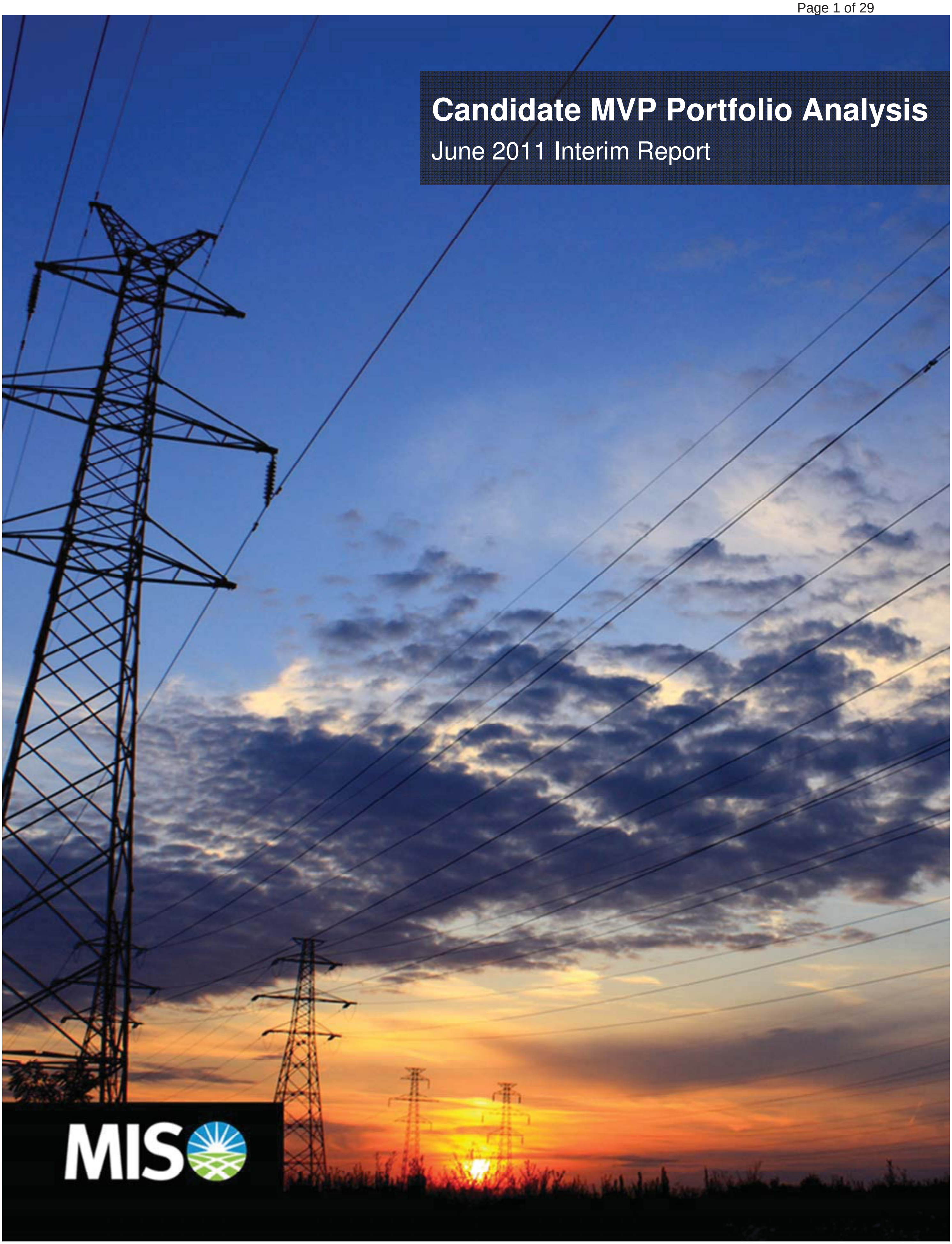
Candidate MVP Portfolio Analysis

June 2011 Interim Report



MISO

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1 Executive Summary

This document presents the MISO Staff recommendation that the Brookings to Twin Cities 345kV project (Brookings Project) be approved as a part of a broader system portfolio of transmission expansion projects that form a Multi Value Project (MVP) portfolio. The Brookings Project is recommended for inclusion in MTEP Appendix A in June 2011. The remainder of the Candidate MVP Portfolio is expected to be recommended for approval at the December 2011 MISO Board of Directors meeting after the completion of the business case for the remaining projects in the portfolio.

The Brookings Project is the second project in the Candidate MVP portfolio recommended for approval, following the Michigan Thumb Loop MVP, which was approved by the MISO Board of Directors in August 2010. Like the Michigan Thumb Loop MVP, the Brookings Project clearly meets the tariff criterion to be approved as an MVP and demonstrates substantial reliability, public policy, and economic benefits to the transmission system. Moreover, when taken as a part of the Candidate MVP Portfolio, the Michigan Thumb Loop and Brookings Projects enable the energy policy mandates of the MISO states to be met reliably and with enhanced economic value. The Candidate MVP Portfolio will distribute this value regionally across the MISO system in a manner commensurate with the portfolio's costs.

The past decade has seen great changes in public policy, which have driven subsequent changes in how the transmission system is planned. Societal pressures related to the environment have led to the recent adoption of Renewable Portfolio Standards (RPS) across the MISO footprint, as shown in Figure 1.1. In turn, these RPS mandates have driven the need for a more regional and robust transmission system to deliver renewable resources from the often remote renewable energy generators to load centers.

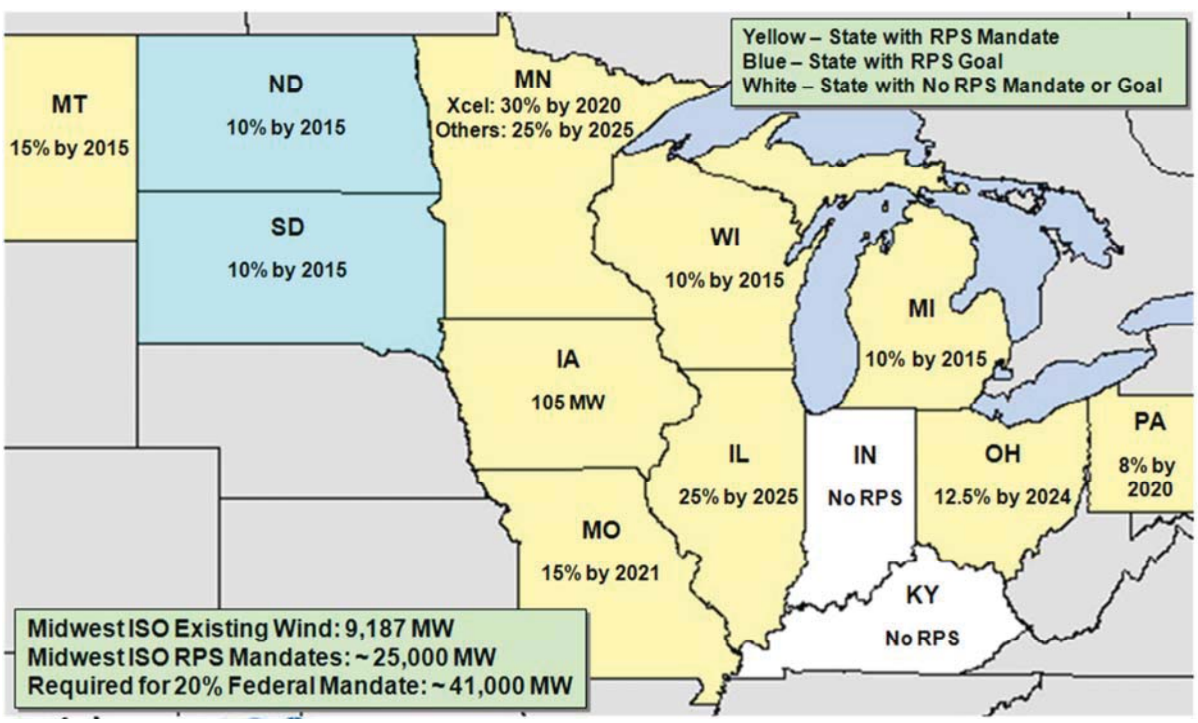

Figure 1.1: RPS Mandates and Goals Within the MISO Footprint[1]

[1] Existing wind projected to be in-service as of March 1, 2011. State RPS mandates and goals include all policies signed into law by May 1, 2011.

In 2008, MISO, with the assistance of state regulators and industry stakeholders, began the Regional Generation Outlet Study (RGOS) to develop a set of transmission portfolios that will help Load Serving Entities (LSEs) to meet their RPS mandates at the lowest delivered wholesale energy cost. RGOS was premised upon a regional set of wind zones, represented in Figure 1.2, chosen in conjunction with the MISO states via a least-cost wind siting methodology.

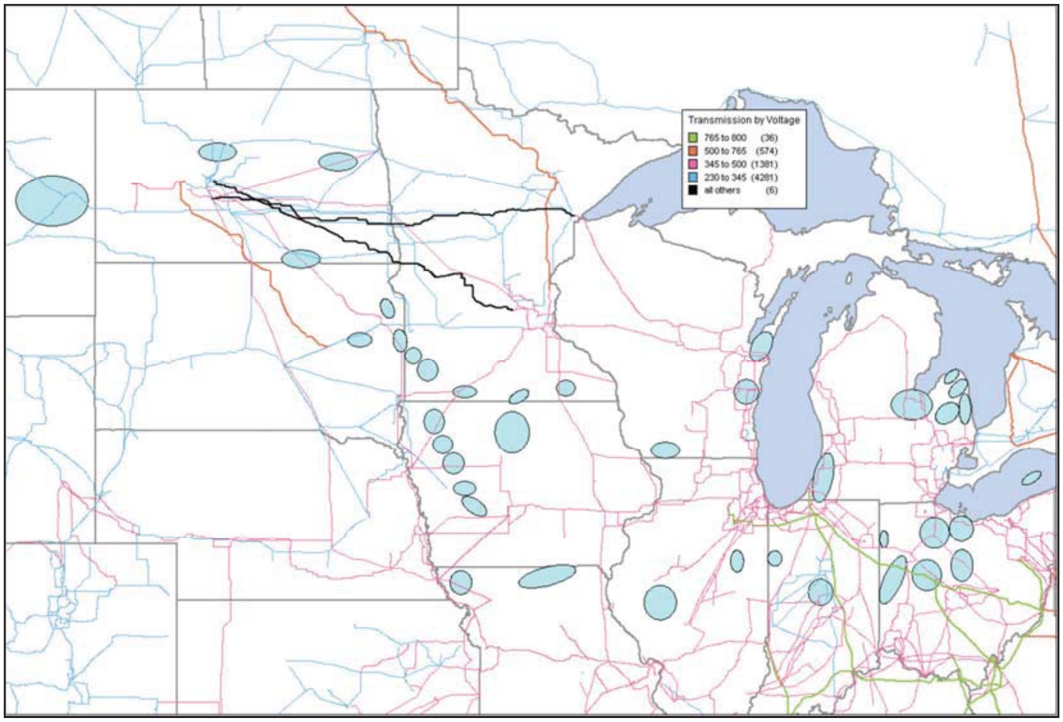

Figure 1.2: RGOS and Candidate MVP Incremental Energy Zones

At the conclusion of the RGOS analysis, a set of projects compatible with all three RGOS portfolios were identified. These projects, along with complimentary projects from recent MISO congestion analyses and planning studies, created the 2011 Candidate MVP Portfolio, shown in Figure 1.3. This portfolio represents the set of “no regrets” projects that will provide benefit under all alternative futures.

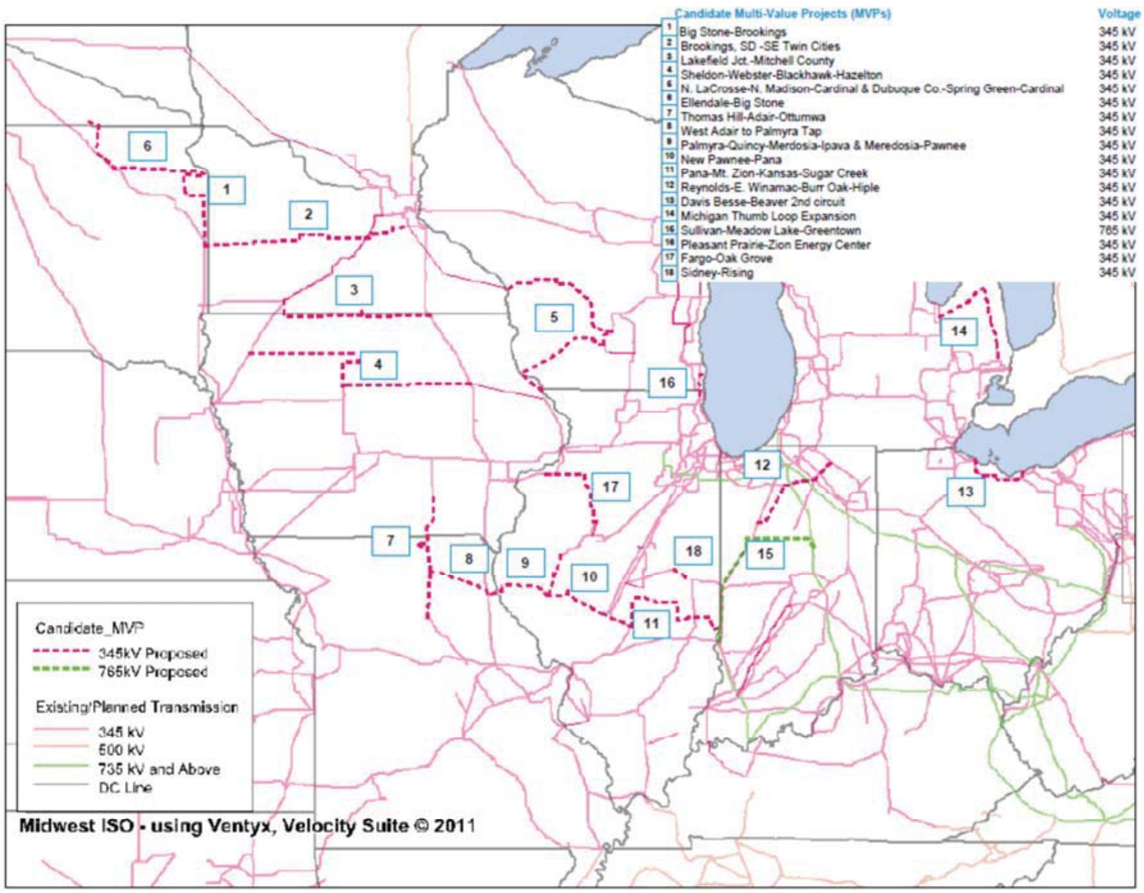

Figure 1.3: 2011 Candidate MVP Portfolio

The 2011 Candidate MVP Portfolio analysis was initiated to determine a high-value transmission portfolio which will enable the MISO LSEs meet their near-term RPS mandates more reliably and economically. This study evaluates the Candidate MVP Portfolio against the MVP cost allocation criterion to design a portfolio which provides widespread benefits as a first step towards a regional transmission solution. The final portfolio will reduce the wholesale cost of energy delivery for the consumer by enabling the delivery of low cost generation to load, reducing congestion costs, and increasing the system reliability, regardless of the future generation mix.

The MISO staff recommends the Brookings Project, shown below in Figure 1.4. to the MISO Board of Directors for approval in June of 2011. This recommendation is based upon the evaluation of the project against MVP cost allocation criterion 1, which requires transmission to reliably enable the delivery of energy in support of public policy, such as renewable energy mandates.

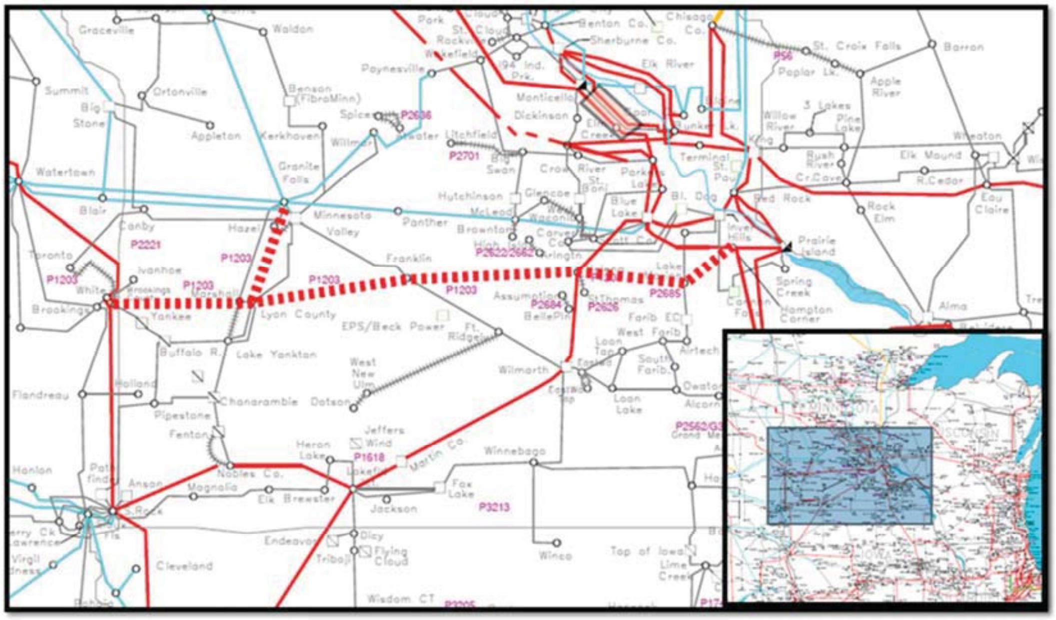

Figure 1.4: Brookings Project

The Brookings Project supports the delivery of renewable energy, as required by the public policy mandates, in a manner that is more reliable than it would be without the transmission upgrade. Specifically, the project mitigates approximately 3,485 different transmission outage conditions, for steady state and transient conditions under both peak and shoulder load scenarios. Some of these conditions would be severe enough to cause cascading outages on the system. Through the mitigation of these constraints, approximately 2,050 MW of nameplate renewable capacity may be delivered to load centers in the Twin Cities of Minnesota and beyond.

Table 1.1: Brookings Project Valuation

Analysis Name	Key Findings
Steady state: Shoulder Peak	3,299 transmission outage conditions are mitigated through the addition of the Brookings Project.
Steady state: Summer Peak	180 transmission outage conditions were mitigated through the addition of the Brookings Project
Transient stability: Shoulder Peak	7 transient stability violations were mitigated or alleviated through the addition of the Brookings Project
Wind capacity enabled	Mitigation of reliability issues enables the delivery of 2,049 MW of nameplate wind capacity This is equivalent to about 15% of the existing state RPS requirements

Although the Brookings Project is justified based on the benefits discussed previously, the project is also expected to provide additional economic and reliability benefits as an integrated part of the full MVP Portfolio. The overall MVP Portfolio will serve to improve the overall reliability of the transmission system while spreading the economic benefits of lower-cost generation throughout the footprint. Under a variety of different potential future policy scenarios, the Candidate MVP Portfolio consistently delivers widespread regional benefits to the transmission system. For example, based on an analysis of the Adjusted Production Cost (APC), the Candidate MVP Portfolio has an estimated 20-year Net Present Value (NPV) of $13.5 to $33.4 billion, resulting in a 20-year benefit-to-cost ratio of 1.1 to 2.8.

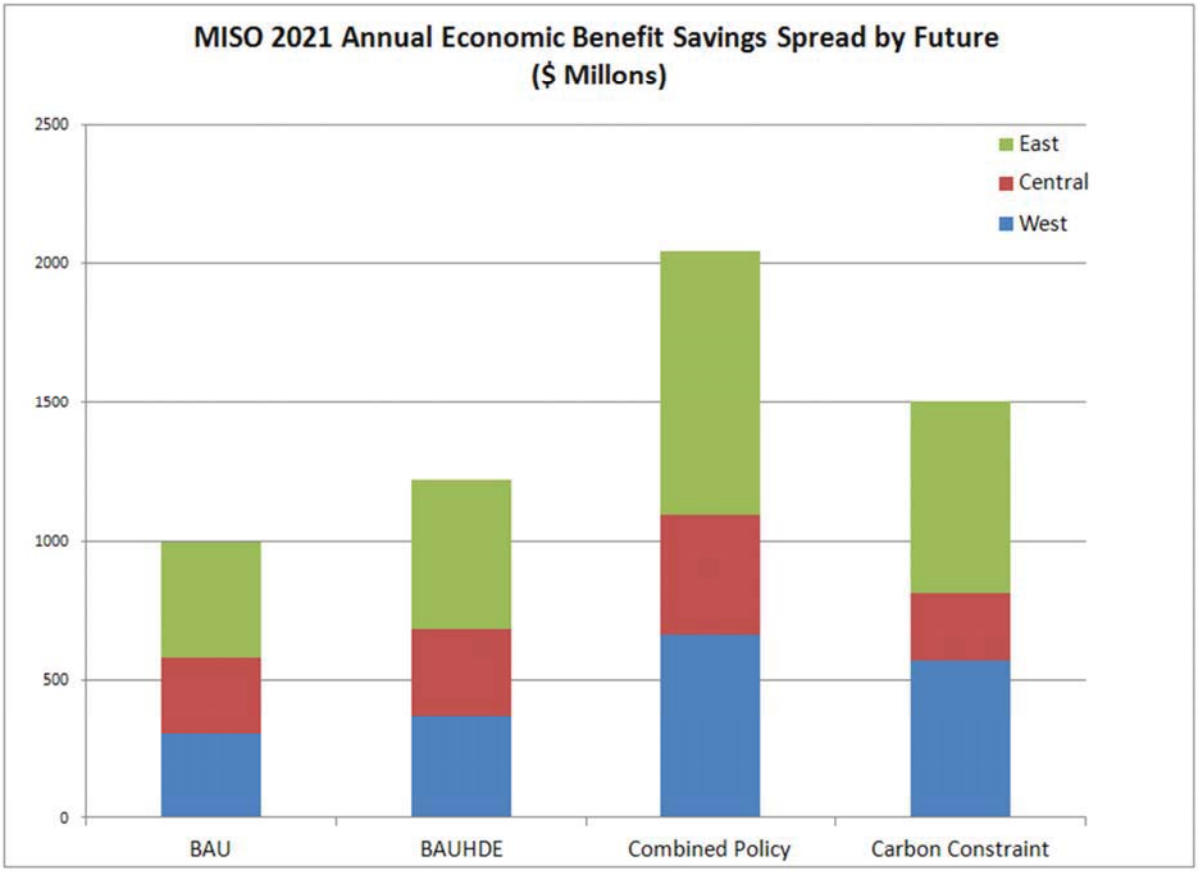

Figure 1.5: Candidate MVP Portfolio Preliminary Benefits Spread

Although ideally all the projects in the final 2011 MVP Portfolio would be approved at the same time, in certain instances, it is neither feasible nor desirable to wait. For example, the Michigan Thumb Loop project, which is a component of the final 2011 MVP Portfolio, was approved in August of 2010 due to construction and RPS timelines. Likewise, the Brookings Project requires an approval prior to the remainder of the portfolio based on regulatory risks, potential cost penalties, and construction timelines.

The Brookings Project has achieved all of its regulatory approvals barring one at the present time, and it is expected to achieve its last regulatory approval in June 2011. These approvals are premised upon a 2015 in-service date, and right-of-way acquisition must start in the fall of 2011 to enable this in-service date. Similarly, a delayed project approval could drive an additional $15 million in project costs, due to material supply and construction schedule modifications. Finally, the business case for the Brookings Project has been completed, and the project has been fully justified.

2 Study Overview

2.1 MISO Planning Approach

The goal of the MISO planning process is to develop a comprehensive expansion plan that reflects a fully integrated view of project value inclusive of reliability, market efficiency, public policy, and other value drivers across all planning horizons. This process is guided by a set of principles established by the MISO Board of Directors, initially adopted on August 18, 2005. The principles were created in an effort to improve and guide transmission investment in the region and to furnish an element of strategic direction to the MISO transmission planning process. These principles, reconfirmed in August 2009, are as follows:

- **Guiding Principle 1**: Make the benefits of a competitive energy market available to customers by providing access to the lowest possible electric energy costs
- **Guiding Principle 2**: Provide a transmission infrastructure that safeguards local and regional reliability and supports interconnection-wide reliability
- **Guiding Principle 3**: Support state and federal renewable energy objectives by planning for access to all such resources (e.g. wind, biomass, demand side management)
- **Guiding Principle 4**: Provide an appropriate cost allocation mechanism
- **Guiding Principle 5**: Develop a transmission system scenario model and make it available to state and federal energy policy makers to provide context and inform the choices they face

A number of conditions must be met in order to build longer-term transmission able to support future generation growth and accommodate new energy policy imperatives. These conditions are intertwined with the planning principles put forth by the MISO Board of Directors and supported by an integrated, inclusive transmission planning approach. The conditions that must be met in order to build transmission include:

- A robust business case that demonstrates value sufficient to support the construction of the transmission project
- Increased consensus on current and future energy policies
- A regional tariff that matches who benefits with who pays over time
- Cost recovery mechanisms that reduce financial risk

In order to ensure that the costs of transmission are allocated in a manner that is roughly commensurate with their benefits, MISO has developed several different types of cost allocation methodologies through open, stakeholder driven forums. This transmission cost allocation approach, as shown below in Table 2.1, seeks to match the business case with the allocation method.

Table 2.1: MISO Transmission Cost Allocation Methodology

Allocation Category	Driver(s)	Allocation to Beneficiaries
Participant Funded (“Other”)	Transmission Owner identified project that does not qualify for other cost allocation mechanisms.	Paid by requestor (local zone)
Generator Interconnection Project	Interconnection Request	Paid for by requestor; 345 kV and above 10% postage stamp to load
Market Efficiency Project	Reduce market congestion when benefits are 1.2 to 3 times in excess of cost	Distribute to planning regions commensurate with expected benefit; 345 kV and above 20% postage stamp to load
Baseline Reliability Project	NERC Reliability Criteria	Primarily shared locally through Line Outage Distribution Factor Methodology; 345 kV and above 20% postage stamp to load
Multi Value Project	Address energy policy laws and/or provide widespread benefits across footprint	100% postage stamp to load

The fundamental goal of the MISO’s planning process is to develop a comprehensive expansion plan that meets the reliability, policy, and economic needs of the system. This goal is accomplished through the implementation of a top-down, bottom up planning process, creating a consolidated transmission plan which delivers regional value while meeting near term system needs.

2.2 Multi Value Project Portfolio Drivers

The 2011 Candidate MVP Portfolio Analysis is based upon the need to economically and reliably help states meet their public policy needs. In particular, the study is designed to build the robust business case required to build transmission, as discussed previously. The study will establish a regional transmission strategy that enables the MISO Load Serving Entities (LSEs) to meet their Renewable Portfolio Standards (RPS).

It is important to note, while the study focuses upon the RPS requirements, the transmission portfolio will ultimately have widespread benefits beyond the delivery of wind. It will enhance system reliability and efficiency under a variety of different generation build outs. It will also act to open up markets to competition, reducing congestion and spreading the benefits of low-cost generation across the MISO footprint. The Candidate MVP Portfolio Analysis scope has been designed to identify and maximize the total benefits of the transmission portfolio, including the reliability, economic, and public policy drivers.

2.2.1 Tariff Requirements

The Candidate MVP Portfolio analysis is premised upon the MVP criterion described in Attachment FF of the MISO Tariff and shown below.

> Criterion 1
> A Multi Value Project must be developed through the transmission expansion planning process for the purpose of enabling the Transmission System to reliably and economically deliver energy in support of documented energy policy mandates or laws that have been enacted or adopted through state or federal legislation or regulatory requirement that directly or indirectly govern the minimum or maximum amount of energy that can be generated by specific types of generation. The MVP must be shown to enable the transmission system to deliver such energy in a manner that is more reliable and/or more economic than it otherwise would be without the transmission upgrade.
>
> Criterion 2
> A Multi Value Project must provide multiple types of economic value across multiple pricing zones with a Total MVP Benefit-to-Cost ratio of 1.0 or higher where the Total MVP Benefit-to-Cost ratio is described in Section II.C.6 of this Attachment FF. The reduction of production costs and the associated reduction of LMPs resulting from a transmission congestion relief project are not additive and are considered a single type of economic value.
>
> Criterion 3
> A Multi Value Project must address at least one Transmission Issue associated with a projected violation of a NERC or Regional Entity standard and at least one economic-based Transmission Issue that provides economic value across multiple pricing zones. The project must generate total financially quantifiable benefits, including quantifiable reliability benefits, in excess of the total project costs based on the definition of financial benefits and Project Costs provided in Section II.C.6 of Attachment FF.

The MVP cost allocation criterion requires the evaluation of the portfolio on a reliability, economic, and energy delivery basis. The scope of the analysis, shown in Section 3, was designed to demonstrate this value, both on a project and portfolio basis.

2.2.2 Public Policy Needs

Currently, 11 out of 13 states in the MISO footprint have enacted either RPS requirements or renewable energy goals which require or recommend varying amounts of load be served with energy from renewable energy resources. The Candidate MVP Portfolio study is focused on the transmission necessary to economically and reliably meet the state RPS mandates. More details on these renewable energy requirements and goals may be seen in Figure 2.1 below.

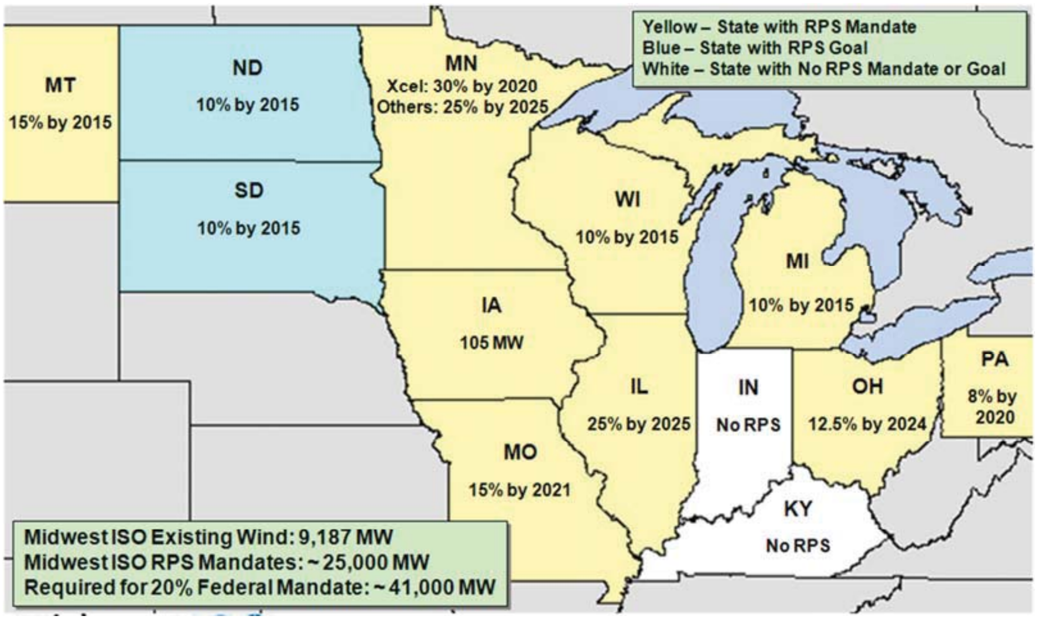

Figure 2.1: RPS Mandates and Goals Within the MISO Footprint

RPS mandates vary from state to state in specific requirements and implementation timing, but they generally start in about 2010 and continue on into the next decade. While the state laws support a number of different types of renewable resources, and multiple types of renewable resources will play a role in meeting state RPS mandates, the majority of renewable energy resources installed in the foreseeable future will likely be wind resources. A summary of the state-by-state renewable energy mandates are included in Appendix 1.

2.2.3 Wind Siting Strategy

In 2009, MISO developed a set of potential energy zones, or locations where wind generation could feasibly be located, on a state-by-state basis[2]. In conjunction with state regulators and other stakeholders, MISO then used these zones to explore a number of long-term transmission and generation strategies to meet the state RPS requirements. These analyses focused on the tradeoffs between local wind generation, which typically requires less transmission expansion at the cost of a larger amount of wind turbines, and regional wind generation, which requires fewer wind resources at the cost of higher levels of transmission expansion.

The study results demonstrated that the least-cost approach to wind generation siting, when both generation and transmission capital costs are considered, is a combination of local and regional wind

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[2] More information on the zone development may be found in the RGOS report at http://www.midwestiso.org/Library/Repository/Study/RGOS/Regional%20Generation%20Outlet%20Study.pdf.

generation locations, as shown by the white area on Figure 2.2. This approach was affirmed by the Midwest Governors' Association as the best method for wind zone selection and used as the basis for the final phase of the RGOS analysis in 2010. It was also used as the basis for the wind siting approach for the Candidate MVP Portfolio Analysis. The set of energy zones chosen for the Candidate MVP Portfolio analysis are shown below in Figure 2.3 as blue circles.

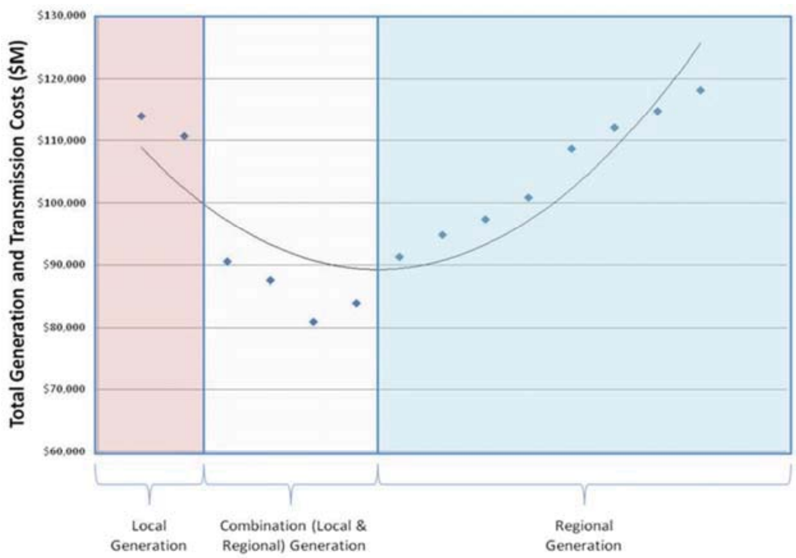

Figure 2.2: Capital Costs of Transmission and Generation

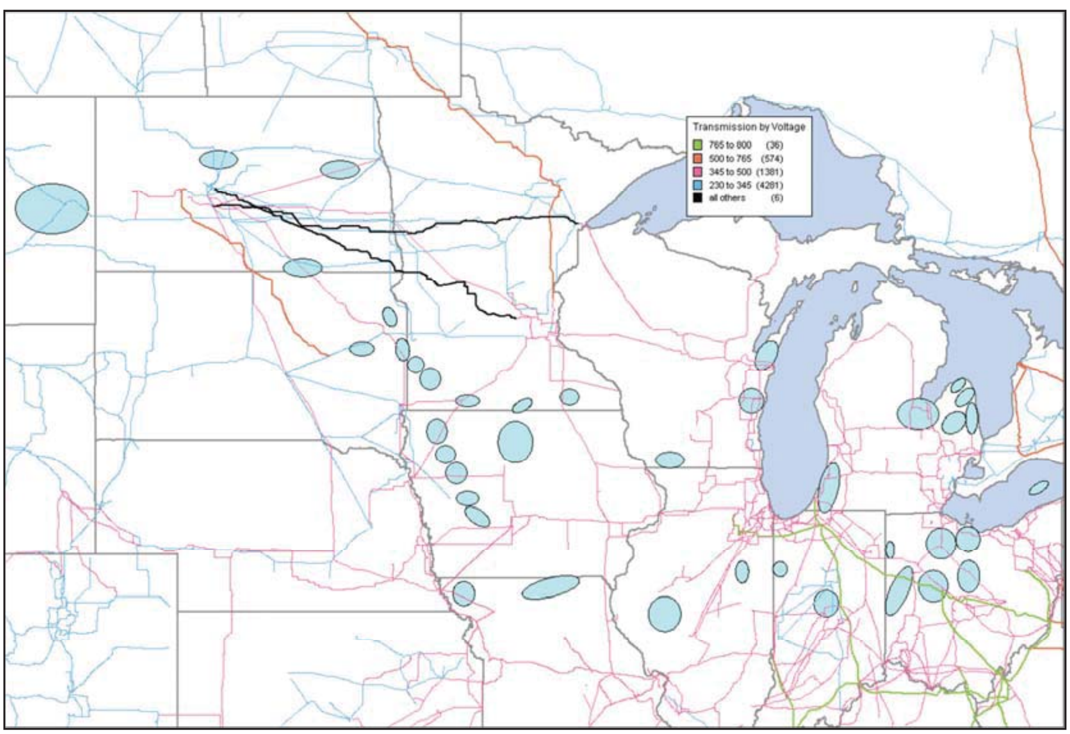

Figure 2.3: Candidate MVP Incremental Energy Zones

2.2.4 Enhanced Reliability and Economic Drivers

The goal of the MISO planning process is to deliver energy to load at the lowest possible cost. This requires a strategy that is premised upon a least-cost approach to both transmission and generation investment. This premise supports the overall constructability of the transmission portfolio, while reducing transmission risk associated with overbuilding the system. An introduction to the study drivers for the Candidate MVP Portfolio analysis is provided below; these drivers are supported and elaborated upon throughout the remainder of the interim report and documentation.

2.2.5 Transmission Strategy

A regional transmission strategy allows for significant amounts of economic and reliability benefits to be realized by MISO load on a regional basis. Regional transmission will increase the reliability of the MISO footprint, open up the market to increased competition, and provide access to low-cost generation, regardless of fuel type. Development of a strong regional transmission backbone is analogous to the development of the United States interstate highway system, which while developed for specific reasons, has resulted in numerous additional benefits over the subsequent years.

The overall transmission strategy for the Candidate MVP Portfolio is to take advantage of linkages between reliability and economic benefits to bring overall value to the entire MISO system. The portfolio is designed via both reliability and economic analyses, and several futures are analyzed to determine the robustness of the designed portfolio under a number of future potential policy bookends.

2.3 Development of the Candidate MVP Portfolio

In order to provide widespread benefits commensurate with cost allocation, MISO seeks to develop portfolios of MVP projects that provide widespread benefits across the footprint. Projects selected as candidates for possible recommendation within the broader portfolio are then evaluated to establish the business case for the portfolio.

The current Candidate MVP Portfolio is the first portfolio developed for review under the recent tariff revisions establishing the MVP classification of projects. It was developed by considering regional system enhancements that could potentially provide multiple types of value, including enhanced reliability, reduced congestion, increased market efficiency, reduced real power losses, and the deferral of otherwise needed capital investments in transmission. The portfolio was designed to enhance and complement the existing system performance, working synergistically amongst the individual elements of the portfolio and with the existing transmission grid to produce a more robust and efficient system. Ultimately, the first portfolio represents the set of “no regrets” projects that will provide benefits to the system in all futures.

2.4 Candidate MVP Portfolio Analysis

The Candidate MVP Portfolio analysis seeks to combine the MISO Board of Director Planning Principles and the conditions precedent to transmission construction in its evaluation of a transmission portfolio to meet public policy, economic, and reliability requirements. The analysis seeks to build a robust business case for the recommended transmission, using the newly created Multi Value Project (MVP) cost allocation methodology approved by the FERC. This proposed transmission will be tested against a variety of potential policy futures to maximize the value of the transmission portfolio and reduce any potential negative risks associated with its construction due to changes in future demand and energy growth. At the study’s conclusion, a justified portfolio of MVPs will be recommended for inclusion in MTEP Appendix A and, if approved by the MISO Board of Directors, subsequent construction.

The MVP cost allocation criterion requires the evaluation of the portfolio on a reliability, economic, and energy delivery basis. The scope of the analysis, discussed in detail in more detail in Appendix 2, was designed to demonstrate this value, both on a project and portfolio basis.

2.5 Progress to Date

The Candidate MVP Portfolio Analysis is currently in progress. The full analysis will be completed later this year, and results will be available in a summary form as part of the MTEP11 December approval report and in a comprehensive version in a full Candidate MVP Portfolio analysis report. More information on the current study progress, and the expected work remaining, is below.

2.5.1 Completed Analyses

Current analysis on the Candidate MVP Portfolio has focused on the value achieved through constructing the Brookings Project as part of the overall Candidate MVP Portfolio. These analyses included the following items and outputs:

Table 2.2: June Approval Analyses and Output

Analysis Name	Analysis Output	Output Purpose
Steady state	List of thermal overloads mitigated by the addition of the Brookings Project	Project valuation
Transient stability	List of violations mitigated or alleviated by the addition of the Brookings Project	Project valuation
Components	List of ancillary portions of the Brookings Project, as well as a determination of whether those project components are eligible for MVP cost allocation	Project valuation
Portfolio sensitivities	Confirmation that the Brookings Project is correctly sized, when other portfolio components are considered Demonstration that the majority of the constraints mitigated by the Brookings Project could not be mitigated by another project in the portfolio	Project valuation
Production cost	Adjusted Production Cost (APC) benefits of the entire Candidate MVP Portfolio	Portfolio valuation
Underbuild requirements	Document any incremental transmission required to mitigate constraints created by the addition of the Brookings Project to the system	No harm analysis

A detailed description of the steady state, components, and portfolio sensitivities analyses is included in Appendix 4. This description includes information on the study models used, NERC events analyzed, and the results obtained. A similar description for the transient stability work is located in Appendix 5.

2.5.2 Remaining work

Prior to the completion of the Candidate MVP Portfolio analysis, additional analyses must be performed to establish the most valuable design for the remainder of the 2011 MVP Portfolio. These analyses are outlined in the subsequent section.

The Brookings Project, currently recommended for June approval, as well as the Michigan Thumb loop project which was approved in 2010, will be included in the full portfolio analysis, which will be completed later in 2011.

Table 2.3: Full Candidate MVP Portfolio Analyses and Output

Analysis Name	Analysis Output	Output Purpose
Steady state	List of thermal overloads mitigated by the addition of projects in the final 2011 MVP Portfolio	Project valuation
Transient stability	List of violations mitigated by the addition of projects in the final 2011 MVP Portfolio	Project valuation
Components	List of ancillary portions of projects in the final 2011 MVP Portfolio, as well as a determination of whether those project components are eligible for MVP cost allocation	Project valuation
Avoided capital investment (transmission)	Document the cost avoided of generally lower voltage upgrades that would be needed without the projects in the final 2011 MVP portfolio	Project valuation
Underbuild requirements	Document any incremental transmission required to mitigate constraints created by the addition of the projects in the final 2011 MVP Porfolio	No harm analysis
Short Circuit Analysis	Determine if any incremental upgrades are required to mitigate any short circuit / breaker duty violations	No harm analysis
Voltage Stability Analysis	List of violations mitigated by the addition of projects in the final 2011 MVP Portfolio; confirmation that system reliability is maintained	No harm analysis
Planning Reserve Margin (PRM) benefits	Change in Zonal or System-wide Planning Reserve Margin requirements and related financial benefits of this change in requirements	Portfolio or project valuation
Production cost	Adjusted Production Cost (APC) benefits of the entire final 2011 MVP Portfolio	Portfolio valuation
Avoided capital investment (generation)	Quantification of the incremental wind generator capital cost savings enabled by the wind siting methodology supported by the final 2011 MVP Portfolio	Portfolio valuation
Transmission loss reductions	Change in system peak transmission losses and the related financial benefits of these avoided losses	Portfolio valuation
Robustnesss Testing	Quantification of portfolio benefits under various policy futures or transmission conditions	Portfolio valuation
Installed capacity delivery	Quantification of additional non-network resources that may be utilized as capacity resources due to the final 2011 MVP Portfolio	Portfolio valuation

3 Key Results

3.1 Michigan Thumb Loop Project

The Michigan Thumb Loop Project was approved by the MISO Board of Directors in August 2010 as the first project component of the 2011 MVP Portfolio. Although this project has already been approved, and thus does not require additional justification, is it important to recall that it is a portion of the final 2011 MVP Portfolio. The Michigan Thumb Loop project provides key benefits to the system through enabling the delivery of wind in the Thumb area of Michigan to load centers in Flint, Detroit, and beyond.

Figure 3.1: Michigan Thumb Loop Project

Additional information on the Michigan Thumb Loop project, its project justification, and its benefits may be found in the MTEP10 report at the following link:
http://www.midwestiso.org/Library/Repository/Study/MTEP/MTEP10/MTEP10_Appendix_D1_OOC_Project_Justifications_East_9162010.pdf

3.2 Brookings County to Twin Cities 345 kV Project

The Brookings Project is a 237 mile long 345 kV line from the Minnesota and South Dakota border to the Minneapolis / St. Paul region of Minnesota. It includes multiple 345 kV line segments and a subsystem of transformations supporting the lower voltage system at intermediate substations along the path of the line, with minor associated 115 kV upgrades. Its estimated cost is approximately $720 million. Additional information on the project may be found in Appendix 3.

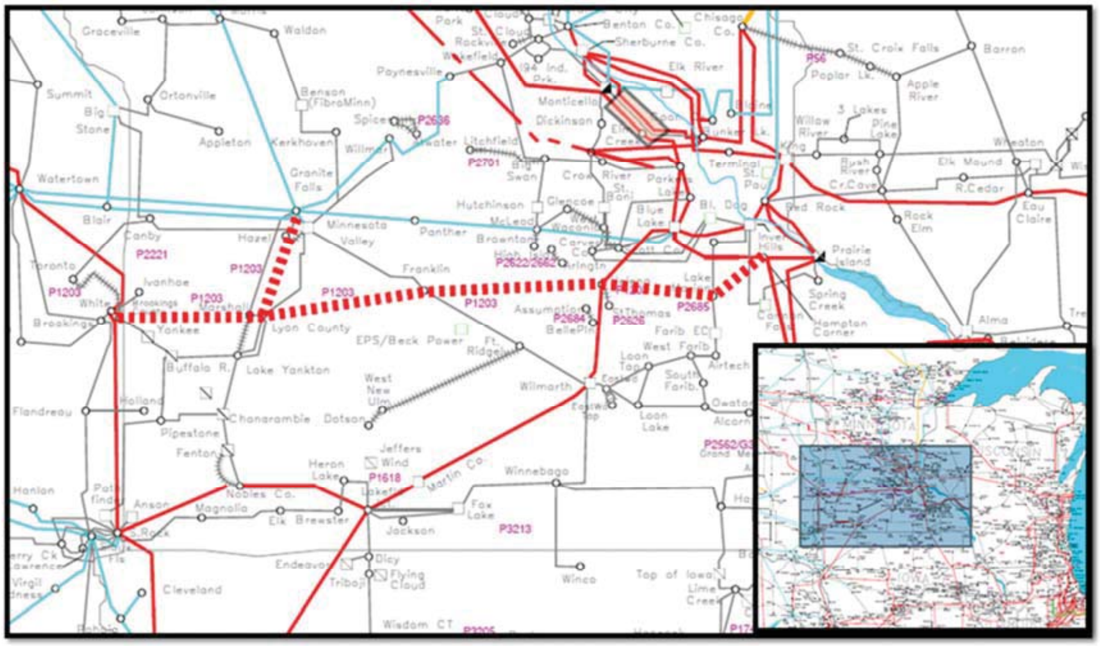

Figure 3.2: Brookings Project

The purpose of the project is to deliver energy from the wind-rich region in southwestern Minnesota and eastern South Dakota to the load center at the Twin Cities of Minnesota and beyond. There is approximately 3100 MW of planned or proposed wind near the western terminal of the line.

3.2.1 Evaluation against MVP Criterion

For a project to be considered a Multi Value Project, it must meet one of three criterion which require regional benefits, based on a combination of public policy, reliability, and/or economic drivers. The Brookings Project was specifically evaluated against MVP criterion 1, which is quoted below:

> A Multi Value Project must be developed through the transmission expansion planning process for the purpose of enabling the Transmission System to reliably and economically deliver energy in support of documented energy policy mandates or laws that have been enacted or adopted through state or federal legislation or regulatory requirement that directly or indirectly govern the minimum or maximum amount of energy that can be generated by specific types of generation. The MVP must be shown to enable the transmission system to deliver such energy in a manner that is more reliable and/or more economic than it otherwise would be without the transmission upgrade.

A summary of the project justification for the Brookings Project is shown in Table 3.1 below. These findings are discussed in greater detail in the subsequent sections.

Table 3.1: Brookings Project Justification

Analysis Name	Key Findings
Steady state: Shoulder Peak	3,299 transmission outage conditions are mitigated through the addition of the Brookings Project.
Steady state: Summer Peak	180 transmission outage conditions were mitigated through the addition of the Brookings Project
Transient stability: Shoulder Peak	7 transient stability violations were mitigated or alleviated through the addition of the Brookings Project
Wind capacity enabled	Mitigation of reliability issues enables the delivery of 2,049 MW of nameplate wind capacity This is equivalent to about 15% of the existing state RPS requirements

The Brookings Project supports the delivery of renewable energy, as required by the public policy mandates, in a manner that is more reliable than it would be without the transmission upgrade. Specifically, the project mitigates approximately 3,485 different transmission outage conditions, for steady state and transient conditions under both peak and shoulder load scenarios. Through the mitigation of these constraints, approximately 2,050 MW of nameplate renewable capacity may be delivered to load centers in the Twin Cities of Minnesota and beyond. Furthermore, although the Brookings Project is justified based on the benefits discussed above, the project is expected to provide additional economic and reliability benefits as an integrated part of the full MVP Portfolio. .

3.2.2 Project Valuation

The primary analysis and project valuation for the Brookings Project focused upon determining the ability of the project to more reliably deliver energy from wind rich areas to the load center of the Minneapolis / St. Paul twin cities. This determination occurred in three main areas: through a series of analyses on a shoulder peak case, through analyses on a summer peak case, and through an analysis of the wind capacity enabled by the Brookings Project.

<u>Shoulder Peak Evaluation</u>

The Brookings Project creates a new outlet out of the Brookings / White region on the edge of South Dakota. Currently, White is connected via 345 kV lines to Watertown, South Dakota in the north and to Split Rock, South Dakota in the south. This configuration is heavily overloaded with the addition of the wind required to meet the state RPS mandates; over 1,000 single events on the system result in overloads of the White to Split Rock outlet path. Likewise, the outage of White to Split Rock pushes power north to Watertown, overloading transformers and lower voltage equipment. These overloads extend past the South Dakota / Minnesota border into the middle and southern portion of Minnesota, under a variety of different contingent events, as shown in Figure 3.3 below.

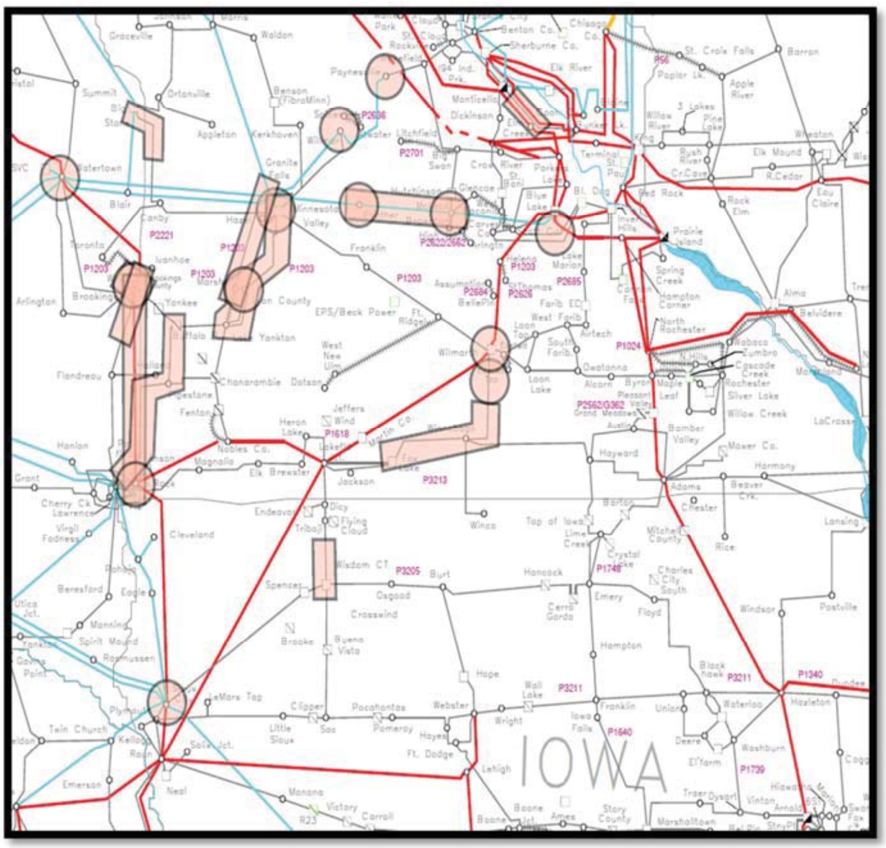

Figure 3.3: Overloads Mitigated by the Brookings Project

Specifically, the Brookings Project mitigates 3,300 different transmission outage conditions which would otherwise result in heavily loaded or overloaded system elements under shoulder peak conditions. This includes seven conditions which would result in transient system instability without the project or other mitigation. Additionally, some steady state overloads are of sufficient magnitude that it is expected they would cause uncontrolled tripping or cascading thermal failures.

More information on individual constraints and loadings may be found in Appendix 4. Stability results may also be found in Appendix 5.

Summer Peak Evaluation

The Brookings Project shows additional value when it is evaluated under summer peak conditions, when wind output tends to be at lower levels. Specifically, the creation of an additional outlet from the Brookings / White area, as discussed previously, alleviates constraints around Watertown, as well as alleviating substantial loading on the southwestern Minnesota 115 kV transmission network. The Brookings Project also prevents substantial 115 kV line overloads for the loss of one of the 345 kV lines into the Twin Cities of Minnesota by providing an additional inlet into this major load center.

Finally, the Brookings Project alleviates constraints along the Minnesota-Wisconsin interface through bringing an additional 345 kV transmission line into the area. Constraints on this interface were identified for the loss of a local 345 kV line, which would overload a transformer and several 115 kV transmission lines without the support provided by the Brookings Project. Constraints mitigated by Brookings that were unique to the summer peak analysis may be seen in Figure 3.4 below.

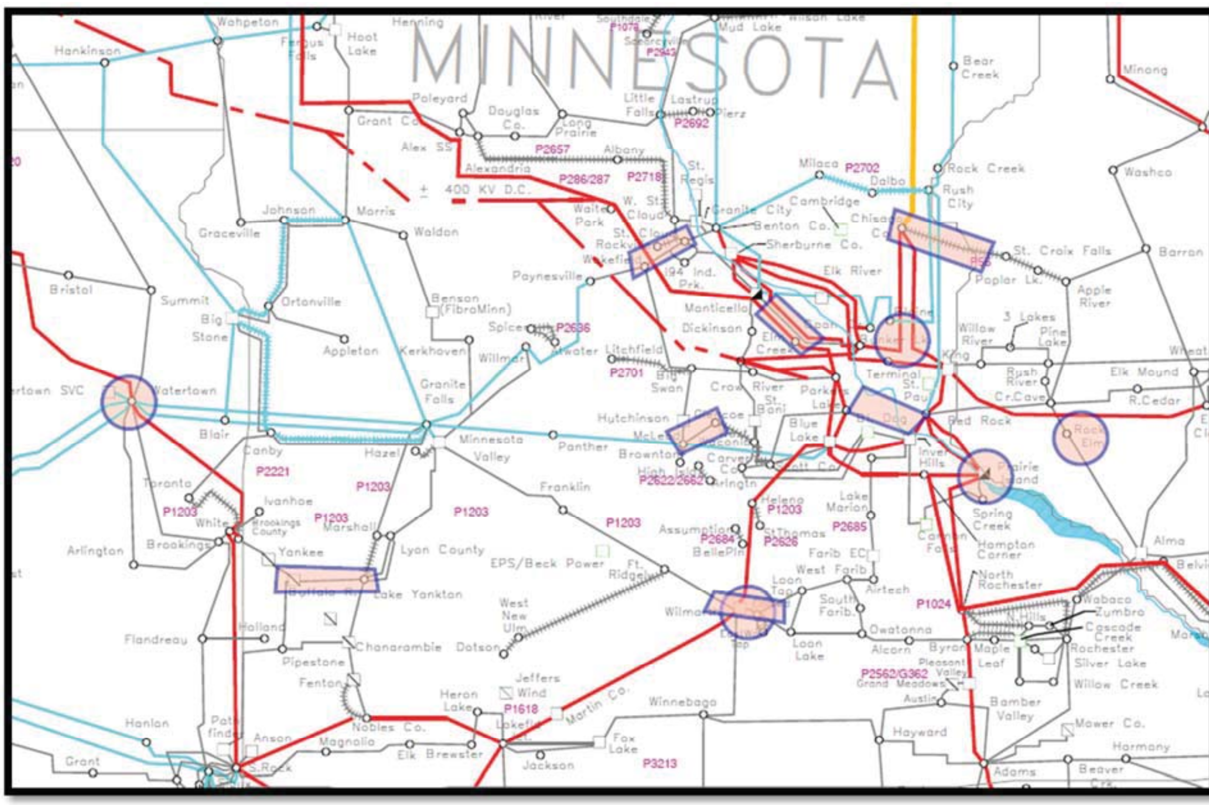

Figure 3.4: Additional Summer Peak Overloads Mitigated by the Brookings Project

Specifically, the Brookings Project mitigates approximately 180 different transmission outage conditions specific to the summer peak scenario which would otherwise result in heavily loaded or overloaded system elements. More information on individual constraints and loadings may be found in Appendix 4.

Public Policy Evaluation

Through mitigated the violations described above, the Brookings Project enables approximately 2,049 MW of wind capacity to be delivered to load. This capacity is equal to approximately 15% of the state RPS energy requirement. Additional information on the specific generation units that would be curtailed without the Brookings Project is contained in Appendix 6.

3.2.3 Underbuild Requirements

The system was analyzed for any violations that were caused or aggravated by the addition of the Brookings Project. Of these violations, five are in the vicinity of other Candidate MVP projects as shown below in Table 3.2, such as the Ellendale to Big Stone or the Lakefield to Mitchell County projects. They will be analyzed in the full portfolio analysis and are not recommended for additional mitigation at this time.

Table 3.2: Brookings Project Underbuild Violations Near Other Candidate MVP Projects

Element	Expected Mitigation
Farmington to Castle Rock 69 kV	Near Lakefield – Mitchell Co project Will be analyzed in full portfolio analysis
Adams 345 / 161 kV transformer	Near Lakefield – Mitchell Co project Will be analyzed in full portfolio analysis
Ellendale 230 / 115 kV transformer	Near Ellendale – Big Stone project Will be analyzed in full portfolio analysis
Galesville to Tempealeau 69 kV	Near North LaCrosse –Cardinal project Will be analyzed in full portfolio analysis
Tunnel City Tap to Timeberwork 69 kV	Near North LaCrosse –Cardinal project Will be analyzed in full portfolio analysis

The remaining constraints had the following mitigation. These upgrades will be incorporated into the design of the Brookings Project.

Table 3.3: Other Constraints and Mitigation for Conditions Aggravated by the Brookings Project

Constrained Element	Expected Mitigation
Lake Marion 115 / 69 kV transformer	Replace the existing Lake Marion transformer with a larger unit
Lake Marion to Lake Marion tap 69 kV	Install a breaker at the Lake Marion 69 kV substation
Franklin 115 / 69 kV transformer	Replace both existing Franklin transformer with larger units

3.2.4 Component Analysis

The Brookings Project has a number of different components, each of which has multiple benefits to the transmission system. To ensure that the entire project meets the MVP cost allocation criterion, each component was analyzed separately to demonstrate its value. It was determined that each project component, listed below, supports the MVP criterion, through enabling a more robust system, increasing system reliability, and/or reducing flows on neighboring transmission system.

- Lyon County 345/115 kV transformer
- Cedar Mountain 345/115 kV transformer and Cedar Mountain to Franklin 115 kV line
- Lake Marion 345/115 kV transformer
- Lyon County to Hazel 345 kV line, Hazel to Minnesota Valley 230 kV line, and Hazel 345/230 kV transformer
- Lyon County to Cedar Mount to Helena double circuit 345 kV line

More specifically, the removal of individual project components results in increasing loading on the 230 kV path from Minnesota Valley to Twin Cities, as well as on the existing 345 kV outlet from Brookings to White to Split Rock and Split Rock to Lakefield to Wilmarth to the Twin Cities. Of the overloaded facilities that the Brookings Project mitigates, approximately half the constraints re-appear as individual components are removed from the overall project. As a result, it was determined that the full Brookings Project, as originally submitted, meets the MVP criterion.

3.2.5 Sensitivities to other projects in portfolio

Sensitivities were run to show the linkages between the overall Candidate MVP Portfolio and the Brookings Project. These sensitivities and their conclusions are described below.

<u>Ellendale – Big Stone – Brookings Sensitivity</u>

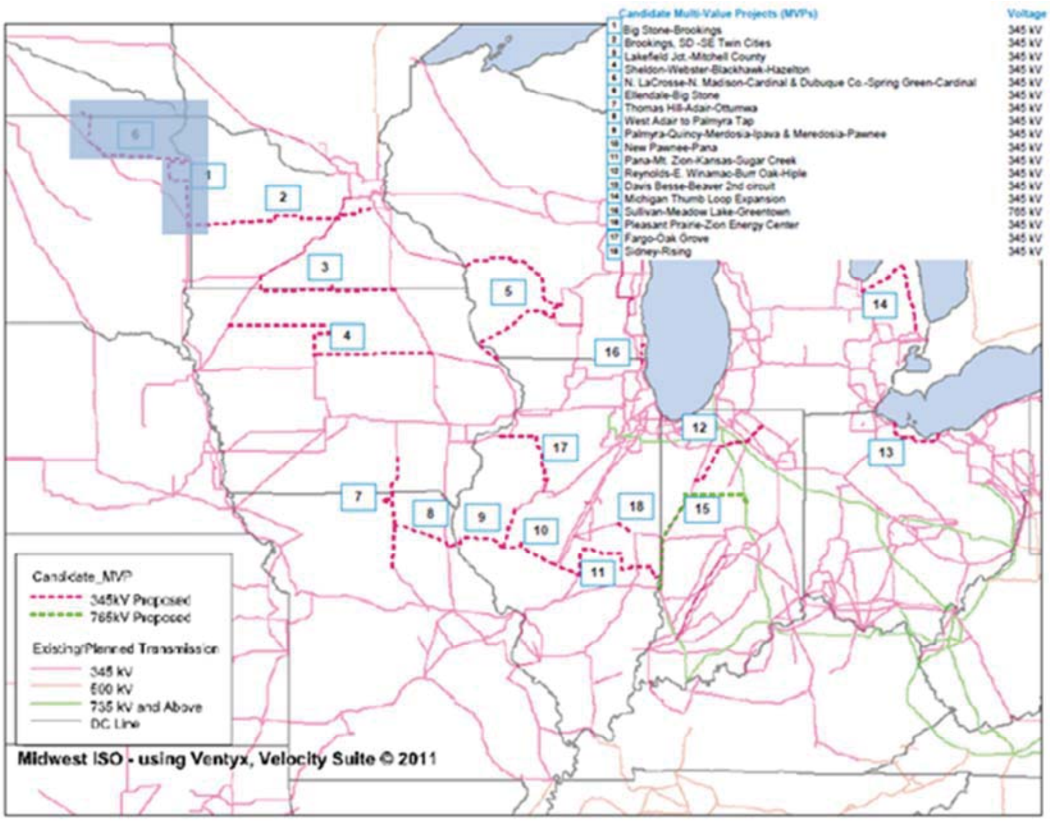

Figure 3.5: Ellendale to Big Stone and Big Stone to Brookings Projects

The purpose of this sensitivity was to determine if, with the expected increase in flows provided by the Candidate MVP projects from Ellendale to Big Stone and from Big Stone to Brookings, the Brookings Project is still adequately sized for the wind energy requirements described in the state RPS mandates. Although this analysis demonstrated that additional power did flow on the Brookings Project with the addition of the Ellendale to Big Stone and Big Stone to Brookings project, these flows did not require that the Brookings Project be increased in size.

An additional analysis was performed with the Ellendale to Big Stone, Big Stone to Brookings, and North LaCrosse to Madison projects in the model, to test the hypothesis that the North LaCrosse to Madison project would further increase the flows on the Brookings Project. Although this hypothesis was validated, the additional flows did not require that the Brookings Project be increased in size.

<u>Iowa Projects Sensitivity</u>

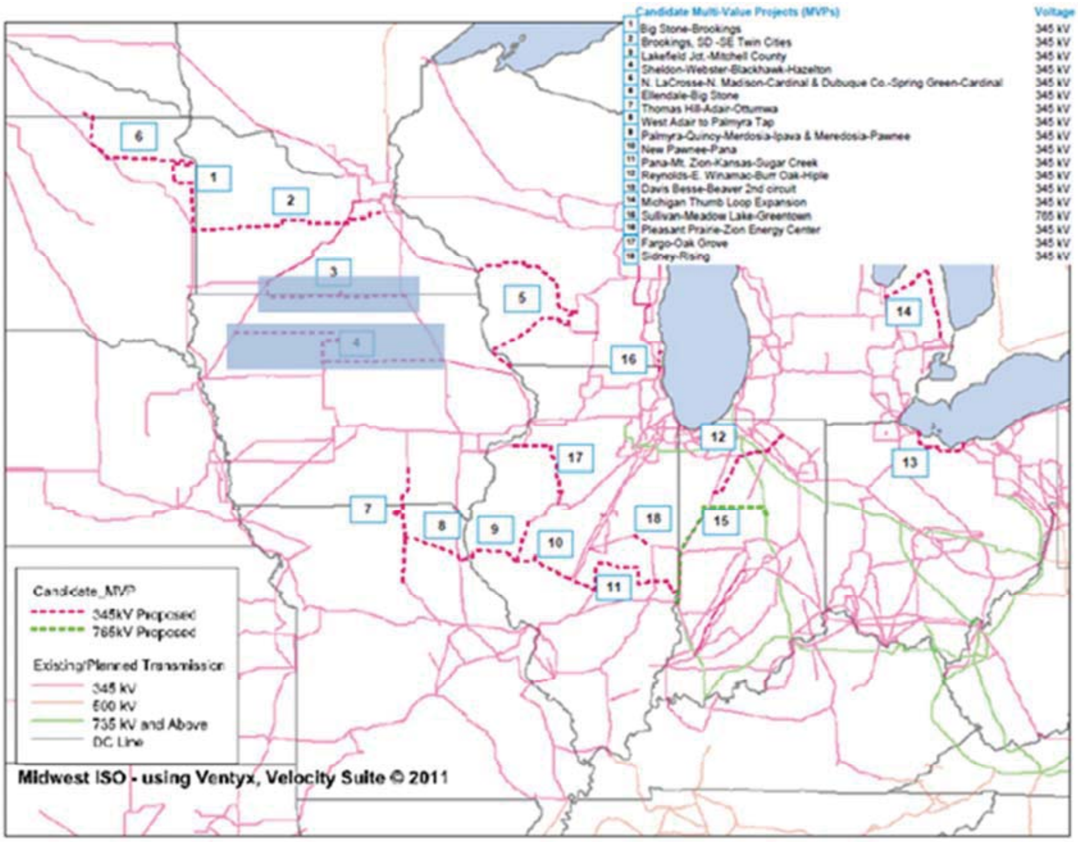

Figure 3.6: Iowa Projects

The Iowa projects sensitivity was performed to show any constraints that could be mitigated by the Lakefield-Mitchell Co or the Sheldon-Webster-Blackhawk-Hazelton projects in Iowa, in lieu of the Brookings Project. The intent of this analysis was to review if the Brookings Project could be replaced by one or both of the Iowa projects. Although some shared constraints were found, it was determined that the Brookings Project could not be replaced by a combination of Iowa projects; it largely mitigates constraints that could not be resolved by either the Lakefield-Mitchell Co or the Sheldon-Webster-Blackhawk-Hazelton projects.

North LaCrosse – Cardinal – Madison Sensitivity

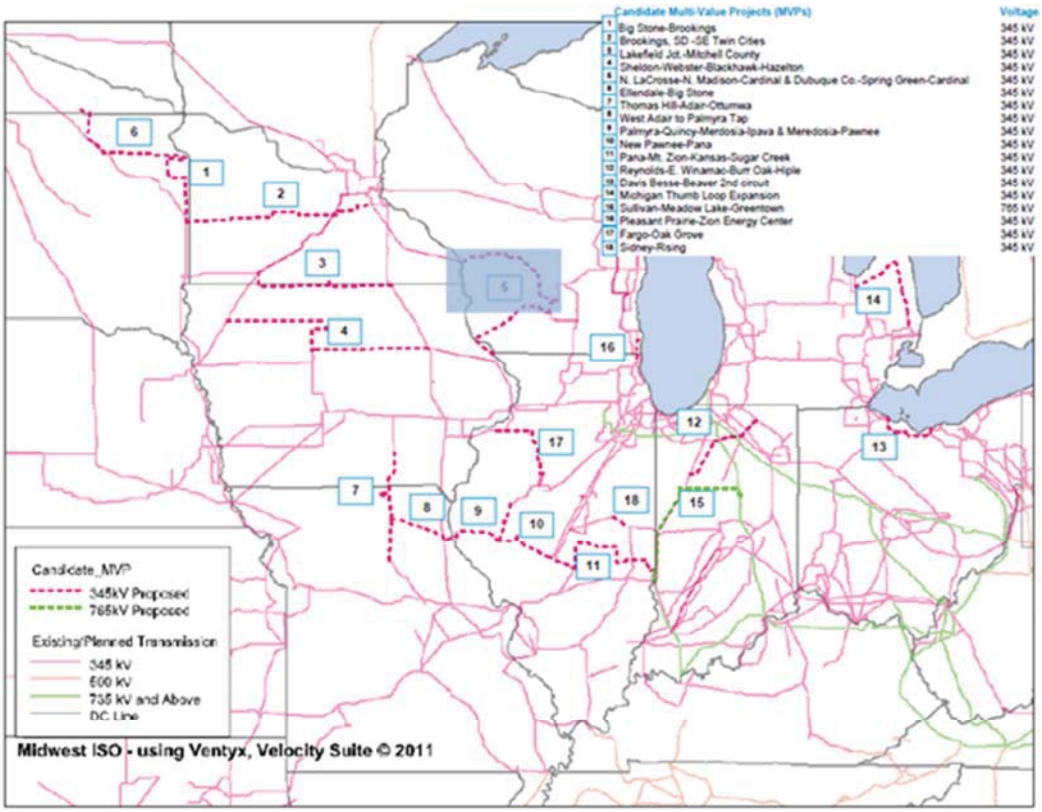

Figure 3.7: North LaCrosse – North Madison – Cardinal Project

Based on previous study work, it was suspected that the Brookings Project would cause additional flows in Wisconsin without the support of the North LaCrosse – North Madison – Cardinal project. A sensitivity was performed to document any increased flows, as well as the impact of the North LaCrosse – North Madison – Cardinal project in reducing them. This work is preliminary, and additional analyses will be done to show the full value of the North LaCrosse – North Madison – Cardinal project.

3.3 Candidate MVP Portfolio Overview

Although the previous section focused on the benefits of the Brookings Project on a relatively stand-alone basis, it should be stressed that the project is a piece of the 2011 Candidate MVP Portfolio. Analysis is ongoing on the full portfolio, and this analysis will be completed for a December project recommendation. This full Candidate MVP Portfolio is shown below in Figure 3.8.

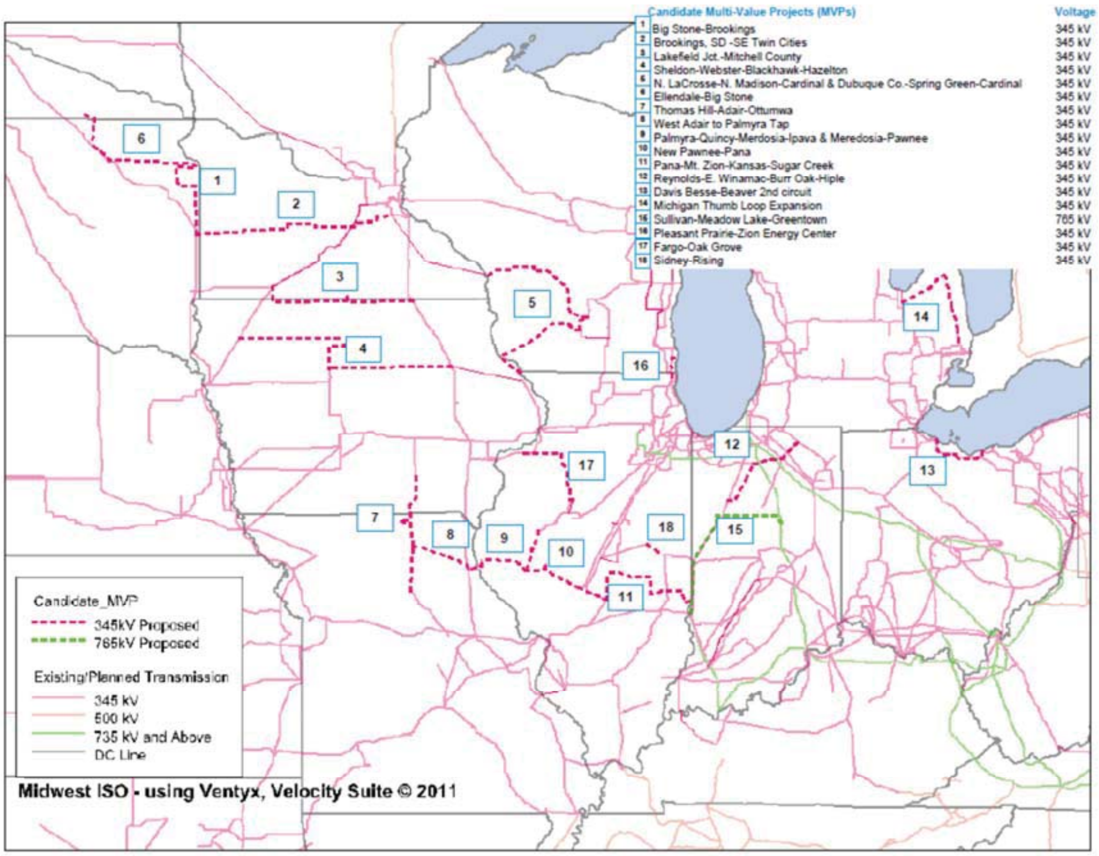

Figure 3.8: 2011 Candidate MVP Portfolio

3.3.1 Preliminary Portfolio Economic Value Quantification and Spread

Preliminary analysis was performed to quantify some of the benefits surrounding the full Candidate MVP Portfolio, as it is currently configured. Please note that these benefits will vary as further analysis may alter the composition of the project in the MVP Portfolio.

Adjusted Production Cost (APC) Benefits

The addition of transmission to the system allows for the more efficient dispatch of generation resources, opening up markets to competition and spreading the benefits of low-cost generation throughout the footprint. APC benefits reflect the savings achieved through the reduction of transmission congestion costs and through more efficient generation resource utilization.

In order to show the benefits of the portfolio under a variety of different potential policy based futures, a total of four sets of APC benefits were calculated. The futures that were analyzed were designed to 'bookend' the range of potential future policy outcomes, ensuring that all of the most likely future policy scenarios and their impacts were within the range bounded by the results. The futures analyzed are described below.

- **Business As Usual** assumes that current energy policies will be continued, with no large changes in current demand and energy growth projections.
- **Business As Usual with High Demand and Energy Growth** assumes that current energy policies will be continued, with increased demand and energy growth rates.
- **Carbon Constraint** assumes that current energy policies will be continued, with the addition of a carbon cap modeled on the Waxman-Markey bill.
- **Combined Energy Policy** assumes a myriad of energy policies are enacted, including a 20% federal RPS, a carbon cap modeled on the Waxman-Markey bill, the implementation of a smart grid, and the widespread adoption of electric vehicles.

When all futures were analyzed, the Candidate MVP Portfolio produced an estimated $13.5 to $33.4 billion in 20 year Net Present Value (NPV) Adjusted Production Cost benefits, depending on what future policies were considered in the analyses. These benefits result in a 20-year benefit-to-cost ratio of 1.12 to 2.77, assuming a total portfolio cost of $5.2 billion.

An important component of the Candidate MVP Portfolio is its ability to produce widespread regional benefits. The spread of the APC benefits is shown below in **Error! Reference source not found.**. The Candidate MVP Portfolio successfully spreads the benefits of low cost generation and reduced congestion across the MISO footprint, resulting in benefits for each subregion.

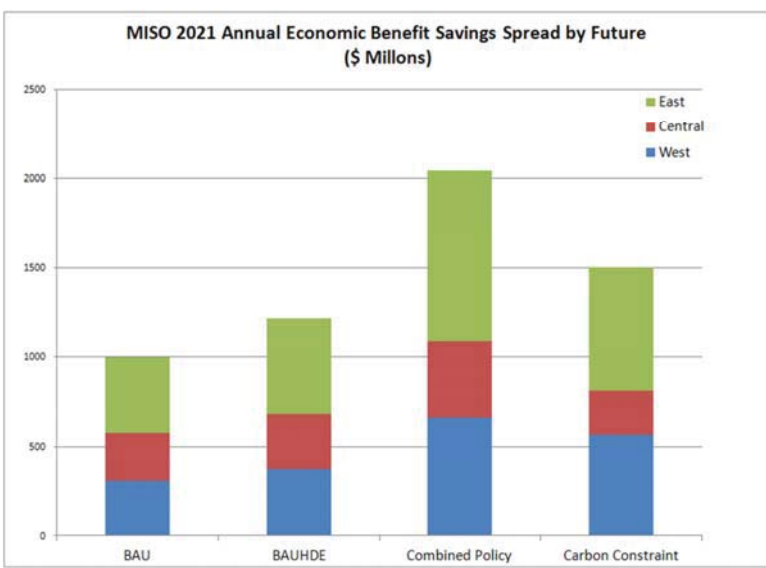

Figure 3.9: Candidate MVP Portfolio Preliminary Benefits Spread

Capital benefits of wind siting

As discussed in section 2.2.2, the MISO determined that the least cost approach to generation wind siting, when both transmission and generation capital costs are considered, is to source generation in a combination fashion, where wind is located both local to load, where less transmission is required, and regionally, where the wind is the strongest. However, this strategy depends on a strong regional transmission system to deliver the wind energy from where it is sited to load centers. Without this regional transmission backbone, the wind generation would have to be sited locally to load, requiring the construction of significantly larger amounts of wind capacity.

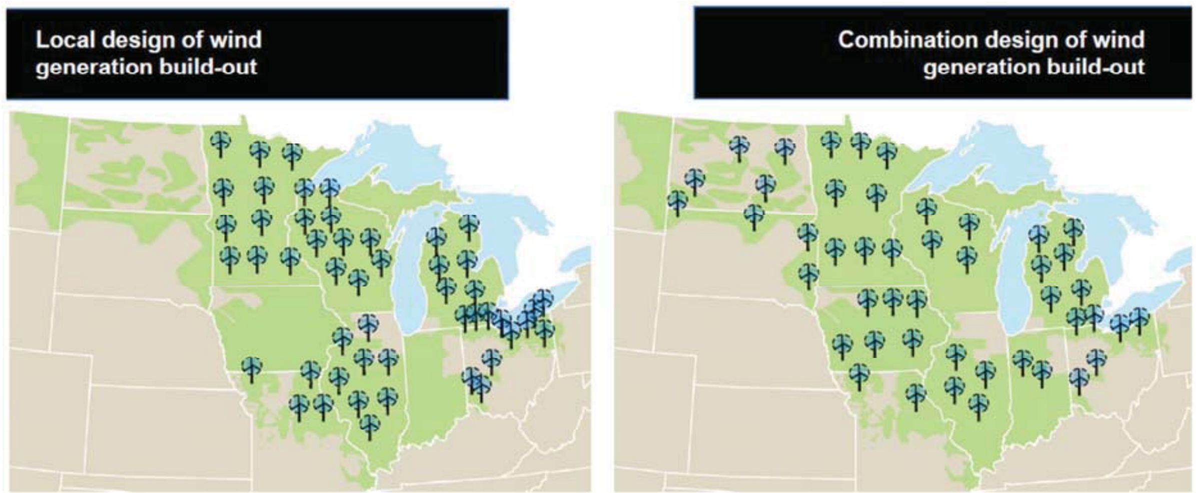

Figure 3.10: Local versus Combination Wind Siting

As part of the MISO 2010 Value Proposition, it was determined that the annual benefit of this wind siting methodology was equal to between $34 and $42 million in 2010, with a 10-year NPV of $1,043 to $1,294 million[3].

[3] Additional details on these analyses may be in the MISO corporate value proposition at the link below. https://www.midwestiso.org/WhatWeDo/ValueProposition/Pages/ValueProposition.aspx

3.3.2 Additional Project and Portfolio Benefits

The Candidate MVP Portfolio provides widespread benefits across the system. These benefits include the delivery of wind energy and the reliability benefits shown for the Brookings Project. They also include the APC and generation capital benefits quantified above. However, these metrics do not fully quantify the full benefits of the portfolio; some additional qualitative values are discussed below. These values support and inform the primary project justification. They also demonstrate the value of the portfolio in aggregate.

It should be noted that not all project and portfolio value can be quantified, and that not all the values below may demonstrate a strong benefit for each project in the 2011 Candidate MVP Portfolio. However, the Candidate MVP Portfolio study team will continue to explore methods to capture the full impact of the portfolio and its component transmission on the system.

<u>Transmission loss reductions</u>
In a future scenario where the installed generation capacity is only just sufficient to meet peak load need, a reduction in transmission losses can create benefits through reducing the amount of generation that must be to serve peak load.

<u>Planning Reserve Margin (PRM) reduction</u>
In a scenario where the installed generation capacity is merely sufficient to meet the system's PRM, a reduction in the system's PRM reduces the amount of addition generation capacity which must be installed to maintain the Planning Reserve Margin. This benefit may also apply if zonal import or export constraints are relaxed through the installation of transmission.

<u>Enabling Installed Generation Capacity Delivery</u>
Existing generation capacity may be limited in its ability to acquire Network Resource (NR) status, and therefore use that capacity for Reserve Margin Requirements. The installation of additional transmission may allow additional generation to achieve NR status, delivering additional capacity value to the system.

<u>Portfolio robustness</u>
The ultimate goal of the MISO planning process is to develop a transmission system that will enable market efficiency and competitiveness while maintaining system reliability under any resource mix. This robustness reduces the investment risk for the portfolio, and it allows for flexibility under various future policy conditions.

<u>Enabling Generation Interconnection Projects</u>
Although Multi Value Projects are not Generator Interconnection projects, they serve to create a regional backbone which enables the installation of new generation into the MISO system. This removes the responsibility from the generators to build regional upgrades, allowing their upgrades to focus on more local interconnection issues. A list of the generation interconnection requests in the Definitive Planning Phase (DPP) or beyond that are impacted by the projects in the Candidate MVP Portfolio are included in Appendix 7. Without the Candidate MVP Portfolio, these projects would either be responsible for funding the associated Candidate MVP project or funding a restudy to determine an alternative upgrade.

4 Conclusions and Recommendations

The MISO staff recommends the Brookings Project to the MISO Board of Directors for approval in June of 2011. This recommendation is based upon the strong reliability benefits of the project, as described above, and its ability to enable large amounts of wind generation to be delivered to load. The project also functions as an effective part of the overall Candidate MVP Portfolio, which serves to improve the overall reliability of the transmission system while spreading the economic benefits of lower-cost generation throughout the footprint.