Proposed Multi Value Project Portfolio

Business Case Workshop

September 19, 2011

September 29, 2011

Overview

- Multi Value Projects reflect the transformation of the MISO planning process by creating a regional network that, when combined with the existing system, provides value in excess of its costs under a variety of future policy and economic conditions
- Today's meeting will focus on the process used to reach that recommendation as well as present a summary of the business case that reveals projected benefits well in excess of cost
- Specifically, we will walk through the following topics
  - MISO Planning Approach
  - Candidate MVP Portfolio Study Scope
  - Proposed MVP Portfolio Reliability and Public Policy Benefits
  - Economic Variables and Assumptions
  - Economic Benefits
  - Sensitivities
  - Qualitative and Social Benefits

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MISO Planning Approach

MISO Planning Objectives

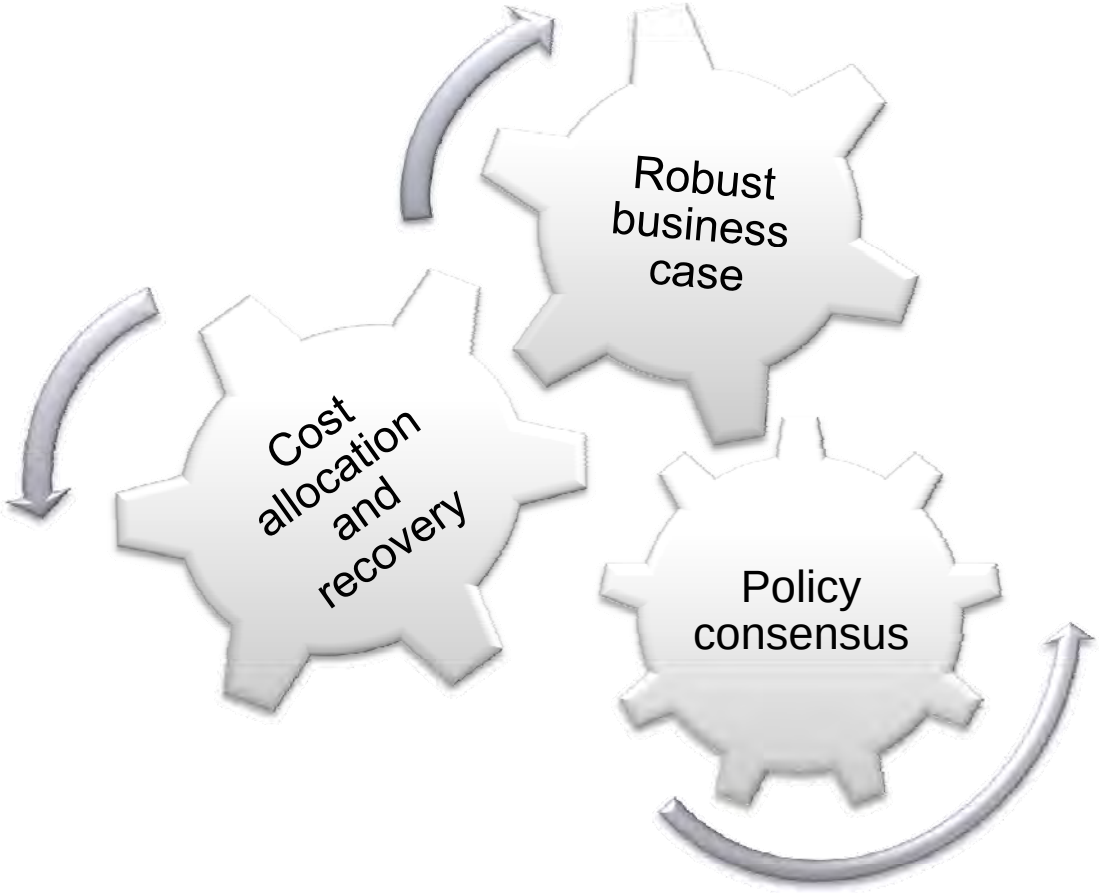
Fundamental Goal

The development of a comprehensive expansion plan that meets reliability needs, policy needs, and economic needs

MISO Board of Director Planning Principles*

- Make the benefits of an economically efficient energy market available to customers by providing access to the lowest electric energy costs
- Provide a transmission infrastructure that safeguards local and regional reliability and supports interconnection-wide reliability
- Support state and federal energy policy objectives by planning for access to a changing resource mix
- Provide an appropriate cost mechanism that ensures the realization of benefits over time is commensurate with the allocation of costs
- Develop transmission system scenario models and make them available to state and federal energy policy makers to provide context and inform the choices they face

Conditions Precedent to Increased Transmission Build

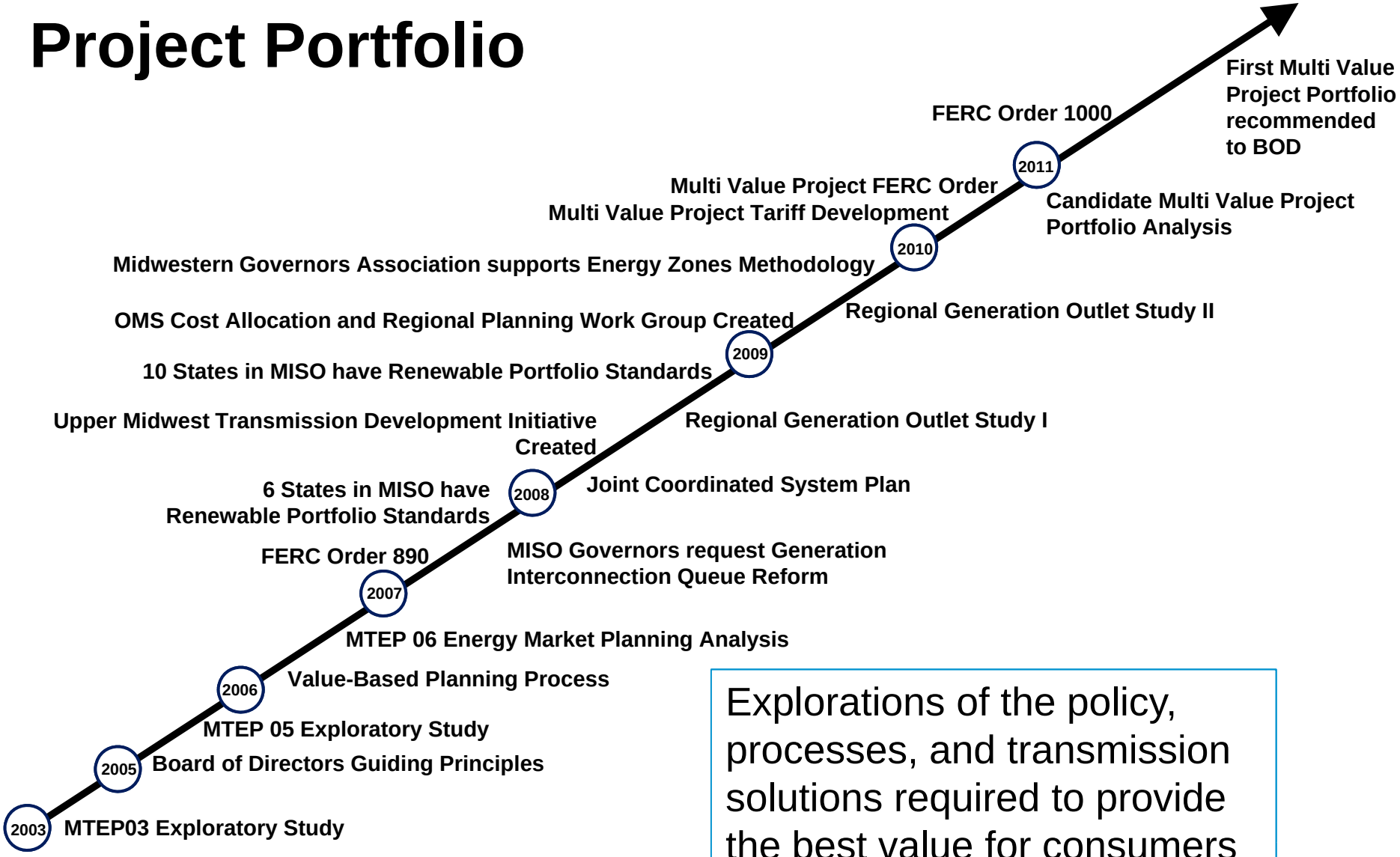


Before transmission is built a number of conditions must be met

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

MISO

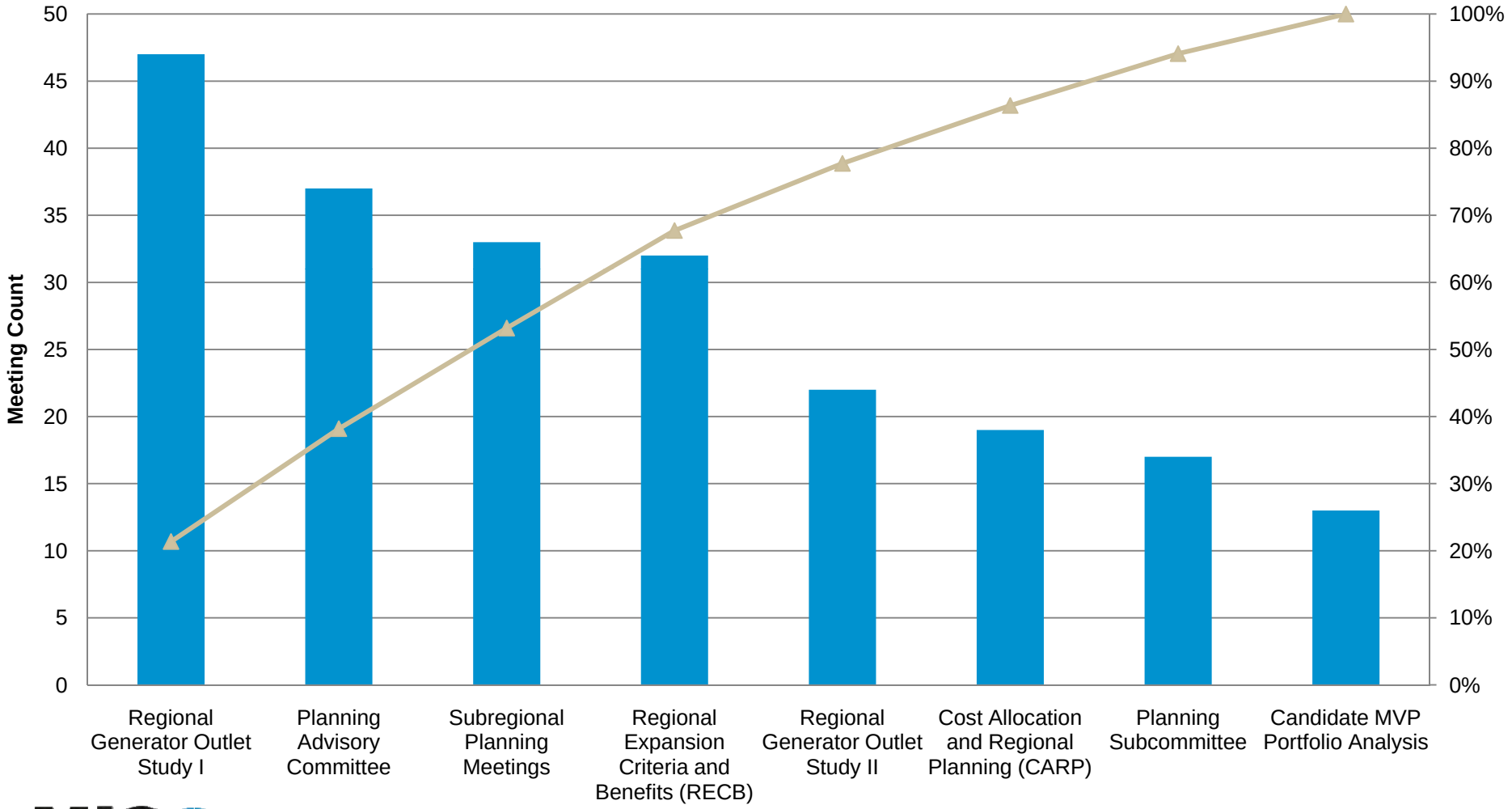
The Road to the First Multi Value Project Portfolio



Explorations of the policy, processes, and transmission solutions required to provide the best value for consumers began in 2003

Regional Transmission Planning Efforts

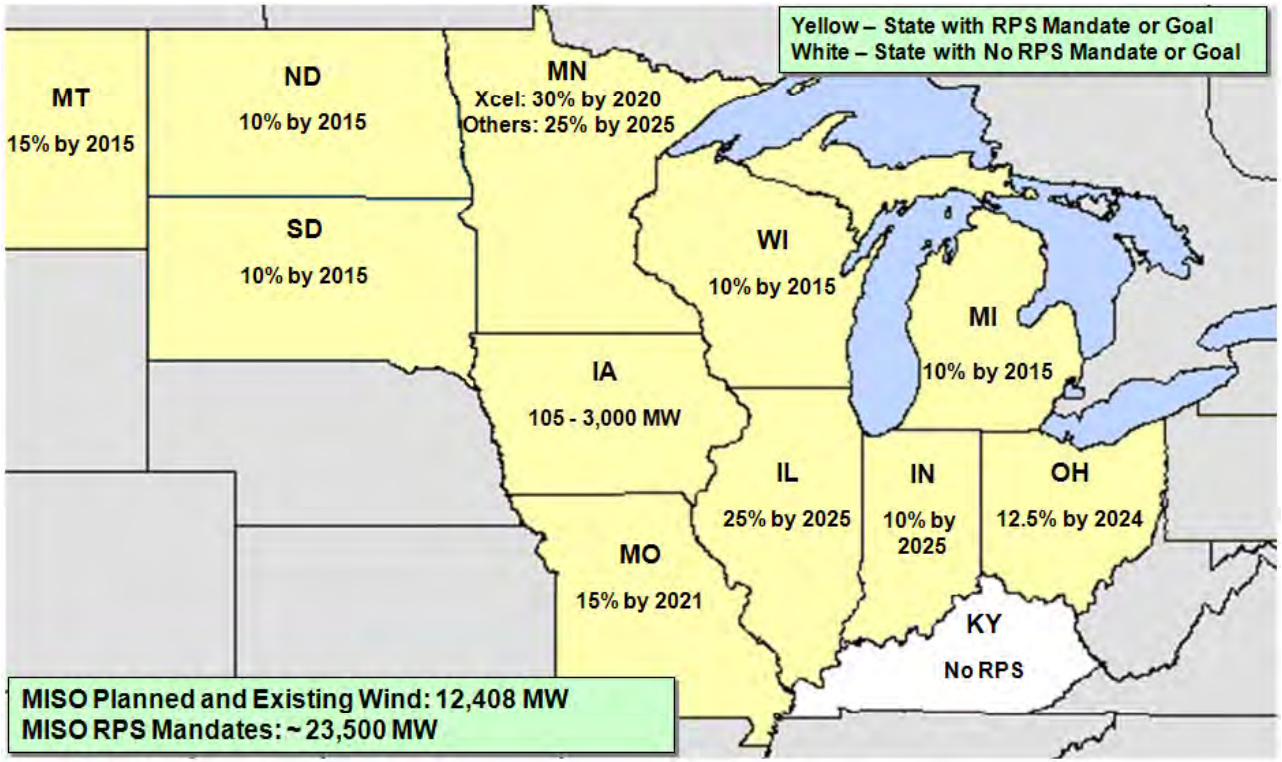
Stakeholder Meetings



Required: Policy Consensus

Current State Renewable Portfolio Standards

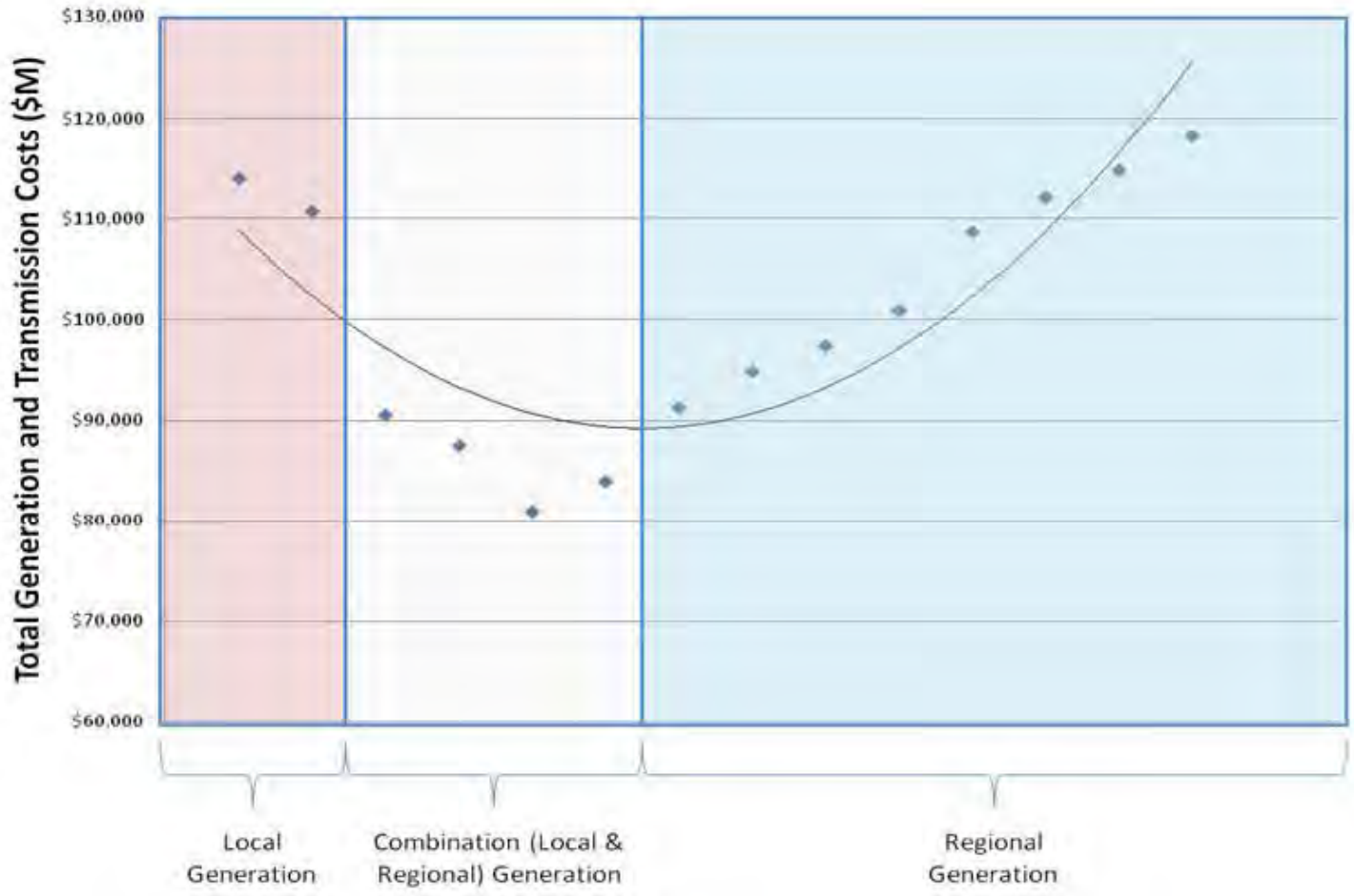
As of 07/27/2011



Planned and Existing Wind as of 3/28/2011

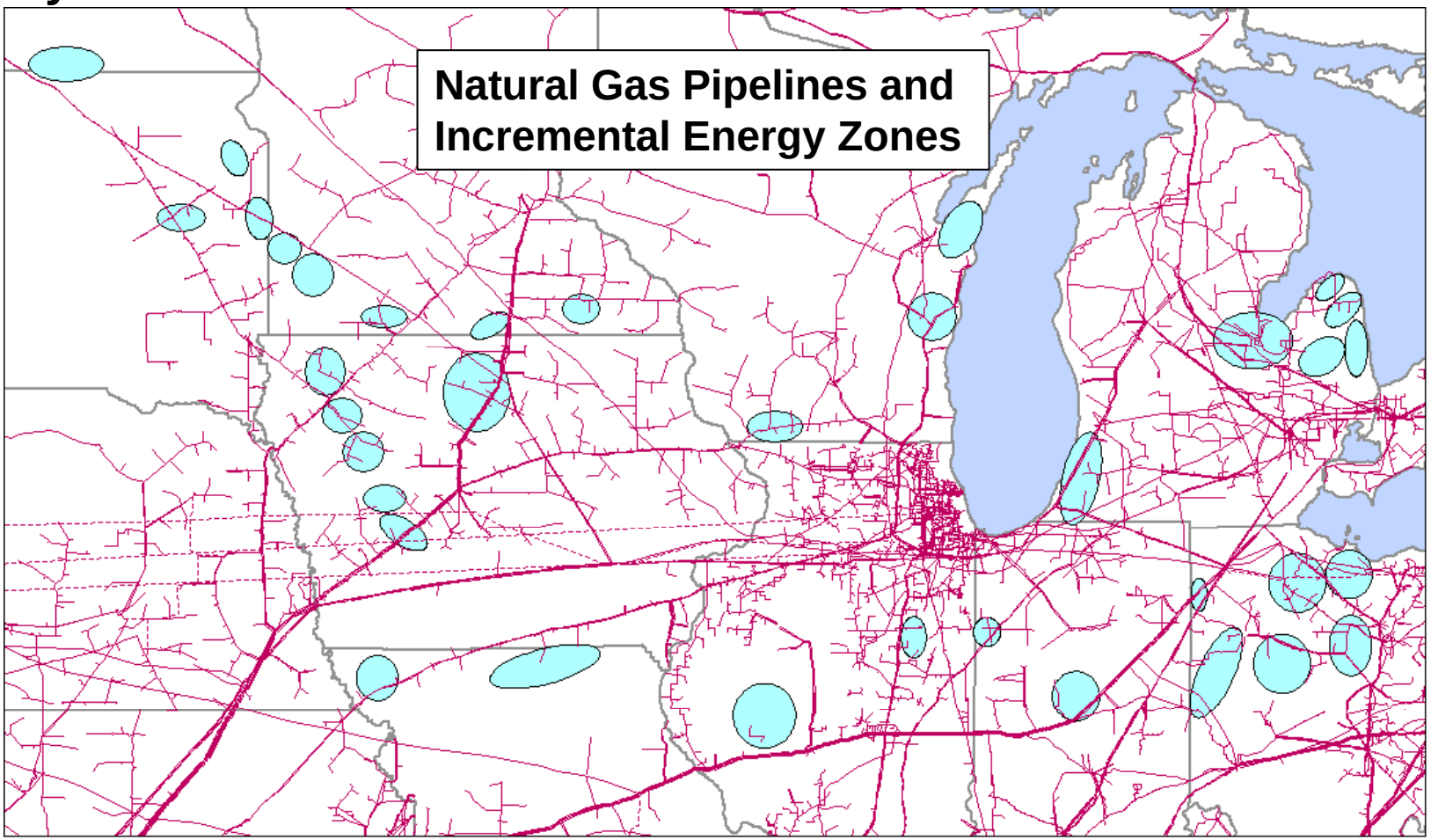
- MISO believes an informal consensus has been reached regarding appropriate planning for energy policies.
- This belief is based on the widespread implementation of Renewable Portfolio Standards across the MISO footprint and the work of many stakeholders, spearheaded by the:
  - ✓ Midwest Governor's Association
  - ✓ Upper Midwest Transmission Development Initiative
  - ✓ Organization of Midwest ISO States Cost Allocation and Regional Planning

To meet the MISO planning goal of providing consumers with access to the lowest cost electric energy, analyses were performed to determine the costs associated with different wind generation siting methodologies



The low cost approach to wind generation siting, when both generation and transmission capital costs are considered, is a combination of local and regional generation locations.

This methodology resulted in a set of energy zones which were used as the locations for incremental generation in continuing analyses



These energy zones were created by balancing relative wind capacities along with distances from natural gas pipelines and existing transmission infrastructure

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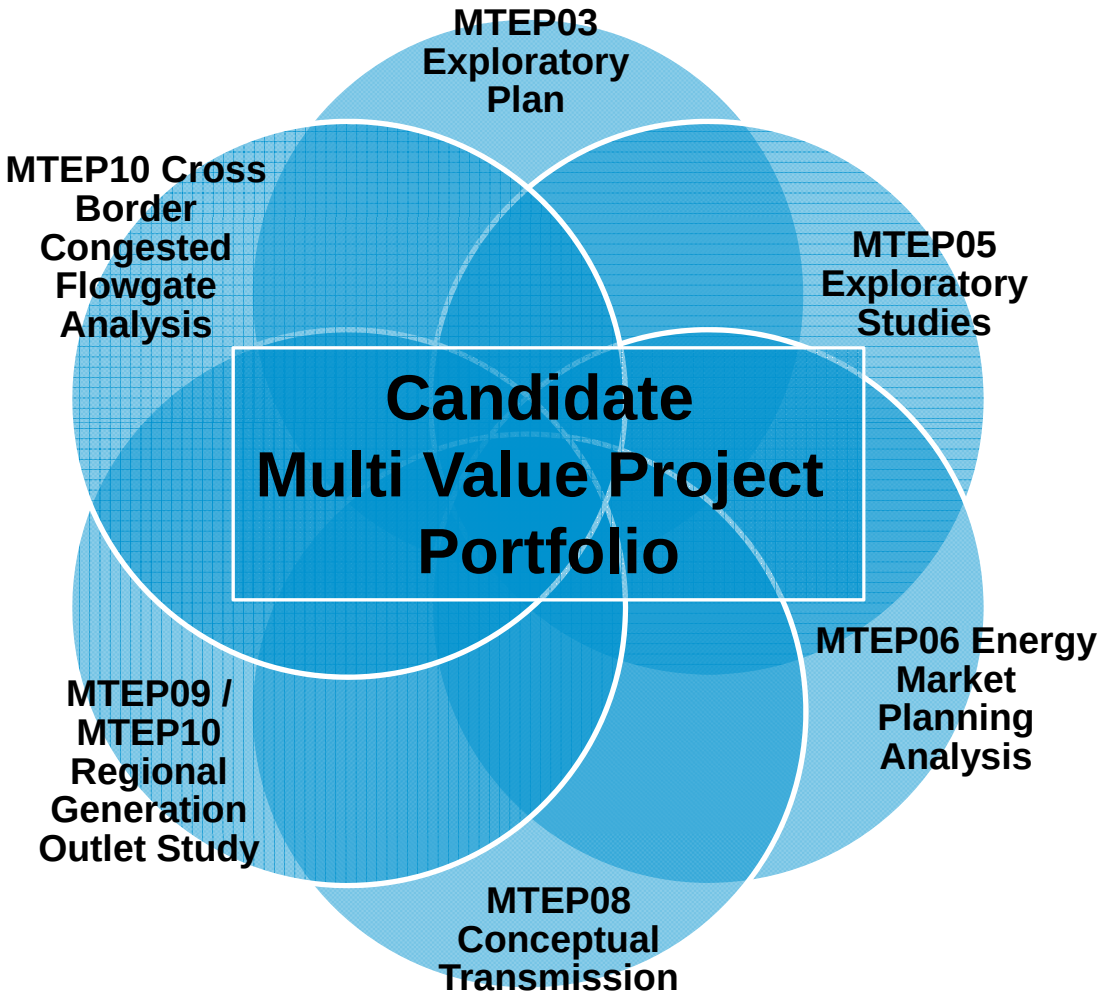
Candidate MVP Portfolio Analysis Scope

Required: Robust Business Case



Through consolidating the transmission solutions developed throughout the years, the Candidate Multi Value Project Portfolio was created

Multi Value Projects must meet one of the three Tariff defined criteria

Criterion 1

A Multi Value Project must be developed through the transmission expansion planning process to enable the transmission system to deliver energy reliably and economically in support of documented energy policy mandates or laws enacted or adopted through state or federal legislation or regulatory requirement. These laws must directly or indirectly govern the minimum or maximum amount of energy that can be generated. 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.7 of Attachment FF to the MISO Tariff. The reduction of production costs and the associated reduction of LMPs 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.

** More information may be found at https://www.midwestiso.org/Library/Tariff/Pages/Tariff.aspx*

The Tariff also identifies specific types of economic value which Multi Value Projects may provide, including:

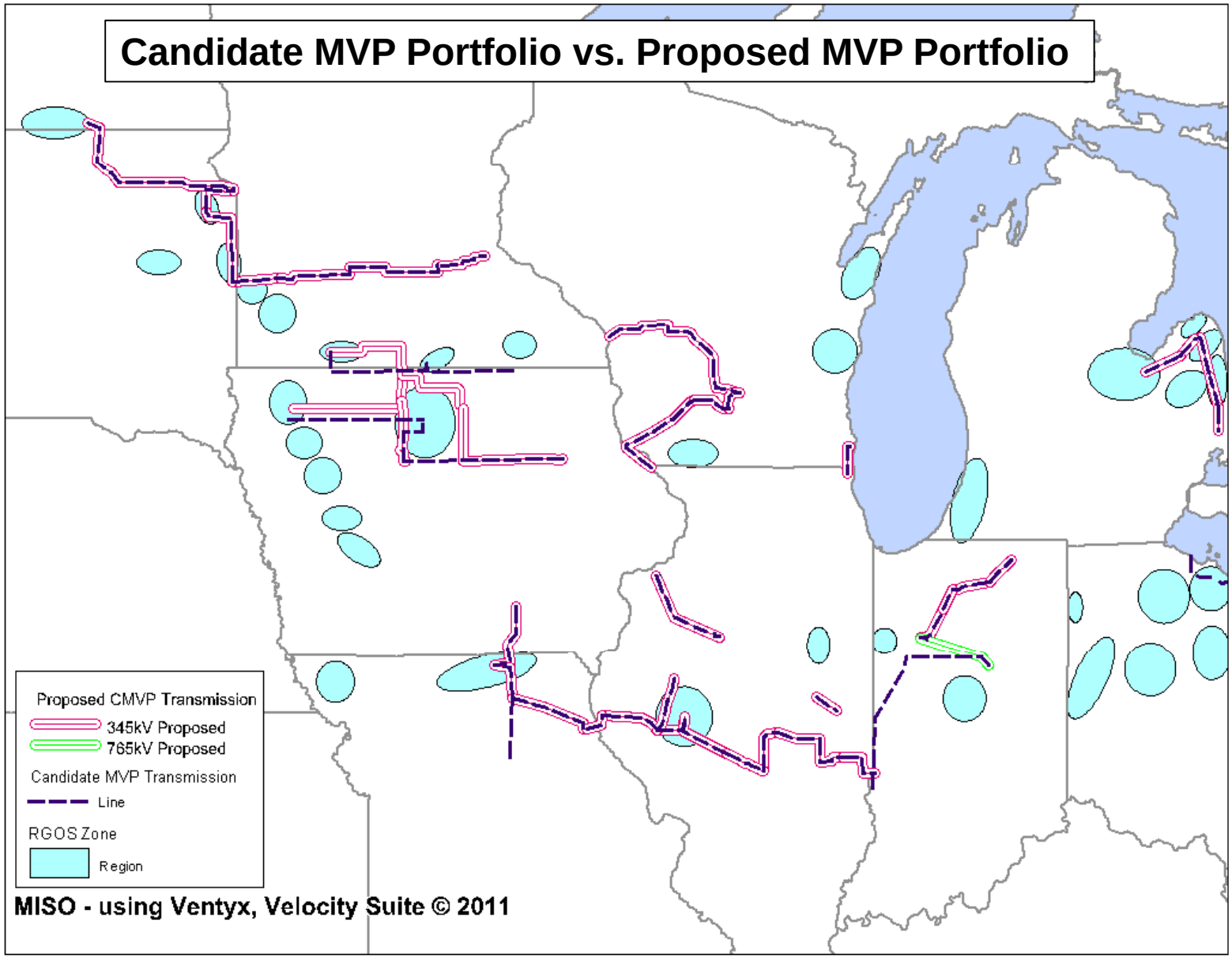
- Production cost savings where production costs include generator startup, hourly generator no-load, generator energy and generator Operating Reserve costs. Production cost savings can be realized through reductions in both transmission congestion and transmission energy losses. Productions cost savings can also be realized through reductions in Operating Reserve requirements within Reserve Zones and, in some cases, reductions in overall Operating Reserve requirements for the Transmission Provider.
- Capacity losses savings where capacity losses represent the amount of capacity required to serve transmission losses during the system peak hour including associated planning reserve.
- Capacity savings due to reductions in the overall Planning Reserve Margins resulting from transmission expansion.
- Long-term cost savings realized by Transmission Customers by accelerating a long-term project start date in lieu of implementing a short-term project in the interim and/or long-term cost savings realized by Transmission Customers by deferring or eliminating the need to perform one or more projects in the future.
- Any other financially quantifiable benefit to Transmission Customers resulting from an enhancement to the transmission system and related to the provisions of Transmission Service.

** More information may be found at https://www.midwestiso.org/Library/Tariff/Pages/Tariff.aspx*

The scope of the Candidate MVP Portfolio Analysis was designed to quantify the benefits of the MVP portfolio against the Tariff criteria

Analysis Type	Analysis Output
Steady state	List of thermal overloads mitigated by the proposed MVP portfolio transmission projects
Alternatives	Relative value of the candidate MVP projects against a stakeholder or MISO identified alternative Can include steady state and production cost analyses
Underbuild requirements	Document any incremental transmission required to mitigate constraints created by the addition of the proposed MVP portfolio
Short circuit	Document any incremental upgrades required to mitigate any short circuit / breaker duty violations
Stability	List of violations mitigated by the proposed MVP portfolio transmission projects Includes both transient and voltage stability analysis
Generation enabled	Document wind curtailed, and additional wind that is enabled by the proposed MVP portfolio
Production cost	Adjusted Production Cost (APC) benefits of the entire proposed MVP portfolio
Robustness testing	Quantification of portfolio benefits under various policy futures or transmission conditions
Operating reserves Impact	Impact of the proposed MVP portfolio on existing operating reserve zones and quantification of this benefit
Planning Reserve Margin (PRM) benefits	Capacity savings due to reductions in the system wide Planning Reserve Margin caused by the addition of the proposed MVP portfolio to the transmission system
Transmission loss reductions	Capacity losses savings, where capacity losses represent the amount of capacity required to serve transmission losses during the system peak hour
Wind generation capital investment	Quantification of the incremental wind generator capital cost savings enabled by the wind siting methodology supported by the proposed MVP portfolio
Transmission capital investment	Document the future baseline transmission investment that may be avoided due to the installation of the proposed MVP portfolio

After intensive analysis, the candidate portfolio was refined into a final proposed Multi Value Project portfolio



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MVP Portfolio Reliability and Public Policy Benefits

The proposed MVP portfolio reliably enables the delivery of energy in support of policy mandates

- A series of steady state analyses were conducted to determine the transmission line overloads and system voltage constraints mitigated by the proposed MVP portfolio
  - This analysis also ensured that the system reliability was maintained with the inclusion of the MVP portfolio into the transmission system
  - Any new violations with the MVP portfolio were identified, and transmission upgrades were included in the MVP portfolio to resolve these issues
- The proposed MVP portfolio maintains system reliability by resolving
  - Approximately 500 thermal overloads for approximately 6,400 system conditions
  - 150 voltage violations for approximately 300 system conditions

The proposed MVP portfolio reliably enables the delivery of energy in support of policy mandates

- Additional analyses were performed to analyze the benefits of the MVP portfolio on transient stability
  - Transient stability is the ability of existing and proposed generation to remain synchronous with other system generation under severe fault conditions
  - Instability can cause the system to experience undamped oscillations, causing generators to trip offline or incur damage due to high speed rotation, creating safety risks for plant personnel and potentially cause a large scale loss of load
- The proposed MVP portfolio mitigates 31 fault conditions that could cause system instability

The proposed MVP portfolio reliably enables the delivery of energy in support of policy mandates

- Voltage stability analyses were performed to voltage collapse conditions under high energy transfer conditions from major generation resources to major load sinks.
  - Such transfers may occur during critical dispatch scenarios, such as when local area generation near large load centers are offline and remote generation resources are supplying energy to the load centers.
  - Additional transfer capacity will increase system reliability and robustness, allowing additional energy sources to be dispatched to serve load centers as needed.
- The proposed MVP portfolio causes an increase in transfer capability from wind rich regions of 960 to 1,841 MW

The proposed MVP portfolio reliably enables the delivery of energy in support of policy mandates

- Through resolving reliability constraints that would otherwise result in the curtailment of wind generation, the proposed MVP portfolio will reliably enable the states in the MISO footprint to meet their renewable energy mandates and laws
- The proposed MVP portfolio enables the delivery of 41 million MWh of renewable energy annually
  - This energy will support the renewable energy mandates of the MISO states through at least 2026.

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Economic Variables and Assumptions

Business Case Variables
Future Policy Scenarios

- To ensure that the proposed MVP portfolio delivers benefits under a variety of future assumptions, several different future scenarios were analyzed
  - **Business As Usual with Continued Low Demand and Energy Growth** assumes that current energy policies will be continued, with continuing, recession-level low demand and energy growth projections.
  - **Business As Usual with Historic Demand and Energy Growth** assumes that current energy policies will be continued, with demand and energy returning to pre-recession growth rates
  - **Carbon Constrained** 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.
- The majority of the analysis focused on the 'Business as Usual' scenarios, although sensitivities were completed to determine the benefits of the proposed MVP portfolio under scenarios with new energy policies

Business Case Variables
Discount Rate and Timeframe

- **Time horizon:** 20 – 40 years from portfolio in-service date
  - Overhead transmission lines are projected to have a total lifespan of 70 – 80 years
  - The tariff typically refers to a 20 year time horizon for B/C calculations
  - A 40 year time span allows additional benefits to be captured for each transmission facility, without requiring extremely long range projections
    - It also matches the assumed book life of the facilities
- **Discount rate:** 3.00 - 8.2%
  - The social discount rate of 3.00% is roughly equal to the value a typical rate payer would be able to receive on their risk-adjusted investment
  - The Weighted Average Cost of Capital (WACC) of 8.2% was calculated by a Gross Transmission Plant-weighted Transmission owner cost of capital
    - This reflects the minimum return the Transmission Owners must receive to satisfy their creditors, owners, and other providers of capital
- These variables were adjusted in the base business case calculations

Additional Business Case Variables

- **Wind Turbine Capital Cost:** $2.0 – $2.9 Million / MW
  - Based upon the US Energy Information Administration's capital cost estimates for onshore wind (updated November 2010)
  - This variable was adjusted in the base business case analysis
- **Operating Reserve Optimization Benefit:** $5 - $7 / MWh
  - Based upon changes in Day Ahead Market Clearing Prices for June 1, 2010 through May 31, 2011
  - This variable was adjusted in the base business case analysis
- **Natural Gas Prices:**
  - Business as Usual Scenarios: $5 - $8 / MMBtu
  - Carbon and Combined Policy Scenarios: $8 - $10 / MMBtu
  - A natural gas price of $5 was used for the base business case analysis. Higher natural gas prices were used as sensitivities.

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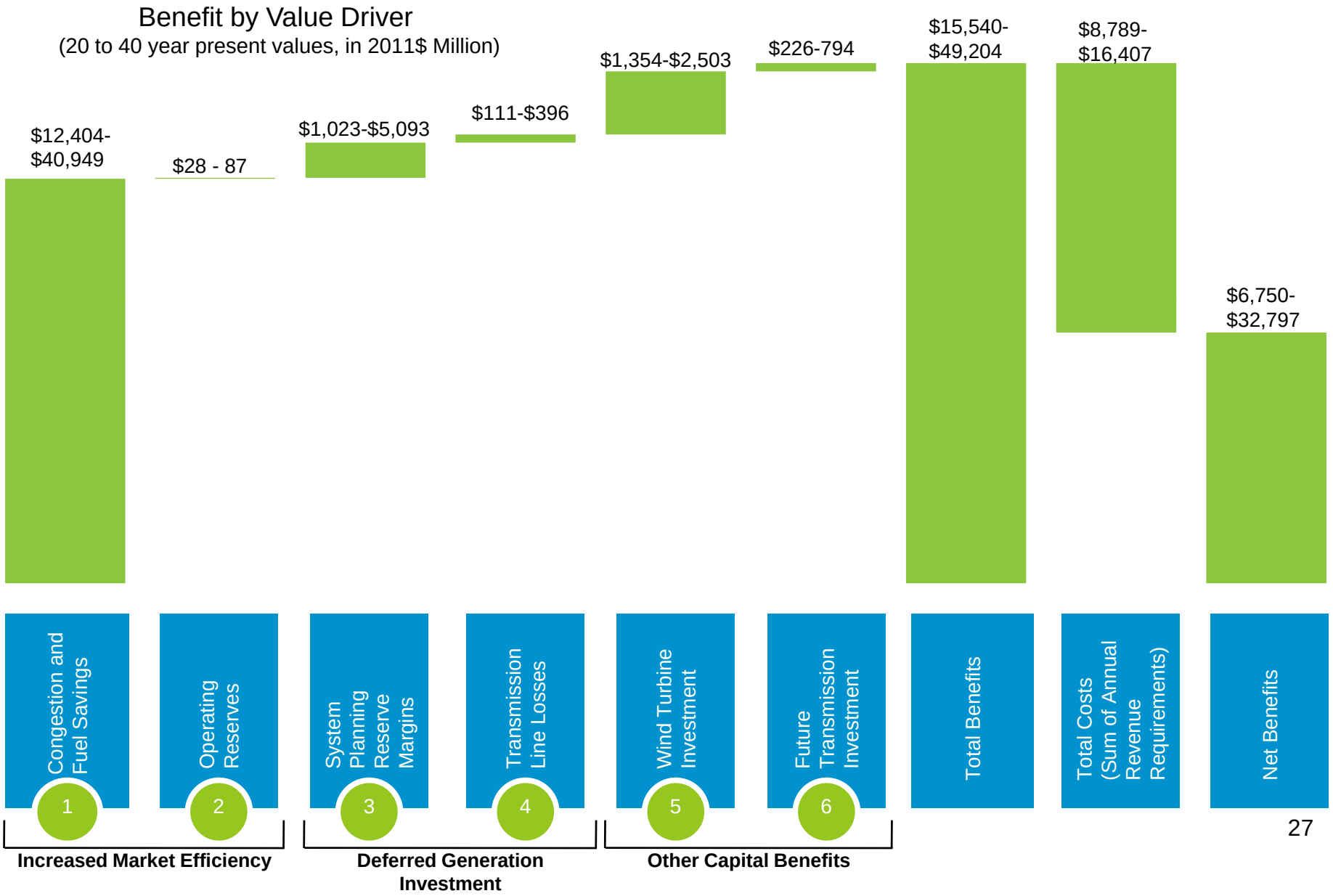
MVP Portfolio Economic Benefits*

*All values included in the portfolio Benefit/Cost ratio are 20 - 40 year present values, based on an 3% - 8.2% discount rate. Also, only existing energy policies were considered in calculating these benefits. As such, they represent conservative estimates of the value provided by the MVPs.

MVPs create a variety of economic benefits



MVPs enhance market efficiency and provide access to low cost generation

1 Congestion and Fuel Savings

- Production cost models were used to simulate how the market would function, both with and without the MVP Portfolio and its associated wind generation
  - Simulations were conducted for all hours of a year, under various policy scenarios, to capture the robustness of the MVP Portfolio
- The difference in the production costs, or the costs of operating the fleet of generators that comprise the MISO footprint, is a direct benefit of the MVP Portfolio.
  - This difference is driven by the reduction of congestion, which increases market efficiency
  - It also is driven by the increased ability of low cost generation to serve load, displacing higher cost resources

MVPs enhance market efficiency and provide low cost generation

1 Congestion and Fuel Savings

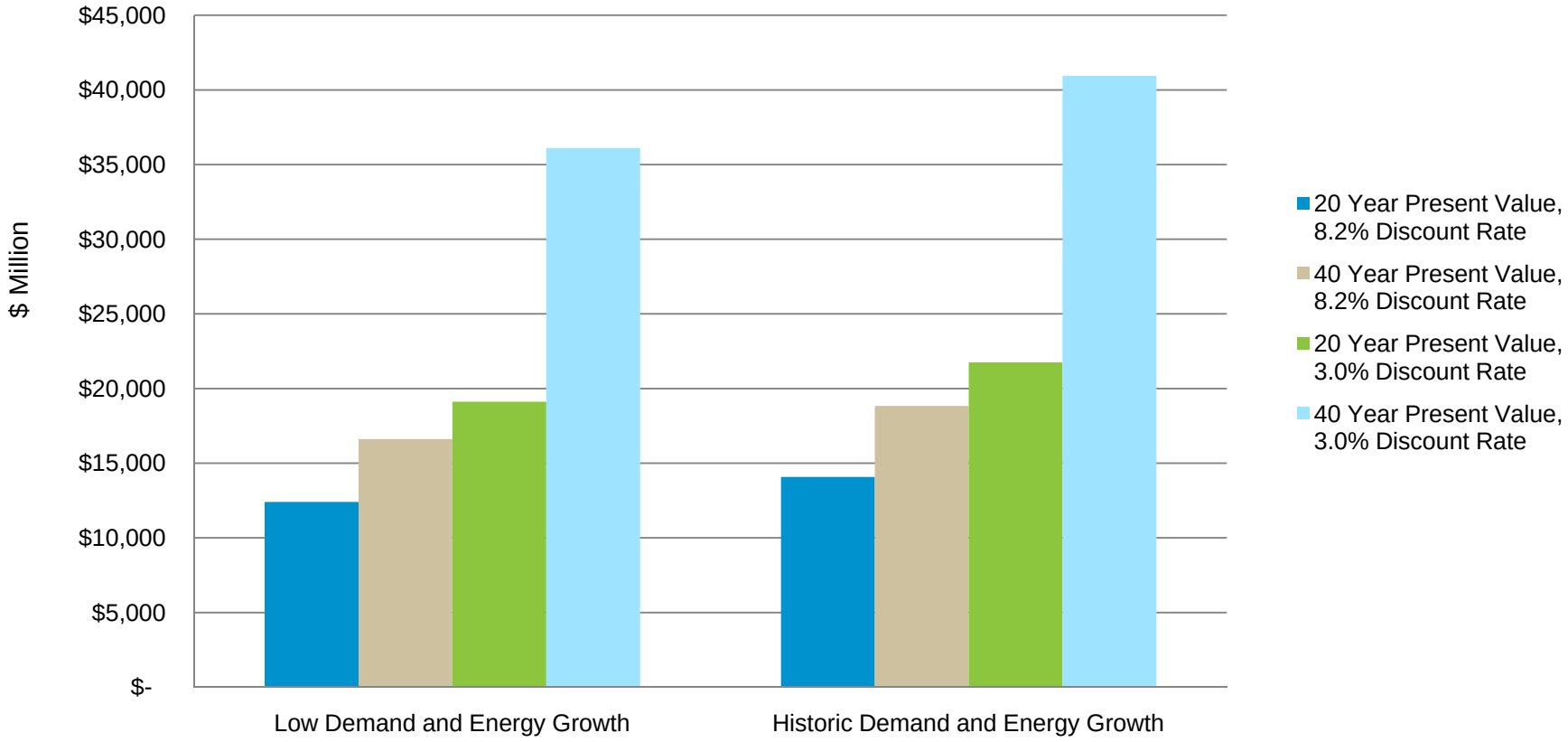
- Three years of production cost benefits were calculated
  - 2021 RPS mandates and load levels
  - 2026 RPS mandates and load levels
  - 2026 load levels + all generation enabled by the proposed MVP portfolio
    - This value was used to simulate benefits in 2031
- Values for years 2022-2025 and 2027-2030 were interpolated between the actual results shown above
- Values beyond 2031 were extrapolated based on the trend created by the 2026 and 2026 + all generation results
- All values were then discounted back to 2021 dollar figures, using the assumed discount rate

	Nominal Benefit Savings ($)	
Year	Example Output	Formulas
2021	**138,649,492**	**From analysis**
2022	146,824,424	= (2026 value - 2021 value)/5 + 2021 value
2023	154,999,356	= (2026 value - 2021 value)/5 + 2022 value
2024	163,174,288	= (2026 value - 2021 value)/5 + 2023 value
2025	171,349,220	= (2026 value - 2021 value)/5 + 2024 value
2026	**179,524,153**	**From analysis**
2027	185,661,983	= (2031 value - 2026 value)/5 + 2026 value
2028	191,799,814	= (2031 value - 2026 value)/5 + 2027 value
2029	197,937,645	= (2031 value - 2026 value)/5 + 2028 value
2030	204,075,476	= (2031 value - 2026 value)/5 + 2029 value
2031	**210,213,306**	**From analysis**
2032	216,351,137	= (2031 value - 2026 value)/5 + 2031 value
…	….	…

MVPs enhance market efficiency and provide access to low cost generation

1 Congestion and Fuel Savings

Through relieving areas of congestion in the system and enabling transfer capacity from low-cost generation, the MVPs create $12.4 to $40.9 billion in present value benefits.*



* 2011$ benefits shown. All 2021$ benefits were discounted back to 2011$ terms using the appropriate inflation rate.

MVPs enhance the benefits inherent in the MISO Operating Reserve Market.

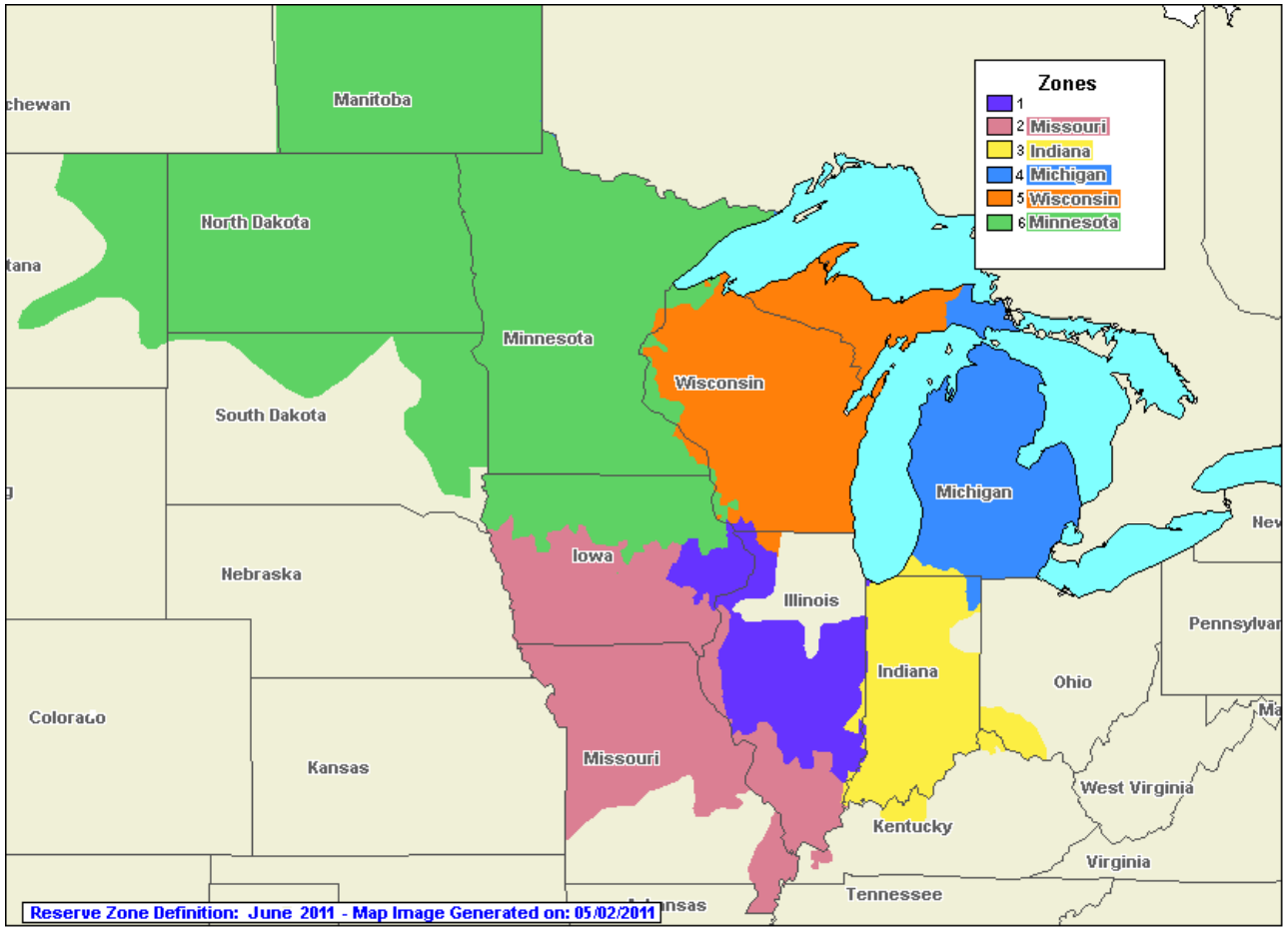
2 Operating Reserves

- **These benefits include**
  - Increased market efficiency
  - Reduced congestion
  - Enhanced reliability and system robustness
- **More specifically, the MVPs provide**
  - More economical dispatch of units
  - Improved unit commitments
  - Reduced instances of binding constraints
  - Reduction in stranded generation reserves
  - Enhanced access to generation with high ramp capabilities
  - Access to a wider variety and number of generators under emergency conditions

MVPs enhance the benefits inherent in the MISO Operating Reserve Market.

2 Operating Reserves

Operating reserve zones are established to ensure that reserves are properly distributed throughout the system, in response to transfer limitations. This results in the inefficient commitment of reserves and higher associated reserve costs



MVPs enhance the benefits inherent in the MISO Operating Reserve Market.

2 Operating Reserves

- Operating reserve requirements are determined, on an ongoing basis, by monitoring the energy flowing through certain areas of the footprint, under specific transmission outage conditions
  - These monitored areas are commonly referred to as flowgates
- Transfer analyses were performed to determine the change in energy flow on these flowgates caused by the proposed portfolio
  - The proposed MVP portfolio caused a significant reduction in flows, as shown below:

Zone	Limiter	Contingency	Change in Flows (Pre MVP – Post MVP)
Missouri	Coffeen - Roxford 345	Newton-Xenia 345	-0.8%
Indiana	Bunsonville-Eugene 345	Casey-Breed 345	-17.5%
Indiana	Crete-St. Johns Tap 345	Dumont-Wilton Center 765	-4.5%
Michigan	Benton Harbor - Palidsades 345	Cook - Palisades 345	-10.8%
Wisconsin	MWEX	N/A	-20.2%
Minnesota	Arnold-Hazelton 345	N/A	-60.9%

MVPs enhance the benefits inherent in the MISO Operating Reserve Market.

2 Operating Reserves

- As a result of these analyses it was determined that the need for an Indiana operating reserve zone would be eliminated by the proposed MVP portfolio
- Also, the need for operating reserve requirements in other zones throughout the MISO footprint would be reduced by half
- It was determined that the ability to locate reserves at the least-cost location, rather than in a specific zone, will drive a benefit equal to between $5/MWh and $7/MWh
  - This benefit is calculated based on the changes in Day-Ahead Market Clearing Prices for reserves, from June 2010 through May 2011

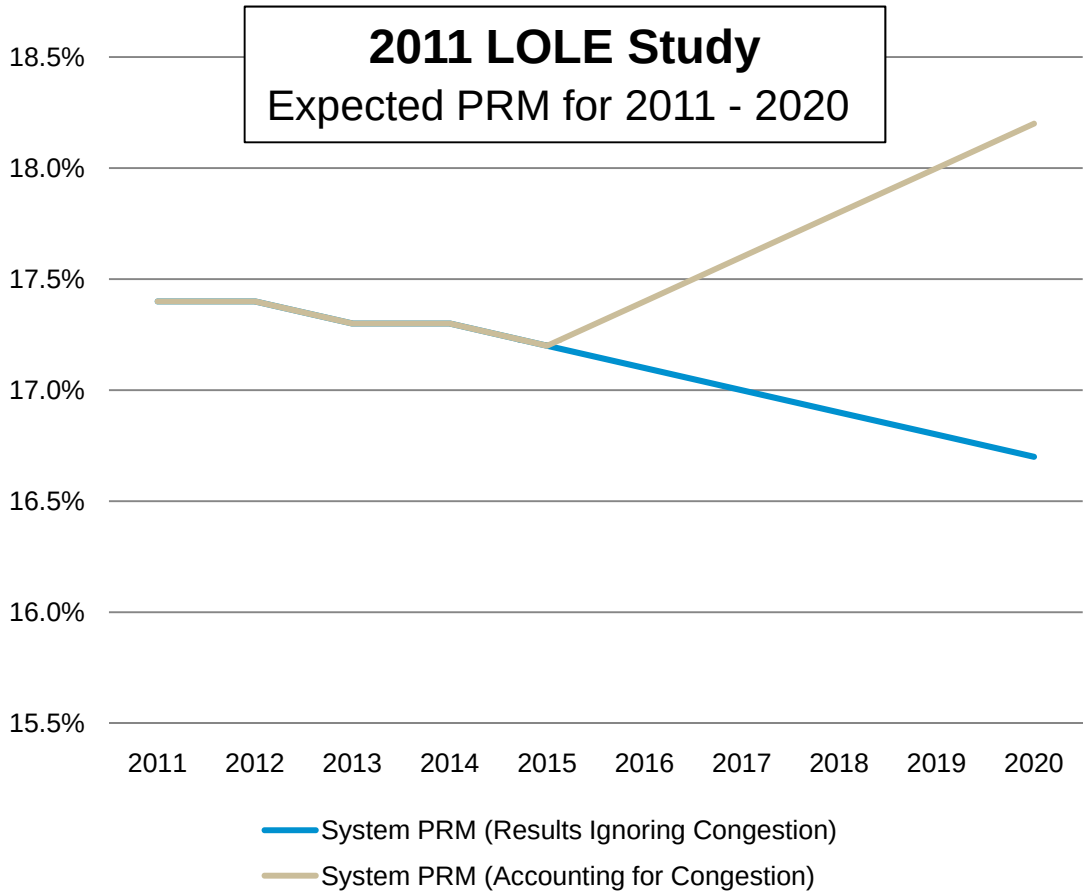
MVPs enhance the benefits inherent in the MISO Operating Reserve Market.

2 Operating Reserves

- Based on an analysis of historical conditions, the Indiana operating reserve zone would be required to hold an average of 282 MW of reserves 53 days in a given year
  - The proposed MVP portfolio would eliminate the need for this zone entirely, allowing for about 360 GWh of reserves annually to be sourced from the most economic locations
  - These reserve requirements would be expected to increase as the system load increases, so they were indexed to rise by 1% annually
- Additionally, an average of 410 MW of reserves would be required in other zones for a combined total of 36 days annually
  - The MVPs would eliminate about half of these zonal requirements, allowing for the annual optimization of 180 GWh of reserves initially, with a 1% annual growth rate
- The total economic benefit of this optimization is equal to a present value of $28 to $87 million.

MVPS reduce the need for future generation buildout to meet reserve requirements

3 System Planning Reserve Margin



- The system Planning Reserve Margin (PRM) is a number which tracks how much generation in excess of load must be available so that the risk of losing firm load is one day in ten years
- Based on the 2011 Loss of Load Expectation study results, the system PRM is projected to increase due to congestion beginning in 2016
  - This congestion component is projected grow at 0.3% annually, adding 1.5% to the PRM by 2020

MVPS reduce the need for future generation buildout to meet reserve requirements

3 System Planning Reserve Margin

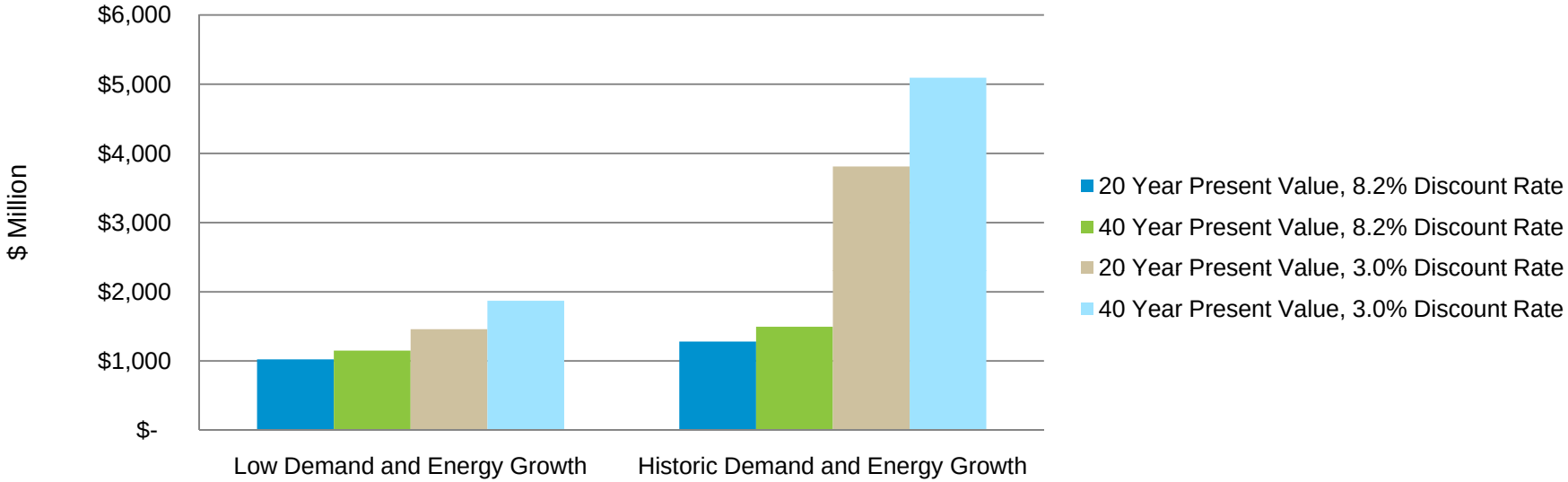
Year	PRM Congestion Component	MVP Impact	PRM Without MVPs	PRM With MVPs
2020	1.5%	0.26%	18.90%	18.64%
2021	1.8%	0.38%	19.20%	18.82%
2022	2.1%	0.44%	19.50%	19.06%
2023	2.4%	0.50%	19.80%	19.30%
2024	2.7%	0.57%	20.10%	19.53%
2025	3.0%	0.63%	20.40%	19.77%
2026	3.3%	0.69%	20.70%	20.01%
2027	3.6%	0.76%	21.00%	20.24%
2028	3.9%	0.82%	21.30%	20.48%
2029	4.2%	0.88%	21.60%	20.72%
2030	4.5%	0.95%	21.90%	20.96%

Through production cost simulations, it was estimated that the MVPs will reduce the system wide congestion which drives the PRM increase by about 20%

- This congestion reduction was applied to the congestion component of the system Planning Reserve Margin (PRM), reducing it by 20% annually

MVPS reduce the need for future generation buildout to meet reserve requirements

3 System Planning Reserve Margin



- The reduced reserve margin was inserted into the MISO generation capacity expansion model (EGEAS), and a set of simulations were run to estimate the future generation buildout required
  - The benefit of the MVPs is equal to the difference in generation capital investment for the full (without MVP) and reduced (with MVP) reserve margin scenarios
- Through reducing the Planning Reserve Margin and, with it, future generation investment, the MVPs create $1.0 to $5.1 billion in present value benefits.

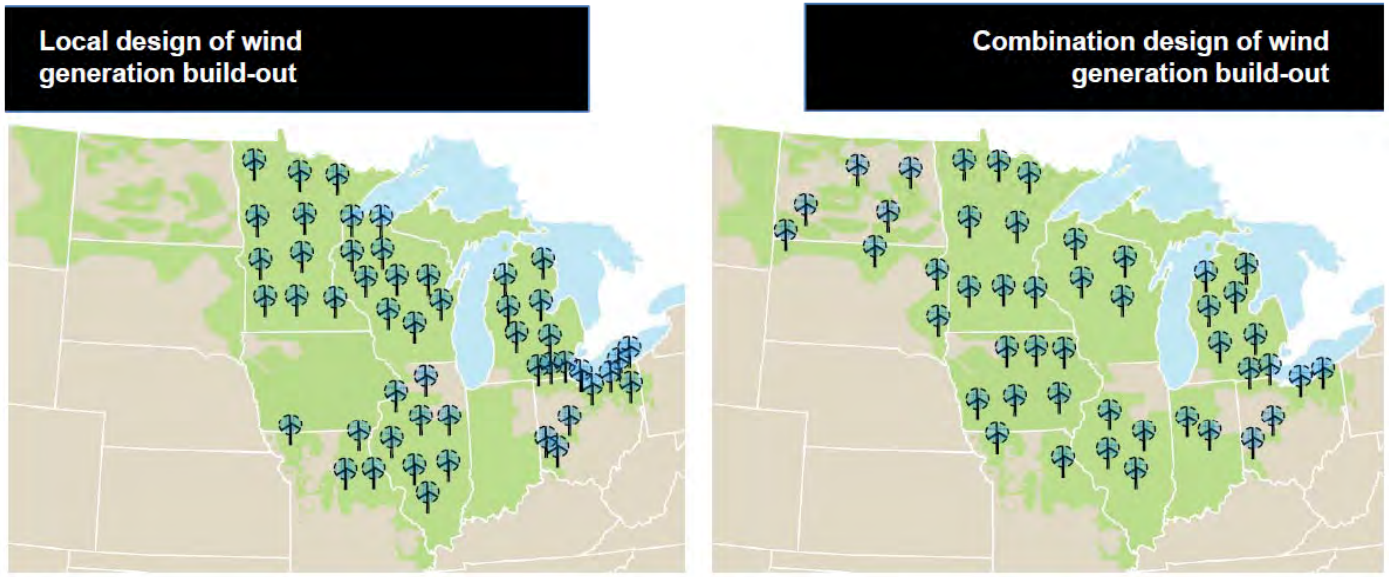
MVPs reduce the energy wasted in transmission line losses throughout the system.

4 Transmission Line Losses

- The addition of the MVPs to the transmission system reduces the total system energy spent on transmission line losses under peak conditions.
  - The change in the transmission losses was calculated from the peak system losses, both with and without the MVP portfolio
  - The system losses decreased by approximately 150 MW with the inclusion of the proposed MVP portfolio
- This decrease in system losses under peak conditions reduces the total generation needed to serve load, lessening the need for future generation buildout.
  - The benefit of the MVPs is equal to the difference in generation capital investment for the full and reduced transmission loss scenarios
- Through reducing the peak system losses and, with it, future generation investment, the MVPs create $111 to $396 million in present value benefits.

MVPs allow for the optimization of wind generation locations.

5 Wind Turbine Investment



- Without regional transmission, wind generation would have to be sited close to load centers
  - This would require the construction of many more wind turbines than optimal due to low wind in these areas
  - The low cost wind siting methodology, when both transmission and generation costs are included, is a combination of local and regional transmission generation
- In the RGOS analyses, it was determined that the capital investment in wind turbines required to meet the renewable energy mandates may be reduced by approximately 11% through this combination siting methodology

MVPs allow for the optimization of wind generation locations.

5 Wind Turbine Investment

Year	RPS Mandated and Proposed MVP Portfolio Enabled Wind (MW)	Equivalent Local Wind Generation (MW)	Incremental Wind Benefit (MW)
Pre-2016	12,408	13,802	1,394
2016	17,276	19,217	547
2021	21,173	23,552	438
2026	23,445	26,079	255
Total	25,675	28,559	251

- To determine the wind turbine capital savings enabled by the MVPs, the amount of regional generation enabled by the MVPs was calculated.
- The difference between this generation investment, and the amount of local generation required to produce the same output, is a benefit of the proposed MVP portfolio

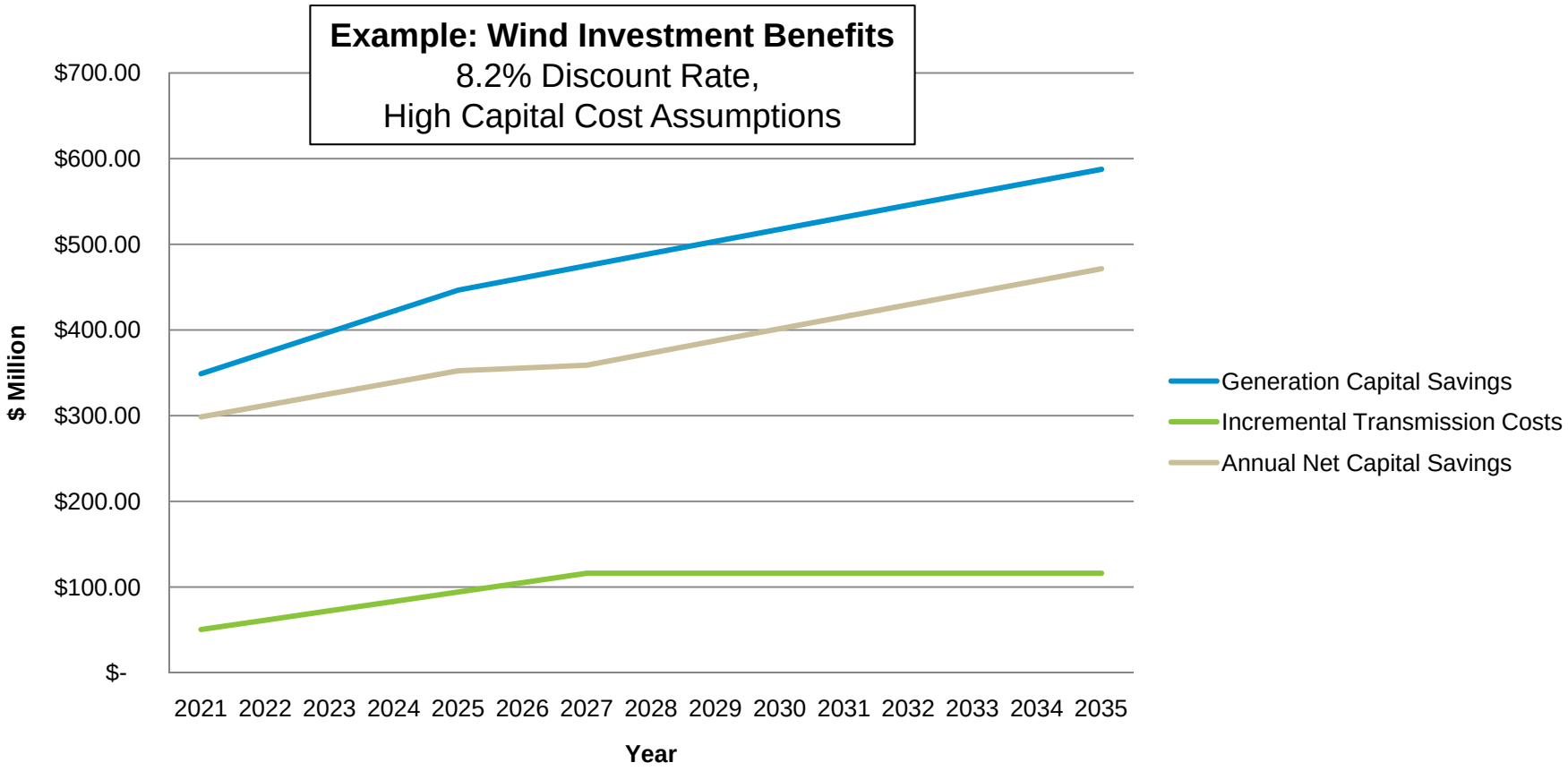
MVPs allow for the optimization of wind generation locations.

5 Wind Turbine Investment

- A value of between $2.0 and $2.9 million / MW was used to quantify the benefits of reduced wind turbine investment
  - This value is based upon the US Energy Information Administration's estimates of the capital costs to build onshore wind, as updated in November 2010
- The wind capital investment reduction is slightly offset by a higher expected transmission cost for the combination wind siting scenario.
  - To account for this factor, a transmission cost differential of approximately $1.5 billion was subtracted from the overall wind turbine capital savings
- The wind turbine investment benefit was spread from 2015 through 2030, to follow the distribution required by renewable energy mandates
  - To calculate the benefit created by the proposed MVP portfolio, approximately half of the pre-2020 benefits and incremental transmission costs were lumped into the 2021 value
  - Wind energy enabled by the proposed MVP portfolio in excess of the 2026 renewable energy mandates was assumed to be installed from 2027 through 2030

MVPs allow for the optimization of wind generation locations.

5 Wind Turbine Investment



The low cost wind siting methodology enabled by the proposed MVP portfolio creates benefits ranging from a present value of $1.4 to $2.5 billion.

MVPs eliminate the need for baseline transmission investment

6 Future Transmission Investment

- The implementation of a regional transmission portfolio will increase the system's overall reliability, decreasing the need for future baseline reliability upgrades
- To determine the value of this deferred and avoided investment, the load in the pre-MVP and post-MVP summer peak steady state reliability models was grown by about 8 GW to simulate a 2031 model
- Through these analyses, the following transmission investment was found to be eliminated by the addition of the proposed MVP portfolio to the system
  - One Bus tie
  - Two transformers
  - 131 miles of transmission operating at less than 345 kV
  - 29 miles of 345 kV transmission

MVPs eliminate the need for baseline transmission investment

6 Future Transmission Investment

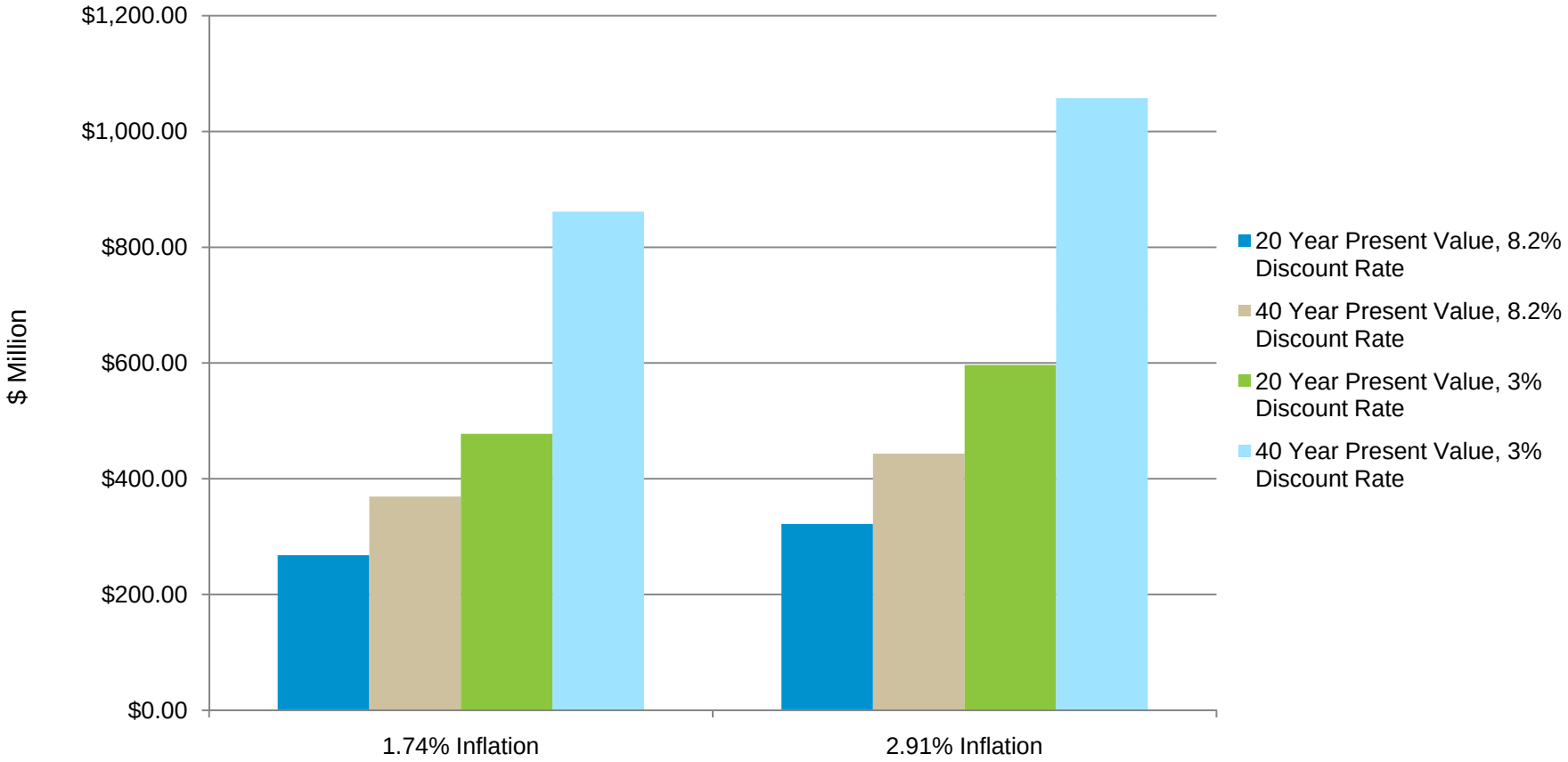
- The following estimates were used to calculate the capital benefits associated with the avoided transmission investment.

Avoided Transmission Investment	Estimated Upgrade Cost
Bus Tie	$1,000,000
Transformer	$5,000,000
Transmission lines (per mile, for voltages under 345 kV)	$1,500,000
Transmission lines (per mile, for 345 kV)	$2,500,000

- This total capital benefit was assumed to be spread between 2027 and 2031.
  - To create an annualized value, the Annual Revenue Requirement of this transmission was calculated, and this annualized figure was discounted back to a 2011 present value
  - The benefit of the 345 kV upgrades were reduced by 50% to incorporate the potential production cost benefits of the avoided transmission

MVPs eliminate the need for baseline transmission investment

6 Future Transmission Investment



Through avoiding the need to upgrade this transmission, the proposed MVP portfolio creates $268 to $1,058 million in present value benefits.

Proposed MVP Portfolio Business Case

Sensitivities

MVPs provide benefits under a number of different assumptions and policy situations

- The proposed MVP portfolio provides significant benefits under every scenario studied
  - Our base business case was built upon a fixed set of energy policies, with variances in discount rates and time horizons driving the range of benefits
- Additional variables also have the potential to impact the benefits provided by the proposed MVP portfolio
  - These variables cause the portfolio benefit/cost ratio to range from between 1.8 to 5.8 times its cost
- The variables include
  - Future policies enacted
  - Time horizon studied (20 or 40 years from in-service date)
  - Discount rate
  - Wind turbine capital cost
  - Natural gas prices

MVPs provide benefits under a number of different assumptions and policy situations

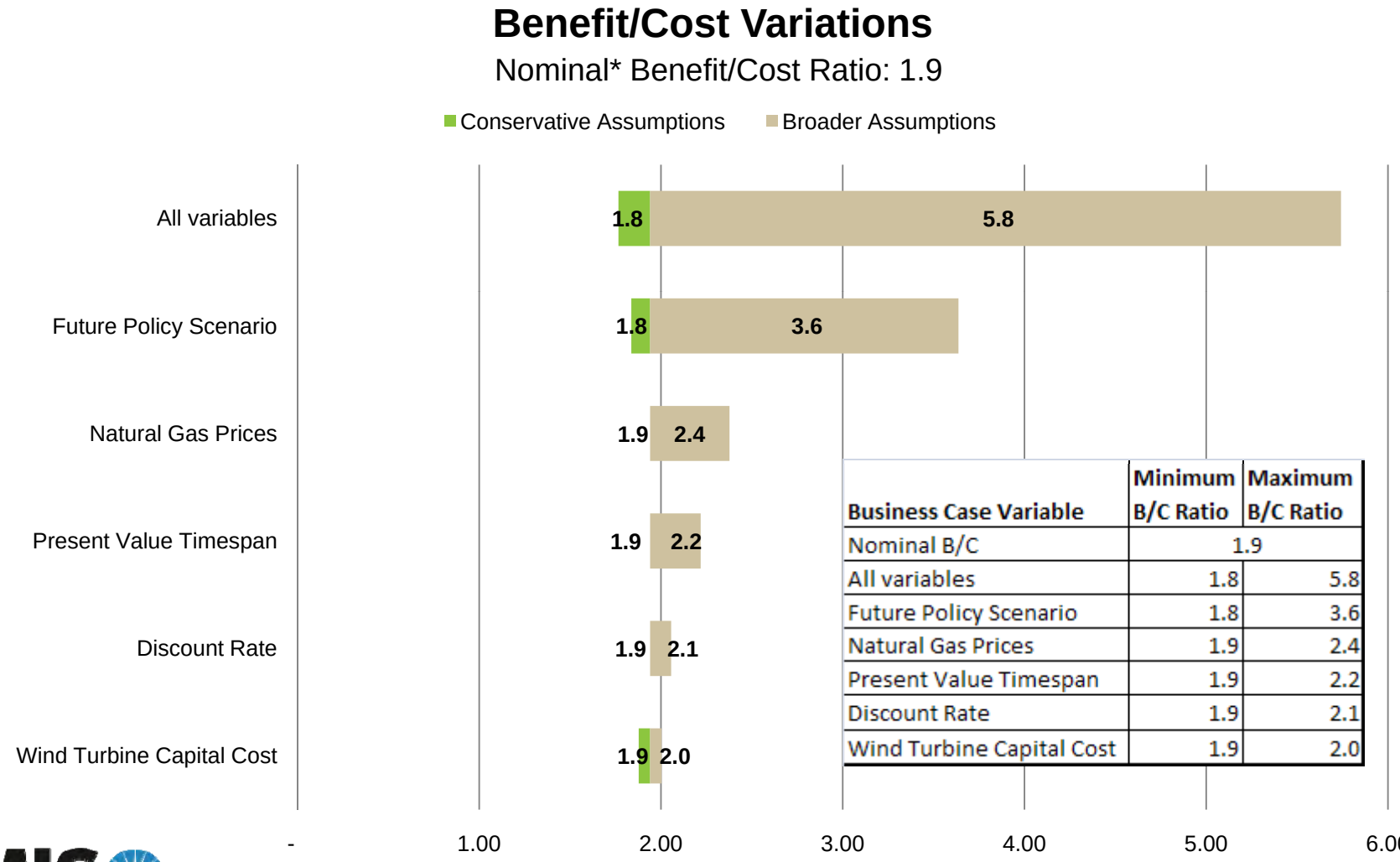
Sensitivity Results ($M)										
	Nominal Benefits*	Low Wind Turbine Capital	High Wind Turbine Capital	3% Discount Rate	40 Year Present Values	Future Policy Scenario (Low Demand and Energy Growth)	Future Policy Scenario (Combination Policy)	Natural Gas Price (High)	Maximum Benefit / Cost	Minimum Benefit / Cost
Congestion and Fuel Savings	$16,747	$16,747	$16,747	$25,846	$22,421	$14,740	$37,710	$21,534	$118,011	$14,740
Operating Reserves	$40	$40	$40	$59	$50	$40	$40	$40	$116	$33
Transmission Line Losses	$1,461	$1,461	$1,461	$3,406	$1,680	$272	$699	$1,461	$1,111	$272
System Planning Reserve Margin	$340	$340	$340	$262	$388	$1,216	$1,293	$340	$2,961	$1,216
Wind Turbine Investment	$2,635	$1,936	$3,334	$2,194	$2,635	$2,635	$2,635	$2,635	$2,778	$1,936
Future Transmission Investment	$295	$ 295	$295	$537	$406	$295	$ 295	$ 295	$ 1,058	$268
Total Benefits	$21,518	$ 20,819	$22,217	$32,304	$27,581	$19,198	$42,672	$26,305	$126,035	$8,465
Total Costs	$11,076	$ 11,076	$11,076	$15,699	$12,419	$10,444	$11,709	$11,076	$21,858	$10,444
B/C	1.9	1.9	2.0	2.1	2.2	1.8	3.6	2.4	5.8	1.8

* Nominal case for comparison used a 20 Year PV, 8.2% discount rate, and average values. Only the BAU future scenarios were considered for this nominal value, and the average of the BAULDE and BAUHDE values were used to create an average.

** Maximum value set to 40 year PV, 3% discount rate, high natural gas prices, high wind turbine capital, high operating reserves, combination policy future

*** Minimum value set to 20 year PV, 8.2% discount rate, low wind turbine capital, low demand and energy growth rates, business as usual policy scenario

MVPs provide benefits under a number of different assumptions and policy situations



Business Case Variable	Minimum B/C Ratio	Maximum B/C Ratio
Nominal B/C	1.9	
All variables	1.8	5.8
Future Policy Scenario	1.8	3.6
Natural Gas Prices	1.9	2.4
Present Value Timespan	1.9	2.2
Discount Rate	1.9	2.1
Wind Turbine Capital Cost	1.9	2.0

*Nominal B/C was calculated using 20 year Net Present Values, using an 8.2% discount rate and an average of the Business as Usual future scenarios output.

Proposed MVP Portfolio Business Case

Qualitative and Social Benefits

MVPs provide additional qualitative and social benefits

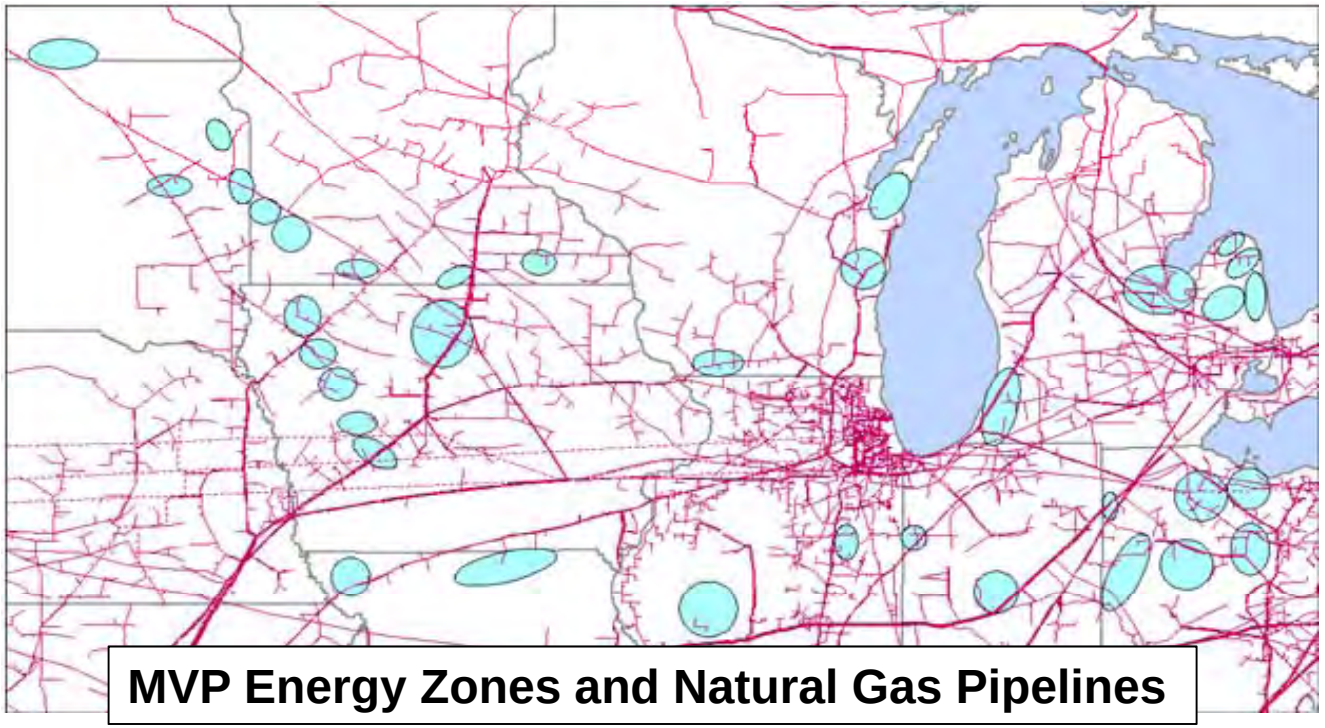
- **In addition to the value drivers included in the Benefit-to-Cost ratio, MVPs provide a number of difficult to quantify benefits.**
- **These values include**
  - Enhanced generation policy flexibility
  - Increased system robustness
  - Decreased natural gas price risk
  - Decreased carbon output
  - Decreased wind generation volatility
  - Increased local investment and job creation

MVPs provide additional qualitative and social benefits

1. Enhanced Generation Policy Flexibility
2. Increased System Robustness
3. Decreased Natural Gas Risk
4. Decreased Carbon Output
5. Decreased Wind Generation Volatility
6. Local Investment and Job Creation

MVPs support multiple types of fuel resources

1 Enhanced Generation Policy Flexibility



MVP Energy Zones and Natural Gas Pipelines

- The proposed MVP portfolio was designed using a set of energy zones as sites for the incremental generation required
- These energy zones were created considering relative wind capacities along with distances from existing natural gas pipelines and transmission infrastructure
- As a result, the energy zones selected have an ability to support multiple types of generation resources and policies, increasing the flexibility of the proposed MVP portfolio

MVPs increase the ability of the system to respond to and recover from real time events

2 Increased System Robustness

- A transmission system blackout, or similar event, can have wide-spread repercussions, resulting in billions of dollars in damages
  - For example, the blackout of the Eastern and Midwestern US during August 2003 impacted more than 50 million people and had an estimated economic impact between $4 and $10 billion*.
- MVPs create a more robust, regional transmission system which will decrease the likelihood of future event through
  - Strengthening the overall transmission system reliability by decreasing the impacts of transmission outages
  - Increasing access to additional generation under contingent events
  - Enabling additional transfers of energy to portions of the system under severe conditions

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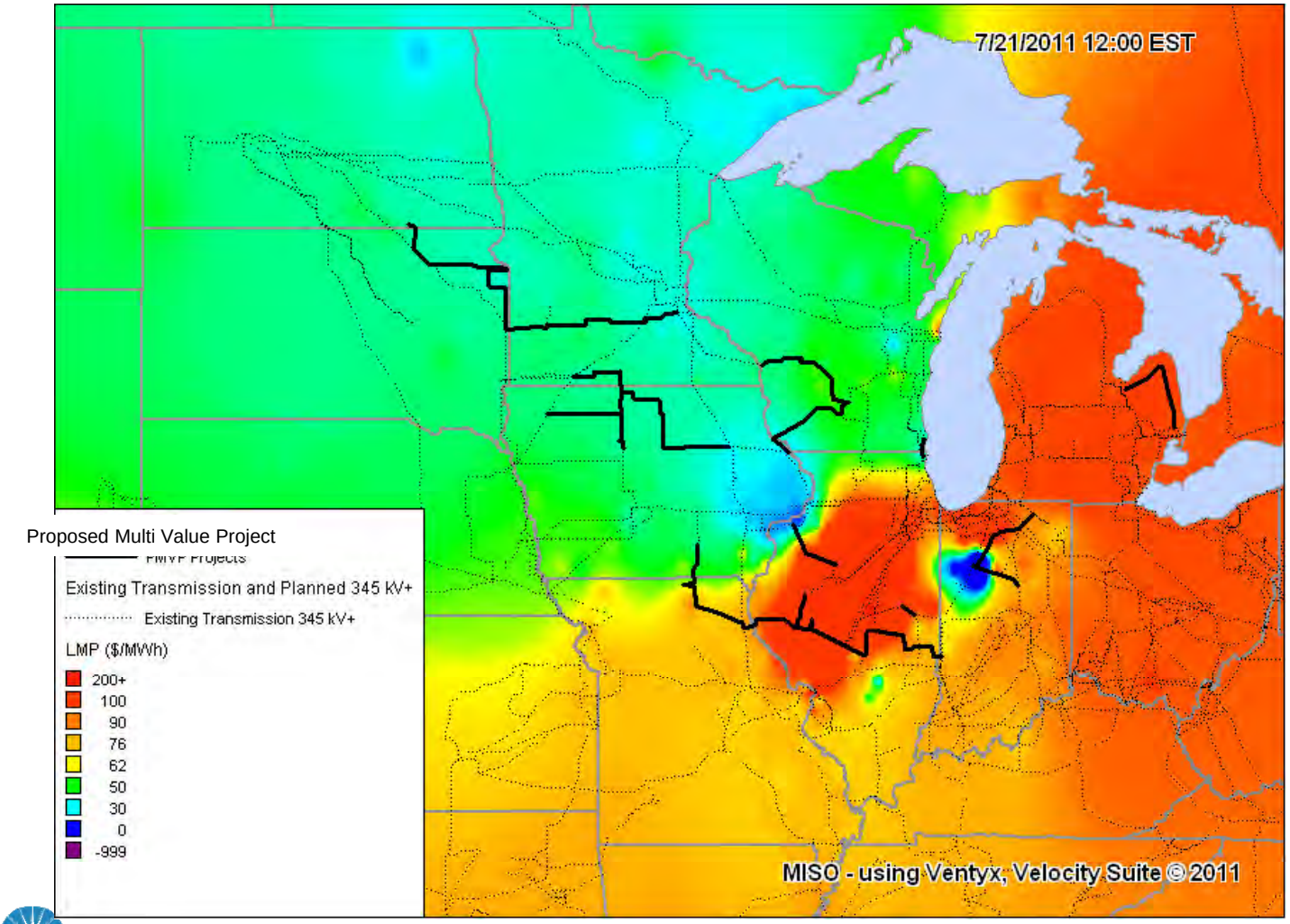
*Source: *The Economic Impacts of the August 2003 Blackout*, The Electricity Consumers Resource Council (ELCON)

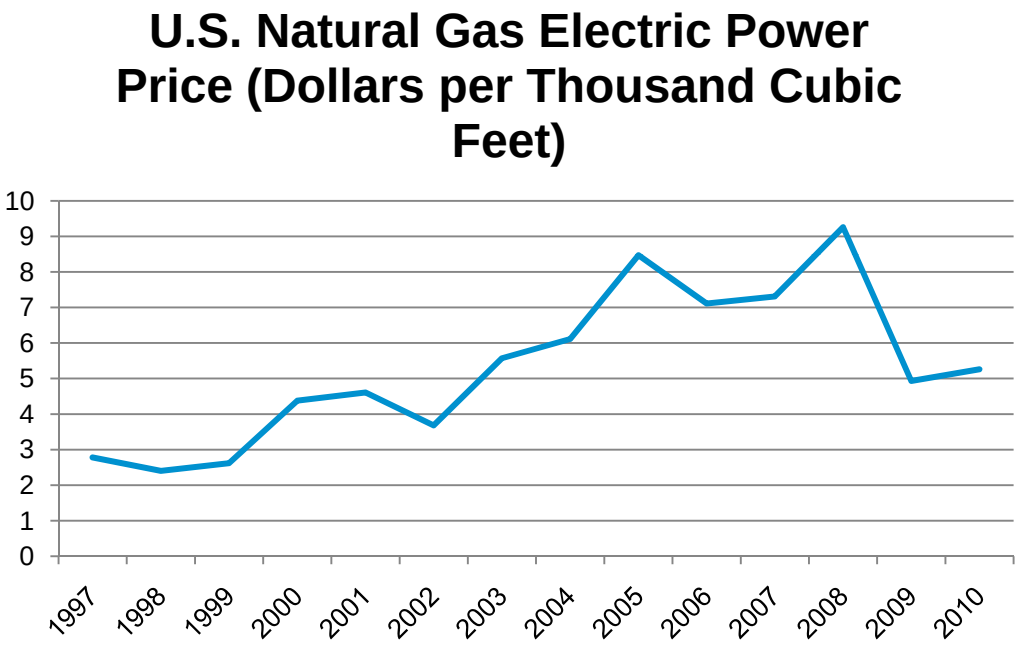
MVPs increase the ability of the system to respond to and recover from real time events

2 Increased System Robustness



MVPs decrease the system-wide impacts of natural gas volatility

3 Decreased Natural Gas Risk



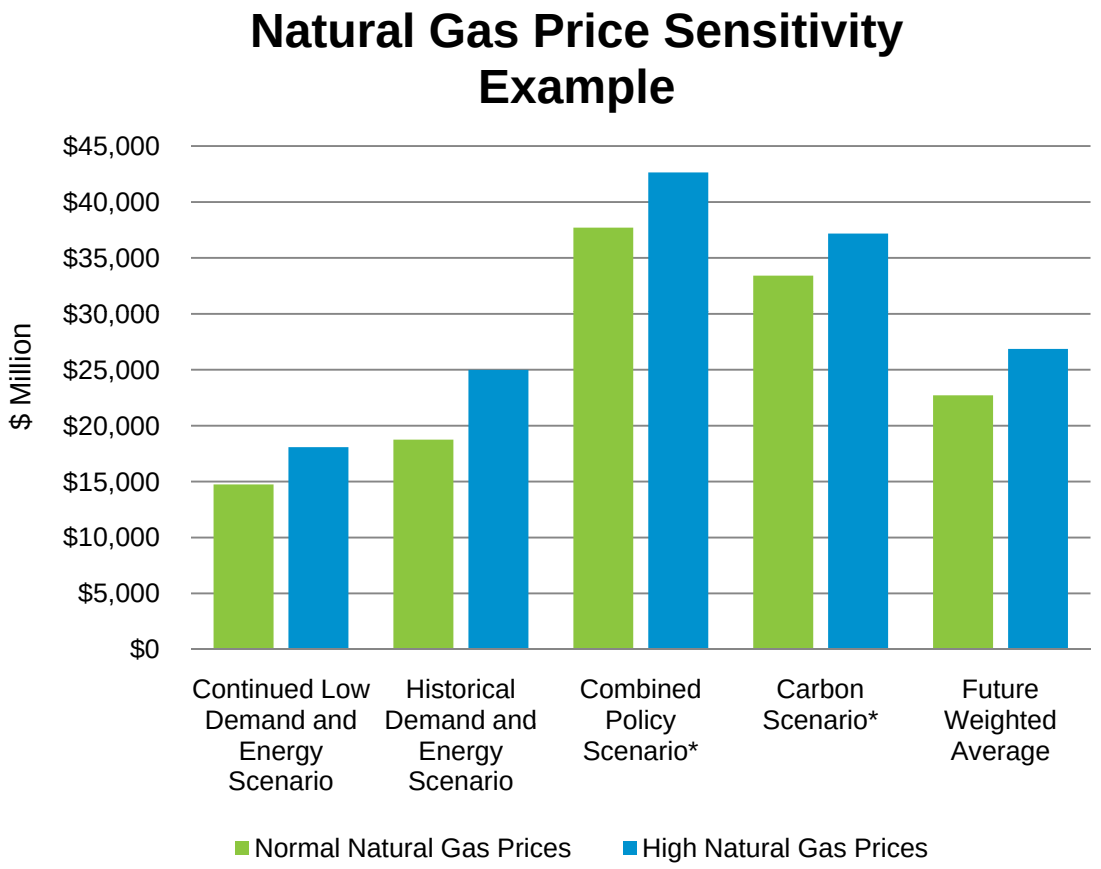
Source: US Energy Information Administration

- Transmission investment cannot completely insulate electric consumers from the risks associated with fuel price volatility.
- However, MVPs offset this risk by providing additional benefits under high natural gas prices.
- These benefits were analyzed through a series of production cost analyses, with higher natural gas cost assumptions.

MVPs decrease the system-wide impacts of natural gas volatility

3 Decreased Natural Gas Risk

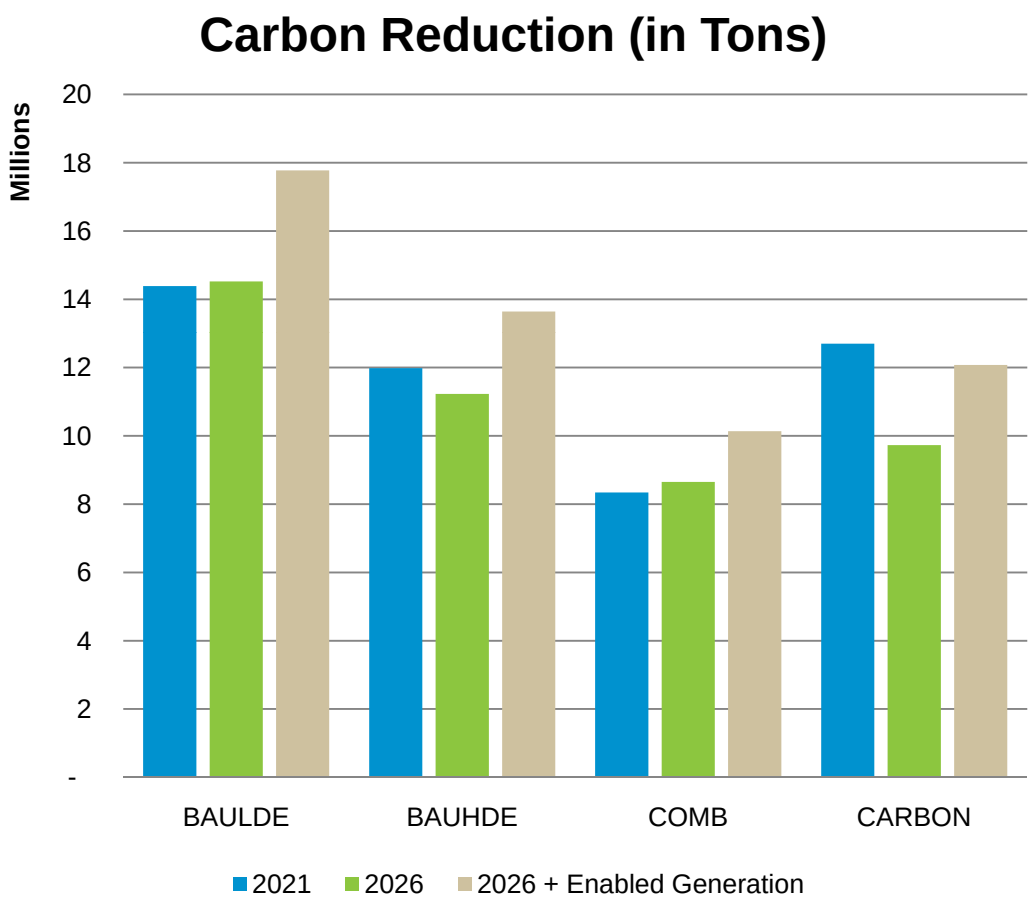
- Natural gas prices were increased from $5 to $8 /MMBtu under the Business as Usual policy scenarios
- Prices were increased from $8 to $10/MMBtu under the Carbon and Combined policy scenarios
- Under the business as usual scenario, with a natural gas price increase of 60%, the proposed MVP portfolio produced an average of 25% higher production cost benefits.
- Under the carbon and combined policy futures, with a natural gas increase of 25%, the proposed MVP portfolio produced an average of 12% higher production cost benefits



MVPs reduce carbon emissions

4 Carbon Emissions

- MVPs enable the more economical dispatch of resources, as low cost wind resources dispatch higher cost generation
  - This creates a reduction in the total carbon output produced by MISO generation
- The carbon reduction is equal to 8.3 to 17.8 million tons, annually.



MVPs reduce carbon emissions

4 Carbon Emissions

Potential Financial Cost of Carbon ($M)			
	2021	2026	2026 Enabled
Combined Policy Future Scenario	$ 417.10	$ 432.54	$ 506.94
Carbon Constraint Future Scenario	$ 634.95	$ 486.46	$ 603.75

- Three years of carbon reductions were calculated
  - 2021 RPS mandates and load levels
  - 2026 RPS mandates and load levels
  - 2026 load levels + all generation enabled by the proposed MVP portfolio
    - This was used to simulate a 2031 carbon reduction level
- In addition to the potential societal cost of carbon, the Combination and Carbon future policy scenarios modeled included a financial cost of carbon.
  - The carbon cost was set to $50/ton for the purpose of this study.
  - This was used to determine the potential financial benefit of reducing carbon output, for each year above

MVPs reduce carbon emissions

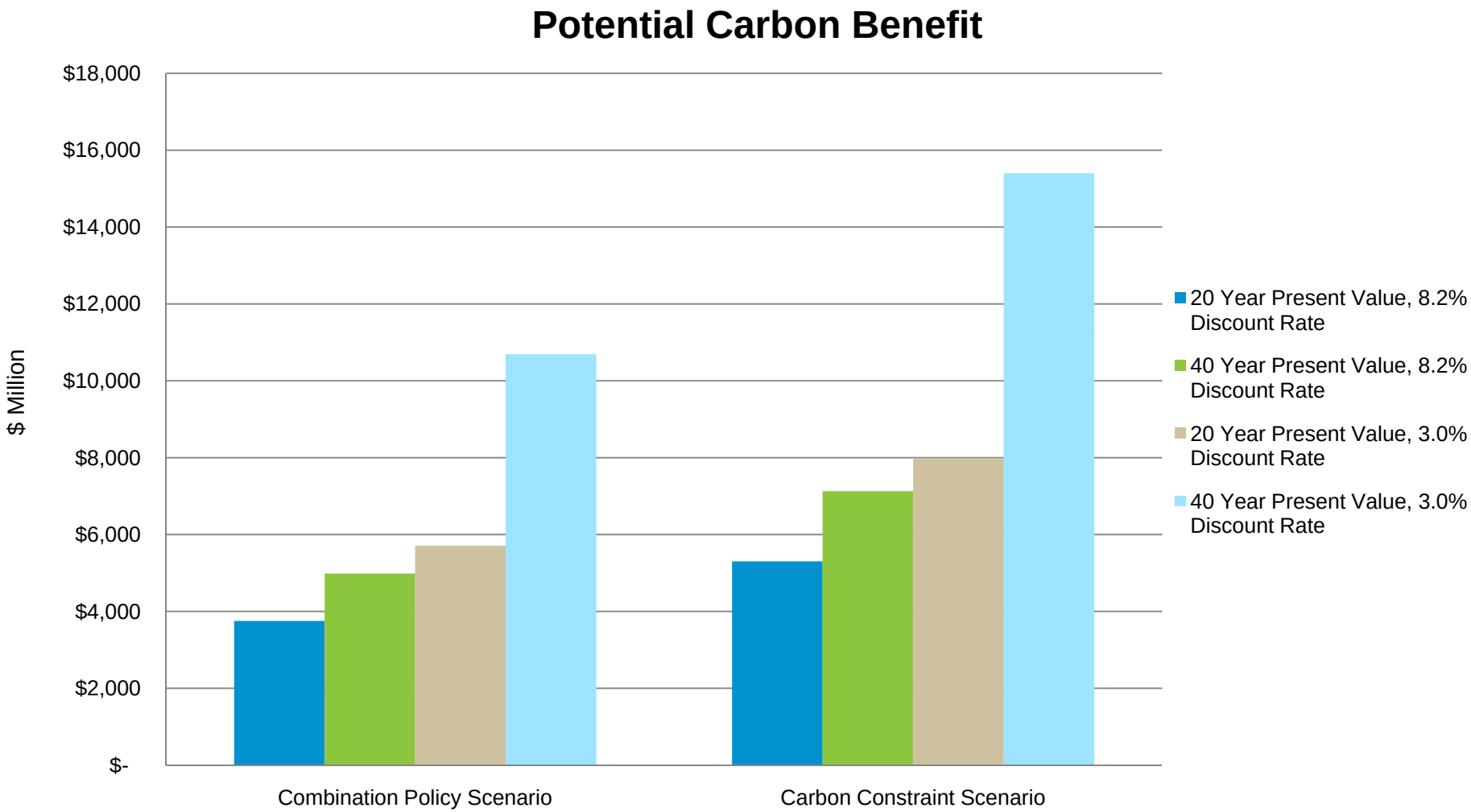
4 Carbon Emissions

- Using the financial cost of carbon from the previous slide, values for years 2022-2025 and 2027-2030 were interpolated between the years analyzed
- Values beyond 2031 were extrapolated based on the trend created by the 2026 and 2026 + all generation results
- All values were then discounted back to 2021, using the assumed discount rate
- The 2021 present value was then discounted back to a 2011 dollar figure, using the appropriate inflation rates.

	Nominal Benefit Savings ($)		
Year	Example Carbon Output ($M)		Formulas
2021	$	417.10	From 2021 analysis
2022	$	420.19	= (2026 value - 2021 value)/5 + 2021 value
2023	$	423.28	= (2026 value - 2021 value)/5 + 2022 value
2024	$	426.36	= (2026 value - 2021 value)/5 + 2023 value
2025	$	429.45	= (2026 value - 2021 value)/5 + 2024 value
2026	$	432.54	From 2026 analysis
2027	$	447.42	= (2031 value - 2026 value)/5 + 2026 value
2028	$	462.30	= (2031 value - 2026 value)/5 + 2027 value
2029	$	477.18	= (2031 value - 2026 value)/5 + 2028 value
2030	$	492.06	= (2031 value - 2026 value)/5 + 2029 value
2031	$	506.94	From 2026 + generation enabled analysis
2032	$	521.82	= (2031 value - 2026 value)/5 + 2031 value
…	….		…

MVPs reduce carbon emissions

4 Carbon Emissions

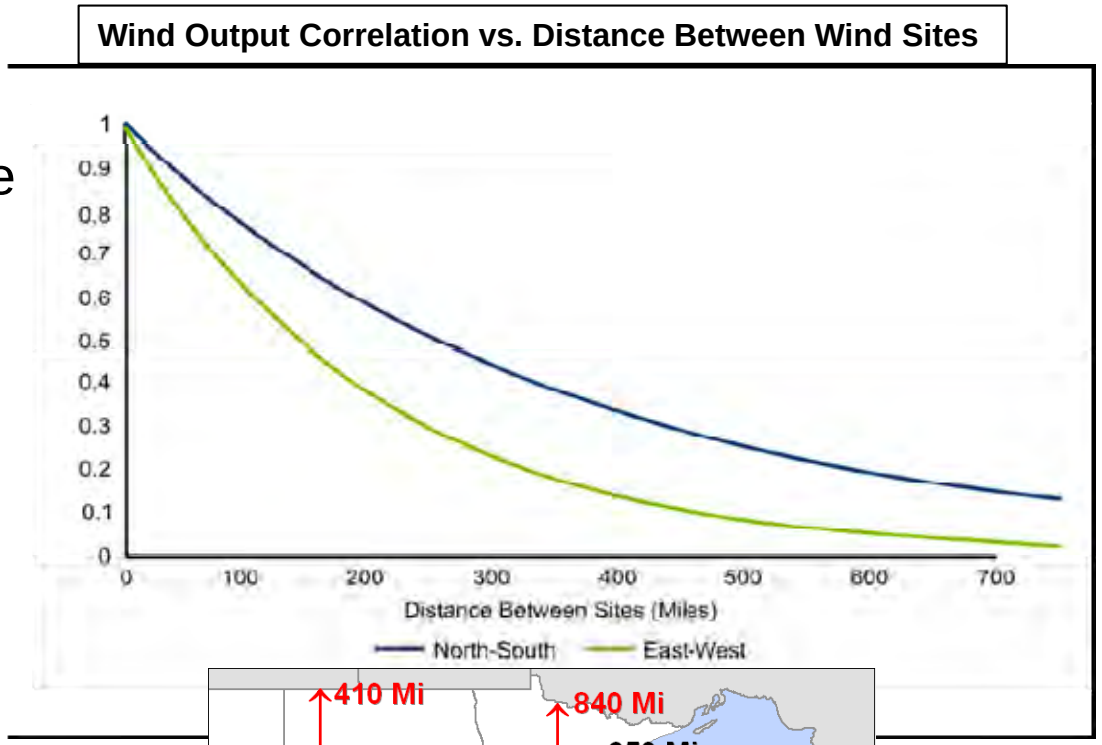


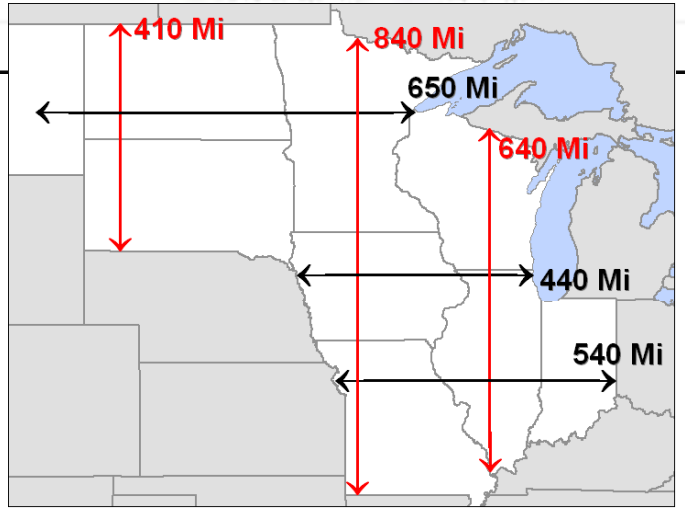
If policies are enacted that mandate a financial cost of carbon, the benefits provided by the proposed MVP portfolio would increase by between $3.8 and $15.4 billion

MVPs increase the geographic diversity of wind resources

5 Decreased Wind Generation Volatility

- As the geographical location of a group of wind turbines expands, the correlation in the output from the wind sites reduces.
  - This results in a higher average output from wind for a geographically diverse set of wind turbines
- MVPs increase the geographic diversity of wind resources that can be delivered, increasing the average output available at any given time





MVPs create local jobs and investment

6 Local Investment and Job Creation

- Various studies have been performed that show the economic benefits of transmission investment. These studies concluded that, for each million dollars of transmission investment:
  - Between $0.2 and $2.9 million of local investment is created
  - Between 2 and 18 employment-years are created
- The wide variations in these numbers are primarily due to the extent to which materials and equipment can be sourced from a local region
  - For example, each million dollars of local investment supports 11 to 14 employment-years of local employment

Source: *Employment and Economic Benefits of Transmission Infrastructure Investment in the U.S. and Canada*, The Brattle Group

MVPs create local jobs and investment

6 Local Investment and Job Creation

- Using the estimated in-service date of each project in the proposed MVP portfolio, an annual value was determined for the local jobs and investment benefits
  - Each project's capital investment was assumed to occur equally over the three years prior to its final in-service date
  - The transmission investment was indexed by inflation to put it in terms of the year it occurs in (construction year dollars)
- The construction year dollars for each year were then used to calculate the local investment and jobs created
  - The local investment created by the proposed MVP portfolio were calculated assuming that between $0.3 and $1.9 million of additional local investment was created per million spent on transmission investment
  - Likewise, the study assumed that between 3 and 7 direct employment-years were created per million of transmission investment
  - These values were based upon the responses of MISO stakeholders in the *Employment and Economic Benefits of Transmission Infrastructure Investment in the U.S. and Canada* publication by The Brattle Group
- The annual benefits were discounted back to create a single present value, in 2011 dollars

MVPs create local jobs and investment

6 Local Investment and Job Creation

Year	Capital Investment by In Service Date ($M, 2011$)	Investment Spread ($M)		Local Investment Created ($M)		Jobs Created (Man-Years)	
		2011 $	Construction Year $	Low Estimate	High Estimate	Low Estimate	High Estimate
2011	$0	$0	$0	$0	$0	0	0
2012	$0	$9	$9	$3	$17	27	63
2013	$0	$570	$591	$177	$1,122	1,772	4,134
2014	$26	$769	$810	$243	$1,539	2,430	5,669
2015	$1,685	$955	$1,023	$307	$1,943	3,069	7,160
2016	$596	$504	$550	$165	$1,044	1,649	3,847
2017	$583	$642	$712	$214	$1,353	2,136	4,984
2018	$333	$769	$868	$260	$1,648	2,603	6,073
2019	$1,009	$658	$755	$227	$1,435	2,265	5,286
2020	$964	$321	$375	$113	$713	1,126	2,627

MVPs supports the creation of between 17,000 and 39,800 local jobs, as well as a present value of $1.1 to $9.3 billion in local investment.

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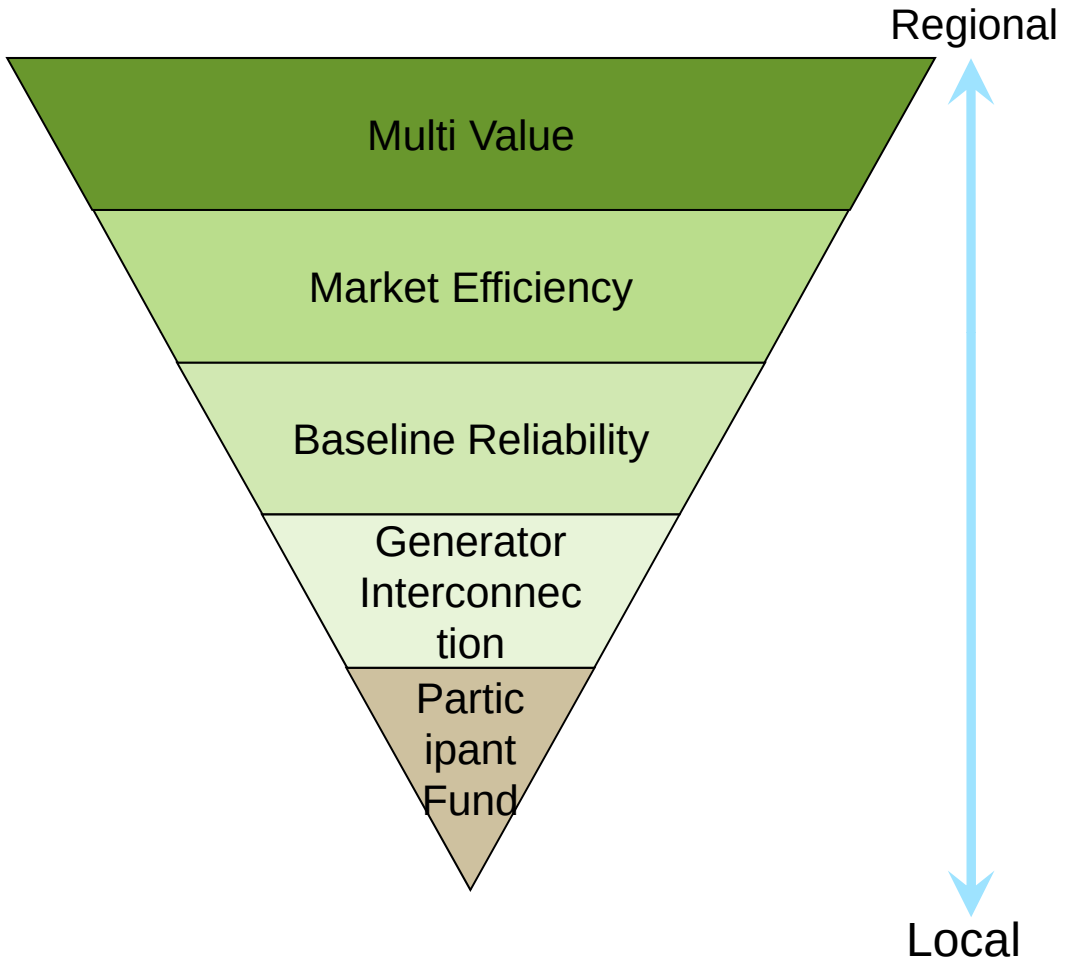
Proposed MVP Portfolio Business Case

Cost Allocation and Benefits Distribution

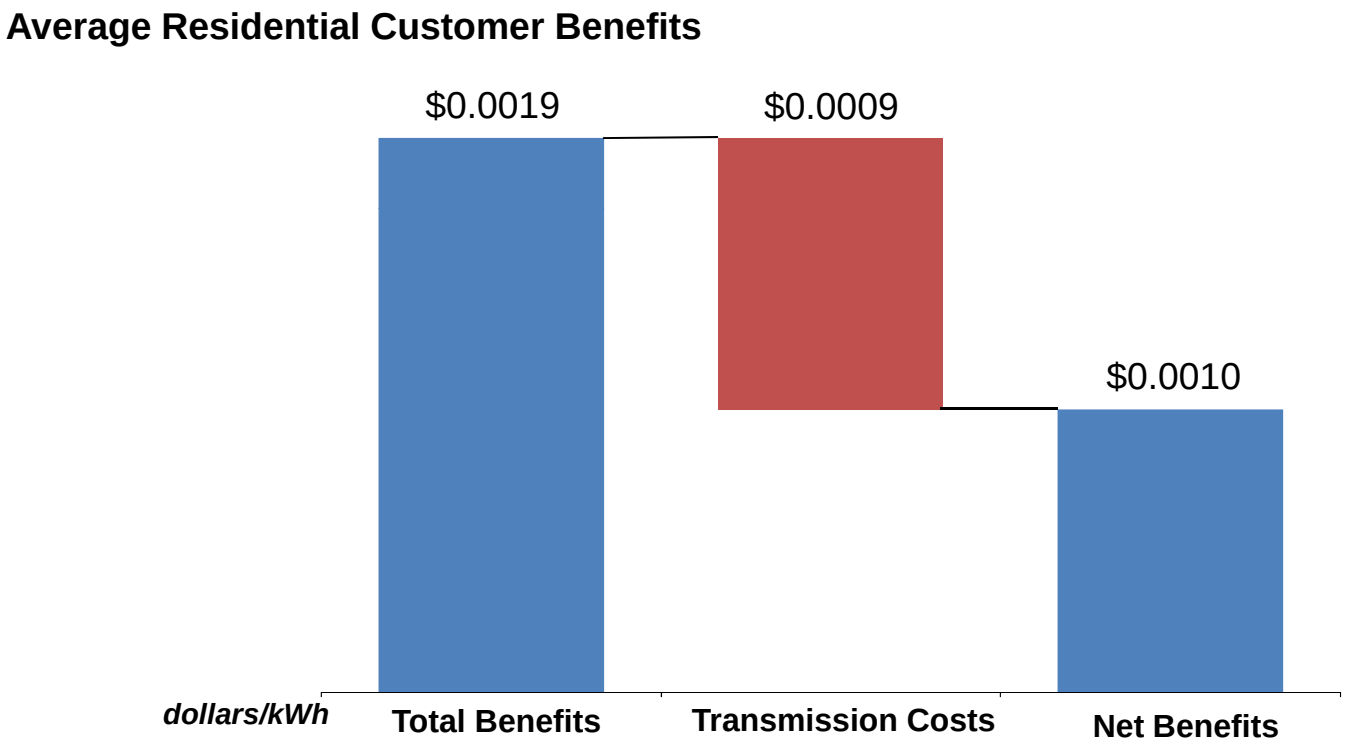
Required: Transmission Cost Allocation



In the MISO cost allocation approach the business case (i.e. benefits) defines the spread of dollars

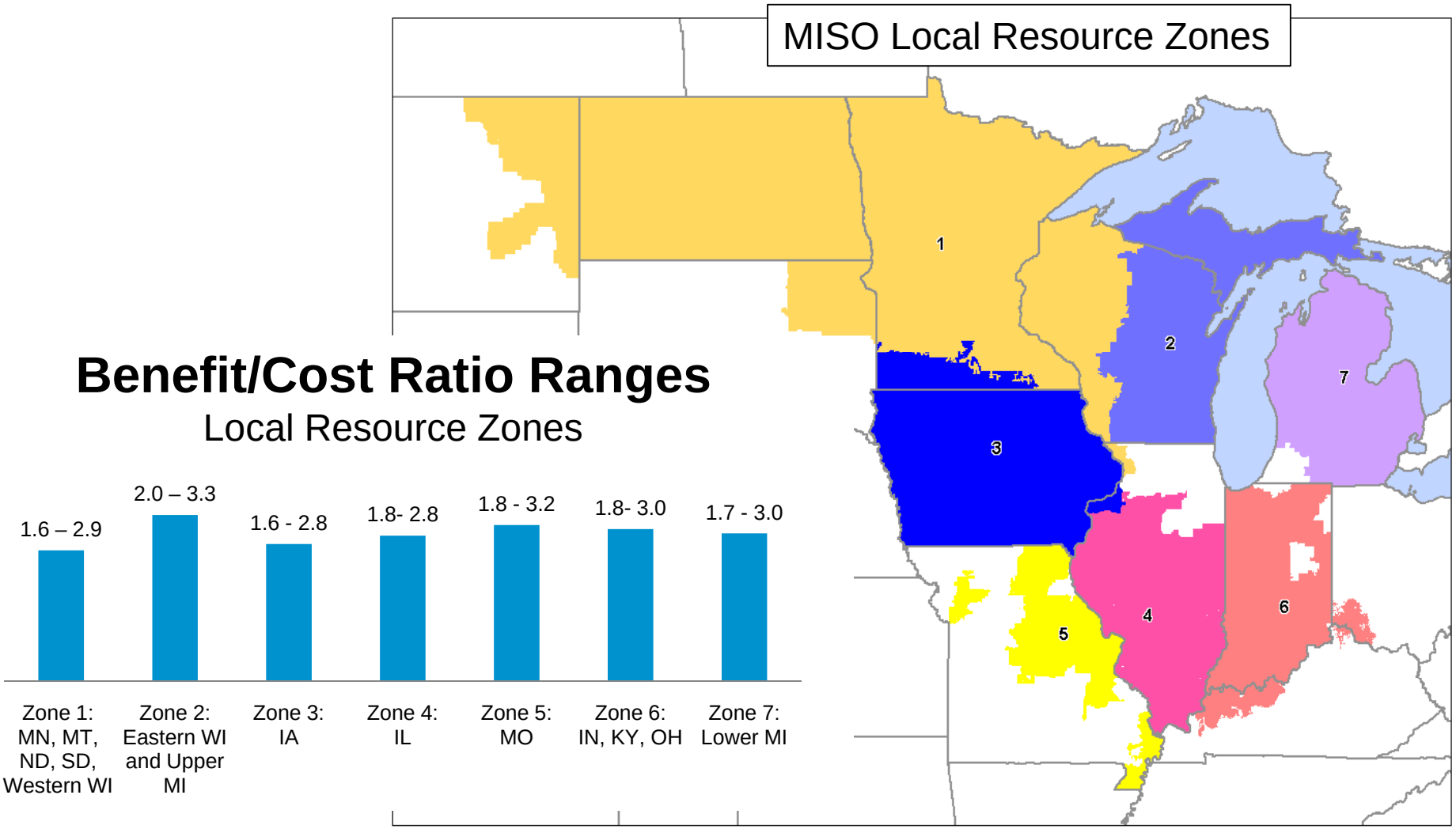
- Benefits of Multi Value Projects are spread regionally consistent with the widespread benefits from regional plan
- Economic benefits of Market Efficiency Projects spread farther beyond the local zone
- Reliability benefits of Baseline Reliability Projects primarily stay in the zone in which the reliability issue exists
- Generator Interconnection Projects paid primarily by Interconnection Customer
- Participant funded projects are paid by the party proposing the project

Multi Value Projects provide the average residential customer $23 in annual benefits, at an annual cost of $11



** Assumes average residential customer uses 1,000 kWh per month.*
Costs and benefits based on the first 40 years of operation, in 2011 dollars

Multi Value Projects create benefits that are spread across MISO in a manner commensurate with costs



Benefit/Cost Ratio Ranges

Local Resource Zones

The zonal allocation was based upon the spread of each benefit's value.

Example of System Wide Benefits ($M)		
Benefit Type	**Benefit Value**	**Zonal Split**
Congestion and Fuel Savings	$ 14,078	Zonal allocation derived directly from PROMOD results
Operating Reserves	$ 35	Zonal allocation based on load share ratio
System Planning Reserve Margin	$ 1,281	Zonal allocation based on load share ratio
Transmission Line Losses	$ 305	Zonal allocation based on load share ratio
Wind Turbine Investment	$ 2,503	Zonal allocation based on a weighted average of relative capacity factors and RPS mandates/goals that can be sourced out of state
Future Transmission Investment	$ 276	Zonal allocation based on the upgrade's location (80%) and a system wide spread (20%)
Total Benefits	$ 18,478	Value is equal to the sum of the benefit values
Total Costs	$ 8,817	Zonal allocation based on load ratio share
B/C	2.1	Value is equal to benefit divided by costs

Example of Zonal Benefits ($M)							
Zone	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Benefit Type	**Benefit Value**						
Congestion and Fuel Savings	$ 1,585	$ 1,379	$ 846	$ 889	$ 1,054	$ 2,545	$ 2,270
Operating Reserves	$ 4	$ 3	$ 2	$ 2	$ 3	$ 6	$ 5
Transmission Line Losses	$ 38	$ 28	$ 20	$ 21	$ 23	$ 54	$ 47
System Planning Reserve Margin	$ 159	$ 117	$ 83	$ 86	$ 95	$ 227	$ 195
Wind Turbine Investment	$ 349	$ 304	$ 173	$ 417	$ 195	$ 442	$ -
Future Transmission Investment	$ 87	$ 35	$ 9	$ 30	$ 6	$ 34	$ 6
Total Benefits	$ 2,221	$ 1,866	$ 1,133	$ 1,445	$ 1,374	$ 3,308	$ 2,523
Total Costs	$ 1,094	$ 803	$ 574	$ 593	$ 651	$ 1,559	$ 1,344
B/C	2.03	2.32	1.97	2.44	2.11	2.12	1.88

Proposed MVP Portfolio Business Case

Conclusions and Next Steps

Multi Value Projects reliably and economically enable established energy policy choices

- The proposed Multi Value Project Portfolio creates a robust transmission system that provides value under a wide range of policy, economic, and operating conditions
- Specifically, it
  - Provides benefits in excess of its costs under all scenarios studied, with its Benefit–to–Cost ratio ranging from 1.8 to 3.0
  - Maintains system reliability by resolving reliability violations on about 650 elements for more than 6,700 system conditions and mitigating 31 system instability conditions
  - Enables 41 million MWh of wind energy annually to meet renewable energy mandates and goals
  - Provides an average annual value of $1,279 million over the first forty years of service, at the cost of an average annual revenue requirement of $624 million*
  - Supports a variety of generation policies through utilizing a set of energy zones which support wind, natural gas, and other fuel sources

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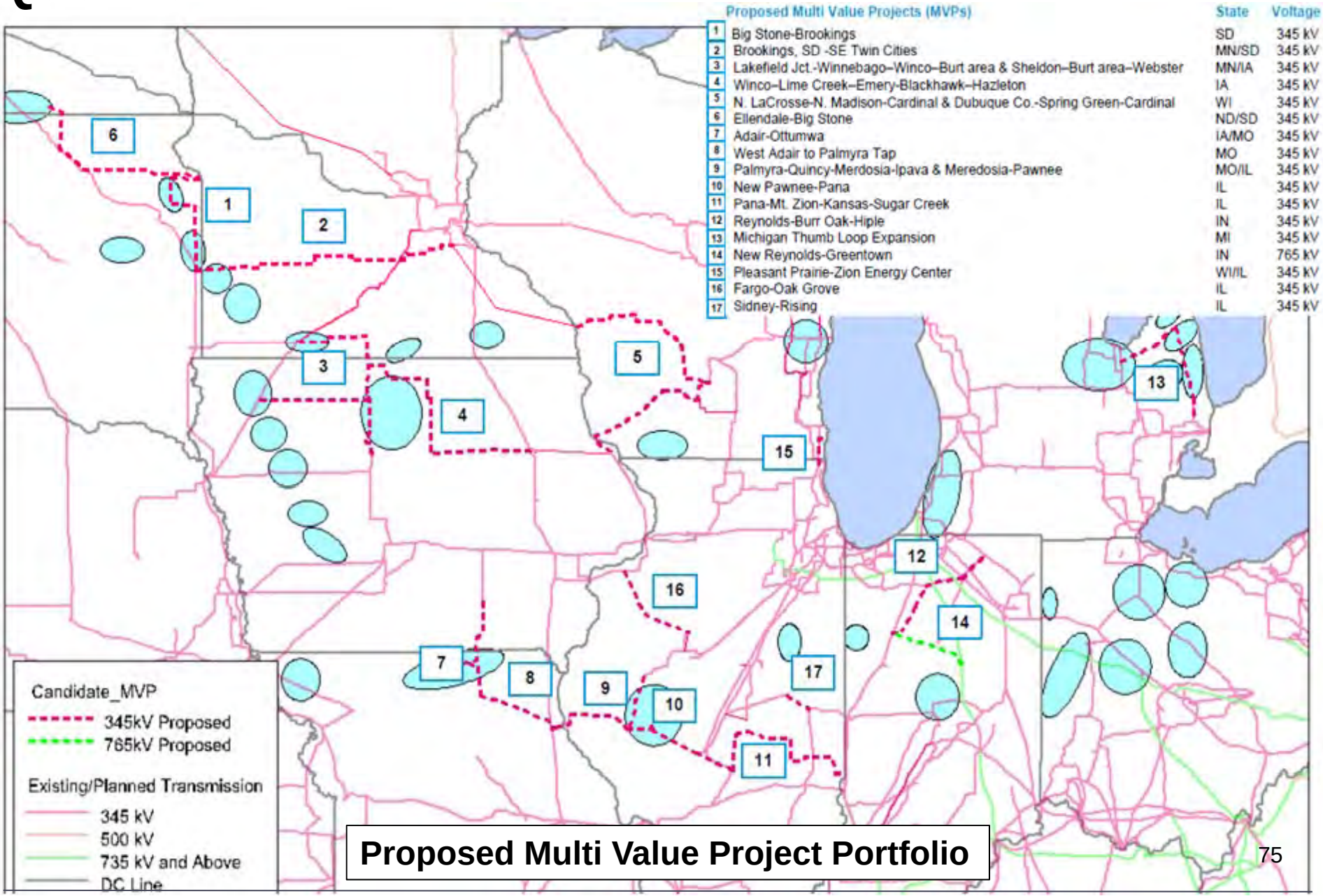
** Based on a total portfolio capital cost of $5.2 billion, in 2011 dollars*
Final costs are subject to change as actual construction estimates are received

Conclusions and Next Steps

- The proposed Multi Value Project portfolio represents the culmination of over 8 years of planning efforts by MISO and its stakeholders to minimize the total cost of delivered power to consumers while maximizing their benefits
- The proposed Multi Value Project portfolio provides widespread reliability, public policy, and economic benefits in excess of costs to the MISO footprint
- MISO Staff will be presenting this portfolio of project for your approval in December, in combination with other MTEP11 Appendix A projects

Questions?



Proposed Multi Value Project Portfolio

Proposed MVP Portfolio Business Case

Appendix

Proposed MVP Portfolio

	Project	State	Voltage (kV)	In Service Year	Cost (M, 2011$)
1	Big Stone–Brookings	SD	345	2017	$191
2	Brookings, SD–SE Twin Cities	MN/SD	345	2015	$695
3	Lakefield Jct. –Winnebago–Winco–Burt area & Sheldon–Burt area–Webster	MN/IA	345	2015	$511
4	Winco–Lime Creek–Emery–Blackhawk–Hazleton	IA	345	2015	$485
5	N. LaCrosse–N. Madison–Cardinal & Dubuque Co. –Spring Green–Cardinal	WI	345	2018/2020	$714
6	Ellendale–Big Stone	ND/SD	345	2019	$261
7	Adair–Ottumwa	IA/MO	345	2017	$184
8	West Adair–Palmyra Tap	MO/IL	345	2018	$98
9	Palmyra–Quincy–Merdosia–Ipava & Meredosia–Pawnee	IL	345	2018	$392
10	New Pawnee–Pana	IL	345	2018	$88
11	Pana–Mt. Zion–Kansas–Sugar Creek	IL/IN	345	2020	$284
12	Reynolds–Burr Oak–Hiple	IN	345	2018	$271
13	Michigan Thumb Loop Expansion	MI	345	2015	$484
14	New Reynolds–Greentown	IN	765	2018	$245
15	Pleasant Prairie–Zion Energy Center	WI/IL	345	2014	$26
16	Fargo–Oak Grove	IL	345	2018	$193
17	Sidney–Rising	IL	345	2017	$90
Total					$5,214

Proposed MVP Portfolio Transmission Underbuild

Underbuild requirements
Burr Oak to East Winamac 138 kV line uprate
Lake Marian 115/69 kV transformer replacement
Arlington to Green Isle 69 kV line uprate
Columbus 69 kV transformer replacement
Casey to Kansas 345 kV line uprate
Lake Marian to NW Market Tap 69 kV line uprate
Franklin 115/69 kV transformer replacements
Castle Rock to ACEC Quincy 69 kV line uprate
Kokomo Delco to Maple 138 kV line uprate
Wabash to Wabash Container 69 kV line uprate
Spring Green 138/69 kV transformer replacement
Davenport to Sub 85 161 kV line uprate
West Middleton West Towne 69 kV line uprate
Ottumwa Montezuma 345 kV line uprate