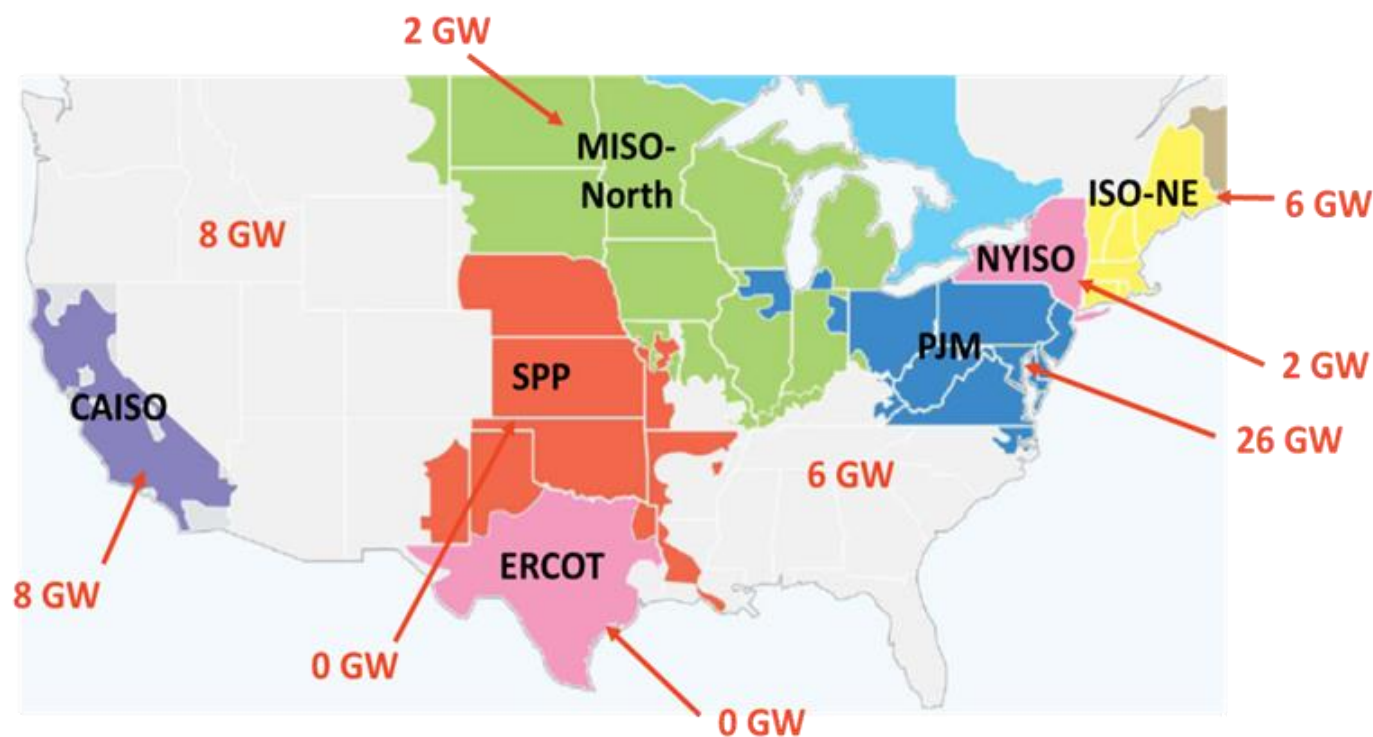
- *Employment:* 50,000 – 100,000 full-time equivalent (FTE) years
- *Economic Activity:* \$7 – 15 billion
- *Property Taxes:* \$33 – 66 million

Additional Wind Capacity MW	Full-Time Equivalent Years of Employment			Economic Activity			Property Taxes \$/yr
	Wind	Transmission	Total	Wind	Transmission	Total	
	FTEs	FTEs	FTEs	\$m	\$m	\$m	
1,000	7,700	-	7,700	1,100	-	1,100	7
5,000	38,500	9,800	48,300	5,400	1,600	7,000	33
10,000	76,900	26,300	103,200	10,800	4,200	15,000	66

# Appendix Slides

# Renewable Portfolio Standards and Targets

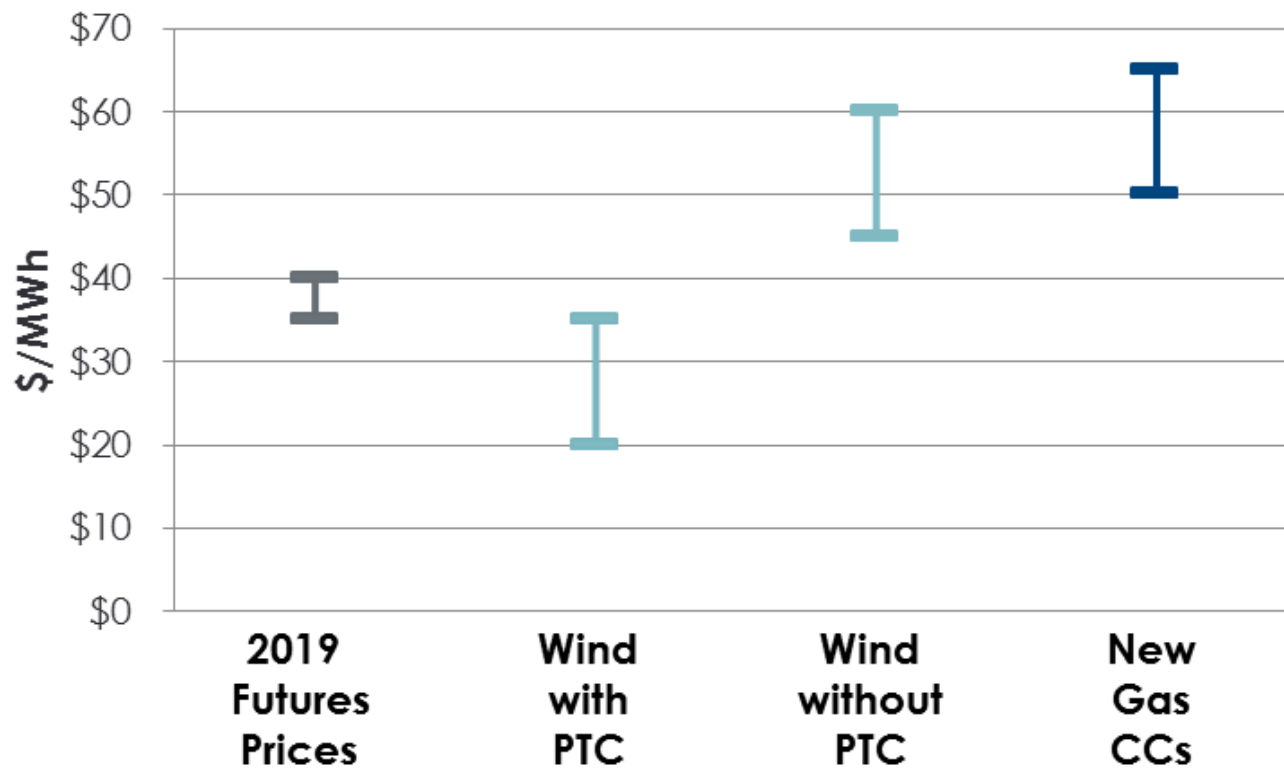
Figure 1  
Remaining Demand for Wind Generation Driven by  
Renewable Portfolio Standards and Targets for 2025



# Estimated PPA Prices

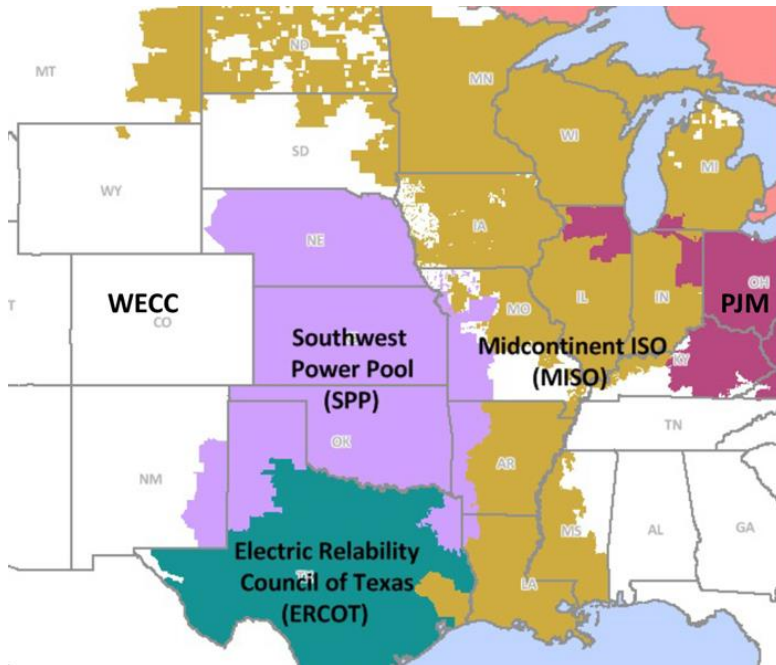
Figure 2

Comparison of 2019 SPP Electricity Futures to Estimated PPA Price for Wind and Gas CCs

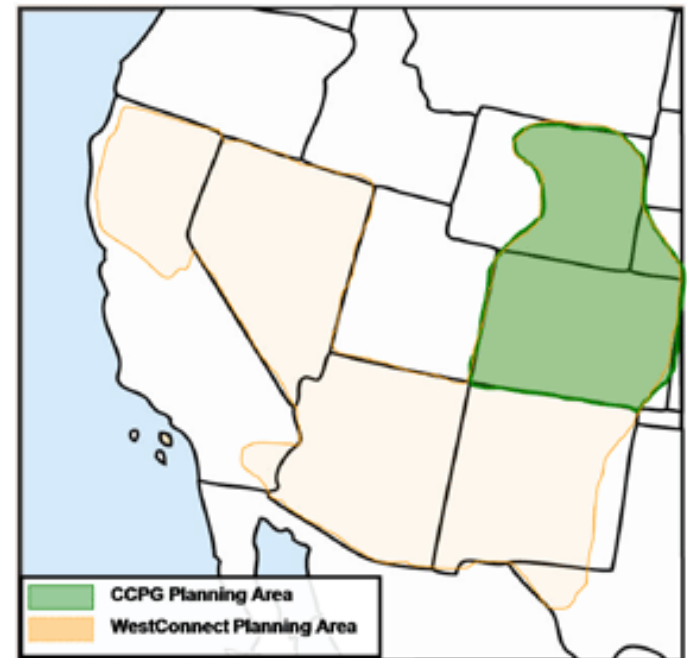


# Transmission Planning Regions

**Figure 5**  
**Regional Transmission Organizations in and around Nebraska as of 2014**

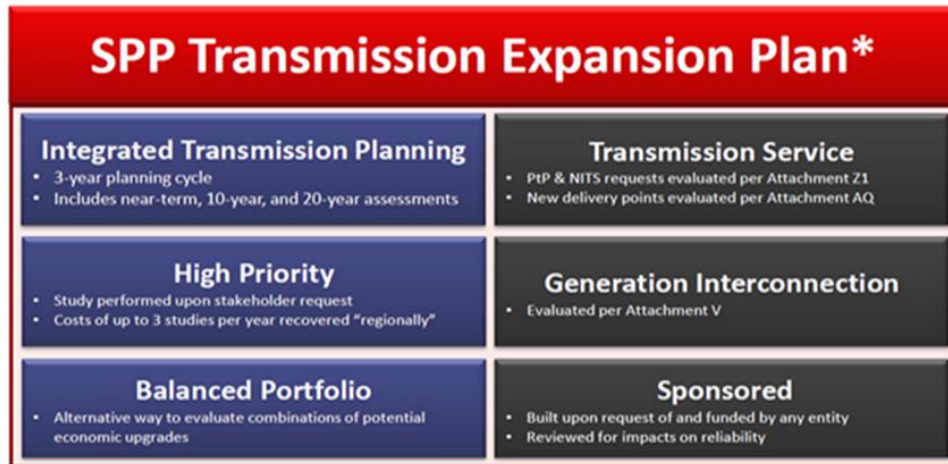


**Figure 6**  
**Colorado Coordinated Planning Group and WestConnect Planning Areas**



# SPP Transmission Planning

**Figure 7**  
**Summary of SPP Transmission Planning Processes**



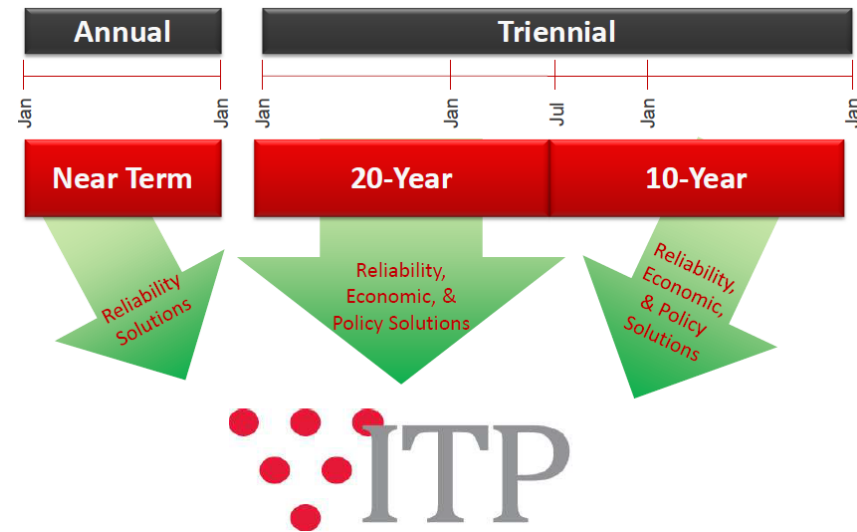
\*STEP submitted at least once per year for SPP Board review and approval

Board Approval Required

Board Endorsement Required



**Figure 9**  
**SPP Integrated Transmission Planning Process Timeframe**



# SPP Cost Allocation

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**Table 1**  
**SPP Highway/Byway Cost Allocation Methodology**

Facility Voltage	Transmission Zone	% Allocated to Nebraska
>300 kV ("Highway")	Anywhere in SPP	14%
100–300 kV ("Byway")	Nebraska	71%
	Rest of SPP	5%
<100 kV	Nebraska	100%
	Rest of SPP	0%



# SPP Transmission Build Out

Figure 8

SPP Transmission Projects in Progress  
as of July 2014

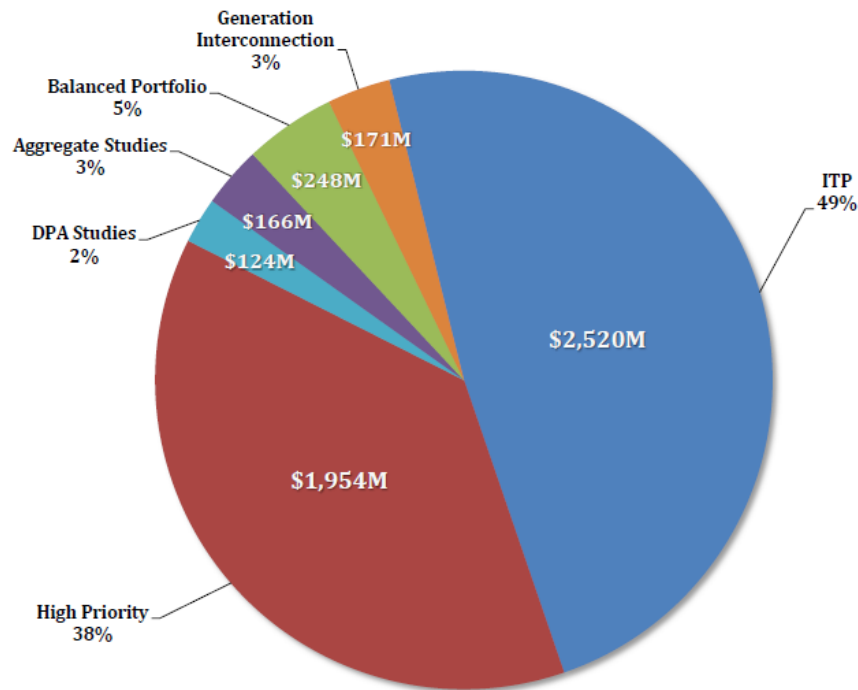
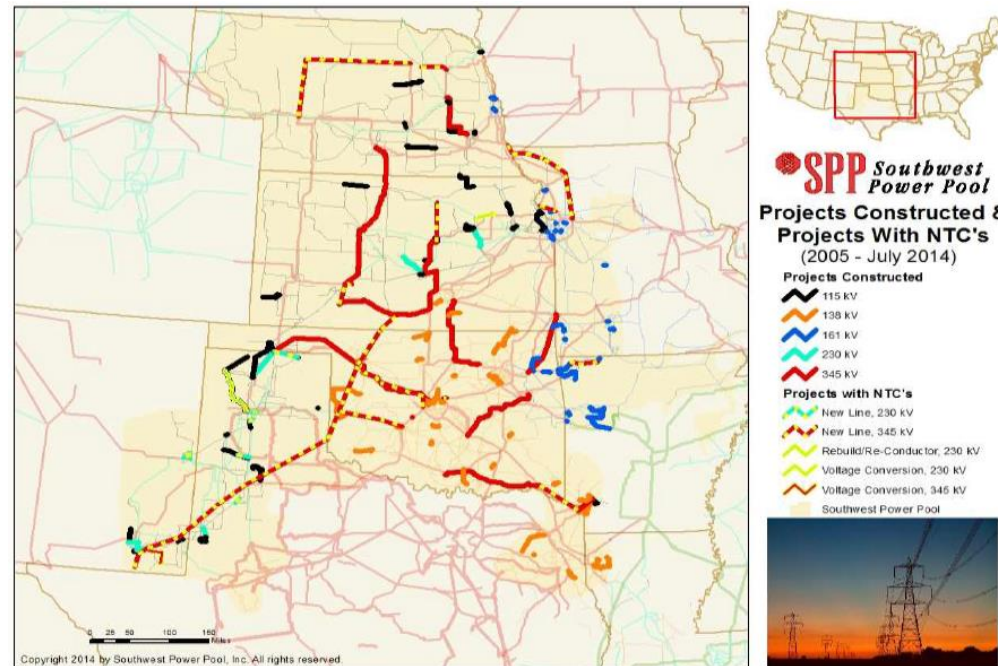


Figure 10

SPP Projects Constructed and  
Projects with NTC's, 2005–2014



# Nebraska Wind and Transmission In Development

**Table 3**

**Major SPP Transmission Projects Planned, Approved, and Under Construction in Nebraska**

Transmission Line	Study	Length	Cost	In-Service Date
Nebraska City–Sibley 345 kV	2010 Priority Projects	215 miles	\$410 million	2017
Gentlemen–Cherry County–Holt County 345 kV (“R-Plan”)	2012 ITP10	220 miles	\$215 million	2018
Neligh–Hoskins 345 kV	2012 ITP10	40 miles	\$80 million	2016
Rebuild North Platte–Stockville–Red Willow 115 kV	2015 ITP10	94 miles	\$68 million	n/a

**Table 5**

**Renewable Generating Plants Operating or Under Development in Nebraska Since 2012**

Wind Generation Facility	Capacity (MW)	Stage of Development	Commercial Online Date	Largest PPA Counterparty
Broken Bow Wind Farm	80	Operating	2012	NPPD
Crofton Bluffs Wind Farm	42	Operating	2012	NPPD
Steel Flats Wind Project	75	Operating	2013	NPPD
Prairie Breeze Wind Energy	201	Operating	2014	OPPD
Broken Bow Wind Farm II	73	Under Construction	2014	NPPD
Verdigre Wind Farm	80	Under Construction	2015	N/A
Grand Prairie Wind	400	Permitted	2016	OPPD

# State Taxes and Incentives for Renewable Energy

**Table 4**  
**State Taxes for Renewable Energy Generation**

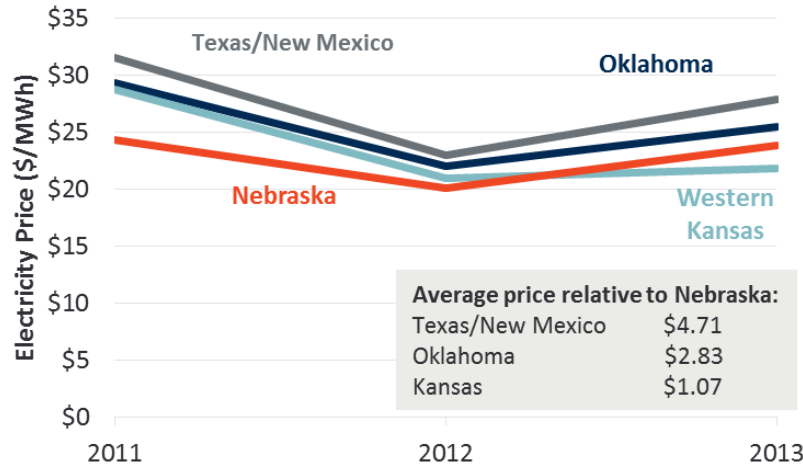
State	Property Tax	Nameplate Capacity Tax	Sales and Use Tax	Production Tax Credit	Estimated Incentives Relative to Nebraska
<b>Nebraska</b>	Exempt from personal property taxes, but not real property taxes	\$3,518/MW	Refunded, except for 1.5% local tax	No Credit	—
<b>Iowa</b>	5 year exemption from real property taxes; no personal property tax	None	Exempt	No Credit	Ranges from \$1/MWh more to \$2/MWh less attractive depending on county
<b>Kansas</b>	Exempt from all property taxes	None	Not Exempt	No Credit	Equivalent incentives
<b>Oklahoma</b>	5 year exemption from ad valorem tax	None	Not Exempt	\$5/MWh for 10 years	\$3.00/MWh <i>more</i> incentives

# SPP Wholesale Energy Prices

Figure 18

## Average Historical Wholesale Energy Prices in SPP

(a) Annual Average SPP Energy Imbalance Service Market Prices for 2011–2013



(b) Monthly Average Day-Ahead Prices in SPP Integrated Marketplace

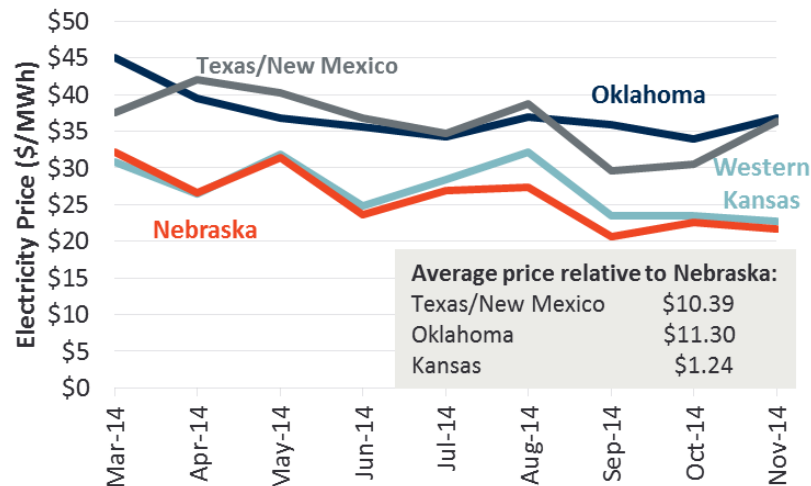
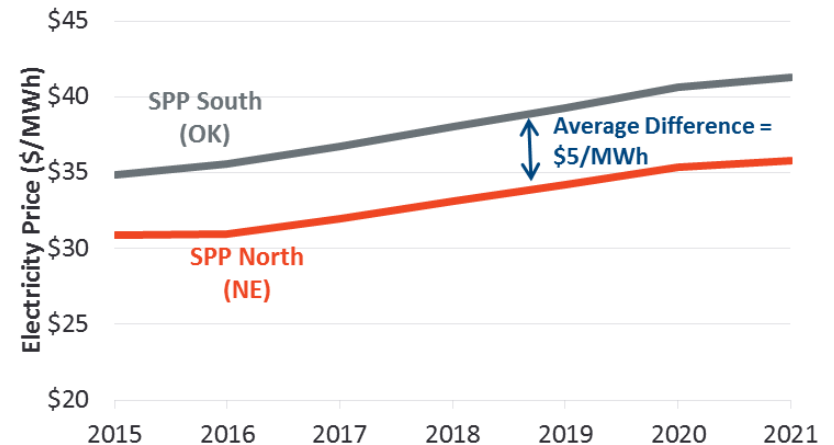


Figure 19

## Electricity Futures Prices by SPP Trading Hub



# Wind Generation Capacity by State

Figure 20

Wind Generation Operating and Under Construction by State

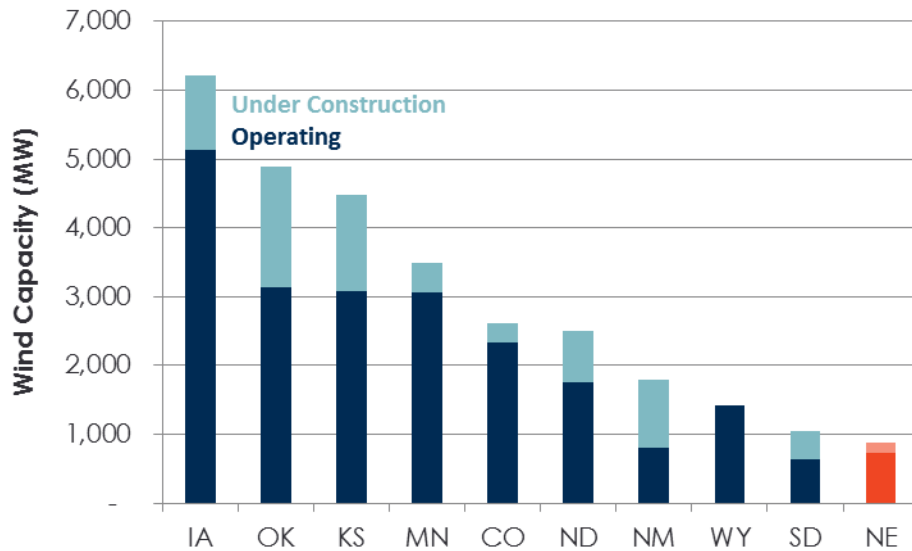
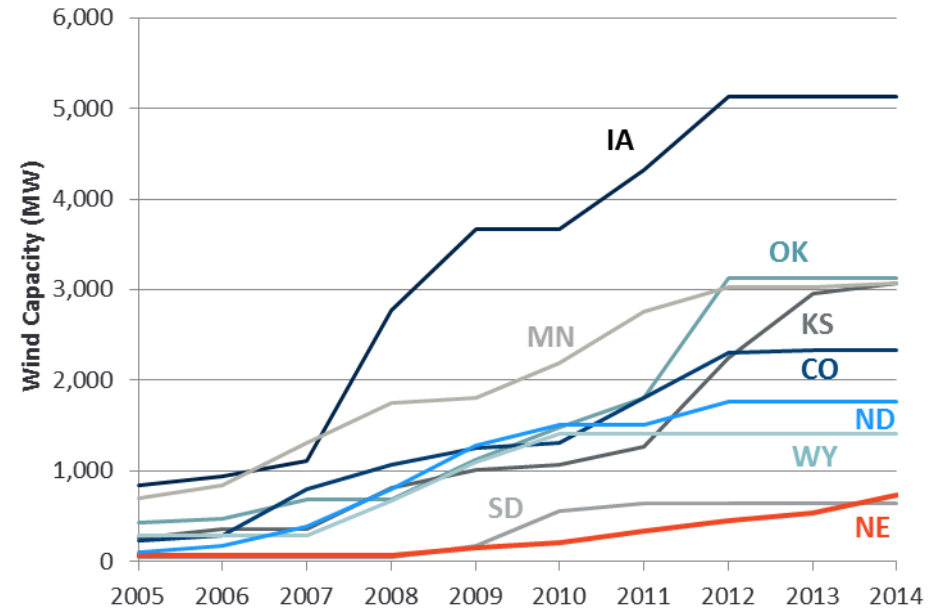



Figure 21

Wind Generation Growth by State





















# CREF Process

**Figure 22**  
**Summary of Nebraska's CREF Process**

Conditional Approval	
Facility must use renewable energy resources and be developed by a non-public power entity	
Demonstrate identifiable and quantifiable public benefits	
Demonstrate intent to negotiate a PPA with a purchaser outside NE for at least 90% of output for 10 years or more	
Offer NE suppliers an option to purchase up to 10% of output	
	
Applicant must notify PRB within 18 months whether it is prepared to proceed to Final Approval	
Final Approval	
Demonstrate facility will not have a materially detrimental effect on the state's retail electric rates	
Demonstrate executed agreements for generation interconnection and transmission service with appropriate transmission provider	
No demonstration (from third-parties) of substantial risk of creating stranded assets owned by NE consumer-owned electric utilities	
Applied for and is actively pursuing required approvals from other federal, state or local entities, including all environmental permits	
Demonstrate that applicant and interconnecting transmission owner have a joint transmission development agreement	
Agree to reimburse electric suppliers for transmission costs not otherwise covered, including renewable integration costs	
Submit a decommissioning plan	
Must meet CREF definition, including having a PPA for at least 90% of output for 10 years or more	

**Table 6**  
**Recommended Options for Simplifying CREF Process**

Requirement	Current Process	Option A	Option B
Demonstrate identifiable and quantifiable public benefits			
Demonstrate intent to sign a PPA with a purchaser outside NE for at least 90% of output for 10 years or more			
Offer NE suppliers an option to purchase up to 10% of output			
Demonstrate facility will not have a materially detrimental effect on the state's retail electric rates			
Demonstrate executed agreements for generation interconnection and transmission service with appropriate transmission provider			
No demonstration (from third-parties) of substantial risk of creating stranded assets owned by NE consumer-owned electric utilities			
Applied for and is actively pursuing required approvals from other federal, state or local entities, including all environmental permits			
Demonstrate that applicant and interconnecting transmission owner have a joint transmission development agreement			
Agrees to reimburse electric suppliers for transmission costs not otherwise covered			
Submit a decommissioning plan			
Must meet CREF definition, including having a PPA for at least 90% of output for 10 years or more			

# Speaker Bio and Contact Information

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### **Note:**

The views expressed in this presentation are strictly those of the presenter and do not necessarily state or reflect the views of *The Brattle Group, Inc.*

Ms. Judy Chang is an energy economist and policy expert with a background in electrical engineering and over 17 years of experience in advising energy companies and project developers with 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 and renewable energy. She also has authored numerous reports and articles detailing the economic issues associated with system planning, including comparing the costs and benefits of transmission. 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 international and multilateral agencies on the valuation of renewable energy investments. She holds a Bachelor of Science in Electrical Engineering from University of California, Davis, and a Master's in Public Policy from Harvard Kennedy School, is a member of the Board of Directors of the Massachusetts Clean Energy Center, and the founding Executive Director of New England Women in Energy and the Environment.

# Speaker Bio and Contact Information

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### Note:

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- Experience with transmission planning and development, climate and renewable policy analysis, and wholesale electricity market design
- Recent transmission-related projects include analysis of the benefits of new transmission, review of transmission permitting processes and costs, and long term scenario analysis for the ERCOT transmission system
- Renewable and climate policy analysis completed for New England RPS market, California AB32 programs, and federal Renewable Fuel Standard
- Assisted utilities, RTOs, and cooperatives in identifying future scenarios to consider in strategic planning efforts
- Brings project management and operations experience from previous work commissioning and operating oil refinery process units while working for Honeywell
- M.S. in Technology and Policy from the Massachusetts Institute of Technology; B.S. in Chemical Engineering from the University of Notre Dame



# Speaker Bio and Contact Information

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### Note:

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- Economist with a background in finance and power engineering
- Over 25 years of power industry experience
- Testified before FERC, U.S. Congress, courts, arbitration panels state and Canadian regulatory agencies
- Extensive experience in transmission and wholesale markets, including transmission cost allocation, inter-regional planning, and analyses of economic benefits
- Worked for utilities, independent system operators, transmission companies, regulatory agencies, public power companies, and generators across North America
- Extensive experience in SPP, MISO, ERCOT, PJM, CAISO and Arizona
- M.A. in Economics and Finance from Brandeis University; M.S. in Power Engineering and Energy Economics from the University of Technology in Vienna, Austria

# About The Brattle Group

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The Brattle Group provides consulting and expert testimony in economics, finance, and regulation to corporations, law firms, and governmental agencies around the world.

We combine in-depth industry experience, rigorous analyses, and principled techniques to help clients answer complex economic and financial questions in litigation and regulation, develop strategies for changing markets, and make critical business decisions.

Our services to the electric power industry include:

- Climate Change Policy and Planning
- Cost of Capital & Regulatory Finance
- Demand Forecasting & Weather Normalization
- Demand Response & Energy Efficiency
- Electricity Market Modeling
- Energy Asset Valuation & Risk Management
- Energy Contract Litigation
- Environmental Compliance
- Fuel & Power Procurement
- Incentive Regulation
- Market Design & Competitive Analysis
- Mergers & Acquisitions
- Rate Design, Cost Allocation, & Rate Structure
- Regulatory Compliance & Enforcement
- Regulatory Strategy & Litigation Support
- Renewables
- Resource Planning
- Retail Access & Restructuring
- Strategic Planning
- Transmission

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