

Annotations in Magenta

Badger Coulee 345 kV Transmission Line Project

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Planning Analysis of the Badger Coulee Transmission Project

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March 31, 2014

Table 1: Monetized Benefits of Transmission Alternatives for ATC Customers

	Badger Coulee	Low Voltage
PROJECT COSTS		
Total Project Cost (\$M – Nominal)	(\$579.79)	(\$428.73)
2012 Present Value of the Revenue Requirement (PVR 2012) - \$M	(\$11.88)	(\$466.91)
PROJECT BENEFITS		
All Futures		
Insurance Value	\$23.57	\$0.00
Robust Economy		
Energy Benefits (PROMOD)	\$356.26	\$500.83
Loss Savings	\$61.21	\$33.75
RIB	\$309.93	\$408.60
NPV 2012 (\$M)	\$739.10	\$476.27
Green Economy		
Energy Benefits (PROMOD)	\$285.45	\$267.11
Loss Savings	\$67.63	\$32.67
RIB	\$335.33	\$450.08
NPV 2012 (\$M)	\$700.10	\$282.95
Slow Growth		
Energy Benefits (PROMOD)	\$37.09	\$34.58
Loss Savings	\$17.01	(\$8.59)
RIB	\$52.81	\$52.39
NPV 2012 (\$M)	\$118.66	(\$388.54)
Regional Wind		
Energy Benefits (PROMOD)	\$212.06	\$277.34
Loss Savings	\$33.12	\$8.00
RIB	\$340.04	\$458.52
NPV 2012 (\$M)	\$596.91	\$276.96
Limited Investment		
Energy Benefits (PROMOD)	\$146.85	\$140.50
Loss Savings	\$56.49	\$3.49
RIB	\$155.59	\$152.69
NPV 2012 (\$M)	\$370.63	(\$170.23)
Carbon Constrained		
Energy Benefits (PROMOD)	\$112.10	\$135.29
Loss Savings	\$36.98	\$1.96
RIB	\$347.87	\$452.40
NPV 2012 (\$M)	\$508.65	\$122.74

Economic & Policy “Futures”

Badger Coulee and Low Voltage, along with three other projects, were also evaluated to determine local reliability benefits in the Western Wisconsin Transmission Reliability Study (WWTRS). Each of the alternatives provided local reliability benefits by reducing the number of

Minnesota to Wisconsin to deliver wind generation to load. The Minnesota RES and Capacity Validation Study (CVS) identified Badger Coulee as a necessary transmission facility to accommodate the 4,000 to 6,000 MW of generation capacity that is expected to be needed to satisfy Minnesota's RPS mandate by the year 2025.⁶

MISO also identified several Candidate MVPs in the Regional Generator Outlet Study (RGOS) that would be compatible with potential transmission overlays developed.⁷ Badger Coulee and an additional 345-kV tie between Wisconsin and Iowa are MISO MVPs that will provide a continuation of west to east transmission paths to provide better access to wind generation to the west. As noted previously, the MVP Tariff has been approved by FERC and these projects have been approved for development and cost allocation by the MISO BOD.

1.5 Non-Transmission Alternatives to the Project

In addition to studying Low Voltage, ATC also incorporated numerous non-transmission alternatives into the Futures upon which its modeling is based. These non-transmission alternatives included varying levels of increased energy efficiency, load reduction, conventional generation, and renewable generation. These resources were added at the distribution level, within the ATC transmission system, and MISO-wide. The results showed that Badger Coulee produced value for Wisconsin customers even in the futures in which additional non-transmission alternatives were most vigorously implemented. Badger Coulee will thus be a valuable enhancement to non-transmission alternatives such as energy efficiency and renewable resources.

For this Planning Analysis, ATC developed and applied a planning technique that models "Distributed Resources" (DR) within the ATC system. DR incorporates additional demand response by customers and distributed generation within the ATC system. Deployment of these resources did not materially reduce or eliminate the need for and multiple benefits of Badger Coulee.

ATC has also provided a description of the energy-efficiency and load-response services that the statewide Focus on Energy (FoE) program provides to Wisconsin customers and the historical and potential future impacts of this program on load growth.

ATC has also considered the extent to which additional energy efficiency and load reduction could supplant the need for and multiple benefits of Badger Coulee. As noted above, Badger Coulee is an MVP that provides various reliability, economic, and policy benefits. ATC's analysis indicates that there is no basis for concluding that additional resources of this type could feasibly provide, on a firm, cost-effective basis, the same package of benefits as Badger Coulee.

1.6 Conclusion

Based on its analysis, ATC concludes that Badger Coulee provides substantial net economic, reliability, and policy benefits to its customers and to Wisconsin. Also, numerous studies

⁶ *Final Report, Minnesota Capacity Validation Study* (3/31/09)

⁷ *Midwest ISO Regional Generator Outlet Study* (11/19/10), Study Overview

Transmission Overlay (for 25 GW of incremental wind and 32 GW Overall) and the MISO Gas-Only generation expansion plan.

Slow Growth Future

Energy and peak demand grow at a slower rate in this future due to a sluggish economy inside and outside ATC.

Lower demand and the high cost of retrofitting to meet environmental regulations cause some smaller, older coal-fired units within ATC to be retired for economic reasons. Beyond the currently planned wind generation facilities, there are virtually no new generator additions within ATC.

An enhanced RPS does not become law in Wisconsin, and the percentage of energy from renewable sources remains at the level required by current law, 10 percent.

The combination of lower energy demand and no carbon regulation results in lower costs for natural gas. For the same reasons, coal plants serve proportionately more of the need, resulting in continuing demand for coal, and the cost of coal increases as projected.

Regional wind development is at a lower level as RPS in other states also remains at present levels. The required transmission overlay is the most limited scenario (“Overlay Light”), and the MISO Reference case is the regional generation expansion plan.

Regional Wind Future

In this future, the potential of the Upper Midwest to produce and transfer its full potential of wind energy is realized.

ATC and regional energy and peak-demand growth are at higher levels.

Because of the additional wind resources and some level of carbon regulation, substantial retirements of older, and smaller Wisconsin coal plants occur. Mid-levels of additional wind are needed in Wisconsin, though regional wind development outpaces Wisconsin wind development. Renewable-energy usage in Wisconsin increases to 20 percent.

Additional generation capacity is needed in Wisconsin to meet the higher peak-demand growth rate. Steady demand for natural gas results in projected cost levels. Less coal-fired generation is needed because of the additional wind power, reducing the demand and cost for coal.

Additional environmental regulations are promulgated in the form of some carbon regulation and additional limits on other emissions.

Regionally, the highest capacity-factor wind zones are developed. The Intra-Regional Transfer 765-kV Overlay for 25 GW of incremental wind (32 GW Overall) is thus needed. The MISO Reference case provides the non-wind generation expansion plan.

Limited Investment Future

The main driver of this future is reduced capital investment in new energy infrastructure, especially new base load generation. There is less need for such investment because energy and peak-demand growth is modest within ATC and MISO due to an economy that is not growing at a robust rate.

In this future, credit markets do not provide easy access to investment capital, thus increasing the cost and transaction time for major projects. Regulatory proceedings for new, large generating facilities and major transmission facilities are also lengthy and uncertain due to public opposition, concern for rate impacts, and new environmental requirements.

Hence, there are limited generator additions within ATC, including new wind farms. The Wisconsin RPS remains as is, and there is no federal RPS. Natural gas prices are higher because of increased reliance on lower capital cost gas-fired units for new generation. Coal prices are also higher than projected because new supplies of coal are limited due to the investment climate. Finally, new environmental regulations do not increase production costs for or cause high retirement levels of existing coal units.

Regional wind development is at a relatively low level because the Minnesota and Iowa RPS also remain as is and are met from wind development in those states and the Dakotas. The transmission expansion case is the most limited scenario (“Overlay Light”), and the regional generation expansion plan is the MISO Gas-Only generation expansion plan.

Carbon-Constrained Future All futures assume badger-coulee is in place

The basic premise of this future is that carbon emissions must be reduced due to federal regulation, either a cap-and-trade system specifying increasingly stringent emissions levels or a direct tax on carbon emissions.

In this future, energy and peak-demand growth inside and outside ATC are restricted to low levels because demand reduction and energy efficiency are effective means of reducing carbon emissions. Expanded funding for programs like Focus on Energy and increased incentives for green building and energy-efficient appliances reduce peak demand and energy consumption below projected levels.

The pace of retirement of smaller, older coal plants within ATC increases to its highest feasible level. Generator additions within ATC are mainly additional wind facilities. The percentage of energy generated within the ATC footprint from renewable resources is at its highest plausible level, since renewable-energy usage increases in Wisconsin and new renewable generation within ATC is another means of reducing carbon emissions.

Natural gas prices are as projected because increasing demand for natural gas is offset by the fact that natural-gas fired generation also produces carbon emissions. Coal prices are lower than forecast because the demand for coal decreases as a result of carbon regulation.

The level of carbon regulation in 2020 is as projected because direct regulation of carbon emissions is still needed but is not the exclusive means of constraining carbon output. These levels increase to the highest plausible levels by 2026.

Regional RPS continue in effect as a contributor to carbon reduction, but are not at the highest plausible levels. Mid-levels of additional wind power are developed in Minnesota, Iowa, Illinois, and the Dakotas.

In this future, due to the relative prevalence of gas and wind generation, the transmission overlay is the UMTDI Local 345-kV Overlay for 15 GW of incremental wind (22 GW Overall), and the regional generation-expansion plan is the MISO Gas-Only generation expansion plan.

5.2.5 Futures Matrices

Table 12 and Table 13 list the various 2020 and 2026 drivers and the associated futures that were examined for Badger Coulee. Detailed information about the drivers and futures can be found in Badger Coulee Planning Analysis – Addendum C.

Table 12: ATC Futures for the 2020 Study Year

Drivers	Load Growth within ATC	Energy Growth within ATC	Load Growth outside ATC ²	Energy Growth outside ATC ²	Total Small Capacity Coal Retirements (or conversions to natural gas) Within ATC ³	Generator Additions Within ATC ⁴	Total Percent Energy from Renewables for ATC & Inside/Outside Percent ⁷	Natural Gas Price Forecast	Coal Price Forecast for New Units ⁹	Environmental Regulations ¹¹	Renewable Portfolio Standards (RPSs) and Wind Power Zones	Transmission Overlay Outside ATC ¹⁶	Generation Portfolio Outside ATC ¹⁷
Bounds	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020	2020
Lower	0.2%	0.1%	0.3%	0.3%	907 MW	Planned Wind ⁵ Plus Wind Specified Below	10/7.4/2.6%	-40%	-10%	\$0/ton for CO ₂ , 0% higher mercury costs	Current State RPSs for MN, IA & WI (for 2020) and Allocation to Wind Zones located only in the UMTDI States in Proportion to Associated Cap. Factors ¹²	Overlay Light-CAPX, Corridor & RIGO Projects	See Below
Mid ¹	1.40%	1.10%	0.75%	1.00%	453 MW	Planned Wind ⁵ Plus Wind Specified Below	20/10.5/9.5% ⁸	NYMEX for as many years as available followed by EIA esc. rate.	MISO Central & West \$2.07 & \$1.74 per MMBTU, respectively, for 2020. ¹⁰	\$25/ton for CO ₂ , 25% higher mercury costs	WI 20% ¹³ RPS & MN, IA & IL RPSs (for 2020) and Allocation to RGOS I Wind Zones in Proportion to Associated Capacity Factors ¹⁴	15 GW RGOS I Overlay	See Below
Upper	2.5%	2.2%	1.6%	2.19%	Announced (289 MW)	Fossil ⁶ & Planned Wind ⁵ Plus Wind Specified Below	25/13/12% ⁸	50%	20%	\$44/ton for CO ₂ , 25% higher mercury costs	WI 25% ¹³ & All MISO States with an RPS (for 2020) and Allocation to RGOS I Wind Zones in Proportion to Associated Capacity Factors ¹⁵	25 GW RGOS I Overlay	See Below
2020 Futures Descriptions													
Robust Economy	2.50%	2.2%	1.6%	2.19%	Upper	+1,176 MW ATC Wind ⁶	20/9.8/10.2% ⁸	Mid-Upper +25%	Upper	Low	Mid (Existing + ~9.2 GW) ²²	15 GW-765KV Overlay	Reference
Green Economy	1.4% ¹⁸	2.2% ¹⁸	0.75%	2.19%	Lower	+1,823 MW ATC Wind & DRG ²⁰	25/12.5/12.5% ⁸	Upper	Mid	Upper	Upper (Existing + ~20.7 GW) ²²	25 GW-345kV Overlay	Gas-only
Slow Growth	0.2%	0.1%	0.3%	0.3%	Mid	+31 MW ATC Wind	10/7.4/2.6%	Lower	Mid	Low	Low (Existing + ~3.2 GW) ²²	Overlay Light	Reference
Regional Wind	1.70%	1.4%	1.6%	1.32%	Lower	+918 MW ATC Wind ⁶	20/9.7/10.3% ⁸	Mid	Lower	Mid	Upper-20% WI (Existing + ~17.5 GW) ²²	25 GW-765kV Overlay	Reference
Limited Investment	1.0%	0.7%	0.75%	1.0%	Mid	+113 MW ATC Wind	10/7.2/2.8%	Mid-Upper +25%	Upper	Mid	Low (Existing + ~3.8 GW) ²²	Overlay Light	Gas-only
Carbon Constrained	0.2% ¹⁹	0.1% ¹⁹	0.3%	0.3%	Lower	+1,047 MW ATC Wind & DRG ²⁰	25/12.4/12.6% ⁸	Mid	Lower	Mid ²¹	Mid-25% WI ²³ (Existing + ~7.3 GW) ²²	15 GW-345kV Overlay	Gas-only

Notes:

- 1) For ATC, the Mid load and energy growth rates are based on 2009 customer-supplied forecasts.
- 2) Outside ATC is defined as all of MISO, the Non-MISO Midwest Reliability Organization (MRO) Areas and Commonwealth Edison excluding the ATC utilities (e.g. Alliant, MG&E, We Energies, WPPI, and WPS). Load and energy growth rates are those from the Organization of MISO States (OMS) Cost Allocation and Regional Planning (CARP) planning study. For reference, MISO's 15 GW Reference PROMOD model has MISO on peak load and energy growth rates of 1.21% and 1.07%, respectively, and Outside ATC rates of 1.31% and 1.15%, respectively.
- 3) Some small coal-fired retirements have been publicly announced and/or have recently occurred and are included as basecase assumptions. Conversion of Blount 6 & 7 from coal to natural gas at the end of 2011 is included in the "Announced" coal-fired retirements total. Other announced retirements include Blount units 3, 4 & 5 (totaling ~90 MW) by the end of 2013. Presque Isle Units 3 & 4 (116 MWs) and Pulliam units 3 & 4 (~55 MW) were already retired.
- 4) The uprate of Point Beach is a basecase assumption.
- 5) 439 MW of wind are expected to be in-service by the end of 2009 within ATC. An additional 539 MW of "planned" wind have signed Interconnection Agreements (IAs) that are not in suspension as of June 30, 2009. These total 978 MW.
- 6) Generator Additions Within ATC from MISO's Expansion Plans:
- | PowerBase In-Service Date | Regional Wind | Location | Robust Economy | Location |
|---------------------------|---------------|--------------------------------------|----------------|---|
| 1/1/2013 | 600 MW CT | 699785_ROCKY RN (WPS) (S. of Weston) | 600 MW CT | 699119_ROE 345 (WPL) (Rockdale) |
| 1/1/2016 | ----- | ----- | 600 MW Coal | 699157_COL 345 (WPL) (Columbia) |
| 1/1/2020 | ----- | ----- | 600 MW CT | 699785_ROCKY RN (WPS) (South of Weston) |
- 7) 2,080 MW of new Manitoba Hydro generation is a basecase assumption in MISO's PROMOD models, however, it does not qualify under the current Renewable Portfolio Standard (RPS) for WI, but would under the WI Governor's Global Warming Task Force (GWTF) recommended RPS.
- 8) The new Manitoba Hydro (MH) generation for WPS and WPPI, which totals 600 MW, is estimated to provide approximately 3,504 GWh of energy to meet the WI GWTF RPS recommended renewable percentages.
- 9) Most existing coal-fired generators have unit specific coal price forecasts from Ventyx (formerly NewEnergy Associates).
- 10) Use "MISO Central" coal costs for MISO expansion plan generators added within ATC.
- 11) The generation expansion plan comes from MISO so the CO₂ tax only affects generation dispatch in ATC's PROMOD model. CAIR's and CAMR's status is uncertain, but other air pollution regulations have a similar impact to these regulations.
- 12) The RPS requirements for Illinois, Michigan, Ohio-Pennsylvania & Missouri are assumed to be met internally. UMTDI is the Upper Midwest Transmission Development Initiative and includes wind zones in SD, ND, MN, IA & WI to primarily serve the RPS requirements for MN, IA & WI.
- 13) Based on the Wisconsin Governor's Task Force on Global Warming (GWTF) recommendation of 20% by 2020 and 25% by 2025.
- 14) RGOS is MISO's Regional Generator Outlet Study. The RGOS I wind zones include the UMTDI wind zones plus zones in Illinois. The RPS requirements for the RGOS II states (including MI, OH-PA & MO) are assumed to be met internally.
- 15) Sufficient wind power is added so that all of the Load Serving Entities (LSEs) within MISO that have state RPS requirements can meet them from wind power coming from the RGOS I wind zones. However, the wind power to meet Michigan's RPS must be met by in-state resources and therefore does not come from the RGOS I wind zones. States without RPS requirements as of 9/15/09 with MISO LSEs include Indiana and Kentucky. North and South Dakota have renewable goals, rather than mandates, and are therefore not included in the requirements.
- 16) CAPX Group 1 and the Minnesota "Corridor" and "RIGO" projects are assumed in place by 2020. The transmission overlays are designed to move wind generation to load centers. However, transmission was not added to deliver the expansion plan generation (mainly fossil) added by MISO to maintain adequate reserve margins in 2020.
- 17) Reference and Gas-Only refer to separate MISO generation expansion plans and futures.
- 18) A lower peak load growth rate relative to energy growth rate was selected for the Green Economy future due to increased Demand Side Management and Smart Grid, not because of low economic growth.
- 19) The low peak demand and energy growth rates are assumed to result from increased demand-side management (DSM) and energy efficiency.
- 20) Distributed Renewable Generation (DRG) provides 0.5% of the energy subject to the WI RPS in 2020 and includes Solar PV, Biogass, and Wind. Depending on the assumed energy growth rate, this percentage results in up to 67 MW of DRG. PSC Staff assumed 80 MW of DRG in its ratepayer impact scenario in its 5/20/09 Advanced Renewable Tariff (ART) Memo.
- 21) The Mid carbon-tax value is used to serve as a proxy for having to purchase a moderate level of allowances. It is unlikely that 100% of allowances will be allocated, some will have to be purchased. The significant amounts of renewables and DSM available and in use in this future would probably help moderate allowance costs and therefore it makes sense to use the "Mid" value.
- 22) The "existing" renewables are from MISO's PowerBase database. For MN, IA and WI the existing renewables total 4.4 GW, of which 0.9 GW is hydro and biomass. For MN, IA, WI and IL the existing renewables total 4.8 GW, of which 0.9 GW is hydro and biomass. The incremental GWs of wind needed to meet the specified "Lower", "Mid" and "Upper" RPS requirements are provided for information purposes and are approximate. The wind power to meet Michigan's RPS must be met by in-state resources and therefore does not come from the RGOS I wind zones and is not included in the total.
- 23) Consistent with a lower amount of additional transmission.