Nebraska Renewable Energy Exports: Challenges and Opportunities

(LB 1115 Study)

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Executive Summary

This "Nebraska Renewable Energy Export Study" is prepared in response to Nebraska Legislative Bill ("LB") 1115 passed in 2014 and the associated Nebraska Power Review Board ("NPRB" or "PRB") Request for Proposal ("RFP"), RFP NPRB-1115. As specified in the RFP, the objective of this report is to identify the opportunities and challenges that impact the capability and desirability of developing 5,000 to 10,000 megawatts ("MW") of renewable generation capacity in Nebraska for export purposes and to provide options that the Nebraska Legislature can consider for meeting its policy objectives. This scope specifically includes:

1. The review of current state, regional, and national transmission infrastructure and policy;
2. The identification of future needs for transmission infrastructure and policy;
3. The assessment of market availability, opportunities, and barriers to the construction of generation facilities using renewable resources in Nebraska primarily designed to export electricity outside the State of Nebraska; and
4. Analyzing the implications on the rates and service to Nebraska's electricity consumers and utilities.

The RFP specified that detailed modeling of the electric power system in and around Nebraska was outside the scope for this study.

In our analysis, we focus on wind generation capacity as the primary renewable resource to be developed in Nebraska for export due to the high quality of the resource in the state. While solar photovoltaic generation capability is growing quickly in many regions of the country, the highest-quality resources are located in states to the south and west of Nebraska. For that reason, we have not specifically evaluated the challenges to building large-scale solar facilities in Nebraska for export markets (assuming those challenges would differ from those identified for wind generation).

To identify the challenges to renewable generation development in Nebraska and provide potential solutions for consideration, we completed the following steps:

- We reviewed the transmission planning processes utilized for expanding the grid and the capabilities of the existing transmission system in and around Nebraska;
- We analyzed the supply and demand balances for renewable generation in the region with a particular emphasis on the competitive landscape in and around Nebraska and the likely target export markets;
- We researched policies and financial incentives for renewable generation development in neighboring states; and

- We interviewed numerous stakeholders, including individuals representing developers of wind generation and transmission projects, the Nebraska public power utilities, environmental regulatory agencies, and the Southwest Power Pool ("SPP").

Based on these analyses and outreach efforts, we arrived at the following findings:

- The broader regional market for additional renewable generation is currently saturated but a new wave of renewable generation development would likely occur in the region if economic opportunities present themselves in the form of higher wholesale electricity prices, implementation of more stringent federal environmental policies, and/or the renewal of federal tax credits. Additional state renewable energy mandates or utility renewable energy targets could also lead to a new wave of development.
- There are currently several market and regulatory challenges that limit the expansion in Nebraska of renewable generation capacity intended for export in the near term and longer term. We find that the most important near-term barriers are primarily cost disadvantages and the perceived permitting and regulatory risks relative to neighboring states. Limited transmission capacity will become a significant barrier in the longer term after exhausting the additional interconnection capabilities and congestion relief provided by already-approved new transmission projects that will be coming online over the next several years.
- Nebraska renewable power exports face substantial competition from neighboring states. In the near term, renewable generation developers in Nebraska face competitive disadvantages that include: (a) lower financial incentives from the state; (b) lower wholesale power prices due to transmission congestion; (c) the perception of a more burdensome permitting and regulatory process; and (d) perceived condemnation risks.
- If Nebraska sets a policy goal to capitalize on the next wave of renewable generation development opportunities, options are available to address the identified competitive disadvantages, including modifications to the permitting process and state tax incentives that could eliminate the economic disadvantage relative to other states.
- The existing transmission system, including transmission additions already approved or under construction, will likely allow for the integration of at least 2,000 MW of additional renewable generating resources into the SPP footprint once the already-approved facilities are placed into service over the next several years. We estimate that the total investment in the local, regional, and interregional transmission infrastructure needed to support the very ambitious target of 5,000 to 10,000 MW of renewable generation in Nebraska would likely range from $1.5 billion to $4 billion (in addition to the transmission upgrades currently under development). A potentially significant portion of this cost would likely have to be borne by Nebraska utilities and their customers, depending on the extent to which the new lines are developed through the regional transmission planning processes. Some of these costs however will be offset by the benefits of reduced transmission congestion that increase the value of all power sales by Nebraska electric suppliers and reduce the net cost to Nebraska ratepayers.

- To address the long-term transmission expansion and cost allocation challenges, Nebraska will need to explore how to best take advantage of the regional planning and cost allocation processes of SPP and, additionally, evaluate other options to construct the necessary transmission to minimize any adverse impacts on the state's electricity customers. These other options include "sponsoring" self-funded transmission projects within SPP and interconnecting wind resources directly into the Western power market, the Midcontinent Independent System Operator ("MISO") market, or to a merchant line. Due to the long-term nature of transmission planning and development, Nebraska would need to start the process now of evaluating its options and setting its long-term transmission strategy.
- Developing 5,000 to 10,000 MW of new renewable generation and associated transmission in Nebraska would almost double the total wind generation currently installed in the entire SPP footprint and exceed the wind development assumptions made in any of the pre-existing industry studies. This ambitious level of renewable resource development would provide significant economic stimulus benefits and support additional jobs in the state. However, these and other potential benefits to the Nebraska economy will need to be weighed against the potentially significant costs of additional transmission infrastructure and the associated economic impacts on Nebraska utilities and their consumers.

We address these topics in the body of the report by: (1) reviewing transmission planning and cost allocation challenges; (2) analyzing the potential market for renewable power exports out of the State of Nebraska; (3) documenting the challenges faced by renewable development efforts in the state; and (4) developing a menu of options available to Nebraska policy makers to address the identified transmission-related and competitive challenges.

A. Challenges to Increasing Nebraska Renewable Energy Exports

Based on our analysis and input from stakeholders, we identified the following challenges in Nebraska to increasing the wind generation capacity intended for export:

Challenge #1: Transmission Constraints

Based on our review of SPP studies, we find that the existing transmission system in Nebraska, including transmission additions already approved or under construction, will likely allow for the integration of at least 2,000 MW of additional renewable generating resources in Nebraska once the currently approved facilities are placed into service from 2016 to 2018. Achieving the targeted development of 5,000 to 10,000 MW of Nebraska renewable generation, however, will require a substantial further expansion of the state and SPP regional transmission systems.

Experiences elsewhere show that new wind resources are not developed until sufficient transmission infrastructure is expected to be available and accessible. Expanding transmission infrastructure often cannot be justified without committed development of new wind resources. This relationship between wind generation and transmission development creates a "chicken-or-

egg" challenge such that the pace of new wind generation development depends greatly on the projected transmission capabilities.

The three largest electric suppliers and transmission owners in Nebraska are part of the SPP regional transmission organization ("RTO"), which has the overall responsibility of planning expansions necessary to meet the future needs of the member states. SPP and the SPP Regional State Committee ("RSC") developed transmission planning and cost allocation processes that identify the need for local and regional transmission upgrades and assign the costs of the new transmission to generators, transmission service customers, and SPP load-serving transmission owners based on a complex set of rules and criteria. The details of SPP's current transmission planning process is described in more detail in Section III of this report, but some important facts include:

- The SPP transmission planning process consists of near-term, 10-year, and 20-year planning horizons. Including state permitting processes and the construction of the facilities, it has taken approximately three to eight years to plan and build major regional transmission upgrades in SPP.
- SPP (and any other) regional planning processes are multi-state, multi-stakeholder processes that are often contentious and, thus, create both planning and cost allocation risks that need to be considered in any state's renewable or transmission strategy.
- SPP plans transmission on a portfolio basis. During any planning cycle, the portfolio of transmission projects may consist of lines justified primarily by reliability needs, economic needs (*e.g.*, to reduce transmission congestion), or public policy needs. The justification of a line according to one or more of these needs does not affect transmission cost allocation under the SPP highway/byway tariff.[1]
- Allocation of the total cost of a transmission project on an SPP-wide basis (of which Nebraska utilities would pay approximately 14%) requires that (a) the transmission facilities operate at a voltage level above 300 kilovolt (kV) and (b) they are approved by the SPP board as part of the SPP regional planning process.
- For transmission facilities, which operate at voltage level of 100–300 kV (the typical voltage level for renewable "gathering" lines), one-third of a project's cost is shared on an SPP-wide basis if the facilities are approved as part of the SPP regional planning process.
- The cost of transmission upgrades is allocated directly to renewable generators if the upgrade is necessary to support the generation interconnection. For transmission service requests ("TSRs"), the customers (*e.g.*, the offtakers for a wind plant) are

[1] The classification of projects will, however, affect the Regional Cost Allocation Review ("RCAR") process developed by the SPP RSC, which attempts to make sure that the utilities and states who receive cost allocations also receive commensurate benefits. Under the current approach, the assumed benefits of public policy projects are assigned to the local zones that required the public policy upgrade, even though this does not directly affect the cost that had previously been allocated.

allocated upgrade costs beyond certain thresholds. SPP also allows the regional allocation of two-thirds of the transmission upgrades required to accommodate requests for long-term transmission service from a designated wind power resource located in one SPP zone for delivery to another zone within the SPP footprint.

- Nebraska, through its public power utilities, can "sponsor" self-funded transmission projects within the SPP planning process. Such sponsored projects would largely bypass SPP's increasingly contentious planning and cost allocation processes.

To expand transmission to Western power markets would likely be costly as there is limited capacity between the Eastern and Western Interconnection and, even within the Western Interconnection, significant constraints exist between western Nebraska and load centers in Colorado and further west. In addition, Nebraska resources will face significant competition from similar-quality wind resources in Wyoming and Colorado.

While transmission planning processes are well established within regions, few effective and actionable planning processes currently exist for transmission upgrades across regional boundaries. Although, in Order 1000 FERC mandated that the regional transmission organizations develop "interregional" planning, relatively little progress has been made to date and FERC has not yet ruled on the adequacy of the proposed interregional planning processes. Moreover, neighboring regions do not yet fully agree on how interregional planning should be conducted.

Challenge #2: Limited and Uncertain Demand for Renewable Energy

The broader regional market for additional renewable generation is currently saturated as there is limited unmet demand for renewable generation created by state Renewable Portfolio Standards ("RPS") and renewable energy targets in the region around Nebraska. We find that the regions within the United States with the greatest remaining demand for renewable resources are located along the east and west coasts. The regions with the highest known RPS-driven demand for renewable energy are the Mid-Atlantic states located within the PJM Interconnection ("PJM").

Beyond demand associated with state RPS requirements, wind resources can be attractive for development if their costs are competitive with energy market prices and conventional generation sources, such as new natural-gas-fired combined-cycle ("CC") plants. Despite the expiration of the federal production tax credit ("PTC"), the levelized cost of wind energy ($45 to $60 per MWh) is similar, if not lower, than the costs of energy from gas CC plants ($50 to $65 per MWh). It is important to note, however, that natural-gas-fired CC facilities provide significant more system flexibility and capacity value, whereas the capacity value of wind plants is often only 10–20% of its nameplate capacity. Then again, wind generation offers certain advantages, such as providing some price certainty and a natural hedge against volatile gas prices. As a result, the comparison of levelized costs provides only a partial picture of the relative economics of the two types of resources.

Based on our review of the market demand for renewable energy exports, we find it most 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; or
- Environmental regulations around fossil-fueled generation resources, such as EPA's proposed Clean Power Plan ("CPP"), 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 Compared to Neighboring States

Our review of renewable resource development shows that the development of new wind facilities in the Great Plains is very competitive, with many developers competing to sell renewable power to utilities in nearby states. For this reason, even a small difference in the comparative economics of wind generation across states can result in a significant difference in developers' decisions of where to build the new facilities. In the near term, renewable generation developers in Nebraska face competitive disadvantages that include: (a) lower financial incentives from the state; (b) the perception of a more burdensome permitting and regulatory process; (c) perceived condemnation risks; and (d) lower wholesale power prices due to transmission congestion.

Some states offer higher tax incentives to renewable energy than Nebraska. Specifically, tax incentives for wind developers come in the forms of state-provided PTCs, property tax exemptions, and sales tax refunds. While we estimate the tax incentives available in Nebraska to be equivalent to the same resources built in Kansas, our analysis shows that additional tax incentives in Oklahoma put Nebraska at an economic disadvantage of approximately $3.00 per MWh of wind energy produced.

A second reason wind projects located in Nebraska are less competitive than projects in other states is that the prices in SPP's wholesale power market are lower in Nebraska than in some competing states. This means wind resources located in Nebraska (along with other generation resources in the state) receive lower revenues from the SPP wholesale energy market than wind resources located in other SPP states. Historically this disadvantage has been approximately $1 to $5 per MWh on an annual average basis relative to Oklahoma and the wind-rich SPP regions in Texas and New Mexico. More recently, the differential between prices in Nebraska and the southern portion of SPP in the Integrated Marketplace ("IM") has been $10 to $11 per MWh. However, wind generators located in Nebraska now see about the same prices as those in western Kansas.

Looking forward, electricity futures in SPP suggest that the price differentials between Nebraska (represented by the SPP North Hub) and southern SPP (represented by the SPP South Hub,

which primarily reflects market prices in Oklahoma) are expected to persist at a level of approximately $5 per MWh.

All other factors being equal (including wind quality, labor costs, and development costs), the combination of more attractive financial incentives and higher wholesale power prices enjoyed by wind project developers in other states consequently can provide an additional $5 to $10 per MWh economic disadvantage for developing wind generation in Nebraska.

Challenge #4: Greater Perceived Risks Compared to Neighboring States

Our interviews with stakeholders indicated that many large wind plant developers have already gained substantial experience in neighboring states. This leaves Nebraska as an "unfamiliar territory." Due to the limited experience of developing new renewable generation in Nebraska, some developers are much less familiar with the time and cost required to develop projects in Nebraska than in some neighboring states. Due to this lack of familiarity with Nebraska-specific regulations, renewable energy development in Nebraska is perceived to face more risks than in some neighboring states.

For example, Nebraska is the only state in the region to require special regulatory approvals for wind developers intending to either export their renewable power or sell it into the wholesale market. These approvals need to be obtained from the Nebraska PRB through the Certified Renewable Export Facility ("CREF") process. The CREF process, though designed not to be overly complicated, nevertheless is perceived as an intimidating additional regulatory step that is not required in other states. Developers indicated that the PRB, as a regulatory agency, has been "easy to conduct business with." However, because no developer has actually completed the full CREF approval process, it is difficult to estimate the time and costs that such a process might add to a renewable generation development effort.

Permitting requirements in Nebraska, such as obtaining environmental permits or completing county and local zoning and permitting processes, are no more difficult than in neighboring states.

B. Options for Addressing the Identified Challenges

We anticipate that demand for renewable energy will continue to grow in the long term because of the market forces discussed above. If Nebraska wants to pursue the very ambitious development of 5,000 to 10,000 MW of renewable resources in the state, we offer four options for further consideration by the Nebraska Legislature.

Option #1: Develop a State-Wide Transmission Strategy

Since the planning, development, and construction of major transmission projects have taken three to eight years to complete, addressing transmission constraints within and out of Nebraska as a long-term barrier will be an essential component of the state's long-term renewable

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

a. **Pursue transmission infrastructure development through the SPP planning process:** Nebraska will need to continue to work within the existing SPP Integrated Transmission Planning ("ITP") process to identify the regional transmission upgrades necessary to support the integration of renewable generation developments in Nebraska and facilitate associated energy exports. To take advantage of the SPP ITP process, Nebraska could identify transmission projects necessary for meeting its public policy objective and work with SPP and its other stakeholders to develop the necessary transmission upgrades within the SPP planning process for inclusion in SPP's transmission plan. The advantage to this approach is the opportunity to share all or a portion of the costs of new transmission facilities across the entire SPP region.

b. **Evaluate and reduce barriers related to the SPP generator interconnection and transmission service request process:** Every generator interconnecting with the transmission system requires an interconnection study by SPP to ensure that the grid is able to support its electricity production and capacity intended for export must submit a transmission service request. SPP will then identify any network upgrades that would be necessary to support the requests. These upgrades can be very expensive if pursued on a case-by-case basis. One option that Nebraska can explore to reduce the costs associated with individual generation interconnection and transmission service requests is to channel renewable developments to specific geographic locations and group likely future requests to achieve a more cost-effective scale.

c. **Explore state-sponsored "gathering" facilities:** To facilitate wind development of sufficient scale within the state, Nebraska may want to consider exploring the development of state-sponsored transmission projects that would act as gathering facilities for future wind farms. Such transmission projects could be targeted to connect the most attractive geographic locations for renewable energy developments in Nebraska to the SPP backbone transmission network. This approach would likely require Nebraska to provide up-front funding for at least some portions of the necessary transmission infrastructure. It may be possible, however, to develop a new tariff for cost allocation that would allow charging back (on a *pro-rata* basis) some of the costs associated with these transmission facilities to renewable generators or transmission service customers when they interconnect with these facilities. Broader regional network upgrades related to such a "gathering system" may also qualify for SPP cost sharing if they are folded into the SPP ITP process.

d. **Explore developing transmission interties to markets outside of SPP:** Nebraska policy makers and transmission owners may want to evaluate the extent to which it may be attractive to bypass interregional planning processes by developing transmission infrastructure that would directly connect Nebraska renewable generation with markets to the west and east of the state. This effort may include connections to merchant lines that could provide access to attractive but more distant markets. Under this option, the transmission facilities and interconnecting Nebraska generators would *not* be part of the

SPP system. Similar to the gathering facilities option discussed above, Nebraska policy makers and transmission owners could identify renewable energy regions that would be attractive for such direct exports to neighboring regions. The costs associated with developing direct transmission interties to neighboring markets or merchant transmission lines would likely require upfront funding from the state, although at least some of the costs could be recovered from interconnecting generators and transmission service customers.

Option #2: Additional Tax Incentives

If Nebraska wants to stand ready to capture the next wave of renewable energy development, the legislators may consider immediately eliminating the economic disadvantage (in terms of tax incentives and wholesale electricity prices) faced by wind generators in the state. This could be achieved through additional tax incentives. We estimate that the additional financial incentive needed to overcome the combined economic disadvantage currently faced by Nebraska renewable resource development efforts would be in the range of $5 to $10 per MWh.

There are several types of tax-related incentives that Nebraska could provide to renewable generators in the state. For example, Nebraska policy makers could:

a. **Eliminate the current Nameplate Capacity Tax** on wind generators, which would provide approximately $1 per MWh of incentives to wind generators.

b. **Provide a state-level production tax credit** of $5 to $10 per MWh, which would offset the combined economic disadvantage that new facilities in Nebraska currently face over those in the most attractive states within the SPP region.

c. **Provide a state-level investment tax credit ("ITC")** that provides an incentive equivalent to $5 to $10 per MWh over the twenty-year lifetime of the facilities. We estimate that an ITC of 9% to 18% would be able to do so.

Among these state incentive options, eliminating the nameplate capacity tax and providing an ITC would likely be most effective.

Option #3: Simplify the CREF Process

To reduce the perceived and actual challenges in Nebraska for approval of wind generation facilities created by the CREF process, the Nebraska Legislature may consider simplifying the current responsibilities of the PRB to limit the scope of approval. We offer two options for consideration by Nebraska policy makers, as summarized in Table ES-1:

a. **Limit CREF approval to include only: the environmental impact assessment and other permits; the offtake power purchase, interconnection, and transmission service agreements; and the decommissioning plan.** Under this first option, Nebraska could eliminate the requirement that renewable energy developers assure that the costs associated with the facilities would not create detrimental impacts on customers' retail electricity rates. Further, Nebraska may consider eliminating the requirement that

renewable energy developers must offer 10% of the output of their facilities to the Nebraska electric suppliers.

b. **Limit the CREF approval process to only the review of environmental impacts, other permits, and the decommissioning plan.** This second option would limit the approval process to only an environmental and permits review and not require the developers to provide any demonstrations of the economics associated with the project. We offer this option recognizing that having adequate offtake power sales opportunities and obtaining the necessary generator interconnection, transmission development, and transmission service agreements are often part of successful renewable generation development and pre-requisites to operating a financially viable project.

Table ES-1
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	✓	✓	

In addition, Nebraska policy makers should consider further reducing or entirely removing the threats of condemnation of renewable energy facilities and related transmission interties built in Nebraska, whether or not the CREF approval is in place.

Option #4: Create a State Function to Promote Nebraska Renewables

Nebraska could consider setting up a function within an existing governmental or quasi-governmental agency (such as within the Nebraska Department of Economic Development) that helps the state to promote and achieve its renewable generation policy goals. This function would actively promote renewable resources development in the state, monitor market conditions to identify emerging opportunities and necessary policy changes, work with the PRB and Nebraska Transmission Owners to evaluate the lowest-cost options for necessary additional transmission infrastructure, and help guide developers through the process of getting facilities permitted in Nebraska. This added function would need the active and credible support of key state policy makers to be effective in the pursuit of its activities and goals, which could include the following:

a. Reaching out to renewable developers and potential renewable energy customers to promote Nebraska as an attractive location that is "open for business" in the renewable energy space.

b. Guiding interested renewable generation developers through the project development process, including accessing the tax incentives provided by the state, obtaining the necessary permits and regulatory approvals, and facilitating the development effort at the local/county level.

c. Streamlining the processes necessary for the development of renewable energy and transmission infrastructure, including providing support for meeting the siting requirements for renewable and transmission projects by conducting preliminary environmental impact analyses across the state to identify and prioritize locations where renewable energy and transmission facilities can be built most economically with the least impact on the environment.

d. Communicating with landowners about the state's efforts in attracting renewable energy development, responding to concerns prior to when specific projects are proposed, and providing educational materials to the public to raise awareness of the value of developing renewable resources and transmission facilities in the state.

e. Continuing to monitor the market conditions for renewable energy, identifying emerging opportunities (such as in response to new federal environmental regulations), and determining if and when state regulatory structure and policies need to adjust to the changing environment to capitalize on emerging opportunities.

f. Contributing to the development of a state transmission strategy.

C. Impacts on Electricity Rates and Economic Development in Nebraska

Increasing renewable energy capacity in Nebraska will affect ratepayers through its impacts on transmission investment and the operation of the wholesale market. We estimate that the total transmission investment to achieve the ambitious target of 5,000 to 10,000 MW of renewable generation, as stated in the RFP, would likely cost between $1.5 billion and $4.0 billion. However, Nebraska ratepayers are not likely to pay for the total cost of the transmission upgrades

due to SPP's cost allocation approach for lines that are identified through the ITP process. In addition, a certain portion of total costs can likely be assigned directly to the developers and offtakers for developing the facilities required for interconnection and transmission service. Major additional transmission investment is unlikely to be required until after 2022 due to the transmission projects currently under development. Thus, any rate increases would be gradual. Excluding consideration of offsetting benefits such as congestion relief, we estimate that the addition of a $1 billion transmission line that operates at 345 kV would increase Nebraska electricity rates by approximately 0.7%.

Nebraska electricity rates may also increase due to the impact of the renewable energy capacity on the wholesale market. Lower SPP wholesale power prices in Nebraska caused by congestion from increased wind generation will reduce the off-system sales revenues that Nebraska electric suppliers use to offset the cost of the surplus generation they own. We estimate that if the average SPP wholesale price in Nebraska were to be reduced by $5 per MWh, Nebraska electricity rates would be expected to increase by 2% on average.

Another impact of adding renewable generation on the wholesale market is an increase in the balancing costs for providing backup capacity to respond to intermittent generation from the wind capacity. The additional costs of balancing the systems with significant wind penetration has been estimated to range from $2 to $10 per MWh of wind generation. These costs are imposed on electricity customers across the entire SPP footprint, including Nebraska, through ancillary service charges and higher generation costs. However, the increased need for balancing services also offers an opportunity for existing generation owners to earn additional ancillary service revenues. These additional revenues earned by Nebraska electric suppliers will offset at least some of the additional costs—particularly if Nebraska electric service providers own generation that can provide (or could be modified to provide) such balancing services at relatively low cost.

Taking on greater costs to the state or its electricity ratepayers should be weighed by the Legislature against the economic stimulus benefits of wind generation and transmission development. As summarized in Table ES-2, we estimate that at the ambitious scale of 5,000 to 10,000 MW, the build out of both the renewable generation and transmission would create approximately 50,000 to 100,000 full-time equivalent ("FTE") years of employment, $7 to $15 billion in economic activity, and $33 to $66 million in annual property taxes.

Table ES-2
Economic Benefits of Additional Wind Capacity in Nebraska

Additional Wind Capacity	Full-Time Equivalent Years of Employment			Economic Activity			Property Taxes
	Wind	Transmission	Total	Wind	Transmission	Total	
MW	*FTEs*	*FTEs*	*FTEs*	*$m*	*$m*	*$m*	*$m/yr*
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

Source and notes: Based on analysis with the NREL JEDI model performed for Nebraska as part of this effort and previous analysis provided in Pfeifenberger, *et al.*, 2010 and Lantz and Tegen 2011. See Table 8 in body of the report for additional details.

I. Introduction

The Nebraska Legislature in 2014 passed Legislative Bill ("LB") 1115 requiring the Nebraska Power Review Board ("NPRB" or "PRB") to conduct a study to analyze the state, regional, and national transmission infrastructure and policy and the future needs for transmission infrastructure and policy to serve electric consumers, utilities, and generation facilities in Nebraska seeking to export electricity outside of the state.[2] As stated in Section 2 of LB 1115, the purpose of the study is to support the policy of the State of Nebraska:

> To encourage and allow opportunities for development and operation of renewable energy facilities intended primarily for export from the state in a manner that protects the ratepayers of consumer-owned utility systems operating in the state from subsidizing the costs of such export facilities through their rates and that results in economic development employment opportunities for residents and communities of the state.[3]

The subsequent PRB Request for Proposal ("RFP"), RFP NPRB-1115, asked for the analysis to be completed in accordance with LB 1115 and provided a more specific goal of identifying the challenges and potential solutions associated with the development of 5,000 to 10,000 MW of renewable power resources in Nebraska for export purposes.[4] The analysis requested by the RFP includes identifying any federal or state legal and/or regulatory requirements or practices that might have created impediments to the development of renewable generation facilities in Nebraska designed for export.[5]

In response to the requirements specified in LB 1115 and the PRB RFP, the scope of our analysis for the Nebraska Renewable Energy Export Study includes: (1) the review of current state, regional, and national transmission infrastructure and policy; (2) the identification of future needs for transmission infrastructure and policy; (3) the assessment of market availability, opportunities, and barriers to the construction of generation facilities using renewable resources in Nebraska primarily designed to export electricity outside the State of Nebraska; and (4) analyzing the implications on the rates and service to Nebraska electricity consumers and

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2 Nebraska State Legislature 2014.

3 Nebraska State Legislature 2014, Section 2.

4 To put the requested target renewable generation development into context of the size of the SPP market, the high end of this target exceeds the current and future total peak load in Nebraska, projected to grow from 7,000 MW to 8,000 MW by 2030. It also exceeds the installed capacity of the leading wind generation states in the region, such as Kansas and Oklahoma, which each have approximately 3,000 MW of wind generation installed with an additional 1,000 MW under construction. Iowa currently has over 5,000 MW of installed wind generation.

5 NPRB 2014b.

utilities, including the economic development benefits of expanded renewable energy development and transmission in the state.

As required in LB 1115 (2014), we have solicited and gathered input from the LB 1115 Working Group on the overall scope and specific areas of expertise to contribute to our analysis. This working group includes members of the Nebraska Legislature, the State Energy Office, the Department of Economic Development, public power districts and other Nebraska electric providers, renewable energy development companies, municipalities, the Southwest Power Pool ("SPP"), the Western Area Power Administration ("WAPA"), other transmission system owners, transmission operators, transmission developers, and environmental interests. A full list of participants is included in Appendix A.

In our analysis, we focus on wind generation capacity in Nebraska as the primary renewable resource to be developed for export due to the high quality of the resource in the state relative to other states. While solar photovoltaic capacity is growing quickly in many regions of the United States ("U.S."), the highest quality resources are located in states to the south and west of Nebraska. For that reason we have not specifically evaluated the barriers to building large-scale solar facilities in Nebraska for export markets (assuming those barriers would differ from the identified barriers to wind generation).

To identify the barriers to wind development in Nebraska and provide potential solutions, we completed the following steps:

- We reviewed the capabilities of the transmission system in and around Nebraska and the transmission planning processes utilized for building future transmission projects;
- We analyzed the supply and demand balances for wind generation in the region with a particular emphasis on the competitive landscape in and around Nebraska and likely export markets;
- We researched policies and financial incentives for renewable generation development in neighboring states; and
- We interviewed numerous stakeholders, including individuals representing developers of wind generation and transmission projects, the Nebraska public power utilities, environmental regulatory agencies, and SPP.

As specified in the RFP, the scope of our analysis did not include modeling the electric power system in Nebraska and SPP. We rely on existing sources and studies to provide high-level or qualitative discussions of some of the issues associated with developing additional wind generation, such as the quantity of wind generation that can be added before significant transmission-related curtailments would be required, the impact of additional wind generation on wholesale market prices, and changes to the market revenues earned by existing generation facilities in Nebraska.

The remainder of this report contains our analyses, findings, proposed solutions, and potential costs and benefits for the Nebraska Legislature to consider. It is organized as follows: Section II

summarizes the current outlook for renewable energy export demand in the states and electricity markets around Nebraska; Section III provides a summary of the transmission planning process in SPP and the Western Interconnection that impacts the amount of renewable generation that can be developed for export markets; Section IV provides perspective on the competitive landscape for renewable generation development in the states around Nebraska; Section V summarizes the barriers in Nebraska to expanding renewable generation primarily intended for export; Section VI includes potential solutions for the Nebraska Legislature to consider for overcoming the barriers; and Section VII provides a summary of the potential rate impacts to Nebraska ratepayers and the economic benefits that renewable generation and the associated transmission development may provide to the state of Nebraska.

II. Potential Market for Renewable Energy Exports from Nebraska

Over the past decade the demand for renewable energy in the U.S. has increased significantly. To date, the growth of renewable energy generation across the country has been driven primarily by state-level Renewable Portfolio Standards ("RPS") or specific targets set by some of the utilities and their governing boards. In addition, the combination of federal tax credits, improvements in wind turbine technology, and abundant wind resources has driven down the cost of wind power in the past few years such that some wind projects can compete with existing and new conventional sources of electricity generation.

The economics of wind generation in wind rich locations is especially compelling on a long-term basis, when considering the proposed U.S. Environmental Protection Agency ("EPA") rules to reduce greenhouse gas ("GHG") emissions from existing fossil generation and the potential costs of complying with the new environmental regulations. This section of the report reviews the current and future demand for renewable energy generation that could serve as markets for Nebraska exports.

A. State Renewable Energy Policies

The current state-level RPS and renewable energy targets typically set a percentage of electricity usage in the state to be met by renewable energy resources. In response to these requirements and targets, electric utilities (termed as "electric suppliers" in Nebraska) are obligated to supply their load with sufficient renewable generation by either building the capacity or entering into long-term power purchase agreements ("PPAs") to purchase wholesale power from renewable generators.

Over the past five to ten years, the state RPS and renewable energy targets have created an increasing demand for new renewable energy generating capabilities. The Midwestern states with the most aggressive RPS mandates are Minnesota and Illinois, both requiring 25% by 2025. In SPP, Kansas has set a renewable target of 20% for the state's investor-owned utilities and requires the electric cooperatives to generate or purchase 20% of the utilities' peak demand by 2020. Oklahoma has a goal of 15% of energy by 2015. Texas and Missouri also have renewable

targets; however, most of the load and therefore renewable energy requirements in those states are located outside of SPP. For this reason, the majority of the mandated renewable energy demand in SPP comes from Kansas and Oklahoma.[6] In Nebraska, both the Nebraska Public Power District ("NPPD") and the Omaha Public Power District ("OPPD") have set renewable energy targets that have been recognized by SPP in its evaluation of public policy projects.

Our analysis of the future renewable energy requirements finds that most, if not all, of the incremental unmet demand through 2025 for the states in the Midcontinent Independent System Operator ("MISO") and SPP have been met by the existing renewable resources. Outside of MISO and SPP, our estimates of the remaining regional demand for renewable energy based on state RPS requirements that have not yet been contracted are shown in Figure 1.[7]

In developing our analysis, we compared the energy produced from existing renewable generation and plants already under construction within each state to the state's RPS mandates, accounting for the entities that are required to meet the mandates.[8] These estimates of unmet renewable demand are similar to those prepared by SPP and PJM Interconnection ("PJM"). SPP reviewed RPS demand at a more granular level, utility by utility, finding that renewable capacity built by December 2012 already provided the majority of total demand associated with mandates and voluntary goals for 2022 and beyond (which does not account for the growth of wind capacity in SPP over the past two years or those currently under construction, which currently exceeds 3,000 MW in Kansas and Oklahoma).[9] PJM's 2014 analysis of future renewable integration challenges projects 28,000 MW of onshore and offshore wind will be necessary to meet RPS requirements, in addition to 7,000 MW of solar capacity.[10]

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6 A complete summary of RPS mandates and targets across the U.S. can be found at DSIRE: Database of State Incentives for Renewables & Efficiency website at: http://www.dsireusa.org/

7 The generation capacity listed is based on the expected capacity factor for new builds in each region. As capacity factors in Nebraska are equivalent or exceed those in other states, the amount of wind capacity in Nebraska to meet these requirements would be less than what is shown.

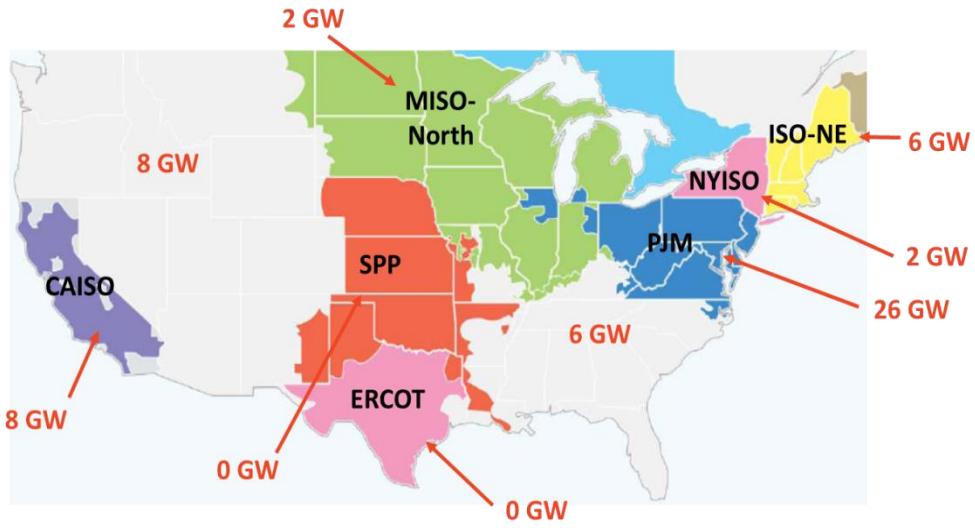
8 A significant amount of proposed renewable generation capacity in neighboring states is in earlier stages of development and includes projects that have received required permits. These proposed projects were not included in this analysis. The proposed projects do, however, compete with any Nebraska renewable generation development efforts for the shown demand for renewables energy.

Because some states allow RPS mandates to be satisfied through imports from other states within the region, several states' renewable generation exceeds their in-state mandates. Based on our experience, however, some utilities procure renewable energy beyond their mandates (or without a mandate). Thus, not all renewable generation in excess of state mandates is available for others within the region. We assumed that only approximately half of the in-state renewable generation that exceeds the state's mandates can be relied upon to satisfy mandates in other states.

9 SPP 2012b.

10 GE 2014.

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



Sources: Database of RPS primarily from DSIRE 2014 and existing capacity from Ventyx 2014. We assume in our analysis that onshore wind generation meets 80% of the remaining unmet demand. The 6 GW of remaining demand in the southeast is based solely on the North Carolina RPS mandate, which is increasingly being met by new solar capacity built in the state. Entergy (operating in AR, LA, TX and MS) has since joined MISO to become "MISO South" (see Figure 5).

This analysis shows that the regions with the greatest remaining demand for renewable resources are located along the east and west coasts. The states that are most likely to provide the largest regional market for generation exported from Nebraska are the Mid-Atlantic States located within PJM. Note, however, that only a portion of the RPS-related demand can be satisfied through imports into the respective states. For example, in PJM only five states (representing approximately half of the region's unmet demand) allow their requirements to be satisfied through imports.[11] Similarly, there are currently very limited opportunities for out of state resources to meet California's requirements.[12] However, satisfying renewable energy needs through exports from Nebraska in any of the regions with such unmet demand presents significant additional challenges related to transmission availability, transmission planning, and cost challenges as discussed in the next section of this report.

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11 Within PJM, New Jersey, Maryland, Delaware, Ohio and the District of Columbia allow out-of-region resources delivered to PJM (or to the state) to qualify.

12 The California 33% RPS is projected by the California Public Utility Commission ("CPUC") to be met with plants currently operating and under development through long-term contracts. (CPUC 2014)

The remaining non-California RPS demand in the Western Interconnection is primarily located in Colorado, Washington, and Oregon with 2–3 GW of demand in each. Over 80% of the total RPS demand in the Western Interconnection is projected to be met by in-state resources. (WECC 2013, p. 41)

To the extent that transmission capacity would be available for exports, one of the cost challenges to serving load in markets outside of SPP is paying for transmission service from SPP to those markets through charges known as "wheeling" rates. We estimate that the wheeling rate for selling wind generation from SPP to MISO or WECC currently is approximately $2 to $3 per MWh, although only very limited amounts of transmission capacity is now available for such exports.[13] The current cost of wheeling wind energy through MISO to regions other than PJM is approximately $8 to $11 per MWh,[14] although very limited amounts of transmission capacity are available for such transactions. Both of these wheeling rates will increase further as both SPP and MISO expand their transmission system over the next years.

B. Economic Entry of Renewable Generation Capacity

While some utilities have decided to develop, construct, and own the renewable energy resources themselves, most of the renewable generation is developed by independent power producers ("IPPs"). IPPs typically finance the renewable energy projects through project-specific debt and equity financing or through balance-sheet financing when it is available as an option. When project-financed, an IPP typically prefers to enter into long-term PPAs with an offtaker to provide certainty as to the revenues from the power sales that support the financing of the project. When a renewable energy project is financed or supported by a corporate balance sheet, the developer may not need to enter into a PPA to secure sufficient funding to build the project.

Beyond the demand for renewable resources created by RPS requirements and other state renewable goals and targets, wind resources in some regions of the U.S. (such as the region in which Nebraska is located) can be economically attractive for development when their costs are competitive with conventional generation sources, particularly when new generation resources are needed to meet growing energy demand or to replace retired capacity.

In the past few years, natural-gas-fired combined-cycle ("CC") plants have been the main conventional generation technology built or considered by utilities and IPPs whenever the need for additional energy arises. Thus, the economics of wind energy in the Midwest is typically compared to those of gas CCs. For wind facilities that are still able to take advantage of the

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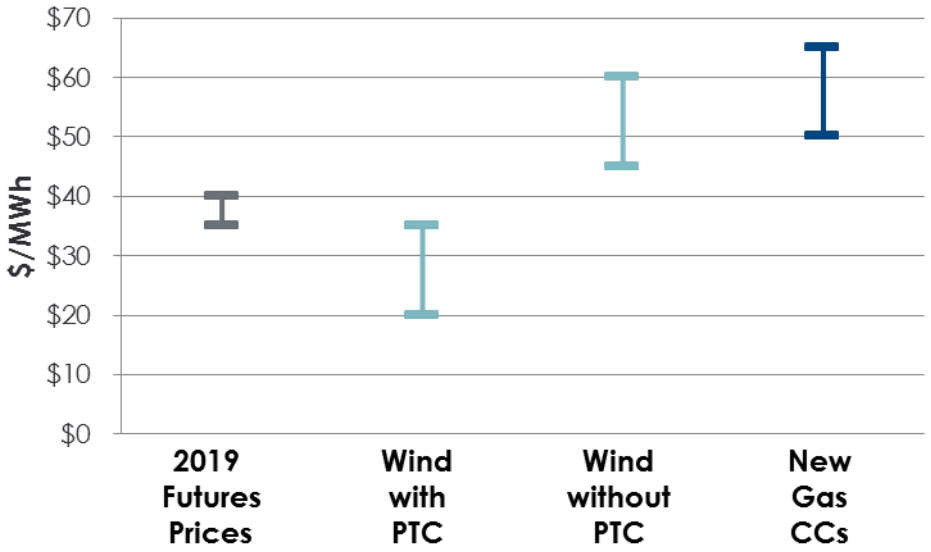
[13] The wheeling rates are estimated based on publicly available transmission service rates. For SPP, we used the KCP&L and OPPD Attachment T Firm Yearly Point-to-Point Rates ($10–12/kW-mo) (SPP 2014e). These rates will increase as already-planned SPP transmission upgrades are coming online. As a result of limited amounts of available transmission capacity between SPP and MISO, exports to MISO could likely be accommodated only through additional transmission upgrades, the cost of which would largely have to be borne by the transmission customer as discussed further in Section III.

[14] For estimating MISO wheeling rates, we used the 2014 Schedule 7 Firm Point-to-Point MISO Wheeling Through and Out rate ($33/kW-mo) (MISO 2014b). Most of MISO's charges for wheeling into PJM have been set to zero under a November 2004 FERC order (109 FERC ¶ 61,168) that required MISO and PJM to "de-pancake" their wheeling through-and-out rates. The cost of MISO network upgrades necessary to accommodate wheeling through transactions would generally have to be borne by the transmission customer (as is the case for SPP wheeling out transactions).

recently expired federal production tax credit ("PTC"), our analysis of the levelized cost of energy ("LCOE"), which is representative of the value at which a new wind farm would be willing to sign a PPA, shows that energy generated by wind generation plants in and around Nebraska can cost as little as $20 to $35 per megawatt-hour ("MWh").[15] As shown in Figure 2 this cost of energy is lower than that of existing conventional generating resources and average futures market prices in SPP of $35 to $40 per MWh.

Compared to our estimates of the LCOE of a new natural-gas-fired CC of roughly $50 to $65 per MWh, wind resources developed in Nebraska and surrounding states are quite competitive.[16] Even without the PTC, the LCOE from wind generation is around $45 to $60 per MWh in Nebraska, which is slightly lower than the range of the levelized cost of new gas CCs but does not include the capacity value provided by CCs. Thus, even without renewable energy mandates set by states, in some cases, the cost of wind energy can be attractive for customers and utilities that must consider the use of new resources.

Figure 2
Comparison of 2019 SPP Electricity Futures to Estimated PPA Price for Wind and Gas CCs



Sources and notes: Electricity prices are based on 2019 futures (on-peak/off-peak average) for SPP North and South Hub from SNL 2014. Estimated range of wind contracts based on $1,600–2,000/kW installed costs and 45–55% capacity factors. New gas CC assumptions for capital costs and fixed operating and maintenance costs based on EIA 2014 and gas prices from $4–6/MMBtu.

We recognize that these estimates of the levelized costs of new resources are not the only reference points that need to be considered in evaluating the economics of wind resources compared to conventional generation resources. This is because other generation resources must

[15] The Lazard Levelized Cost of Energy Analysis, Version 8.0 estimates that subsidized wind energy can cost as little as $14 per MWh. The estimated unsubsidized cost of wind energy in the Midwest is $37 to $61 per MWh. (Lazard 2014)

[16] The Lazard LCOE analysis estimates gas CC costs of $61 to $87 per MWh. (Lazard 2014)

stay available to take its place when wind resources are not generating power (*e.g.*, when wind is not blowing). Thus, while the PPA costs (typically akin to the LCOE of the resources) of wind generation may be low on a per MWh basis, from a system perspective, other costs, particularly those associated with back-up generation and system balancing through ancillary services, must be considered when assessing the relative economics of wind resources and conventional dispatchable resources such as gas CCs. Then again, wind generation can offer some price certainty as its output will not depend on changing fuel prices. In that way, wind generation provides a natural hedge against the volatility of future gas prices.

A recent industry study provides a summary of renewable power integration costs. It shows that these additional costs tend to range from $2 to $10 per MWh of wind energy injected into the system.[17] However, the report also highlights that the recent PJM renewable integration study found "no significant operational issues with up to 30% of PJM's energy coming from wind and solar, given adequate transmission expansion and additional regulating reserves."[18] In addition, the intermittent nature of renewable generation can increase the costs of operating conventional generation plants due to increased cycling in response to changes in output. The Western Wind and Solar Integration Study Phase II finds that "accounting for cycling costs was found to reduce the benefits of wind and solar by $0.14–0.67/MWh."[19]

While wind generation can provide low-cost resources for meeting energy demand, wind resources do not provide much capacity value to the system. The comparison shown in Figure 2 does not account for the capacity value that gas CC plants can provide to the system that wind resources typically do not. Because wind generation is intermittent and less available during peak load hours, utilities and system operators like SPP and MISO discount the capacity value of wind to about 10–20% of the nameplate capacity.

Looking forward, the increase in energy needs from load growth and the retirement of existing generation facilities will lead to demand for more renewable generation. While load growth across the U.S. has fallen to below 1% per year, Nebraska and its neighboring states have experienced slightly higher growth over the past three years.[20] Since the forecast load growth is modest, we anticipate any additional need for renewable energy to meet load will also be modest.

In recent years, the combination of low natural gas prices and EPA's environmental regulations have led to the announcement of the retirement of a significant amount of coal plants. For example, EPA's Mercury and Air Toxic Standards ("MATS") and Cross-State Air Pollution Rule

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17 Wiser and Bolinger 2014, p. 69. "With one exception, wind integration costs estimated by the studies reviewed are below $12/MWh—for wind power capacity penetrations up to and even exceeding 40% of the peak load of the system in which the wind power is delivered."

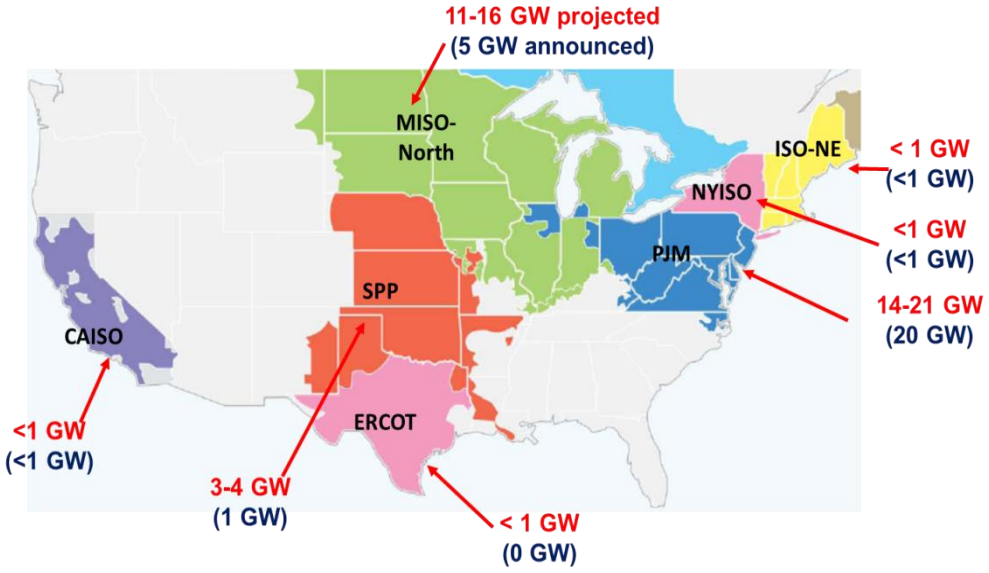
18 Wiser and Bolinger 2014, p. 71.

19 Wiser and Bolinger 2014, p. 71.

20 EIA 2014, p. MT-16. Growth in electricity demand across the U.S. averaged 0.7% since 2000 and is projected to grow on average at 0.9% per year through 2040.

("CSAPR") have compliance periods starting in 2015.[21] Together, these rules require control equipment at some coal-fired (and oil-fired) power plants to reduce the emissions of hazardous air pollutants (mercury, acid gases, and non-mercury metals), sulfur dioxide ("SO_2"), and nitrous oxides ("NO_X"). To comply with these environmental regulations, coal generation owners must evaluate the cost of their compliance methodologies and compare those costs against alternatives, market purchases, and the expected revenues received from customers. Various industry analysts have forecast that approximately 15,000 to 20,000 MW of existing coal plants in the combined footprint of MISO and SPP would retire between 2013 and 2020.[22] A summary of the announced and forecast retirements nationwide is shown in Figure 3. Specifically, MISO is expected to have 11,000–16,000 MW of coal plant retirements, while SPP was forecast to see 3,000–4,000 MW of retirements. PJM is also projecting a significant amount of coal plant retirement. On top of PJM's unmet renewable demand, its coal plant retirements are expected to increase the need for additional generation resources to meet its existing state renewable requirements and targets.

Figure 3
Announced and Projected Coal Plant Retirements



Source and notes: Aydin, *et al.*, 2013. Coal retirements in the non-RTO regions in the southeast are projected to be approximately 30 GW and in the non-CAISO WECC region are expected to be approximately 2–5 GW. The announced coal retirements in CAISO was corrected from the original. Entergy (operating in AR, LA, TX, and MS) has since joined MISO to become "MISO South" (see Figure 5).

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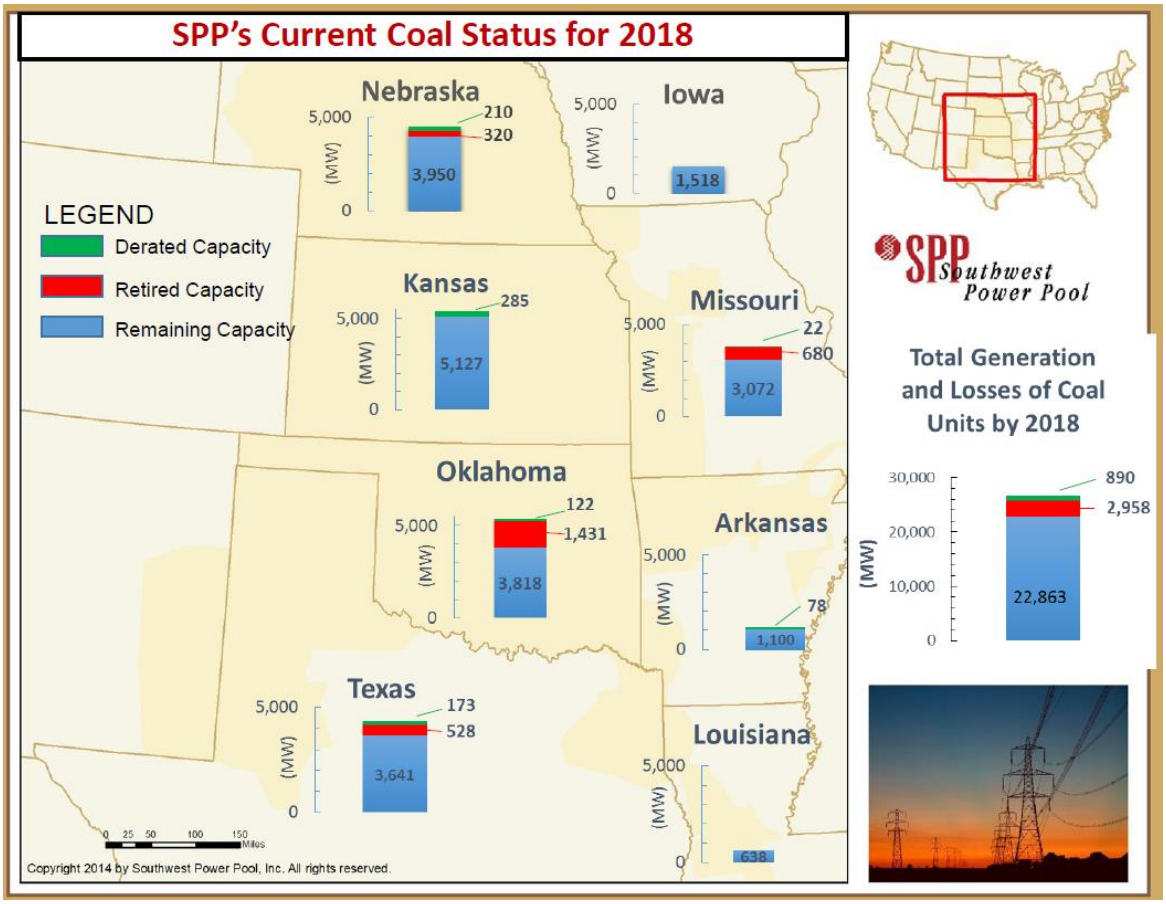
21 The MATS compliance period begins on April 1, 2015 with the possibility of a one year extension to complete retrofits. Additional information on the EPA MATS can be found here: http://www.epa.gov/mats/actions.html

Compliance with Phase 1 of the CSAPR emissions budgets is required in 2015 and 2016 and compliance with Phase 2 emissions budgets and assurance provisions is now required in 2017 and beyond. Additional information on the EPA CSAPR can be found here: http://www.epa.gov/crossstaterule/

22 Aydin, *et al.*, 2013.

SPP recently conducted its own analysis of the economics of existing coal plants. It estimated that the region is likely to witness retirements of close to 3,000 MW of existing coal power plants, as shown in Figure 4. In this study, SPP found that the forecast coal plant retirement in Oklahoma accounts for almost half of all the forecast coal plant retirements in SPP's footprint.

Figure 4
SPP Projection of Coal Retirements in 2018 Prior to Potential Impact of Clean Power Plan



Source: Nickell n.d. SPP projects 2,958 MW of coal will retire and that there will be an additional 890 MW of derated coal capacity in 2018.

Coal plants have low fuel and variable operations and maintenance costs and operate as "baseload" plants. Thus, almost all efficient and well-functioning coal plants operate at high capacity factors, approximately 70% on average. In contrast, wind generation facilities, at best, average about 50% capacity factor, with high variability and uncertainty of production due to the intermittency of the wind power. For this reason, replacing the electricity generated by 3,000 MW of coal plants (if they retire as forecast by SPP) would require about 4,500 MW of new wind capacity. Some of the retired coal plant facilities may be replaced by gas CCs, either through the excess generating capacity already in the market, or by new ones that utilities and IPPs will build in the future. Thus, only a portion of the 4,500 MW will materialize in the form of new renewable generation. Nevertheless, the retiring fleet of coal power plants presents a potential opportunity for new renewable generation.

C. THE PROPOSED EPA GREENHOUSE GAS STANDARD

The EPA in June 2014 proposed a new greenhouse gas ("GHG") emissions standard for existing fossil fuel-based power plants under Section 111(d) of the Clean Air Act, also known as the Clean Power Plan ("CPP"). The proposed regulations set GHG emissions targets for each state using four "building blocks" as the Best System of Emissions Reductions ("BSER") for reducing GHG emissions from the current statewide average.[23] EPA included in the building blocks a wide range of GHG emissions reduction measures, including: (1) coal plant heat rate improvements; (2) re-dispatch of existing generation from coal plants to gas CC plants; (3) increased renewable and new or retained "at risk" nuclear generation; and (4) increased energy efficiency deployment.

The proposed rule sets state-based GHG emissions rate standards starting in 2020 with the standards becoming more stringent through 2030. The state implementation plans for reaching these targets are required to be submitted as early as 2017. While there is a strong expectation that the CPP will face legal challenges, it is clear that the environmental regulations around fossil generation will become more stringent over time, even if the precise magnitude and timing of the impact of the regulations remain uncertain.

In reviewing the proposed Clean Power Plan, SPP found the EPA's simulation of the potential implications of the CPP show a retirement of about 9,000 MW of coal and natural gas steam turbine plants in SPP by 2020.[24] Whether to replace a portion of the existing power generation that will retire due to the new EPA regulations or to help states comply with the regulation by deploying more zero-emitting resources, we expect that the economics of renewable resources relative to those of conventional fossil-fueled generation will only become more favorable over time and increase the demand for renewable resources. For example, a recent analysis of the CPP found that electricity prices in SPP are projected to increase in real terms by $18 to $22 per MWh over the 2020–2029 period.[25]

D. SUMMARY OF MARKET DEMAND FOR NEBRASKA RENEWABLE ENERGY EXPORTS

The current demand for renewable generation is limited. However, significant new demand for renewable generation resources will arise if and when:

1. Load continues to grow significantly in the region around Nebraska;
2. A substantial amount of existing generation retires over the next few years due to the high costs of retrofits and/or low wholesale power prices;

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[23] For a description of the Clean Power Plan and discussion of its potential impacts, see Celebi, *et al.* 2014 at: http://www.brattle.com/system/publications/pdfs/000/005/025/original/EPA%27s_Proposed_Clean_Power_Plan_-_Implications_for_States_and_the_Electric_Industry.pdf

[24] SPP 2014d.

[25] Gelbaugh, *et al.*, 2014.

3. Natural gas prices increase and result in higher wholesale electricity prices; or,
4. Environmental regulations around fossil-fueled generation resources become more stringent over time, which in turn increases electricity prices, particularly if a cost was placed on carbon emissions.

Our analysis finds that, due to the uncertainties in market demand, there is no single region that can be expected to be the main driver of future renewable generation exports from Nebraska. For that reason, any efforts to expand transmission capacity should not be focused on any single market. Considering the unmet RPS demand and the potential for significant coal plant retirements, the greatest anticipated demand for additional renewable resources is in PJM and MISO, with only moderate additional amounts likely from within SPP.

III. The Role of Transmission Planning in Increasing Nebraska's Renewable Energy Exports

In this section, we provide a summary of the process for planning the future transmission system in SPP and Nebraska, and a review of the most relevant transmission planning studies that help provide insights into the extent to which the existing and future transmission system in Nebraska and SPP can support renewable energy development in Nebraska.

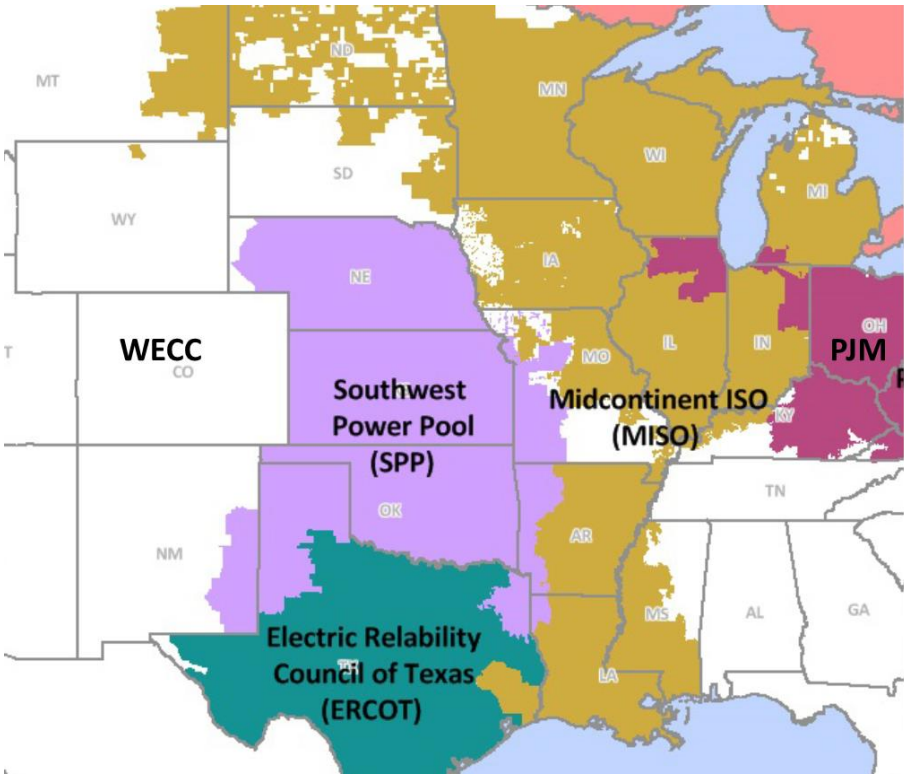
A. Nebraska's Transmission System and Regional Planning Processes

The transmission system in the State of Nebraska is split between the Eastern Interconnection and the Western Interconnection, with the transmission networks in each interconnection operated and planned separately. The majority of the geographic area and load in Nebraska is located in the Eastern Interconnection, served primarily by NPPD, OPPD, and Lincoln Electric System ("LES"), and is a part of the SPP regional transmission organization ("RTO"). As shown in Figure 5 below, the SPP region shares a border with the Western Electricity Coordinating Council ("WECC") in the west, the MISO in the north, northeast, and southeast, and the Electric Reliability Council of Texas ("ERCOT") in the south. Nebraska sits right at the border between SPP, WECC, and MISO.

As the RTO for the portion of Nebraska that is located in the Eastern Interconnection, SPP is responsible for operating and planning the transmissions system in its entire footprint, which currently includes Nebraska, Kansas, Oklahoma, and portions of Missouri, Arkansas, Louisiana, Texas, and New Mexico. The "Integrated System" of the Western Area Power Administration ("WAPA"), the Basin Electric Power Cooperative ("Basin") and the Heartland Consumers Power District ("Heartland")—which serve most of South and North Dakota and for which MISO currently performs certain operational functions—will be joining SPP in late 2015 and in turn

will significantly expand the SPP footprint to the north of Nebraska.[26] Expanding transmission capabilities beyond the borders of SPP into MISO or WECC will require coordinating with these neighboring transmission organizations. We will discuss later in this section the process of doing so.

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



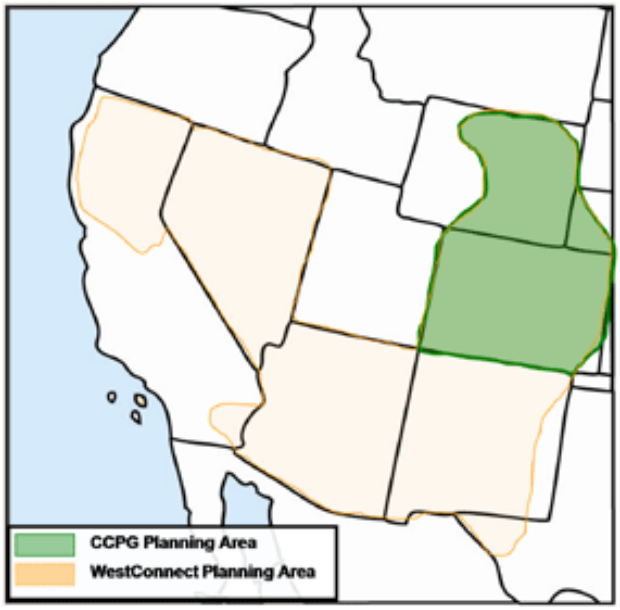
Source: FERC 2014. Modified to indicate regions not listed in the original. Areas between SPP and MISO in SD, ND, and neighboring states are mostly served by the Integrated System (WAPA-Upper Great Plains (Western), Basin, and Heartland) and are scheduled to join SPP in 2015.

The transmission network in the western-most part of the state is in the Western Interconnection. This part of Nebraska is served by the Tri-State Generation and Transmission Association ("Tri-State"), a wholesale electric power supplier owned by the 44 electric

[26] We have not undertaken independent studies of the expected changes in market conditions due to this northern expansion of the SPP footprint. Consistent with the observed forward power prices, the integration of WAPA and Basin will likely have a net neutral impact. While it will create additional opportunities for Nebraska utilities to sell excess generation during some periods of the year it will also create additional competition for transmitting power to markets in southern SPP during other parts of the year. Integration on the Integrated System transmission facilities into SPP will likely significantly simplify operation of the market seam that currently exists between NPPD, OPPD, and WAPA, Basin, and Heartland. It will, however, also complicate seams-related challenges between SPP and MISO.

cooperatives that it serves. Tri-State generates and transmits electricity to its member systems throughout a service territory that covers Colorado, New Mexico, Wyoming, and Nebraska. Tri-State participates in a joint transmission planning process through the Colorado Coordinated Planning Group ("CCPG") that covers parts of Nebraska, Colorado, and Wyoming. The CCPG in turn is part of the WestConnect regional planning organization, as shown in Figure 6.

Figure 6
Colorado Coordinated Planning Group and WestConnect Planning Areas



Source: WestConnect 2014a.

The remainder of this review of transmission planning will first discuss the planning processes in the SPP, followed by those in WECC, and conclude with a discussion of interregional planning issues between SPP and MISO.

B. SPP TRANSMISSION PLANNING

The Nebraska utilities in the Eastern Interconnection became members of SPP in 2008. As an RTO, SPP has the overall responsibility of operating the existing transmission system and planning the future expansions necessary to meet the needs of the member states and utilities within its region. Planning the future transmission system is a heavily stakeholder-driven process to ensure that the regional transmission system provides reliable and economic delivery of power to serve all electricity customers on its system, including gathering input from, and coordinating with, the transmission-owning member utilities. The Nebraska utilities and PRB all play an active role in the SPP transmission planning process.

Following federal regulations promulgated by the Federal Energy Regulatory Commission ("FERC"), SPP and the SPP Regional State Committee ("RSC"), of which the PRB is a member, developed transmission planning and cost allocation processes to identify the need for local and regional transmission upgrades and to assign the costs of the new transmission to generators,

transmission service customers, and SPP transmission owners (such as NPPD, LES, and OPPD) based on a complex set of rules and criteria. A summary of the transmission planning studies that SPP conducts is shown in Figure 7. Each year SPP issues an annual report—the SPP Transmission Expansion Plan ("STEP")—that summarizes transmission planning and development activities.

Figure 7
Summary of SPP Transmission Planning Processes

Source: SPP 2014g.

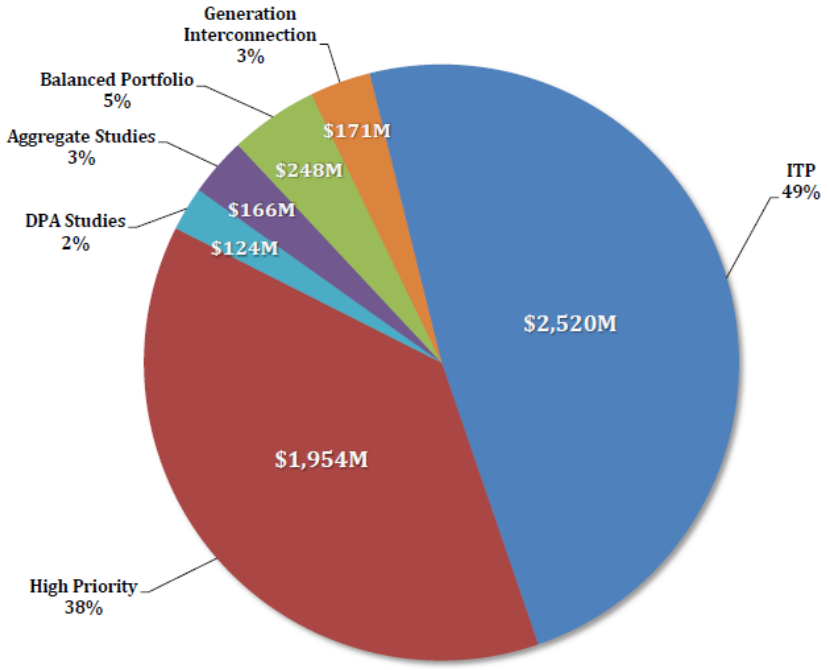
Each component of SPP's planning process, shown in Figure 7, serves a different purpose in meeting the needs of SPP market participants. The Integrated Transmission Planning ("ITP"), High Priority, and Balanced Portfolio studies evaluate the extent to which new transmission facilities are necessary on a region-wide basis with costs allocated across the region. The ITP process consists of a 3-year planning cycle that includes near-term, 10-year, and 20-year studies of the entire SPP region. In addition, High Priority studies can be requested when region-wide issues not systematically covered by the ITP are addressed outside of the three-year cycle of the ITP. Transmission upgrades or projects selected through these planning studies require approval from SPP's Board of Directors before Notifications to Construct ("NTC") are issued by SPP to certain transmission owners to develop and construct the upgrades. The ITP and High Priority planning processes account for the majority of SPP transmission upgrades that lead to actual projects. As discussed further below, the costs of the transmission projects identified through these processes are allocated on a region-wide basis by SPP through its "highway/byway" cost allocation methodology.

The Transmission Service, Generation Interconnection, and locally "Sponsored" studies, shown in Figure 7, evaluate the necessary transmission upgrades (if any) required to accommodate local changes in the power flows, specific requests to interconnect new generation facilities, or "point-

to-point" or "network" transmission service from specific generation resources to loads. Sponsored projects are transmission facilities planned and fully funded by an individual SPP transmission owner. The costs of transmission upgrades (if any) associated with generation interconnection requests are paid for by the interconnecting generator. The costs of transmission upgrades associated with Transmission Service Requests ("TSRs") that exceed certain thresholds are paid for by the customer requesting the service.[27] In addition, SPP allows for the regional allocation of two-thirds of the costs of transmission upgrades required to accommodate requests for long-term transmission service from "designated" wind power resources in one SPP zone to another zone within the SPP footprint.[28]

As of July 2014, the total estimated construction cost of SPP-approved transmission projects currently under development is just over $5 billion. Figure 8 shows the portion of total transmission expansion costs associated with the results of the six study processes listed in Figure 7.

Figure 8
SPP Transmission Projects in Progress as of July 2014



Source: SPP 2014g. Transmission projects resulting from TSRs are broken out for two subsets of TSR studies, the "Aggregate Studies" and Delivery Point Additions ("DPA") Studies.

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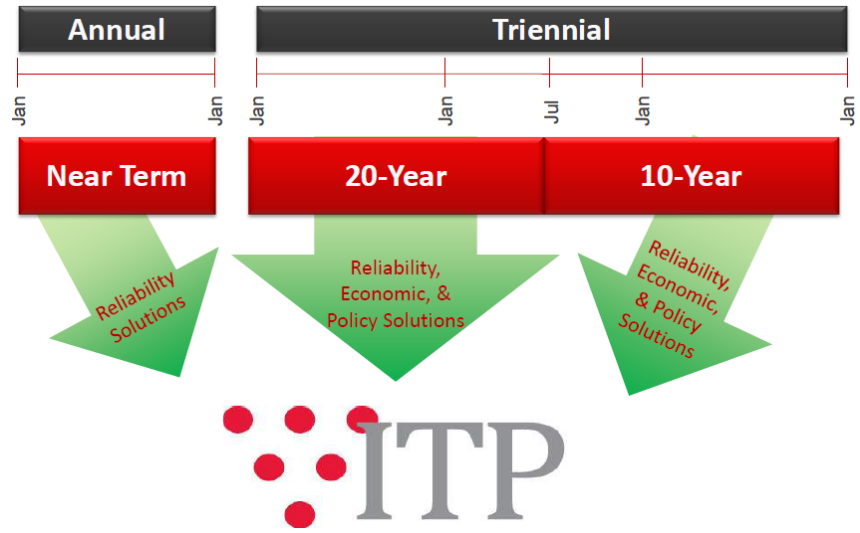
27 For network transmission service within the SPP footprint from "designated resources," customers are directly allocated costs in excess of the Safe Harbor Cost Limit (currently set at $180,000 per MW of the designated resource's capacity). For point-to-point service (*e.g.*, to export out of the SPP footprint), customers are directly assigned costs in excess of the normally applicable transmission charges. (See SPP Tariff, Section 1, definition for Directly Assigned Upgrade Costs.)

28 See SPP Tariff, Attachment J, Section III.A.4.

1. SPP Region-Wide ITP Planning Studies

SPP's ITP process, which accounts for almost half of all committed projects, consists of three studies that are conducted over different time horizons: near-term, 10-year, and 20-year. The near-term ITP ("ITPNT") is conducted on an annual basis and is focused on identifying reliability solutions needed for the transmission system at voltages of 69 kV and higher over the subsequent six year period. The ITP 10-year Assessment ("ITP10") and 20-year Assessment ("ITP20") are conducted triennially with each taking 18 months to complete. The relative timeframes for these three studies are shown in Figure 9. The ITP10 identifies new facilities that will be required over a 10-year period to address expected reliability, economic, and policy needs for facilities at voltages of 100 kV and higher and considers two future scenarios. The ITP20 considers reliability, economic, and policy needs over a 20-year timeframe for facilities at voltages 300 kV and higher across five different scenarios. SPP relies on a range of stakeholder working groups to provide the input assumptions, future scenarios, and potential transmission projects to be considered in the ITP analyses.

Figure 9
SPP Integrated Transmission Planning Process Timeframe



Source: SPP 2014g.

SPP plans the system's transmission needs on a portfolio basis through the ITP process. Within the portfolio of transmission upgrades in each ITP, individual transmission projects are identified based on whether they primarily address reliability, economic (*e.g.*, to reduce transmission congestion), or public policy needs. The justification of a transmission project according to one or more of these needs does not affect transmission cost allocation under the SPP highway/byway tariff. Instead, the classification will affect how the benefits associated with each portfolio of transmission projects are determined, including during the Regional Cost Allocation Review ("RCAR") process that was developed by the SPP RSC, as discussed further below.

SPP uses the ITP process to identify transmission needs and opportunities to address those needs over both the long- and short-term by identifying transmission projects that can provide significant benefits beyond resolving near-term reliability needs. Following the identification of the portfolio of transmission projects developed through each study, SPP also completes a cost-benefit analysis to ensure that the economic benefits of the portfolio sufficiently exceed its costs.

The transmission projects identified through the ITP process are reviewed by SPP's Transmission Working Group ("TWG") and Markets and Operation Planning Committee ("MOPC") and approved by the SPP Board of Directors. Only after approval by the Board will SPP issue an NTC letter to the appropriate Transmission Owner to construct the projects. The NTC initiates the engineering work and permitting processes required for the transmission line to be developed, constructed, and finally operated, including state- and county-level permitting and siting processes.

SPP completes High Priority studies to address certain transmission needs that specific stakeholders request and that have not been sufficiently covered in the ITP studies. For example, SPP completed the High Priority Incremental Load Study ("HPILS") in 2014 to evaluate transmission needs in response to higher-than-projected load growth, primarily as a result of increased oil and natural gas industry growth within the SPP footprint. The High Priority studies are similar to the ITP studies in that they are performed on a region-wide basis and incorporate input from a broad range of stakeholders groups to identify and justify the addition of new transmission facilities.

SPP completed the last Balanced Portfolio planning process in 2009, which identified a portfolio of transmission upgrades that provided region-wide economic benefits. The process resulted in seven projects with estimated costs of $690 million.[29] The Balanced Portfolio approach is not currently being pursued by SPP, although it remains as an option in the tariff.

The transmission projects that have been approved through these SPP planning processes since 2004 and are now being constructed or developed are shown in Figure 10. In 2013, SPP issued 25 NTC letters with a total estimated cost of $1.6 billion for 86 projects to be built over the next five years.[30] Three of these NTCs for major projects were issued to Nebraska Transmission Owners with estimated costs of $460 million. The majority of these costs (estimated at $310 million) are for the 220-mile Gentleman–Cherry County–Holt County 345 kV transmission line, also known as the Nebraska "R-Plan."

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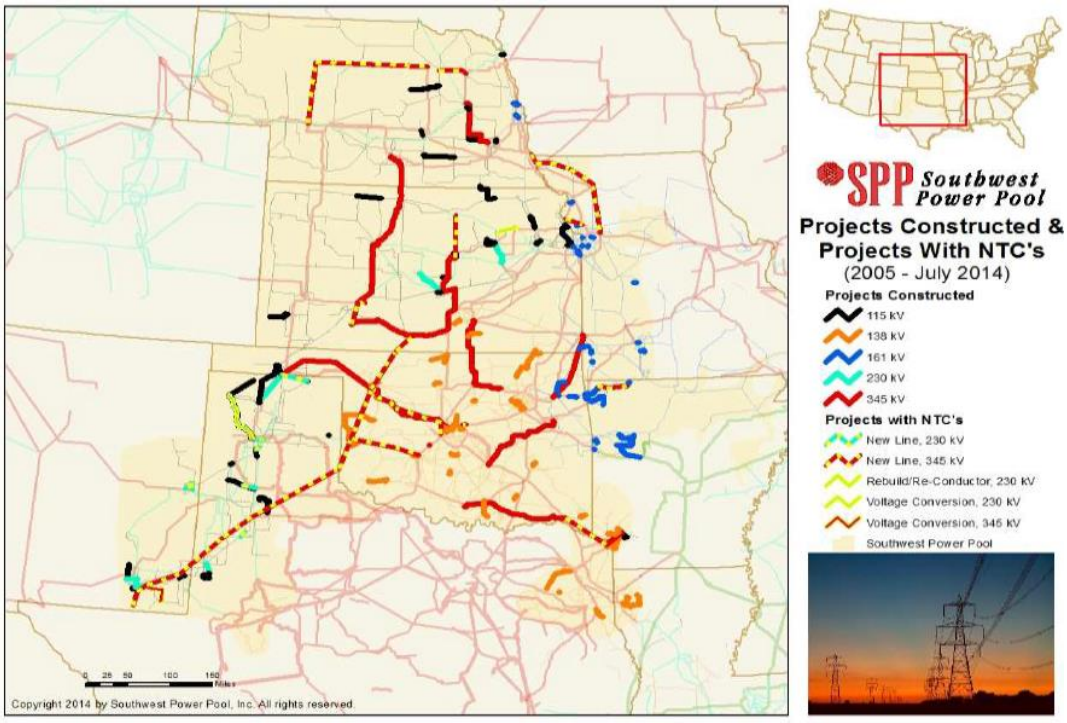
29 SPP 2009.

30 SPP 2014a.

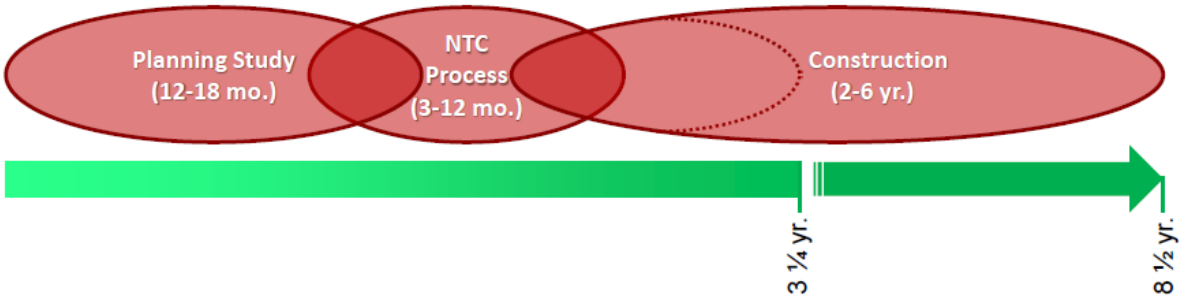
Figure 10
SPP Projects Constructed and Projects with NTC's, 2005–2014



Source: SPP 2014g.

As illustrated in Figure 11, the entire transmission planning process—from identifying transmission-related needs, through completing the ITP process, issuing the NTC, permitting, building, and energizing the new facility—has taken 3 to 8 years.

Figure 11
SPP Transmission Development Time Horizon



Source: Nickell n.d.

Starting in 2015, some of the transmission upgrades identified through the ITP process will become subject to a competitive solicitation process to identify which of the transmission owners will receive the NTC. This additional competitive process was developed in accordance with FERC Order 1000. However, the competitive process will not be applicable within Nebraska because Nebraska's Legislature mandated in LB 388 (signed into law in April 2013) that Nebraska's incumbent transmission providers will retain a right of first refusal ("ROFR") to build

SPP-approved transmission projects that will be physically located in Nebraska. FERC Order 1000 allows for such state ROFR provisions.

2. SPP's Allocation of Transmission Costs

The costs of transmission upgrades that are identified through the ITP, High Priority, and Balanced Portfolio processes are allocated under SPP's highway/byway cost allocation process. While each transmission project is identified as either reliability, economic, or policy project based on the primary need they address within the study, the portfolio of transmission projects developed through each study process is justified based on the overall economic benefits the whole portfolio provides to the SPP system. Irrespective of the primary need addressed by any individual project or subset of projects, their costs are allocated to SPP participants based on the highway/byway cost allocation methodology that was developed by the SPP RSC.

SPP's highway/byway approach allocates transmission costs across the region based solely on the voltage of the facility being upgraded. As shown in Table 1, all transmission facilities operating at a voltage above 300 kV are considered "highway" projects that provide benefits across the region. For all such highway projects, the project costs are fully allocated to utilities across the entire region based on each utility's share of SPP's total load. Based on this load share ratio ("LSR"), Nebraska customers pay for approximately 14% of all SPP highway projects regardless of where the projects are located in the SPP footprint, including if they are built in Nebraska. The rest of the costs associated with these highway projects are allocated to other utilities in the SPP footprint, *including* those costs associated with projects located in Nebraska.

Transmission facilities operating at a voltage of 100–300 kV are considered "byway" projects that provide most of its benefits to the zone in which they are built. The zones are synonymous to utility service footprints. For these byway projects, two-thirds of the costs are allocated to the transmission zone in which the facility is built and the remaining one-third is shared across the entire SPP region. As a result of this two-third and one-third cost allocation methodology for the byway projects, Nebraska customers pay approximately 71% of byway projects located within Nebraska, which is the typical voltage level of transmission facilities and "gathering systems" that interconnect wind farms with SPP's 345 kV regional transmission backbone.[31] Because one-third of other utilities' byway projects are also spread across the SPP footprint, Nebraska ratepayers effectively are allocated approximately 5% of byway projects that are built in other regions within SPP.[32] These cost allocation shares are summarized in Table 1.

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[31] Nebraska customers would pay for two-thirds plus approximately 14% of the remaining one-third that is shared on an SPP-wide basis, for a total of approximately 71%.

[32] Calculated as 14% of the one-third that is shared on an SPP-wide basis.

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%

Source: Brattle estimates based on SPP tariff.

3. Estimates of SPP Transmission Benefits for Cost Allocation Reviews

Following the transmission planning and cost allocation processes, SPP completes a separate RCAR analysis. This review, which was developed by the SPP RSC in conjunction with the highway/byway cost allocation approach, estimates the total benefits that the entire portfolio of regional transmission facilities provides to each individual transmission zone. The RCAR analysis attempts to make sure that the utilities and states who receive cost allocations also receive commensurate benefits. If a utility obtains estimated benefits that are less than 80% of its allocated costs, SPP is obligated to mitigate that outcome to ensure that each zone achieves a benefit-cost ratio of at least 0.8. The several mitigation options available to SPP include: (a) planning additional transmission facilities that provide significant local benefits and (b) applying full SPP-wide sharing to local byway projects.

As shown in Table 2, there are eight benefit metrics considered for estimating the total benefits of the transmission upgrades under the current RCAR approach. The benefits are estimated for each zone based on different methodologies. Even though transmission projects that are "primarily public policy-driven" will provide benefits across the entire system, their benefits are considered to be equal to their costs with all of the benefits attributed to the transmission zones in which they are located.

The most recent RCAR analysis completed in 2013 found that the overall benefit-to-cost ratio for SPP transmission projects subject to the highway-byway cost allocation was 1.4.[33] However, this RCAR analysis also documented that several of the transmission zones were below the minimum target of 0.8, including LES, which had a benefit-cost ratio of 0.61. NPPD was estimated to have a benefit-cost ratio of 1.5 and OPPD cleared just above the minimum threshold at 0.83.[34]

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[33] The next RCAR analysis will be conducted in 2015 and, consistent with the approval of several SPP stakeholder groups and the SPP Board, include the quantification of additional transmission-related benefits, such as increased wheel-out revenues and marginal energy-loss benefits.

[34] SPP 2013c.

Table 2
Benefits Considered in 2013 SPP ITP and Regional Cost Allocation Review

Benefit Metric Name	Standard ITP Metric*	MTF Recommended New Metric	Considered in the 2013 RCAR effort*
Adjusted Production Cost (APC) Savings	✓		Yes
Reduction of Emission Rates and Values	✓		Yes
Savings due to lower Ancillary Service Needs and Production Costs	✓		Yes
Avoided or Delayed Reliability Projects	✓		Yes
Capacity Cost Savings due to Reduced On-Peak Transmission Losses	✓		Yes
Mitigation of Transmission Outage Costs	*	✓	Yes
Assumed Benefit of Mandated Reliability Projects	*	✓	Yes
Benefits from Meeting Public Policy Goals	*	✓	Yes
Increased Wheeling Through and Out Revenues	*	✓	No*
Capital Savings due to Reduction of Members' Minimum Required Margin		✓	No
Reducing the Cost of Extreme Events		✓	No
Reduced Loss of Load Probability		✓	No
Marginal Energy Losses Benefits	*	✓	No*

Source: SPP 2013c.
* The indicated benefits have since been added for standard consideration in SPP's forthcoming (2015) ITP and RCAR analyses.

4. Implications of Recent ITP Studies for Nebraska

The most recent ITP10 (released in January 2012) and ITP20 (released in July 2013) studies have resulted in transmission plans to expand the transmission network in Nebraska. The Nebraska transmission projects identified through the SPP planning processes are listed in Table 3. The first major project—the $410 million Nebraska City–Sibley 345 kV line, which will reduce transmission congestion for power flows from Nebraska to the rest of the SPP footprint—was approved in response to the 2010 Priority Project study. The latest iteration of the ITP10 study,

scheduled to be released in early 2015, includes recommendation of additional transmission projects and, at the time of the writing of this report, is being reviewed by SPP stakeholders.

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

Source: SPP 2014a and SPP 2014f.

Though the scope of this report does not include conducting a technical transmission analysis that would analyze the impact of various levels of added wind resources on the SPP system, a review of the ITP studies offers insights into the range of additional wind generation that the Nebraska system, including the already-planned additions, may be able to accommodate. The 2012 SPP ITP10 study analyzed the transmission needs for two future scenarios with different assumptions of wind generation capacity in the SPP footprint. For Nebraska, the analysis assumed 1,100 MW of wind capacity in Future 1 and 2,100 MW in Future 2. The analysis of reliability, economic, and public policy needs in these futures led to the identification of two major projects to be built in Nebraska: the Gentlemen–Cherry County–Holt County 345 kV line and two substations, known as the Nebraska R-Plan,[35] and the Neligh–Hoskins 345 kV line with a 345/115 kV transformer at Neligh.[36] These transmission additions provide significant renewable integration benefits to the state of Nebraska, although they will very likely be inadequate to support the ambitious 5,000 to 10,000 MW renewable generation target that

[35] Due to the benefits to wind capacity in the state, the R-Plan was considered a "primarily public policy" project in the SPP ITP10 report. However, the ITP 10 acknowledged that the project also provides additional reliability benefits to the system. ("Gentlemen–Cherry Co.–Holt Co. 345 kV: This new line enabled wind sited in Cherry County and provided a parallel line to support the west to east corridor in NPPD.") SPP 2012a, p. 53. Note, however, that the SPP Board has recently reclassified the R-Plan as a reliability project for the purpose of benefits analyses through the RCAR process.

[36] The Neligh–Hoskins 345 kV and transformer project were identified primarily to overcome potential overloads on the system around Neligh ("Neligh–Hoskins 345 kV and transformer: This new line and transformer addressed several potential overloads in the Neligh area due to contingencies in the Neligh area. These overloads occurred primarily in the off-peak hours. The overloads on the WAPA-owned lines occurred on peak.") SPP 2012a, p. 53.

Nebraska is considering. In its 2012 ITP10 study, SPP found that the curtailments of output from the assumed Nebraska wind generation capacity would be reduced from 15% of total output without the addition of the two Nebraska projects to the SPP-wide target of 3% after the new transmission upgrades are built.[37]

The SPP analyses suggest that adding a significant amount of wind to Nebraska prior to the completion of the transmission upgrades identified in ITP10 would risk operational curtailments that exceed the 3% target that SPP has. However, the SPP analyses also show that, once the system upgrades are in place and become operational in 2016–2018, at least an additional 2,000 MW of wind capacity would be expected to be added without significant constraints on the transmission network. In the meantime, the experience from other states and regions show that short-term transmission constraints are not necessarily a significant impediment to renewable energy development if already-planned transmission upgrades will remove the constraints. Some renewable developers and their offtakers have been willing to absorb some of the risks associated with operational curtailments and some generation owners have built generation ahead of the transmission upgrades.

In addition, SPP's 2013 ITP20 study reviewed a broader range of futures with more wind capacity than the ITP10 study.[38] The ITP20 analysis included three additional futures with even more wind generation in Nebraska: Future 2 assumed 2,700 MW, Future 3 assumed 5,000 MW, and Future 4 assumed 2,500 MW of in-state wind generation. Future 3 (the highest wind generation scenario) was primarily intended for identifying the transmission upgrades that would be required for a significant increase in renewable energy exports outside of the SPP footprint.

The ITP20 analysis identified several transmission projects that would be necessary in Nebraska based on reliability needs (prior to considering scenarios with much higher wind capacity), including a new $175 million Keystone–Red Willow 345 kV line in western Nebraska.[39] SPP's ITP20 analysis found only limited operational curtailments of wind generation located in Nebraska across all futures (even Future 3 with 5,000 MW in the state), supporting a finding that no additional public policy-driven projects are needed within Nebraska across the entire range of futures to support up to 5,000 MW of renewable generation.[40] Together, the SPP's ITP 10 and ITP 20 analyses show that with the new lines already under development (*i.e.*, the R-Plan and Neligh–Hoskins), the SPP transmission system is expected to be able to accommodate between 2,000 MW and 4,000 MW of additional wind generation without substantial future transmission upgrades.

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37 SPP 2012a, p. 82.

38 SPP 2013b, p. 17.

39 SPP 2013b, p. 59.

40 In the ITP20, policy needs are considered only after the reliability projects have been included in the analysis. The assumed reliability upgrades in Nebraska prior to considering the policy needs (including the new Red Willow–Keystone line) are estimated to cost $175 million. (SPP 2013b)

The transmission projects already approved through SPP's ITP analysis, however, were based only on wind generation development to meet renewable needs within SPP, without considering an increase in exports to neighboring markets.

Nevertheless, due to the more significant SPP-wide wind generation additions assumed in the ITP20 Future 3 scenario and the operational curtailments experienced in other states, we anticipate that several transmission lines would be needed to increase SPP export capability to neighboring markets and systems. The portfolio of proposed transmission projects for the purpose of increasing SPP exports to external systems included a new 842 mile 345 kV double circuit line from Holt County, Nebraska, to Hazelton, Iowa with estimated costs of nearly $1 billion.[41]

As seen with this example, the costs of transmission projects that can significantly extend the capability to export to outside of SPP can be very expensive. A portion of such upgrades may be facilitated and partially paid for by generation interconnection and TSRs made by renewable resource developers and their potential offtakers in neighboring markets. Further, interregional planning between SPP and MISO could provide opportunities for significant supply exchanges between the regions, which could increase the efficiency of the markets even with renewable energy export considerations. The costs associated with such interregional transmission projects could be developed with the costs spread across two regions, reducing the cost impact on either system. These alternative approaches to building transmission for increased renewable energy exports are explained further in the next sections.

5. Transmission Upgrades Needed to Accommodate Generation Interconnection and Transmission Service Requests

SPP completes transmission studies upon requests from generators to interconnect new generating facilities and from utilities and other offtakers for new SPP-internal or export-related transmission service. In each case, SPP simulates the transmission system based on the anticipated power flow patterns that occur under different system conditions to identify any potential reliability violations or transmission system overloads. If reliability needs are identified, transmission upgrades that address these needs are proposed. As explained earlier, under the SPP generation interconnection process, the costs of the associated transmission network upgrades are assigned directly to the generator. The network upgrade costs incurred to accommodate transmission service beyond certain thresholds are allocated directly to the transmission customer (*e.g.*, the offtakers of wind plants). SPP additionally allows for the regional allocation of two-thirds of the costs of the transmission upgrade required to accommodate long-term transmission requests from designated wind resources in one SPP zone to another zone within the SPP footprint.

From the perspective of desiring more renewable generation for export to locate in Nebraska, assigning the majority of the costs of the necessary system upgrades to the renewable generators

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41 SPP 2013b, p. 97.

or their export customers may not be an attractive option because such assignment of significant costs would likely undermine the economics of renewable generation in Nebraska compared to neighboring states. In addition, information provided by Nebraska market participants suggests that the designs of the transmission interconnection facilities (*i.e.*, the substation needed to interconnect renewable generating plants) used by Nebraska utilities are more expensive than the designs of interconnection facilities used by utilities in other states. This could further add to the disadvantages faced by renewable developers in the state (discussed further in Section IV.D below). Given the documented competitive pressures, a potentially significant portion of transmission infrastructure upgrades necessary to support renewable generation exports would need to be funded by the state and/or Nebraska ratepayers through either the region-wide ITP process or the "sponsored" projects discussed in the next section.

Moreover, under the SPP rules and processes, interconnecting renewable resources and their customers can avoid direct allocation of transmission costs if they decide to simply inject the power into the wholesale market at the generating plant and withdraw power from the grid where they serve load or export the power. Doing so will expose customers to potentially significant congestion charges between the injection and withdrawal points. However, if renewable generators or their offtakers obtain transmission service and pay for any necessary transmission upgrades, they may be able to receive transmission congestion rights associated with the transmission service they obtained. These rights would be valuable as they allow the holders to be reimbursed for transmission congestion charges that would otherwise be incurred between the injection and withdrawal points on the grid.

In cases where transmission capability is available to accommodate additional power sales across the seams between SPP and the neighboring markets, the generator or the offtaker must pay for transmission capability for power delivery from SPP into the neighboring regions, and such deliveries must pay wheeling charges to SPP based on the transmission capacity used to complete the transactions. Such wheeling charges can affect the relative economics of renewable resources from different locations. As mentioned above, the wheeling charges for exporting power out of SPP to MISO, for example, would add to the cost of delivering wind energy from SPP to MISO by $2 to $3 per MWh today, increasing as already-approved SPP projects come online.

6. Locally "Sponsored" Projects

Local transmission owners can propose and "sponsor" new transmission facilities to be built within the SPP footprint if they are willing to pay for all of the sponsored facilities. In this case, SPP will perform analysis on the effect of the sponsored facilities to identify whether the upgrades would cause violations or overloads elsewhere on the system to avoid adverse impacts on other transmission customers. Similar to the generation interconnection and TSR analyses, SPP would offer solutions to overcome the identified reliability concerns (if any) and require them to be built along with the sponsored facilities. Currently, no such facilities are added beyond local reliability upgrades.

Although most of the sponsored projects to date have primarily addressed local reliability needs, Nebraska, through its public power utilities, could also sponsor self-funded, renewable-generation-related transmission projects within the SPP planning process. Because the sponsored projects are self-funded, they would largely bypass SPP's increasingly contentious planning and cost allocation processes. Thus, sponsored and self-funded renewable generation "gathering" or export-related Nebraska transmission facilities could be planned and built more quickly than through the SPP regional planning process.

7. Transmission and its Impact on Wholesale Market Prices in Nebraska

Transmission limitations between Nebraska and the rest of the SPP footprint currently cause congestion that lowers SPP wholesale market prices in Nebraska below that of other SPP locations. The lower wholesale prices reduce the revenues that Nebraska utilities can obtain from the sale of their excess generation, often referred to as "off-system sales." Because profits from off-system sales are used to reduce electricity rates of Nebraska utilities, the current congestion on the system keeps the retail rates of the Nebraska utilities higher than they otherwise would be.

Expanding transmission capacity between Nebraska and the rest of SPP would not only support the development of in-state renewable generation, it would reduce the effects of transmission congestion on Nebraska's utilities and their customers. As discussed in Section IV.B of this report, current and projected wholesale power prices in Nebraska are $5 to $10 per MWh below the wholesale prices in southern SPP.[42] Increasing wholesale market prices in Nebraska by reducing transmission congestion would help reduce Nebraska's customers' electricity costs. As a result, transmission investments that reduce the current level of transmission congestion faced by Nebraska will facilitate renewable generation investment, providing broader benefits to Nebraska's utilities and their customers.

8. Exporting from SPP to the Western Interconnection

The renewable power generated in SPP (Eastern Interconnection) could be exported to the western states, though doing so would require expanding the limited transmission capability between the two interconnections. Although some limited amount of transmission capability

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[42] These projections are based on the pricing of energy in forward power markets and should consequently reflect market participants' anticipated changes in market conditions due to planned transmission additions and the planned integration of new SPP members, in particular the integrated system of WAPA and Basin.

We have not undertaken independent studies of these expected changes in market conditions but rely on SPP reports that include the analysis of the proposed new transmission lines. Consistent with the observed forward power prices, the integration of WAPA and Basin will likely have a net neutral impact. While it will create additional opportunities for Nebraska utilities to sell excess generation during some periods of the year, it will also create additional competition for transmitting power to markets in southern SPP during other parts of the year.

currently exists between the Eastern and Western interconnections, it would be costly to expand capability across the seam because the two interconnections are operated asynchronously and thus require special alternating-current-to-direct-current ("AC-DC") coupling equipment.

C. Western Interconnection Transmission Planning

The western-most portion of Nebraska's transmission system is physically located in the Western Interconnection. Renewable generation located in this part of the state (and the WECC) has the opportunity to sell power into the western states. Selling renewable energy to western states with renewable demands, such as Colorado and California, is challenging. In particular, Nebraska will face competition from other renewables-rich western states, especially from Colorado, California, , and Wyoming, which have already identified and supported renewable energy exports and associated transmission infrastructure as an economic development opportunity.

Tri-State owns and operates the transmission in western Nebraska and conducts system planning primarily in close coordination with other transmission owners in the region. Tri-State's service territories are shown in Figure 12.[43] As a member-owned cooperative, Tri-State's primary mission is to provide its members cost-based, reliable wholesale electric power.[44] As such, Tri-State builds its transmission system to meet this goal, primarily focused on reliable operation of the power system at the lowest cost and not necessarily to build out the transmission system for future renewable generation capacity, unless interest is shown by developers to interconnect generation and pay for the necessary upgrades.[45]

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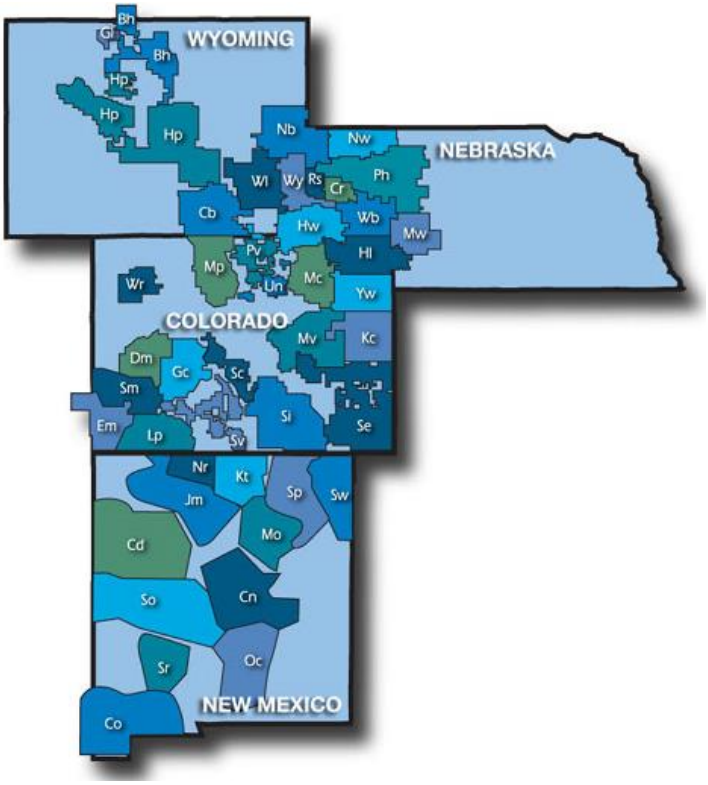
[43] Tri-State's member cooperatives in Nebraska are located in both the Western and Eastern Interconnection.

[44] Tri-State 2014a, p. 28.

[45] Tri-State publishes a guide for generator interconnection requests on its website: http://www.tristategt.org/transmissionPlanning/documents/Facility%20Connection%20Requirements%20Version%202.0%20(March%202012).pdf

Figure 12
Tri-State Generation and Transmission Association Member Cooperatives



Source: Tri-State 2014b.

Tri-State is not a member of any RTO. Instead, Tri-State is responsible for planning its own transmission needs. As is common throughout the WECC, Tri-State and the other transmission owners in the region—in particular Basin, WAPA, and Public Service Company of Colorado ("PSCo," a subsidiary of Xcel Energy)—have a long history of cooperation on the joint development and construction of transmission projects across the larger region. Joint planning among multiple utilities is generally completed through the CCPG, which is part of the WestConnect regional planning entity. This coordinated planning has recently yielded significant transmission projects being developed, such as the 81 mile Burlington–Lamar 345 kV project in eastern Colorado.[46] This project was developed through the joint CCPG planning efforts to comply with Colorado's public policy requirements under Senate Bill 100, which includes identifying "Energy Resources Zones" within Colorado and planning transmission to access those resources at a more cost-effective scale.[47]

The most immediate and significant transmission-related challenge for renewable generation exports from western Nebraska to the rest of the Western Interconnection is a transmission

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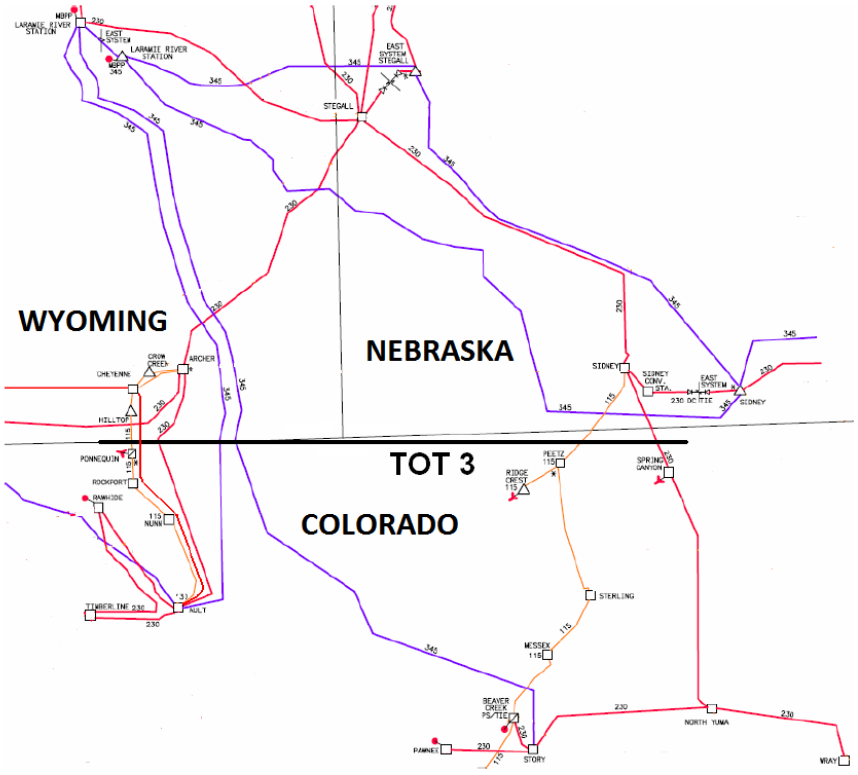
[46] Tri-State 2013. The Burlington–Lamar line is the first section of the larger, 350-mile Lamar–Front Range project that has been proposed to be built in eastern Colorado.

[47] For more information on transmission planning underway to comply with Senate Bill 100, see: http://www.sb100transmission.com/

constraint along the "TOT-3" path, which runs along the borders of Nebraska, Wyoming, and Colorado. The location of the TOT-3 path is shown in Figure 13.[48] The transfer capability of TOT-3 is jointly owned by Tristate, WAPA, Basin, and PSCo. Its capability of approximately 1,680 MW is fully utilized, which leaves very limited capability available for additional transfer of renewable energy from Nebraska to markets in Colorado or other parts of the WECC. The transmission constraint is being analyzed by WECC and efforts for relatively modest upgrades of several hundred megawatts are under way. Any significant development of renewable generation resources in Nebraska, which is located behind the constraint, would likely incur significant costs to relieve the constraint. To facilitate transmission upgrades at a cost-effective scale could require a large-scale renewable development effort—similar to Colorado's renewable generation and transmission policy efforts noted earlier—with costs shared across multiple interconnecting generators or their offtakers.

Figure 13
TOT 3 Transmission Constraint Between Nebraska, Wyoming, and Colorado



Source: WAPA 2010. The image has been modified to better identify each state.

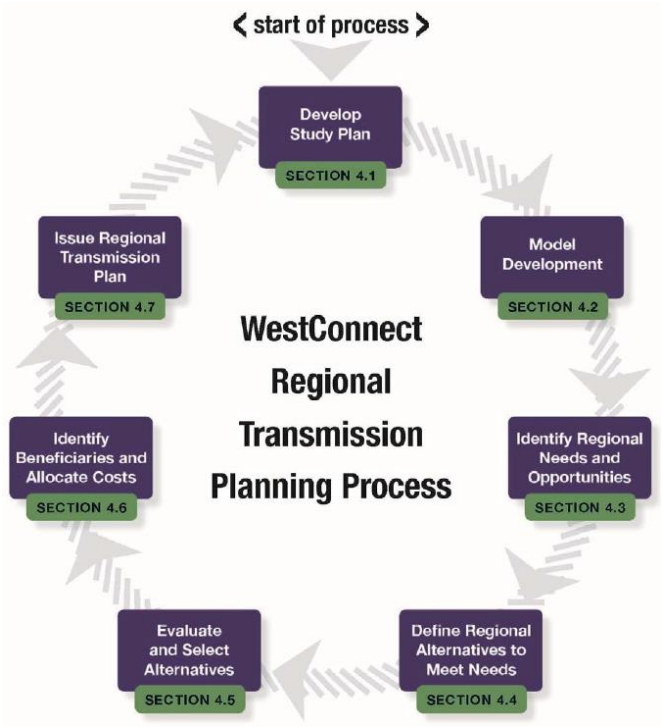
In accordance with FERC Order 1000, Tri-State and a group of other utilities in the West submitted to FERC a plan using a regional planning process facilitated by WestConnect. WestConnect, its members, and its stakeholders, in turn, have developed a regional transmission planning process that is in the final steps of being approved by FERC. The plan will consider reliability, economic, and policy needs of the regional system and include cost allocation

48 WAPA 2010.

approaches to identify who will pay for the needed new facilities.[49] The WestConnect transmission planning process and planning timelines are summarized in Figure 14. The primary goal of the regional transmission study is "to assess transmission and non-transmission alternatives that may meet the region's needs more efficiently and cost effectively than projects identified by individual Transmission Owners in their local planning processes."[50]

The WestConnect regional transmission planning process, which will be completed over a two year horizon, begins by developing a study plan and a base transmission plan that incorporates all new transmission facilities being pursued by the individual transmission owners in the region.[51] WestConnect then identifies broader regional transmission needs by evaluating whether the base transmission plan includes reliability violations, significant congestion, or if opportunities exist for more cost-effective regional lines to address public policy objectives. Based on the regional needs identified by WestConnect, transmission developers are then able to pinpoint options for meeting those needs and propose specific projects to WestConnect for further study and evaluation of whether the transmission alternatives provide a more efficient or cost effective solution.

Figure 14
WestConnect Regional Transmission Planning Process
(a) Summary

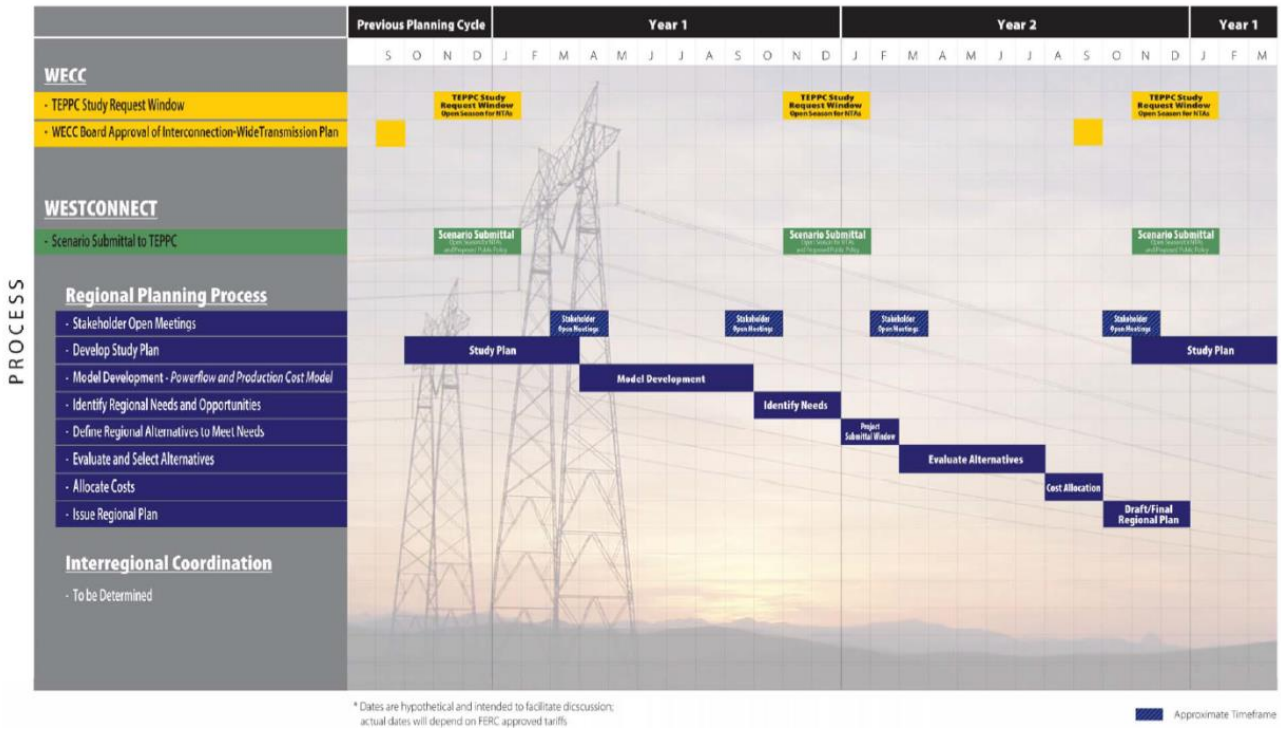


[49] WestConnect 2014b.

[50] WestConnect 2014b, p. 14.

[51] WestConnect 2014b.

(b) Timeline



Source: WestConnect 2014b.

Under this process, WestConnect evaluates whether the proposed projects meet the identified collective regional needs of the members. If so, the proposed transmission projects could qualify for regional cost allocation. Each proposed transmission alternative seeking regional cost allocation is required to calculate the benefits of the new facilities for WestConnect approval based on a pre-specified set of benefits, including the avoided costs of local reliability projects, the production cost savings across a number of future scenarios, and the reduced costs of meeting public policy objectives.[52] Realizing that a single transmission project may provide multiple benefits, WestConnect allows a combination of reliability, economic, and policy benefits to be considered in evaluating whether a proposed regional facility offers a more efficient or cost effective solution to the current facilities in the base plan. Proposed transmission projects that meet these requirements will be approved to be built with cost allocation to the transmission owners who receive the benefits, following a voting process in which transmission owners can choose to opt-out of the project.

At the writing of this report, WestConnect is still in the process of finalizing its planning process by responding to several remaining FERC Order 1000 compliance requirements. WestConnect is currently initiating its "2015 Abbreviated Planning Cycle" before beginning the first iteration of its regional transmission planning process as outlined above in January 2016.[53]

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52 In some cases, WestConnect also allows for consideration of reserve-sharing benefits.

53 WestConnect 2014c.

It is currently unclear whether the WestConnect process eventually will yield cost-effective transmission solutions that would allow for the export of renewable energy from western Nebraska to Colorado and the rest of WECC. As the full regional planning process is not scheduled to begin until 2016, it is unlikely that any transmission solutions that would allow for the export of Nebraska renewable energy could be built before 2022. Until then, the existing transmission constraints between Nebraska and the other western states would represent a significant barrier to renewable generation development in the western portions of Nebraska.

Even if the existing transmission limitation between Nebraska and neighboring western states can be overcome, Nebraska renewable exports would face significant competition from renewable generation in Wyoming, Colorado, and other western states. Further, to reach the major western markets for renewable energy, in particular California, a number of additional transmission constraints would need to be overcome.[54]

D. Interregional Transmission Planning Between SPP and MISO

While transmission planning processes are well established within regions, few effective and actionable planning processes currently exist for transmission upgrades across regional boundaries. Although FERC mandated in Order 1000 that the regional transmission organizations shall develop "interregional" planning, relatively little progress has been made to date and FERC has not yet ruled on the adequacy of the proposed interregional planning processes.[55] Moreover, neighboring regions do not yet fully agree on how interregional planning should be conducted.

Because Nebraska's renewable export opportunities could involve exports out of the SPP footprint, SPP's ability to engage in effective interregional transmission planning with neighboring system operators will be an important defining factor for Nebraska's renewable generation export market. SPP's seam with MISO will be particularly important since MISO and

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[54] Recognizing the multiple constraints within the WECC, a number of transmission projects between Wyoming and interconnection points in Oregon and near California are in various development stages. They include two projects, the Energy Gateway and a WY-CO Intertie that are partly under construction or in advanced development stages, and a number of proposed merchant transmission projects in early development stages, such as Zephyr, TransWest Express, and High Plains Express. For a map of these projects, see http://wyia.org/wp-content/uploads/2009/04/trans-map.png. While Nebraska may be able to take advantage of these transmission projects should they be realized, these project development efforts also illustrate the significant competition that western Nebraska wind generation faces from wind generation development efforts in Wyoming and Colorado.

See also the 2013 WECC Transmission plan (in particular pages 75-77), which summarizes potential transmission needs within the Western Interconnection transmission system under a range of possible 10- and 20-year futures (https://www.wecc.biz/Reliability/2013Plan_PlanSummary.pdf).

[55] SPP's and other regions' proposed interregional planning processes are posted here: http://www.ferc.gov/industries/electric/indus-act/trans-plan/Interregional.asp

regions to the east of MISO may account for a significant portion of the markets with future renewable energy needs.

Unfortunately, significant disagreements still exist between SPP and MISO with respect to interregional transmission planning. While SPP has attempted to approach interregional planning broadly, including consideration of public policy projects, MISO has applied a much more narrow perspective, focused solely on "market efficiency projects" at a voltage level of primarily 345 kV or above. As SPP explained to FERC, MISO's approach excludes interregional transmission projects with voltages primarily less than 345 kV and projects that are primarily needed to resolve reliability concerns or provide public policy benefits.[56] As SPP explains, approximately 80% of the interconnections between SPP and MISO are at a voltage level less than 345 kV, so it is reasonable to expect that many opportunities for more efficient or cost-effective resolution of issues near the SPP-MISO seam would be precluded from being considered using MISO's proposed criteria.[57] More importantly, excluding interregional reliability and public policy projects would severely limit the opportunity and ability to identify interregional transmission facilities that could address transmission needs more efficiently or cost-effectively than separate regional transmission facilities.

While this disagreement is still pending before FERC, SPP and MISO have continued their interregional planning efforts by exchanging planning data, building joint planning models, soliciting stakeholder input on seams-related concerns and opportunities, and defining the scope and timeline of the two organization's first interregional study process. This SPP-MISO interregional planning process is specified in the two organizations' Joint Operating Agreement ("JOA") and implemented by the Joint Planning Committee ("JPC"), the decision-making body consisting of representatives from the staff of SPP and MISO. The JPC considers stakeholder inputs, as facilitated by the Interregional Planning Stakeholder Advisory Committee ("IPSAC"). The IPSAC can make recommendations to the JPC concerning both the need to study transmission issues and solutions and the appropriate action on any solutions identified by the draft of the JPC's report on the results of a study.

The first SPP-MISO effort to develop a Coordinated System Plan ("CSP") formally started in early 2014. The study scope, as approved by the JCP, includes possible transmission solutions to seams-related reliability concerns and possible market efficiency improvements, but excludes interregional transmission projects that would be needed to address public policy objectives. To identify such seams-related reliability concerns and market efficiency opportunities and study them through the CSP effort, SPP, MISO and individual stakeholders submitted descriptions of interregional transmission issues.[58] Nebraska transmission owners have been participating actively in the CSP study process and have submitted information on existing challenges along the Nebraska portion of the SPP-MISO seam. SPP, MISO, and their stakeholders also developed

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56 SPP 2013a, p. 21.

57 SPP 2013a, p. 22.

58 MISO and SPP 2014.

planning models and study assumptions for use in the CSP. However, based on the lack of SPP and MISO stakeholder support to study public policy and renewable export scenarios, this first round of CSP analyses will reflect only "business as usual" study assumptions.

The joint study effort is currently under way and a draft CSP report is expected in June 2015. At the completion of this first MISO-SPP CSP study, the JPC may recommend interregional transmission projects for further evaluation. Any recommended interregional transmission solutions would then be considered by SPP's and MISO's respective regional transmission planning processes, which means each proposed interregional project also needs to be approved by both regional processes, including through SPP and MISO Boards, before it can be implemented as an interregional project as part of a Coordinated System Plan.[59] The fact that interregional projects need to pass three separate approval thresholds—the joint interregional thresholds as well as each RTOs' individual regional planning criteria—adds an additional challenge to the approval of any interregional transmission projects.

As the above discussion should make clear, the combination of analyzing only "business as usual" futures and the very limited scope and stringency of the current SPP-MISO interregional transmission planning process creates a significant barrier to planning for increased SPP renewable exports. While individual renewable generation developers and their offtakers may be able to request interregional transmission service from SPP into MISO and to other eastern power markets, it is unlikely that such individual requests would lead to major transmission upgrades and cost effective solutions that could support Nebraska's objective to develop 5,000 to 10,000 MW of renewable generation projects for export markets.

As discussed above, SPP's most recent regional ITP20 study analyzed a high-SPP-renewables scenario that included 5,000 MW of wind generation in Nebraska. This scenario—primarily intended for identifying the transmission upgrades that would be required for a significant increase in renewable energy exports outside of the SPP footprint—identified several transmission lines that would be necessary to increase SPP export capability. These projects included a new 842 mile 345 kV double circuit line from Holt County, Nebraska, to Hazelton, Iowa with estimated costs of nearly $1 billion.[60] Based on the limited scope of the current SPP-MISO interregional planning process, it is unlikely that such a project could be developed through interregional transmission planning efforts in the near future.

As discussed in more detail in Section VI.A, Nebraska policy makers and transmission owners will have to carefully craft a long-term transmission strategy, continue to work closely with SPP, support both regional and interregional study efforts, and explore all available options, such as self-funded "sponsored" projects and transmission ties to proposed merchant lines that are in early development efforts.

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[59] See SPP 2014c and MISO 2014a.

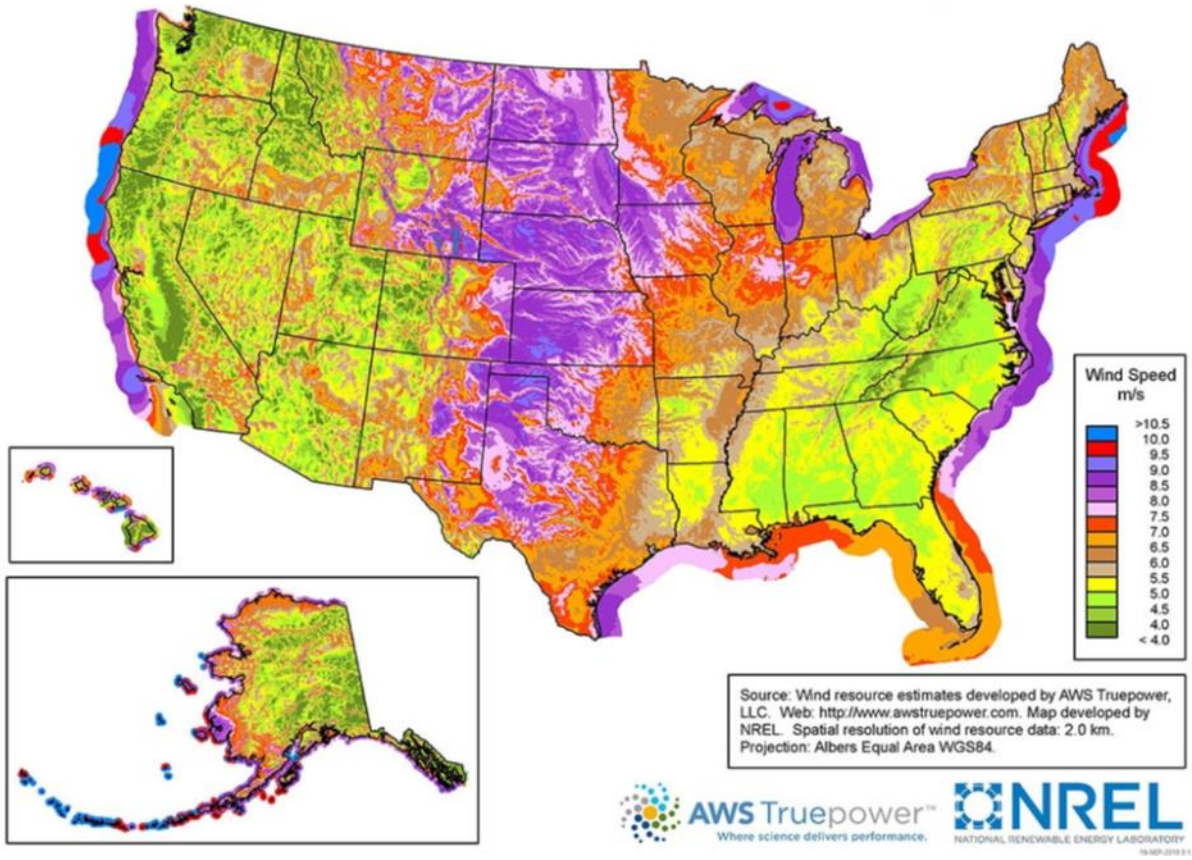
[60] SPP 2013b, p. 97.

IV. Comparative Economics of Wind Generation in Nebraska Relative to Neighboring States

While transmission capacity plays an important role in allowing for increased wind generation capacity in Nebraska, renewable energy development will very much depend on the relative economics of developing resources in Nebraska relative to neighboring states.

Nebraska is located in a multi-state region that offers the highest-quality wind resource for electricity generation in the U.S. Figure 15 below is a map that illustrates that the greatest wind energy potential stretches north to south from the Dakotas to Texas. Because the quality of wind in most of the region is comparable and the majority of the capital costs (such as the cost of the wind turbine, structures, and construction) are nearly identical, the delivered cost of wind power is very competitive across the region.

Figure 15
United States Land-Based and Offshore Annual Average Wind Speed at 100 meters



Given the cost similarities, even a small difference in the comparative economics of wind generation across locations can have significant impacts on developers' decision of where to build the new wind generators. The recent example of the long-term PPA that resulted from the competitive solicitation of Nebraska-based LES is illustrative of that point. LES considered contract offers from wind developers in Nebraska and other SPP states before deciding to

entering into a PPA with the 100 MW Arbuckle Mountain Wind Farm (developed and owned by EDP Renewables) located in Oklahoma, based on it being the lowest-cost offer. The difference in offer prices is related to the economic advantages enjoyed by wind developments in Oklahoma over those in Nebraska.

Looking forward based on our analysis, the comparative economics of additional wind power projects across different states are primarily driven by:

1. Differences in state financial incentives;
2. Electricity prices that the project can realize either through offtake power purchase agreements or through sales in the wholesale market, or both; and
3. Differences in regulatory requirements and the perceived costs and risks of those requirements.

A. State Financial Incentives

Financial incentives for developing renewable generation are used by several states in the Great Plains region. Specifically, state tax incentives for renewable generation developers are in the forms of state-provided production tax credit (for every MWh of renewable energy production), property tax exemptions, and sales tax refunds.

Among the incentives provided by neighboring states, we find that Oklahoma offers the most valuable tax incentives to renewable energy developers. In addition to a five-year exemption from property taxes, Oklahoma provides to renewable energy facilities a $5 per MWh PTC, which can only be monetized by tax-paying entities, therefore at times the full value of the tax credit cannot be monetized. (For our analysis, we assume that approximately 85% of the state-level PTC can be monetized.[61])

Nebraska has instituted a nameplate capacity tax of $3,518 per MW in lieu of property tax for renewable energy resources and decided to refund sales and use taxes for renewable resources.[62] Wind developers, however, must pay real property taxes in Nebraska that have been estimated to be $3,100 per MW per year.[63] We estimate that the higher tax incentives in Oklahoma can decrease the cost or potential offtake PPA price of wind energy built in Oklahoma by roughly

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61 DSIRE 2014. The option to monetize the tax credit reduces the need to find willing tax equity partners to finance the development of the renewable energy facility.

62 Nebraska provides similar sales and use tax exemptions for locally-owned community-based energy development ("C-BED"), which would not be expected to be developed for export purposes. (DSIRE 2014)

63 Bluestem and BairdHolm 2013. The real property tax rate of $3,100 per MW is based on taxes paid by the Elkhorn Ridge wind generation facility. We estimate the combined costs of the nameplate capacity tax and the real property taxes add $1.50 per MWh to the levelized cost of energy in Nebraska relative to states with a full exemption of property taxes.

$3.00 per MWh relative to Nebraska, all else equal.[64] Compared to the costs of wind energy summarized above, Oklahoma's tax incentive reduces the relative cost of wind energy by about 10–15% in cases where the federal PTC continues to be available at the prior magnitude, and 5–10% if the federal PTC is not available. Table 4 below summarizes the taxes imposed and the tax exemptions offered to wind developers in Nebraska, Iowa, Kansas, and Oklahoma.

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
Nebraska	Exempt from personal property taxes, but not real property taxes	$3,518/MW	Refunded, except for 1.5% local tax	No Credit	—
Iowa	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
Kansas	Exempt from all property taxes	None	Not Exempt	No Credit	Equivalent incentives
Oklahoma	5 year exemption from ad valorem tax	None	Not Exempt	$5/MWh for 10 years	$3.00/MWh *more* incentives

Source and notes: The applicable taxes and tax exemptions are primarily gathered from DSIRE 2014, with further review of state incentives based on each state's websites.

We find that Nebraska provides similar tax incentives as Kansas because the value of the refunded sales and use taxes in Nebraska is offset by the Nebraska nameplate capacity and real property taxes. The property taxes paid in Iowa following the end of the 5-year exemption period depend on the county in which the wind generation is located. Based on the likely range across counties, we estimate that incentives in Iowa could range from $1 per MWh more attractive than Nebraska to $2 per MWh less attractive.[65]

B. Lower Electricity Prices

In addition to larger tax incentives provided by certain states, another competitive disadvantage for Nebraska-based generation is that the wholesale energy prices are lower in Nebraska than in some of those competing locations. A visual representation of the differences in wholesale market prices from 2012 and 2013 is shown in Figure 16. Lower wholesale market prices in

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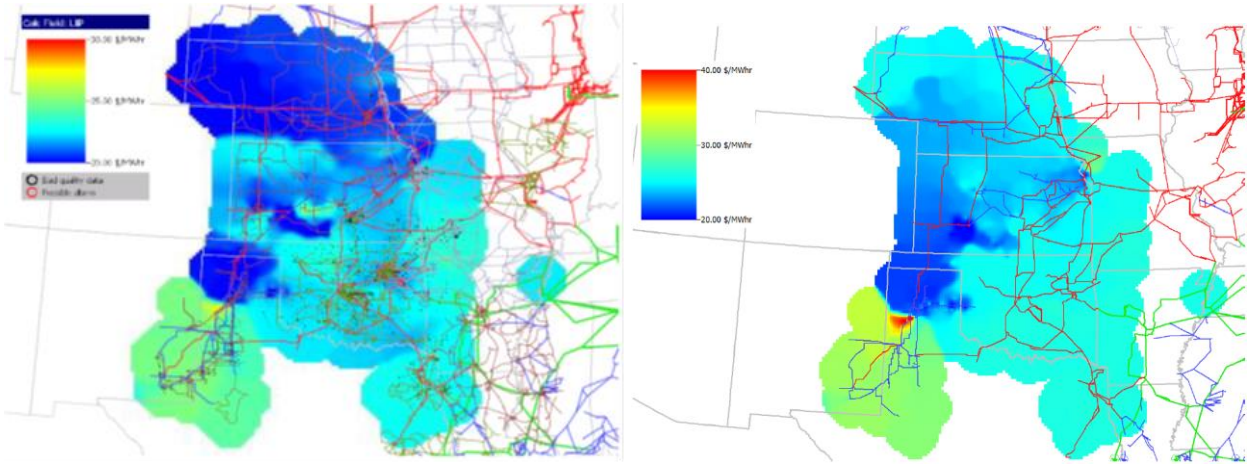
64 We estimate that the property taxes in Oklahoma paid in the years following the 5-year exemption will add $1 per MWh to the levelized cost of wind energy in those states relative to states with a full exemption of property taxes. (OTC 2014)

65 For information on Iowa property tax laws for renewable generation facilities, see https://www.legis.iowa.gov/docs/code/427B.pdf and https://tax.iowa.gov/historical-opinions-property-tax.

Nebraska means that all generation resources located in Nebraska receive lower revenues from the SPP wholesale energy market than generation located in other SPP states. The wholesale power price (in the form of locational marginal prices ("LMPs")) effectively sets the market value of the power delivered onto the grid. Thus, when a generator is located at a low LMP location, the value of that power generated would be lower than the power injected onto a part of the grid that has higher LMPs.

Figure 16
SPP Price Counter Maps

(a) 2012 (b) 2013



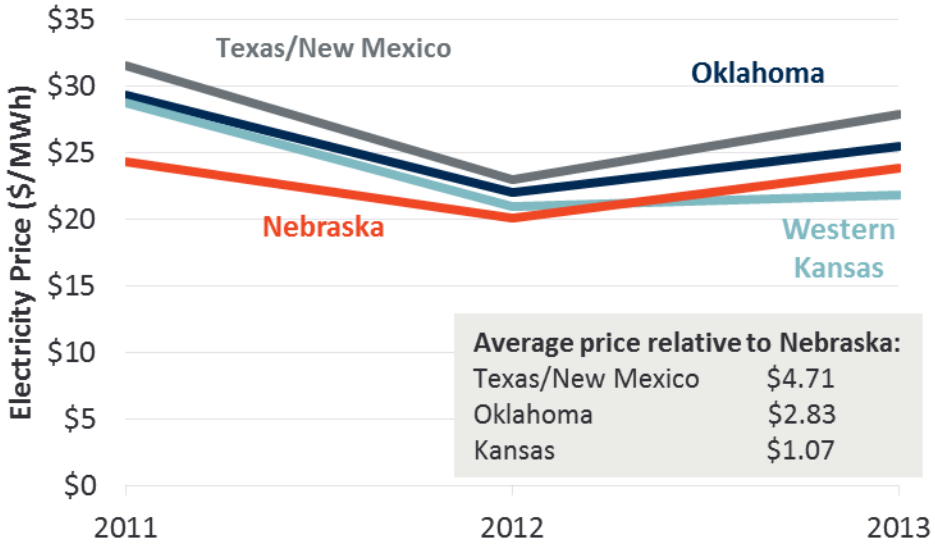
Source: SPP 2014b, pp. 48 – 49.

Historically through 2013, the difference in wholesale market prices in Nebraska and Oklahoma and other wind-rich regions of Texas and New Mexico (within SPP) has been approximately $1 to $5 per MWh on an annual average basis. This average price differential is shown in Figure 17(a).[66] Such a wholesale market price differential creates an economic disadvantage for renewable projects located in Nebraska.

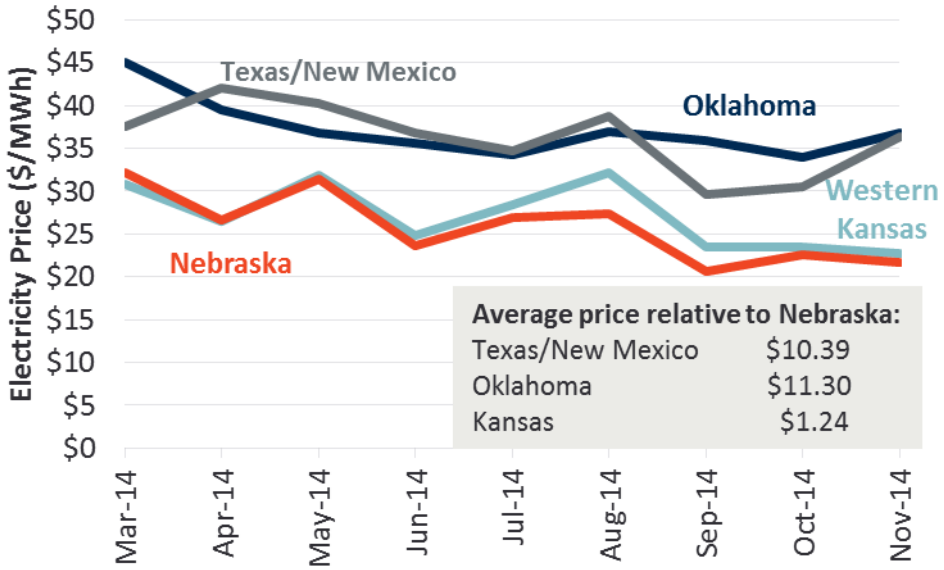
Since March 2014, when the SPP's Integrated Marketplace ("IM") began operating with a Day-Ahead market, the day-ahead prices in Nebraska have averaged about $10 to $11 per MWh below the prices in the southern portion of SPP. However, compared to western Kansas where there are high-quality wind resources, renewable generators in Nebraska receive about the same prices. The price differential in the SPP Day-Ahead market in 2014 is shown in Figure 17(b).

[66] Such price differentials between Nebraska's wholesale power prices compared to the rest of SPP are due to both transmission losses and transmission constraints that occur between Nebraska, located in the northern portion of SPP, and the rest of the SPP system.

Figure 17
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



Source and notes: Ventyx 2014. The annual average prices are weighted 60% off-peak and 40% peak hours to account for greater wind production during off-peak hours. Nebraska prices are based on NPPD zonal prices, Oklahoma prices are based on Western Farmers Electric Cooperative, Texas/New Mexico prices are based on Southwestern Public Service, and Kansas prices are based on Sunflower Electric zonal prices. Real time prices in Oklahoma and Texas/New Mexico relative to Nebraska tend to be closer to $13/MWh. Day-ahead prices in neighboring states in MISO (in particular the MidAmerican and Northern States Power service areas) have been $1 to $2 per MWh above Nebraska prices in 2014, which is similar to the prices in Kansas.

The reason that Nebraska experiences lower LMPs than some other parts of the SPP system is primarily due to the power losses and congestion that occur when power flows from Nebraska to the southern part of SPP. This market price differential increases the net remaining costs of wind power plants that need to be recovered through contract payments. For example, if an

offtaker enters into a contract to purchase the energy output from a generator in Oklahoma, that offtaker will be able to receive a higher price for that power when delivered to the wholesale market in Oklahoma than in Nebraska. This means that, if the capital and operating costs associated with the generators are identical, the generators in Oklahoma may be able to sell the output of renewable resources located in Oklahoma at a slightly higher price than those renewable resources in Nebraska. This effectively means that the power injected in Oklahoma is more valuable than the power injected in Nebraska, reducing the effective cost of a PPA.

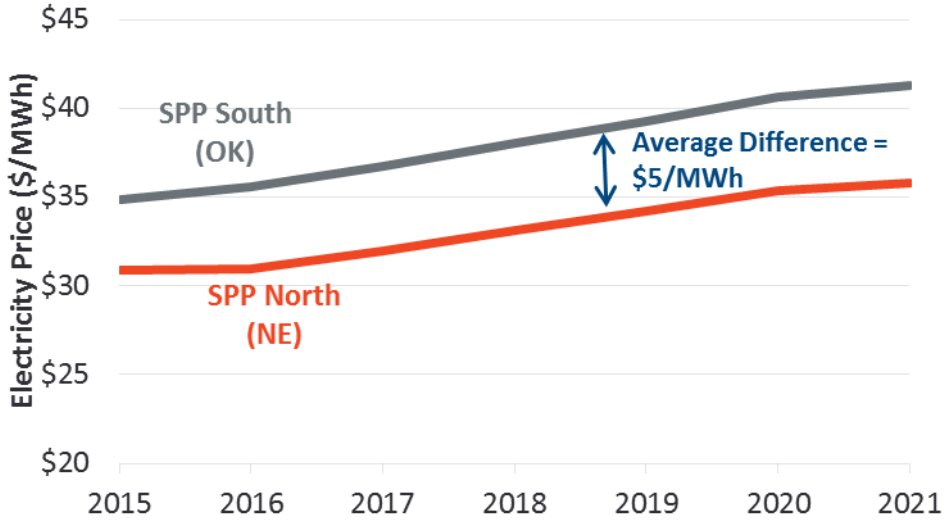
Witnessing lower average wholesale power prices in Nebraska than in the southern portion of SPP can be a benefit for utilities and electricity consumers in Nebraska if they were to rely (at least partially) on wholesale purchases to meet their demand. This means that utilities that are "net energy purchasers" would be better off because they would pay a lower price for the incremental power that they must purchase from the wholesale market. The opposite is true for "net energy sellers" who rely on the wholesale market to earn "off-system sales" revenues that are used to defray the cost of surplus generation to help reduce the electricity costs of their customers. On net, independent generators (those without load-serving responsibilities), whose revenues and plant values rely on the wholesale market would prefer to locate in places with high locational market prices. Just as lower wholesale prices make Nebraska's off-system sales from conventional generation less valuable, it is also a factor that reduces the economic value of Nebraska renewable generation from both a developer (seller) and offtaker (buyer) perspective. As of 2014, the Nebraska electric suppliers are net sellers, which means lower electricity prices in Nebraska tend to reduce their wholesale power market revenues and, thus, leave a larger portion of their costs to be paid by Nebraska ratepayers.

Looking forward, available pricing data for electricity futures in SPP suggest that the price differentials between Nebraska (represented by the SPP North Hub) and southern SPP (represented by the SPP South Hub, which primarily reflects market prices in Oklahoma) are expected to persist for the next several years at a level of approximately $5 per MWh. Figure 18 shows these futures prices for SPP North and South through 2021.

Wholesale power prices in wind-rich areas in the MISO footprint—specifically the Midamerican and Northern States Power service areas in Iowa, Minnesota, and the Dakotas—have been $1–2 per MWh higher than those in Nebraska.[67] This price difference will give those regions a slight economic advantage, particularly if transmission service from SPP to MISO (currently $2–3 per MWh but increasing) is taken into consideration.

[67] Ventyx 2014.

Figure 18
Electricity Futures Prices by SPP Trading Hub



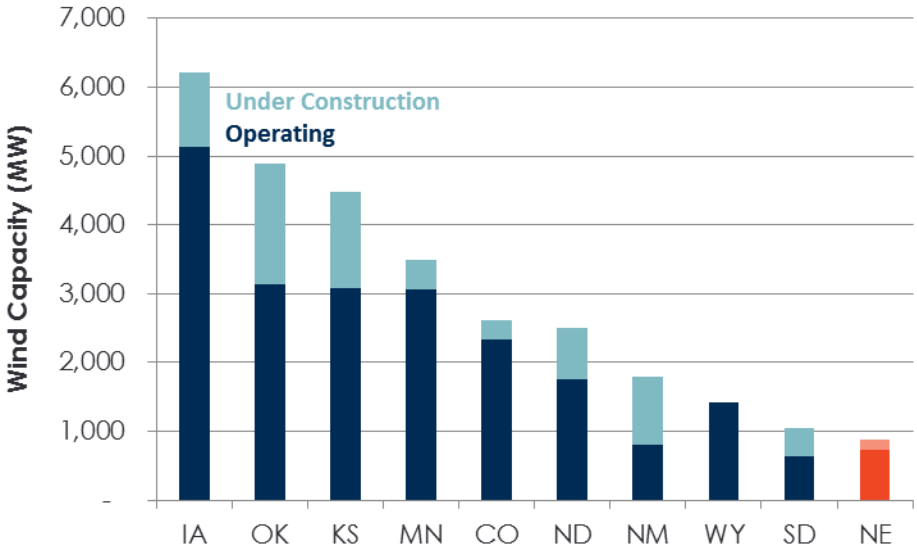
Source and notes: SNL 2014, OTC Global Holdings Forward Power Index. The SPP South trading hub represents average electricity prices across nodes located mostly in Oklahoma and the SPP North trading hub represents average electricity prices across nodes located mostly in Nebraska. The prices shown weigh off-peak prices by 60% and peak prices by 40% to account for greater wind production during off-peak hours.

C. Combined Effects of State Mandates, Tax Incentives, and Wholesale Prices on Historical Renewable Generation Development

The primary state incentives for renewable energy development are RPS mandates. The RPS requirements usually create the initial market. Some states provide "bonus points" for purchases or renewable resources that are built within the state's boundary. Such "in-state" preferences are typically instituted as a way to attract renewable energy development into the state and thereby increase the economic stimulus benefits to the state.

In addition to the RPS mandates for renewable energy in some states, the relative attractiveness of the tax incentives for renewable energy and the apparent high wholesale prices have provided significant direct economic incentive for renewable generators to locate in certain states. Figure 19 below shows the amount of installed capacity of wind generation and those under construction in each of states in the Great Plains.

Figure 19
Wind Generation Operating and Under Construction by State



Source and notes: Ventyx 2014. Texas, which has not been included in the figure above, has 12,700 MW of operating capacity and an additional 5,300 MW under construction. This figure does not yet include the 400 MW Grand Prairie wind facility under contract with OPPD as it is still in early-phase development, as indicated in Table 5.

To date, wind developers in the Great Plains region have constructed more than 35,000 MW of wind generation.[68] Of this large amount, the wind plants added in Nebraska have amounted to 700 MW, with less generating capacity under construction than in most of the neighboring states. This lesser scale of development to date means that renewable energy developers have less experience in developing renewable energy projects in Nebraska than in some of the neighboring states.

The first reason for the limited growth in renewable development in Nebraska relative to its neighbors is the lack of a state RPS that requires the electric suppliers to purchase renewable energy to meet a certain percentage of their load. By requiring renewable energy to be purchased, the RPS mandates in some states have earlier-on provided an initial market for the development of the high quality resources located within their borders. Further, in some cases such as North Dakota, the lack of a state RPS has not stopped project development in the state because neighboring states either have RPS or other electricity purchasers (or load-serving entities) who see that the economics of wind energy suits the need of their resource portfolio. Figure 20 below shows that Iowa began its development activities ahead of others, expanding its capacity significantly between 2007 and 2011, with a gradual ramp up in Oklahoma, Kansas, Colorado, and Wyoming during this period. Between 2011 and 2013, Oklahoma and Kansas also began to significantly increase the build out in their states.

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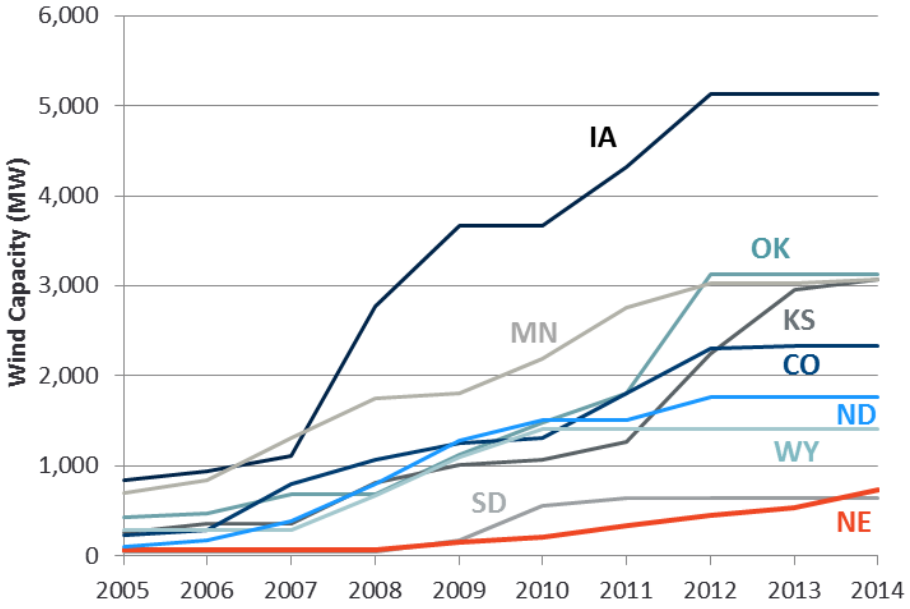
[68] Ventyx 2014. The total capacity of wind generation in the region includes the states shown in the figure above and Texas. Texas is not shown in the figure due to the significant difference in scale between Texas and the other states.

Figure 20
Wind Generation Growth by State



Source: Ventyx 2014.

The Nebraska Legislature in 2010 modified its regulations concerning the development of renewable generation capacity through LB 1048. The bill set up a new regulatory approval process for renewable generation capacity intended for export in the state. The Certified Renewable Export Facility ("CREF") process is overseen by the Nebraska PRB and is primarily intended to provide developers with a better-defined approval process[69] and is intended to minimize the perceived threat of condemnation of merchant wind projects by Nebraska electric suppliers, which was possible under the previous law.

We understand that at least one renewable energy project filed an application using the new CREF process, but exited the process when it was unable to identify an offtaker outside of Nebraska. Thus, to date, wind generation development in Nebraska has remained limited to only projects supported by PPAs with one of the Nebraska public power utilities to serve in-state retail electricity customers. The renewable projects in Nebraska that have become operational since 2012 are shown in Table 5.

[69] NPRB 2014a.

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

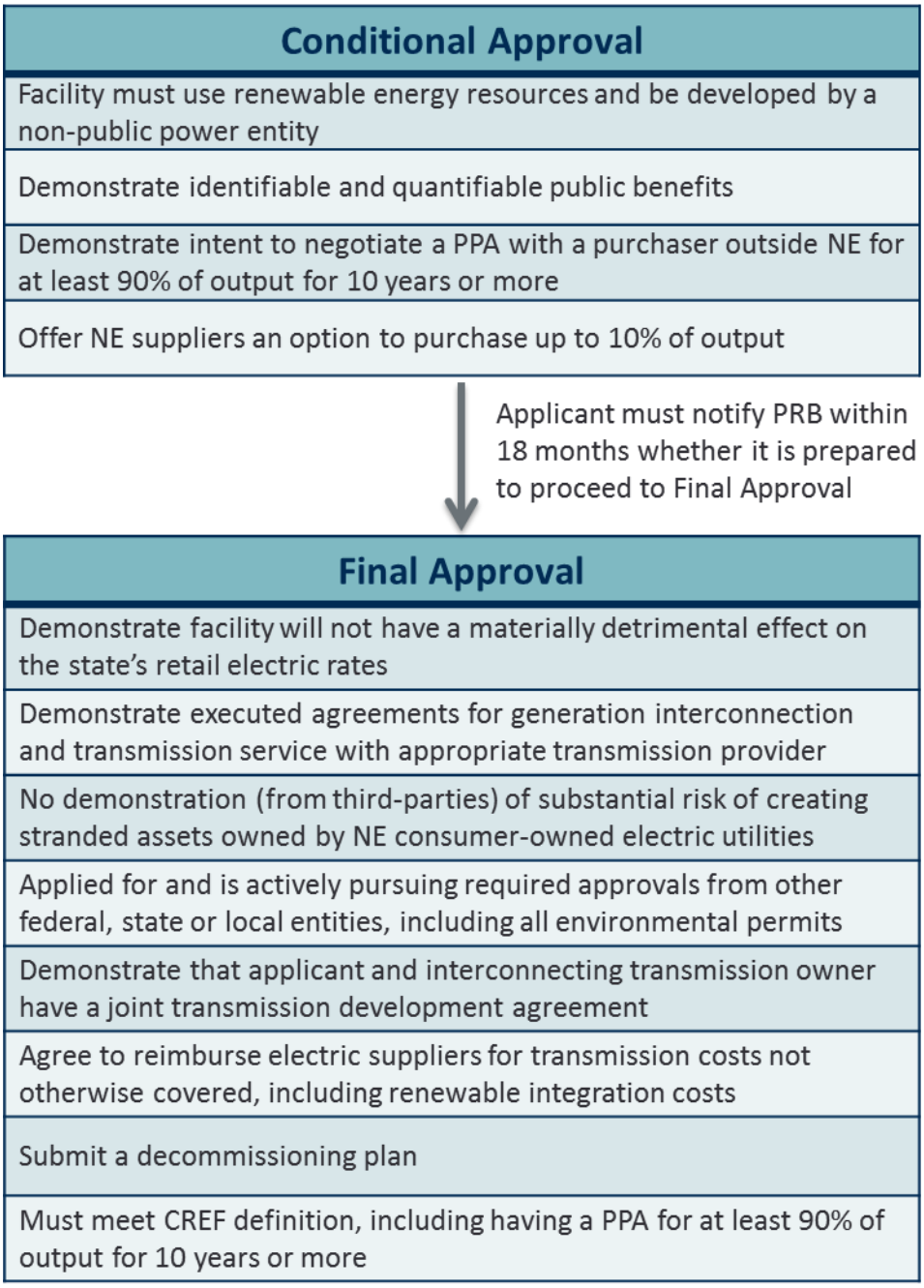
Source and notes: Ventyx 2014 and SNL 2014. 330 MW of wind capacity became operational in Nebraska prior to 2012. The developer of the Verdigre Wind Farm reports on its website that it is negotiating contracts with public power districts within Nebraska.

Throughout our interviews with stakeholders, we have found that many large wind farm developers have gained substantial experience in neighboring states, leaving Nebraska as a more "unfamiliar territory" for potential renewable generation development efforts. These market participants are less familiar with the time and cost required to develop projects in Nebraska compared to those in neighboring states. Consequently, the same renewable generation developers have the perception that projects in Nebraska face greater regulatory requirements and possibly greater risks. Even if not fully accurate, these perceptions will discourage some developers from investing in the state.

D. Greater Perceived Risks of Developing Wind Capacity in Nebraska

The CREF process administered by the PRB was created for approving renewable generation in Nebraska primarily for export. An outline of the CREF process is shown in Figure 21.

Figure 21
Summary of Nebraska's CREF Process



Source and notes: NPRB 2014a. CREF applicants also have the option to proceed directly to the Final Approval process at which time they will have to show that they have also met the conditional requirements.

We understand that the CREF process was intended to be a relatively simple process for renewable energy developers in Nebraska and, through our stakeholder interviews, we found that the developer who had completed the early stages of the CREF process had a positive experience with the PRB. We understand that part of the intent of the CREF process, particularly the requirement of documenting an export PPA, was to protect Nebraska ratepayers

from subsidizing renewable generation developments within the state that are not meant to serve local customers. In effect, the CREF process limits renewable generation from selling primarily into the regional wholesale electricity market operated by SPP. This means that even if a developer is willing to bear the risks of not initially having a long-term offtake PPA for the output of a renewable generator, the CREF process would not be able approve the development and construction of such a generating facility in Nebraska.

In contrast to Nebraska, other states often require that the renewable energy *purchaser* (through a long-term PPA) provides justification for the costs of purchasing the energy from such a facility. This is generally required either through a state regulatory approval process for investor-owned utilities or to a board of directors for public utilities. Other states do not require the developer of renewable generators to have a PPA to obtain approval for construction of the capacity; particularly if the power will be sold to other offtakers unrelated to the regulated in-state utility. For this reason, stakeholders noted that the CREF process continues to reinforce the historical perception of Nebraska being a more burdensome and risky location for developing wind generation facilities. The fact that no developer has yet completed the full CREF approval process adds to this perception.

Our review of the CREF process and input from stakeholders identified a number of items within the process that appear to limit the prospect of achieving a significant amount of renewable energy development for the purpose of exports to other locations.

- The requirement for renewable energy developers to hold a PPA prior to the state's approval to construct can present a significant hurdle because buyers sometimes require that all major permits are obtained before they are willing to offer a PPA. Based on this requirement, a wind plant cannot initially be built by developers based on prices it can receive in the wholesale electricity market or on financial contracts that hedge their wholesale market exposures, without a long-term power purchase contract. This limits development and PPA-contracting options compared to those available in other states.
- The requirement for renewable energy developers to offer in good faith up to 10% of their output to Nebraska electric suppliers can add some perceived risks as projects may need to be sized up by 10% above the amount that the developers could sell to an offtaker outside of Nebraska. In addition, Nebraska electric suppliers have a separate process for procuring wind generation that makes this requirement unnecessary even if the added burden is only modest.
- The requirement for renewable energy developers to obtain transmission service is not clear as it does not specify whether firm or non-firm transmission service is necessary for approval. If firm transmission service is *required* for exporting power out of SPP, such a requirement would be difficult to meet because offtakers often will not use firm transmission service or will not be willing to purchase firm transmission from plants that do not yet have all necessary approvals. If firm service were required, it could ultimately be cost prohibitive to single renewable generators if the existing SPP export transmission capability is still limited, particularly while the already-approved projects are not yet completed.

- The requirements for renewable energy developers to demonstrate that their facility will not have a materially detrimental impact on Nebraska retail rates or otherwise to agree to reimburse any additional costs to electric suppliers significantly adds to the perceived development risk. Such risks, even if only perceived, will make it difficult to attract investors and lenders to renewable generation development efforts.
- The requirement of having to demonstrate that the new generation developed in Nebraska would not impose substantial risk of creating stranded assets for Nebraska electric utilities, introduces additional risks to developers. In theory any added generation in the state could reduce wholesale power prices in Nebraska and thereby reduce the value of surplus existing generation assets in the state.
- There is also a potentially significant time sequencing challenge in the interconnection of requirements imposed by Nebraska transmission owners through their generation interconnection process and the CREF process. We understand that renewable generation developers are required to achieve certain CREF-related milestones prior to obtaining the generation interconnection agreement. Conversely, the CREF process requires the renewable developer to have obtained an interconnection agreement prior to CREF approval. This creates coordination challenges that make it more difficult and risky for developers in Nebraska. In contrast to other states where such conditions do not exist, the inability to meet the generation interconnection milestones can severely impact project development schedules and the ability of developers to obtain PPAs.

We understand from some renewable developers that Nebraska transmission owners seem to apply more costly standards for substation configurations and the amount of land required for generation interconnections, which adds costs to the development effort compared to other states. Beyond these CREF-related issues, we have not found that other permitting requirements in Nebraska—such as obtaining environmental permits or completing county and local zoning and permitting processes—are more difficult than in neighboring states. Based on our discussion with the Nebraska Game and Parks Commission, we understand that there are environmentally sensitive areas within Nebraska that will need to be avoided for renewable energy development and areas in the state that provide development challenges based on the presence of endangered species and migratory birds, especially the whooping crane.[70] We do not find these challenges to be any more significant than those in other states in the region and do not expect them to limit the potential for renewable generation development in Nebraska.

It is the case, however, that developers are less familiar with these requirements and processes in Nebraska due to their limited experience in the state. However, the current development of 400–500 MW of renewable generation capacity in Nebraska to serve local load may assist in reducing some of these perceived challenges.

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[70] Further information on environmental issues, see: Nebraska Game & Parks 2014 and UNL 2014.

V. Summary of the Challenges to Meeting Nebraska Renewable Energy Export Goals

This section summarizes the challenges identified in the previous discussions.

A. Transmission Constraints

Based on our analysis, several hundred megawatts of new renewable generation could be added before the planned transmission upgrades are built and operational in the 2016–2018 timeframe and significantly more could be added after that. Thus, the current transmission capability is not the most immediate challenge to developing more renewable energy in Nebraska. Instead, the existing transmission congestion limits the economics of generation resources located in Nebraska and therefore is one of the locational disadvantages faced by developers interested in developing renewable resources in Nebraska. In the long term, having limited transmission capability is a critical barrier to reach the ambitious goal of 5,000 to 10,000 MW of Nebraska renewable resources for export purposes. Below we describe the longer-term barrier associated with transmission limitations.

Once the transmission upgrades currently under development are completed (most notably the Nebraska R-Plan), SPP's analyses suggest that approximately an additional 2,000 MW of renewable generation could be added to the Nebraska system without experiencing significant system constraints. Beyond that, additional transmission capability to move power from Nebraska to the rest of SPP and/or move that power to markets in MISO and WECC will likely be needed. We find that upgrading transmission to WECC will be particularly challenging due to the cost of building transmission across the Eastern and Western interconnections. Further, even for western Nebraska wind plants located within the Western Interconnection, overcoming transmission constraints that exist between western Nebraska and Colorado (and the rest of WECC) would impose significant costs on Nebraska renewable developers or Nebraska electricity consumers unless other parties are willing to share a significant portion of those costs.

Exporting from SPP to MISO (and then potentially beyond MISO to fulfill the renewable energy requirements and targets of PJM or southeastern states) would be challenging because the interregional transmission planning efforts between SPP and MISO are currently still under development and will need significant improvements before they are able to effectively plan large transmission upgrades across the RTOs' boundaries. We anticipate that those improvements will take a few years to materialize and, once transmission upgrades across the seams are identified and approved, a few more years will be required for their development and construction. The direct interconnection of wind plants in Nebraska through dedicated transmission lines into the MISO footprint may be an attractive option that should be explored further.

Overall, the long-term transmission needs to support the development in Nebraska of 5,000 to 10,000 MW of renewable generation for export would be costly. Some of those costs can be passed on to generators and their offtakers, but imposing those costs could decrease the

competitiveness of Nebraska-based renewable generation relative to other locations that might have lower-cost market access or be willing to bear the costs of transmission upgrades.

B. Limited and Uncertain Demand for More Renewable Resources

Our analysis finds that there is currently limited remaining near-term demand in SPP and MISO for meeting renewable energy mandates and targets. In addition, the expiration of the federal PTC, unless renewed to the previous level, would increase the costs and therefore the prices at which wind generation could be sold to offtakers outside of Nebraska. However, the potential retirement of coal plants in the Midwest (both in SPP and MISO) and the potential impact of EPA's proposed greenhouse gas standards may provide opportunities for significant renewable generation to be developed in Nebraska. This is particularly the case as the need for electricity grows while the economics of renewable generation remain favorable relative to other generation resources.

C. Less Attractive Economics Relative to Some Other SPP Locations

All other factors being equal (including wind quality and wind turbine costs), wind developers will choose to build new wind generation facilities in states that provide the most attractive potential revenues. We find that Nebraska is currently at a disadvantage relative to Oklahoma for renewable energy development due to less attractive tax incentives and lower wholesale energy market prices. At the same time, Nebraska provides tax incentives that exceed those provided by Kansas and Iowa with limited wholesale energy price differences with western Kansas (where the wind capacity is located).

D. Greater Development Risks Relative to Some Other SPP Locations

Nebraska is the only state to require renewable generation developers to show that they have obtained PPAs and transmission service to export their power. Other states do not prohibit renewable generation from initially selling into the wholesale market without PPAs. While designed to be simple and not burdensome, the CREF approval process creates additional hurdles and perceived risks for renewable energy developers and their investors.

While each of the previously-discussed challenges may not inhibit renewable energy development for export purposes, collectively, they have created a less attractive environment for new renewable resources in Nebraska compared to other states with similarly high-quality wind resources.

VI. Options to Address the Identified Challenges

In this section, we lay out a few options that the Nebraska Legislature can consider for addressing the challenges identified above.

A. Develop a Transmission Strategy for the State

Transmission constraints will be a long-term barrier to the development of the ambitious target of 5,000 to 10,000 MW of renewable generation in the state. Since the planning, development, and construction of major transmission projects has taken three to eight years to complete, addressing the transmission constraints as a long-term barrier will have to be an essential component of the state's long-term renewable generation strategy. To develop such a long-term transmission strategy, the PRB could work closely with Nebraska policy makers and Transmission Owners to create concise short-term and long-term transmission strategies.

Nebraska can pursue several approaches to develop the transmission infrastructure necessary to support the target of 5,000 to 10,000 MW of renewable energy resources in the state. A transmission infrastructure strategy that offers the lowest cost to Nebraska ratepayers would most likely be a combination of these approaches:

1. Pursue Transmission Infrastructure Development through the SPP Planning Process

Nebraska will continue to work within the existing SPP ITP process to identify the regional transmission upgrades necessary to support the integration of renewable generation developments in Nebraska and facilitate associated energy exports. SPP's ITP process has already facilitated significant transmission upgrades throughout SPP, including projects beneficial to Nebraska. Under the SPP cost allocation process, Nebraska customers currently pay a share of these regional facilities. To take advantage of the SPP ITP process, Nebraska could identify transmission projects necessary for meeting its policy objectives and work with SPP and its other stakeholders to further develop the proposed transmission upgrades within the SPP planning process for inclusion in SPP's transmission plan. The advantage to this approach is the opportunity to share all or a portion of the costs of new transmission facilities across the entire SPP region. Nevertheless, despite the sharing of costs, expanding the local, regional, and interregional transmission system to support this objective through the SPP ITP process could increase the cost of transmission from a Nebraska ratepayer perspective.

Under the ITP's highway/byway cost allocation process, Nebraska customers pay for 71%[71] of the cost of all transmission facilities operating at a voltage level of 100 to 300 kV, which is the typical voltage level of transmission facilities and "gathering systems" that interconnect wind farms with SPP's 345 kV regional transmission backbone. Nebraska transmission owners and policy makers will have to work closely with SPP and SPP's Regional State Committee to explore available options and benefits for expanding the 345 kV backbone transmission system within SPP, and interconnections to neighboring regions—both MISO and WECC. Under the highway/byway cost allocation process, Nebraska customers pay approximately 14% of all 345 kV transmission upgrades planned by SPP.

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[71] Nebraska customers would pay for two-thirds plus approximately 14% of the remaining one-third that is shared on an SPP-wide basis, for a total of approximately 71%.

2. Evaluate and Reduce Barriers Related to the SPP Generator Interconnection and Transmission Service Request Process

Every generator interconnecting with the transmission system requires an interconnection study by SPP to ensure that the grid is able to support its electricity production. The transmission lines that need to be built to interconnect new renewable generation facilities with the existing transmission system and upgrades to the existing transmission network (if any) are paid for by the interconnecting generators. The network upgrades associated with such generation-interconnection requests (if any), however, generally do not address the economic implications of additional transmission congestion caused by the additional renewable resources. Those congestion-related upgrades would typically need to be addressed through the SPP ITP process as discussed above.

For exports out of the SPP footprint, a renewable generator or buyer of the renewable energy would need to submit a TSR for SPP to analyze and identify any network upgrades that would be necessary to support the request. The costs of the network upgrades needed to accommodate the service request would be allocated to the requesting transmission customer. This option would insulate Nebraska customers from bearing costs, but may impose significant costs on the transmission customers, which would make Nebraska wind resources less economically attractive compared to resources in states and locations able to export power to neighboring regions with no or less costly network upgrades.

Within SPP, the buyers of renewable energy from Nebraska wind resources have the option to request transmission service if they choose to make the wind plant a "designated resource." Such designation would likely allow the power purchasers to reduce their exposure to SPP congestion charges, but would require them to pay for one-third of the cost of any SPP network upgrade necessary to accommodate such requests (with the remaining two-thirds shared across the entire SPP footprint). Using this option would also reduce the transmission costs imposed on Nebraska customers. However, this network transmission service option may not be pursued by other purchasers within SPP if it results in costs that make the Nebraska resource less economically attractive than the available alternatives.

Utilizing generation interconnection and transmission service requests can be a particularly expensive option if the requests are made by individual generators and transmission service customers on a case-by-case basis. One option that Nebraska can explore and pursue to reduce the costs associated with individual generation interconnection and TSRs is to channel renewable developments to specific geographic locations and group prospective future requests to achieve a more cost-effective scale.

In addition, streamlining the generator interconnection process relative to the CREF approval process could significantly reduce renewable generation developers' timing challenges with having to obtain the CREF approval simultaneously with obtaining a generator interconnection agreement with the local transmission provider.

3. Explore State-Sponsored "Gathering" Facilities

To facilitate renewable energy development of sufficient scale within the state, Nebraska may want to consider exploring the development of state-sponsored transmission projects that would act as gathering facilities for future wind farms. Similar to efforts undertaken in Texas, California, and Kansas, such transmission projects could be targeted to connect the most attractive areas for renewable energy developments to the SPP backbone transmission network. These "gathering facilities" and related transmission network upgrades could be developed in anticipation of wind generation development and be sized at a scale that can accommodate multiple wind plants at a lower overall cost per MW of installed wind generation. States with high-quality renewable energy resources and favorable development environments who have built similar transmission networks in anticipation of need (*e.g.*, Texas and California) have experienced significantly accelerated renewable resource development that otherwise could not have occurred within the regions where the lines were built. Under this approach, Nebraska may consider identifying the regions within the state that are most attractive for wind development given the quality of the wind resources, the likely cost of necessary transmission infrastructure, and potential environmental impacts.

Development of gathering facilities would be focused on providing the infrastructure necessary to connect the renewable resources to the regional transmission network. Using this approach would require Nebraska to provide up-front funding for at least some portions of the necessary transmission infrastructure. It may be possible, however, to develop tariff-based cost allocation approaches that allow charging at least some of the costs associated with these transmission gathering facilities (on a *pro-rata* basis) back to renewable generators or transmission service customers when they interconnect onto these facilities.[72] The network upgrades related to such a "gathering system" may qualify for SPP cost sharing if they are folded into the SPP ITP process.

4. Explore Developing Transmission Interties to Markets Outside of SPP

SPP is actively exploring addressing seams-related transmission investments through interregional planning efforts with neighboring regions. Because of the difficulty in coordinating efforts with neighboring regions, little progress has been made to date. Nebraska policy makers and transmission owners could evaluate the extent to which it may be attractive to bypass these interregional planning processes by developing transmission infrastructure that would directly connect Nebraska renewable generation with markets to the west and east of the state. An example would be to explore transmission options that would directly connect Nebraska

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[72] For example, this approach was taken in California for the Tehachapi transmission project, which consisted of gathering lines and network upgrades to facilitate the integration of 4,500 MW of wind generation. The CAISO implemented a Location Constraint Resource Interconnection tariff option that allows for up-front funding of the transmission by the local transmission owner, followed by a *pro-rata* allocation of the project cost to interconnecting customers. Relatedly, Kansas has available a state-wide cost recovery option for transmission projects developed by the Kansas Electric Transmission Authority (KETA, http://www.kansas.gov/keta/).

resources to nearby transmission facilities in the WECC and MISO, including merchant transmission projects that aim to reach attractive renewables markets.[73] These transmission facilities and interconnecting generators likely would *not* be part of the SPP system.

Similar to the gathering facilities option discussed above, Nebraska policy makers and transmission owners could identify renewable generation regions that would be attractive for such direct exports to neighboring regions, based on the criteria listed above and the proximity to these export markets. The costs associated with developing direct transmission interties to neighboring markets would require upfront funding from the state, although at least some of the costs could be recovered from interconnecting generators and transmission service customers.

Without completing technical studies specifically focused on determining where and how much transmission infrastructure would need to be developed, we can only estimate the investment need based on experience elsewhere. Doing so, we estimate that supporting the integration and export of 5,000 to 10,000 MW of renewable generation capacity will require transmission investments in the range of $1.5 billion to $4 billion. The impact of such large-scale transmission investments on Nebraska ratepayers will depend on the approach Nebraska chooses for developing the new facilities. As discussed, some of these costs may be recoverable directly from the interconnecting generators and related transmission customers and some of the costs may be shared within SPP, with Nebraska customers paying approximately 14% for 345 kV "highway" facilities and approximately 71% for 100–300 kV "byway" facilities. Assigning a significant portion of the costs of the necessary system upgrades to renewable generators or related transmission customers may not be feasible, given the economics of renewable generation in Nebraska compared to some of the neighboring states. Unless SPP-wide cost sharing can be accomplished, a potentially-significant portion of the necessary transmission infrastructure consequently may need to be funded by the state directly or be allocated to Nebraska ratepayers.

B. Provide Additional Tax Incentives to Improve Relative Economics

If Nebraska wants to stand ready to capture the next wave of renewable energy development, the Legislature may consider immediately eliminating the economic disadvantage faced by wind generators in the state relative to some neighboring states, especially Oklahoma. If Nebraska wanted to do so, it could provide additional tax incentives to overcome the current disadvantage the state faces in terms of tax incentives and wholesale energy market prices relative to other states in the region. We estimate that the additional financial incentive needed to accomplish these objectives would be in the range of $5 to $10 per MWh. The range is provided to reflect the extent to which lower market prices may persist in Nebraska relative to other regions in SPP.

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[73] Clean Line's 3,500 MW "Rock Island" HVDC line from northwestern Iowa to the PJM portion of Illinois is an example of such a merchant transmission project. Note, however, that merchant transmission lines are not likely to be built in Nebraska. In contrast to neighboring states, the PRB approval process was designed primarily for Nebraska public power utilities. For this reason, a merchant developer may find it difficult to obtain regulatory approval through the existing process. For more information, see: http://www.rockislandcleanline.com/site/page/project-description

There are several types of tax-related incentives that Nebraska could provide to renewable generators in the state. These options include:

a. **Eliminate the current Nameplate Capacity Tax** on wind generators, which would provide approximately $1 per MWh of incentives to in-state wind generators.

b. **Provide a state-level production tax credit** of $5 to $10 per MWh, which would reduce the economic disadvantage new facilities in Nebraska currently have over those in Oklahoma. The estimated range of incentives for the Legislature to consider is based on the joint effects associated with the tax credit offered in Oklahoma and the relative wholesale power price differentials between the wind-rich areas in Nebraska compared to those of Oklahoma.

c. **Provide a state-level investment tax credit** that is equivalent to $5 to $10 per MWh production tax credit over the twenty year lifetime of the facilities. We estimate that a 9% to 18% ITC is approximately equivalent, based on our estimated range of project capital costs and capacity factors in Nebraska.

Among these options, eliminating the nameplate capacity tax and providing an ITC would likely be most attractive and effective. While both the state-level PTC and ITC will improve the economics of wind generation in Nebraska relative to other locations, providing an ITC would be a more attractive option because the it acts as an investment incentive that can be monetized soon after the completion of the renewable generation project, does not affect the marginal opportunity cost of the renewable resources when they consider their participation in the wholesale market, and would not directly affect the price at which renewables generators would bid in the wholesale energy market. Unlike a PTC that links the tax credit to the amount of electricity generated, the ITC should not directly place more downward pressure on the wholesale prices in Nebraska (except for the fact that more energy supply would materialize on the Nebraska system).[74] For this reason, the ITC may be a better approach than the state-level PTC to provide incentives for the development of renewable generation in the state.

C. Simplify the CREF Process to Limit Requirements for Developers

To reduce the perceived or actual challenges for approval of wind generation facilities in Nebraska created by the CREF process, the Nebraska Legislature may consider simplifying the current responsibilities of the PRB to limit the scope of approval.

We offer two options for consideration by Nebraska policy makers, as summarized in Table 6:

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[74] For wind generation, the marginal cost of generation is zero as the "fuel" for operating a wind turbine is free. However, when a PTC is offered to wind generation, the marginal costs of wind facilities are negative due to the foregone value of the tax credit. The resulting effect, which is widely seen with facilities that currently earn the federal PTC, is the negative prices at which wind resources bid into the wholesale energy market, which in turn places downward pressure on the prices.

a. **Limit CREF approval to include: the environmental impact assessment and other permits; the offtake power purchase, interconnection, and transmission service agreements; and the decommissioning plan.** Under this first option, Nebraska would eliminate the requirement that renewable energy developers either assure that the costs associated with the facilities would not create detrimental impacts on customers' retail electricity rates, or otherwise reimburse electric suppliers such costs that occur in the future. This streamlined approval process would ensure that a renewable energy facility constructed in the state is indeed designated for export, but would *not* require a demonstration that such a facility will have *absolutely no* impact on the customer rates, directly or indirectly, *nor* address any demonstration of the potential impact of such investment on the market value of existing generation facilities owned by Nebraska utilities. Further, Nebraska may consider eliminating the requirement that renewable energy developers must offer 10% of the output of their facilities to the Nebraska electric suppliers.

b. **Limit the CREF approval process to only the review of environmental impacts and other permits, and the decommissioning plan.** This second option would limit the review to an environmental and permits review, and not require the renewable energy developers to provide any demonstrations of the economics associated with the project. We offer this option recognizing that having adequate offtake power sales opportunities and obtaining the necessary generator interconnection, transmission development, and transmission service agreements are commonly parts of successful renewable generation development and are at times pre-requisites to operating a financially viable project. While it may seem that those requirements can be "easily met" by some renewable generation developers, little is gained from Nebraska placing this additional layer of requirements on renewable energy projects. Further, some renewable generators may want to simply sell the power through the SPP energy market or find a third party to enter into financial contracts that reduce the project developers' risks. Nebraska's current requirements effectively prevent such "merchant" renewable developments to be located in the state.

While we understand the concerns of the impact associated with adding a large amount of renewable generation on the wholesale market, it is important to understand that in SPP's Integrated Market, the existence of a PPA between a renewable energy resource and an offtaker outside of Nebraska is simply a financial arrangement, and such a financial agreement would not change the actual impact of the renewable generation on the wholesale energy prices. As long as Nebraska is interested in adding significant amounts of renewable generation in the state, the wholesale market impact will exist, regardless where the financial or power purchase offtaker is located. Requiring a demonstration of having entered into a long-term PPA with an out-of-state offtaker does not address the concern of the potential impact of adding a significant amount of renewable energy resources in the state on wholesale energy prices in Nebraska.

Table 6 below contrasts the current CREF process with the two options we offer as potential process simplifications.

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	✓	✓	

If Nebraska wants to allow and invite large renewable energy investments into the state, the above options would allow Nebraska to narrow the difference, real or perceived, in its regulatory approval process compared to neighboring states, while allowing the PRB to maintain oversight on renewable generators' impact on the environment in Nebraska.

In addition, Nebraska may consider significantly reducing or removing the threats of condemnation of renewable energy facilities and related transmission interties built in Nebraska, whether or not the existing CREF process or a simplified version of the CREF process is in place.

D. Create a State Function to Facilitate Achieving Policy Objectives

Nebraska may want to consider setting up a function within an existing governmental or quasi-governmental agency (such as within the Nebraska Department of Economic Development) that helps the state to promote and achieve its renewable generation policy goals. Similar to state

agencies in Kansas, Wyoming, South Dakota, and other states,[75] this new function would actively promote renewable resources development in the state, monitor market conditions and identify emerging opportunities and necessary policy changes, work with the PRB and Nebraska Transmission Owners to evaluate the lowest-cost options for necessary additional transmission infrastructure, and help guide developers through the process of getting renewable energy resources and transmission permitted in Nebraska.

This added function would need the active and credible support of key state policy makers to be effective in the pursuit of its activities and goals. Some activities to consider include the following:

a. Reaching out to renewable developers and potential renewable energy customers to promote Nebraska as an attractive location that is "open for business" in the renewable energy space.

b. Guiding interested renewable generation developers through the project development process, including accessing the tax incentives provided by the state, obtaining the necessary permits and regulatory approvals, and facilitating the development effort at the local/county level.

c. Streamlining the processes necessary for the development of renewable energy and transmission infrastructure. This would include providing support for meeting the siting requirements for renewable and transmission projects by conducting preliminary environmental impact analyses across the state to identify and prioritize locations where renewable energy and transmission facilities can be built most economically with the least impact on the environment.

d. Communicating with landowners about the state's efforts in attracting renewable energy development, responding to concerns prior to when specific projects are proposed, and providing educational materials to the public to raise awareness of the potential value of developing renewable resources and transmission facilities in the state.

e. Continuing to monitor the market conditions for renewable energy, identifying emerging opportunities (such as in response to new federal environmental regulations), and determining if and when state regulatory structure and policies need to adjust to the changing environment to allow the state to capitalize on the emerging opportunities.

f. Contributing to the development of a state transmission strategy, as discussed in the previous section. Specifically, the new function would work with SPP transmission planners and Nebraska transmission owners to make sure they understand and support the options that Nebraska may be pursuing regarding the development of renewable

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[75] For example, see Kansas Electric Transmission Authority (KETA, http://www.kansas.gov/keta/), Wyoming Infrastructure Authority (WIA, http://wyia.org/), South Dakota Energy Infrastructure Authority (http://www.sdeia.com/), New Mexico Renewable Energy Transmission Authority (RETA, http://nmreta.com/), or Idaho Energy Resources Authority (IERA, http://iera.info/purpose/).

resources. The new function could work with other potential stakeholders to ensure that future transmission development supports the longer-term renewable energy vision of the state.

VII. Impacts of Renewable Energy Exports on Electricity Rates and Economic Development in Nebraska

A. Transmission Cost Impacts

As discussed in prior sections, the existing transmission system and already-planned expansions should be able to accommodate approximately 2,000 MW of wind development in the SPP portion of Nebraska (for a total of 2,700 MW) because the transmission upgrades that are approved to be built will significantly increase the available transmission capacity within Nebraska (*e.g.*, through the R-Plan) and between Nebraska and the rest of the SPP footprint (*e.g.*, through upgrades into and within Kansas). Furthermore, SPP analysis shows that potentially up to 4,000 MW of additional capacity could be added (for a total of 4,700 MW of wind capacity in Nebraska) with limited incremental transmission investment, which would approach the lower end of the range (5,000 MW) targeted by the PRB for this analysis.

However, the stated target of 5,000 to 10,000 MW of renewable generation capacity in Nebraska would require significant additional investment in transmission infrastructure in Nebraska, SPP, and between SPP and the neighboring markets. Based on the more conservative estimate that additional transmission will be required after an additional 2,000 MW of wind capacity is installed, we estimate that the total transmission investment to achieve the renewable capacity of 5,000 to 10,000 MW, as stated as a target in the RFP, would likely cost between $1.5 billion and $4.0 billion.[76]

Determining the extent to which these transmission investments would increase electricity rates in Nebraska depends on several factors, including the transmission investments' impact on wholesale power prices as discussed in the next subsection. First, rate impacts will depend on which approach Nebraska pursues for expanding the transmission system. Due to the range of available cost allocation approaches, the transmission costs borne by Nebraska ratepayers will be based on whether transmission is built through the SPP regional planning process (such as the ITP) or through Nebraska-sponsored projects. If Nebraska chooses to develop "sponsored" projects, the ratepayer impact will depend on how the costs for such sponsored projects are allocated between Nebraska retail customers and interconnecting generators and their offtakers. Even within the ITP process, the costs to ratepayers will differ depending on whether the identified lines are high voltage (over 300 kV) "highway" lines (with costs spread on an SPP-wide basis) or if they are lower voltage (100–300 kV) "byway" lines (with most costs allocated to

[76] We do not include the cost of the previously approved transmission lines in this estimate as they have not been built with the purpose of meeting the objective of this analysis laid out in the RFP.

the zones in which they are built). Transmission could also be built solely in response to SPP generation interconnection requests or TSRs by offtakers, which would allocate costs directly to the generators or their offtakers. However, as we also discussed previously, allocating more costs to renewable generators and their offtakers will make Nebraska locations less economically attractive and may be prohibitively expensive if pursued on a generator-by-generator basis.

A summary of how the range of costs borne by Nebraska retail customers would differ depending on the approach chosen is shown in Table 7. The most likely outcome is that a mix of these approaches will need to be used and that the cost to Nebraska ratepayers will be significantly less than the total estimated costs of $1.5 to $4.0 billion for all transmission investment.

Table 7
Potential Transmission Cost Impact to Nebraska Ratepayers (mllion $)

Transmission Investment	Regional Highway *14%*	Regional Byway *71%*	Nebraska "Sponsored" *100%*
$1.5 billion	$210	$1,065	$1,500
$4.0 billion	$560	$2,840	$4,000

Source: Brattle analysis.

Second, the rate impact to customers will depend on the timing of when the lines are built. The approved transmission facilities currently under development are all projected to be in operation by 2018. Once in operation, it will take several years before renewable generation fully utilizes the grid's capability. When that occurs, additional newly-planned transmission facilities would not be likely to affect ratepayers until 2022 to 2025. Because the existing and already-approved new facilities will be more depreciated by then, the rate impacts would be muted and decline further with depreciation after the facilities are placed in operation.

Substantial rate shocks due to the addition of a single transmission investment to the transmission revenue requirements are unlikely because the largest and most expensive transmission projects tend to be 345 kV lines, meaning that their costs will be spread broadly across the entire SPP region. For example, the addition of a $1 billion, 345 kV project approved under the SPP ITP process would be expected to increase the transmission revenue requirement in Nebraska by $15 to $20 million per year.[77] This would represent an approximately 0.7% rate impact (using a percentage of total annual revenues of a Nebraska electric supplier as a proxy for

[77] As first-year transmission revenues requirements for Nebraska electricity suppliers tend to be 10–16% of the investment costs, the initial annual cost of the $1 billion project would be approximately $130 million. Nebraska utilities and their ratepayers would be allocated approximately 14% of that amount or $18 million per year.

total rates).[78] In contrast, if $1 billion of transmission investment was spent on regional byway lines in Nebraska, the rate increase in the first year would be $70 to $115 million, or 3–5% of total Nebraska electric supplier revenues.

B. WHOLESALE POWER MARKET IMPACTS ON NEBRASKA RATEPAYERS

The addition of renewable generation capacity in Nebraska could impact Nebraska ratepayers' beyond the transmission costs. This impact includes a possible reduction in wholesale market prices for power within Nebraska. Because Nebraska electric suppliers own surplus generating capacity and consequently are net sellers in the wholesale power market, lower wholesale prices for power will reduce the off-systems-sales ("OSS") revenues of Nebraska electric suppliers. Because the Nebraska electric suppliers use such OSS revenue to reduce the generation costs they need to recover from their customers, reduced wholesale power prices will tend to increase the retail rates of the Nebraska electric suppliers—at least as long as the companies have surplus generation and remain net sellers in the SPP wholesale market.

In March 2014, the IM was implemented by SPP. In the IM, all generation is committed and dispatched by SPP. As highlighted by the Nebraska Power Association in its peak load forecast, the IM changes the utilization of the existing generation facilities in Nebraska, possibly resulting in reduced hours of operation, depending on how the costs of the Nebraska generation facilities compare to others in SPP.[79] These changes are already occurring in Nebraska, but could be further accelerated by increasing wind generation capacity—particularly if the pace of renewable generation development exceeds the expansion of the transmission grid between Nebraska and its neighboring states.

The addition of significant renewable generation capacity in the state will likely reduce the LMPs in Nebraska unless sufficient transmission capacity is added to minimize congestion between Nebraska and the rest of SPP. As discussed in an earlier section, Nebraska historically has seen depressed prices relative to the rest of SPP, especially compared to the southern portions of SPP (Oklahoma, Texas, and New Mexico). Transmission upgrades that are currently being built across SPP are expected to reduce congestion and the price differential between Nebraska and broader SPP wholesale power prices. Without completing a detailed study of the future system that considers the already-planned and potential additional future transmission build out, renewable capacity additions, and changes in load, we are unable to predict the impact of renewable generation capacity alone on market prices in Nebraska. We are, however, able to estimate the extent to which reduced (or increased) Nebraska wholesale power prices would affect Nebraska retail customers under the current surplus generation conditions of the Nebraska electric suppliers. For example, in 2013, NPPD sold 4.5 million MWh of generation into the

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78 Based on 2013 annual reports, the total revenues of NPPD, OPPD, and LES were $2,487 million.

79 NPA 2014. "The SPP IM energy market will change the utilization of Nebraska generation resources. Utilization of resources that today are marginally economic to operate during a given day may be lessened when dispatched by a SPP market clearing mechanism."

wholesale power market.[80, 81] A $5 per MWh reduction in market prices would thus result in a reduction of OSS revenues equal to $23 million. In light of NPPD's total operating revenues of $1.1 billion, this loss of revenue would increase NPPD rates by approximately 2%. However, due to the addition of already-approved transmission between Nebraska and other states in SPP, a $5 per MWh reduction of wholesale prices and the associated 2% increase in electricity rates would be at the high end of the impacts from increased renewable generation in Nebraska.[82]

Nebraska electric suppliers will be impacted by local as well as SPP-wide wind generation development due to the intermittent nature of the generation output. This would require that conventional generating facilities in SPP be ramped up and down more frequently to balance the system. These balancing services are usually referred to as "ancillary services" and are provided through the SPP wholesale power market at market prices. Such balancing services are required to be available to respond to fluctuating loads and sudden losses of conventional generation or unexpected transmission outages. However, adding wind generation will increase the amount of balancing services needed in the region. Ensuring reliability of the power system is one of the main functions of SPP and is a major focus of system operations and planning.[83] The additional "cycling" of conventional generation in Nebraska and the broader SPP footprint will impose additional costs on the electric system and increase the wear-and-tear of conventional generation resources used to balance fluctuating renewable generation output. As discussed earlier in the report, the additional costs of balancing power systems with significant wind penetration has been estimated to range from $2 to $10 per MWh of wind generation.[84] These costs are imposed on electricity customers in the SPP footprint, including Nebraska, through ancillary service charges and higher generation costs. These costs may be higher in Nebraska if significant wind generation was added without sufficient transmission capacity between Nebraska and the rest of the SPP region. It must be noted, however, that the increased need for balancing services offers an opportunity for existing generation to earn additional ancillary service revenues. These additional revenues earned by Nebraska electric suppliers will offset at least some of the additional costs—particularly if Nebraska electric service providers own generation that can provide (or could be modified to provide) such balancing services at relatively low cost.

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80 NPPD n.d.

81 Due to the changes in the SPP Integrated Marketplace instituted in March 2014, the amount of off-systems sales may differ in 2014 than in 2013 when off-system sales were primarily based on bilateral trades.

82 We estimate similar impacts on OPPD ratepayers based on information included in their 2013 financial statements. See OPPD n.d., p. 51.

83 Other RTOs, such as ERCOT with over 12,000 MW of wind capacity, are currently reviewing whether the procurement of ancillary services should be increased to maintain system reliability with increasing wind generation capacity in the system. For more information on ERCOT's review of ancillary services, see: http://www.ercot.com/committees/other/fast

84 Wiser and Bolinger 2014, p. 69.

The above discussion is relevant to adding Nebraska renewable generation into the SPP footprint. However, as discussed in the previous section, Nebraska also has the option to develop wind generation and associated transmission infrastructure to directly interconnect the renewable resource with neighboring markets, such as in WECC, MISO, or merchant transmission lines that can deliver the energy to markets in the eastern U.S. Not injecting the energy into the SPP wholesale power market would, of course, avoid the wholesale market impacts on the Nebraska electric suppliers who operate in SPP. Directly exporting Nebraska renewable generation would consequently avoid the impacts of reduced OSS revenues and increased SPP balancing costs.

One option to avoid SPP wholesale market impacts would be to build transmission in the eastern section of the state to electrically interconnect new wind resources directly with MISO (instead of SPP). This would avoid SPP wheeling-out charges that otherwise would be incurred to export power from the SPP footprint. From MISO, Nebraska wind generation could be transmitted into PJM and other eastern markets. However, given the limited available transmission capacity between MISO and its neighboring markets and the currently similarly ineffective MISO-PJM interregional planning process, such MISO through-and-out transactions would face significant costs associated with MISO network upgrades that would be necessary to accommodate such transactions. A second option would be to build transmission to directly interconnect Nebraska wind plants to a merchant transmission line—such as the 3,500 MW Rock Island Clean Line currently under development with a terminus in northwestern Iowa—that would be able to transmit the renewable energy to eastern U.S. markets. Connecting Nebraska wind plants directly to the Rock Island merchant line would provide Nebraska generators with the transmission capability to access the PJM market, but would require purchasing potentially-costly capacity on a merchant line that is still in uncertain stages of development.

C. Economic Stimulus Benefits of New Transmission and Renewables Development

Taking on greater costs to the state or its electricity ratepayers should be weighed by the Legislature against the economic stimulus benefits of wind generation and transmission development. We have analyzed economic stimulus benefits in previous studies for SPP and others and have undertaken Nebraska-specific analysis utilizing the Jobs and Economic Development Impact ("JEDI") model developed by NREL. These analyses show that each 1,000 MW of wind development is expected to produce approximately 7,700 full-time-equivalent ("FTE") years of employment plus an additional 3,300 FTE-years for the likely build out of transmission necessary.[85] In addition, each 1,000 MW of new wind farms would also generate

[85] The estimated employment and economic activity benefits include both the construction period and the twenty-year operating period. Based on a review of costs for other major regional wind and transmission development efforts in Texas, California, and the Midwest, we estimate that transmission-related costs range from approximately $400 to $600 million per 1,000 MW of wind capacity.

$7 million of annual property taxes (if the nameplate capacity tax is maintained) and stimulate $1.1 billion of in-state economic activity due to wind generation development and additional $500 million due to transmission investments. As we estimate that there will be limited need for transmission upgrades until 2,000 MW of additional wind capacity has been installed in Nebraska, the additional costs and economic benefits associated with transmission development are realized only at higher wind generation development.

A summary of the employment, economic activities, and property taxes stimulated by wind generation development is shown in Table 8. At the envisioned scale of 5,000 to 10,000 MW, the build out would create approximately 50,000 to 100,000 FTE-years of employment, $7 to $15 billion in economic activity, and $33 to $66 million in annual property taxes.

A significant portion of these economic stimulus benefits are associated with the construction phase of generating plants and transmission lines. Based on the studies reviewed, approximately 60% of the identified employment benefits from renewable generation projects occur during the construction period, while the remaining employment benefits are realized during the 20-year operating period of the plants. Our estimates for transmission-related employment benefits include only construction-phase benefits. The large portion of construction-period benefits does not imply that these benefits are realized only in the short term. Even if all the related benefits occurred solely during the construction period, it would still mean that 5,000 MW of wind plants developed over a 10-year period would support approximately 4,000 FTEs in each of these 10 years within Nebraska.

It is also important to note that the economic stimulus benefits to Nebraska will be higher if larger-scale renewable development efforts increase the extent to which the equipment and materials used in the wind plant and transmission construction is manufactured within the state (rather than imported from other states or outside the country). Most other states with significant renewable generation investments have been successful in attracting such increased local manufacturing of the necessary equipment and materials.

Table 8
Economic Benefits of Additional Wind Capacity in Nebraska

Additional Wind Capacity	Full-Time Equivalent Years of Employment			Economic Activity			Property Taxes
	Wind	Transmission	Total	Wind	Transmission	Total	
MW	*FTEs*	*FTEs*	*FTEs*	*$m*	*$m*	*$m*	*$m/yr*
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
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

Source and notes: For wind projects, approximately 60% of benefits identified occur during the construction period, and the remaining employment benefits are realized during the 20-year operating period. Our estimates for transmission-related employment benefits include only construction-phase benefits.

[1]: We assume 7,700 FTEs per MW of wind capacity by averaging FTE rates from three sources: Pfeifenberger, *et al.*, 2010 (9,500 FTEs per MW in SPP region), Lantz and Tegen 2011 (6,200 FTEs per MW in Wyoming), NREL 2014 (7,400 MW per FTE in Nebraska). The estimates include the construction period plus the 20-year operating period.

[2]: We assume $400–$600 million of transmission cost per 1,000 MW of wind above the 2,000 MW of wind supported by lines already approved. We assume 6.6 FTEs per $ million of transmission investment, calculated by averaging rates from two sources: Pfeifenberger, *et al.,* 2010 (6.6 to 8.2 FTEs per $ million invested in SPP) and Lantz and Tegen 2011 (4.8 FTEs per $ million invested in Wyoming).

[3]: [1] + [2].

[4]: We assume $1.08 million of economic activity per MW of wind capacity based on NREL JEDI 2014, including construction period plus 20-year operating period.

[5]: We assume $1.1 million of economic activity per $ million of transmission investment, equal to the average of range of rates (0.8 to 1.3) for SPP (Pfeifenberger 2010).

[6]: [4] + [5].

[7]: Nameplate capacity tax of $3,518 per MW (DSIRE 2014) and real property tax of $3,100 per MW (Bluestem and BairdHolm 2013).

Appendix A: Study Participants

The following is the list of organizations that participated in the Renewable Energy Export Study through the LB 1115 Working Group:

- Nebraska Energy Office
- Department of Economic Development
- Southwest Power Pool
- Western Area Power Administration
- Lincoln Electric System
- Nebraska Public Power District
- Omaha Public Power District
- Municipal Energy Agency of Nebraska
- Nebraska Rural Electric Association
- Tri-State Generation & Transmission Association
- Blue Stem Energy
- Invenergy
- Trade Wind Energy
- Geronimo Energy
- Wind Coalition
- Cherry County Wind Energy Association
- Burt County Wind Association
- Saline County Wind Association
- Banner County Wind Association
- Sierra Club
- Nebraska Farmer's Union
- Husch Blackwell Law Firm
- Natural Resource Committee
- Center for Rural Affairs

The Brattle consultants held a conference call with members of the Working Group to review the scope of the study and to request specific input from the stakeholders. Most of the stakeholders provided the requested input throughout the study period. Brattle consultants also held biweekly calls with the PRB to review the study progress. A draft summary of this report was provided to all members of the LB 1115 Working Group for their review prior to its completion.

List of Acronyms

AC	Alternating Current
AC-DC	Alternating Current to Direct Current
AEO	Annual Energy Outlook
APC	Adjusted Production Cost
BSER	Best System of Emissions Reductions
C-BED	Community-Based Energy Development
CAISO	California ISO
CC	Combined-Cycle
CCPG	Colorado Coordinated Planning Group
CPP	Clean Power Plan
CPUC	California Public Utility Commission
CREF	Certified Renewable Export Facility
CSAPR	Cross-State Air Pollution Rule
CSP	Coordinated System Plan
CT	Combustion Turbine
DC	Direct Current
DOE	U.S. Department of Energy
DPA	Delivery Point Additions
EIA	Energy Information Administration
EPA	U.S. Environmental Protection Agency
ERCOT	Electric Reliability Council of Texas
FERC	Federal Energy Regulatory Commission
FTE	Full-Time Equivalent
GHG	Greenhouse Gas
GIA	Generation Interconnection Agreement
GW	Gigawatt (equal to 1,000 MW)
HPILS	High Priority Incremental Load Study
HVDC	High-Voltage, Direct-Current
IM	Integrated Marketplace
IPP	Independent Power Producer
IPSAC	Interregional Planning Stakeholder Advisory Committee

ISO	Independent System Operator
ISO-NE	ISO of New England
IRC	ISO/RTO Council
IS	Integrated System (WAPA, Basin Electric, Heartland)
ITC	Investment Tax Credit
ITP	Integrated Transmission Planning
ITP10	ITP 10-Year Assessment
ITP20	ITP 20-Year Assessment
ITPNT	Near-Term ITP
JEDI	Jobs and Economic Development Impact
JOA	Joint Operating Agreement
JPC	Joint Planning Committee
KCP&L	Kansas City Power & Light
kV	Kilovolt
LB	Legislative Bill
LCOE	Levelized Cost of Energy
LES	Lincoln Electric System
LMP	Locational Marginal Price
LSR	Load Share Ratio
MATS	Mercury and Air Toxic Standards
MISO	Midcontinent ISO
M	Million
MMBtu	Million British Thermal Units
MOPC	Markets and Operation Planning Committee
MW	Megawatts
MWh	Megawatt Hour
NE	Nebraska
NO_x	Nitrous Oxides
NPPD	Nebraska Public Power District
NPRB	Nebraska Power Review Board
NREL	National Renewable Energy Laboratory
NTC	Notification to Construct
NYISO	New York ISO
OK	Oklahoma

OPPD	Omaha Public Power District
OSS	Off-Systems Sale
PJM	PJM Interconnection
PPA	Power Purchase Agreement
PRB	Power Review Board
PSCo	Public Service Company of Colorado
PTC	Production Tax Credit
RCAR	Regional Cost Allocation Review
RSC	Regional State Committee
RFP	Request for Proposal
ROFR	Right of First Refusal
RPS	Renewable Portfolio Standard
RTO	Regional Transmission Organization
SO_2	Sulfur Dioxide
SPP	Southwest Power Pool
STEP	SPP Transmission Expansion Plan
Tri-State	Tri-State Generation and Transmission Association
TSR	Transmission Service Request
TWG	Transmission Working Group
WECC	Western Electricity Coordinating Council
WAPA	Western Area Power Administration

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