WHISTLING RIDGE ENERGY LLC
CAMERON YOURKOWSKI
PJM REPORT
EXHIBIT NO. 18.04r

Impact on Prices, Costs and Emissions

Given the CO_2 prices and natural gas prices that can result from implementation of climate change policy, PJM's analysis demonstrates that:

- Holding all other factors constant, the increase in average wholesale electricity prices in the PJM region corresponds to approximately 75 - 80 percent of the CO_2 price in dollars per short ton (2,000 pounds versus a metric ton of 2,204 pounds). This increase results from the fact that coal units, on average, emit approximately one short ton of CO_2 per megawatt-hour (MWh) and coal units determine the price of energy about 70 percent of the time in the PJM Market.

- At CO_2 prices of $10, $40, or $60 per short ton, typical residential customers using 750 kilowatt-hours (kWh)/month could see increases in their monthly bills up to approximately $6 ($72 annually), $23 ($276 annually), or $34 ($408 annually) respectively assuming all wholesale cost increases are passed through on a dollar- for-dollar basis.

- Regardless of the higher electricity prices that could result from CO_2 prices, the increased market penetration of energy efficiency and some types of demand response can reduce total consumption and customer costs for electricity, and in turn mitigate the wholesale price impacts, and result in additional CO_2 emission reductions.

    - Reductions in consumption for energy of two percent, five percent, and ten percent in the PJM region can result in mitigating price increases by as much as $4/MWh, $9/MWh, and $17/MWh, respectively depending on the price of natural gas. This corresponds across the PJM region to reductions in total costs for electricity by as much as $3 billion-$4 billion, $6 billion-$11 billion, and $10 billion-$18 billion per year, respectively, depending on the price of natural gas.

    - Reductions in consumption for energy of two percent, five percent and ten percent in the PJM region can result in corresponding additional CO_2 emissions reductions up to of 14 million, 34 million and 60 million short tons, respectively, in 2013.

    - Only at relatively low CO_2 prices of $10/ton and a natural gas price of $6.44/ million British Thermal Units (mmBtu) in the study, can the increase in wholesale price and market-wide expenditures be completely offset through reductions in consumption of five percent or greater.

The Addition of Wind Capacity

PJM has also modeled separately the impact of an addition of 15,000 MW of wind capacity, most of which is in the western part of PJM. Consistent with historical experience and expectations concerning the number of overall projects proposed versus those actually constructed, PJM used the assumption that only about a third of the approximately 43,000 MW of wind power in the interconnection queue will go into commercial operation by 2013. PJM examined impacts on prices, emissions, and generation mix.

- 15,000 MW of wind capacity displaces about 43,000 GWh (gigawatt-hour) of fossil-fueled generation with about 60 percent of the displaced generation being coal and the remainder being natural gas and oil-fired units.

- 15,000 MW of wind offers CO_2 emissions reductions of almost 35 million short tons in the absence of any CO_2 price,

- 15,000 MW of wind offers wholesale market price reductions of $4.50-6/MWh, translating to reductions in annual market-wide expenditures of $3.55 billion to $4.74 billion versus not having that wind in place.

PJM Results in the Context of Legislative Proposals

PJM has taken the aforementioned general results and linked them to the analyses of the three major legislative measures analyzed by the EIA and EPA.

- EIA and EPA analyses of the Lieberman-McCain (S.280) and Bingaman-Specter (S.1766) bills under base assumptions indicate a CO_2 price close to $10/short ton in 2013. The impact on the PJM Energy Market would be to see power price increases of approximately $7.50/MWh, with market-wide expenditures to increase approximately $5.9 billion, and emissions reductions from PJM sources of almost 6 million tons. The increase the bill of a typical electricity customer could be up to $5.58 monthly or $66.96 annually.

- EIA and EPA analyses of the Lieberman-Warner (S.2191) bill under base assumptions, or assumptions indicating that the availability of lower carbon generation sources may be limited, results in CO_2 prices close to $20/short ton in 2013. The impact on the PJM Energy Market could be power price increases as high as $15/MWh, and market-wide expenditures increase by as much as $12 billion, while providing emission reductions from PJM sources of approximately 14 million tons. The impact on a typical customer's bill could be as high $11.19 monthly or $134.28 annually.

Other analyses performed by EIA and EPA examined the outcomes resulting from major legislation under alternate sets of assumptions. In analyses assuming the availability of CO_2 offsets are limited, CO_2 prices could rise as high as $40/short ton to $60/short ton. The findings demonstrate that:

- At a price of about $40/ton, as modeled by EPA for the Lieberman-McCain Bill (S.280) in the absence of offsets, the impact on the PJM Market would be power price increases up to $30/MWh, market-wide expenditures increasing up to $23 billion and emissions reductions from PJM sources up to 66 million tons. The impact on a typical customer's bill could be as high $22.28 monthly or up to $267.36 annually.

- At a price of just over $60/ton as modeled by EPA for the Lieberman-Warner bill (S.2191) in the absence of offsets, the impact on the PJM Market would be power price increases of approximately $45/MWh and market-wide expenditures increasing up to $36 billion. However, gas prices also rise to nearly $10/mmBtu as shown by EIA, emissions reductions from PJM sources are only 25 million tons. The impact on a typical customer's bill could be up to $34.16 monthly or $409.92 annually.

The range of possible impacts from climate change policy on power prices and expenditures, dispatch of generating units, and emissions are quite large and sensitive to many different assumptions regarding details of legislation and future operating conditions. PJM conducted this study to provide a better understanding of the

In addition to the mitigating effects on LMP, wholesale power cost, and customer power bills, demand reductions also have the effect of further enhancing emissions reductions through the displacement of fossil generation. The results of this can be seen in Table 5.

Table 5: Amounts by Which Generation is Displaced and Additional Emissions Reductions Achieved[26]

	Load Reduction Percentage		
	2%	**5%**	**10%**
Coal	6,741 GWh	18,376 GWh	41,972 GWh
Combined Cycle Gas	6,555 GWh	15,685 GWh	28,587 GWh
Additional CO_2 Reductions (tons)	10-14 million	29-34 million	58-64 million

Wind Penetration Results

With the addition of 15,000 MW of nameplate wind capacity to the system can have mitigating effects on increases in LMP, wholesale power costs, and consumer power bills, while enhancing emissions reductions.The effect on LMP, wholesale power costs and customer bills can be seen in Table 6, while the impact on generation and emissions can be seen in Table 7.

Table 6: Amounts by Which 15,000 MW of Wind Mitigates Price and Cost Increases

	15,000 MW Wind
LMP ($/MWh)	$5-$5.50 per MWh
Wholesale Power Cost	$4-$4.5 billion
Customer Bill	$3.50-$4 monthly ($42-$48 annually)

With respect to emissions levels, the introduction of 15,000 MW of wind capacity provides an additional 34 million to 37 million tons of CO_2 reductions. The mechanism by which wind achieves additional emissions reductions is identical to demand reductions in that wind displaces fossil fuel generation resources. However, unlike demand

[26] Displaced generation is at a CO_2 price of $0/ton in the base gas case. Additional CO_2 reductions depend upon gas price and CO_2 price.

reductions which resulted in displacing almost equal amounts of coal and combined cycle gas generation, wind displaces predominantly coal.[27]

Table 7: Generation Displaced and Additional Emissions Reductions Achieved by 15,000 MW of Wind

	15,000 MW Wind
Coal	26,303 GWh
Combined Cycle Gas	13,009 GWh
Additional CO_2 Reductions (tons)	34-37 million

5. Overview of Proposed Legislative Analyses and Impacts in PJM Markets

Of the eleven bills related to climate change introduced into the 110th Congress, three have garnered the greatest attention based upon the analyses that have been requested by Congress, and conducted by the Energy Information Administration (EIA) and the Environmental Protection Agency (EPA).

S.280 introduced by Senators Joseph Lieberman (I-CT) and John McCain (R-AZ) covers approximately 78 percent of total GHG emissions in 2005, targeting sources with greater than 10,000 metric tons of CO_2 equivalent per year. S.280 targets emissions to be stabilized at 2004 levels from 2012-2019, with step change decreases occurring about every decade. Allowance prices are allowed to move freely based on allowance market conditions.

An EIA analysis of S.280[28] indicates that in 2013 (second year of compliance) CO_2 allowances prices would be close to $14/metric ton ($12.70/short ton)[29] with a natural gas price of $6.10/mmBtu. Sensitivities around the availability of CO_2 offsets might drive CO_2 allowance prices as high as $18/metric ton ($16.33/short ton) and gas as high as $6.34/mmBtu if offsets are limited. CO_2 allowance prices could be as low as $8.50/metric ton ($7.71/short ton) and gas down to $5.78/mmBtu if offsets are unlimited. EPA analyses reveal similar numbers for allowance prices, although in one case (with no offsets allowed), the CO_2 allowance price could be as high as $40 in 2015.[30]

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[27] This occurs because wind runs mostly in off-peak hours when coal is more likely to run than combined cycle gas.

[28] See United States Energy Information Administration, *Energy Market and Economic Impacts of S.280, the Climate Stewardship and Innovation Act of 2007*, January 2008 http://www.eia.doe.gov/oiaf/servicerpt/csia/pdf/sroiaf(2007)04.pdf and associated output files at http://www.eia.doe.gov/oiaf/servicerpt/csia/index.html.

[29] A short ton is equivalent to 2000 pounds while a metric ton is 1000 kilograms or 2204.6 pounds.

[30] See United States Environmental Protection Agency, *EPA Analysis of the Climate Stewardship and Innovation Act of 2007*, July 16, 2007 http://www.epa.gov/climatechange/downloads/s280fullbrief.pdf and associated spreadsheets with outputs at http://www.epa.gov/climatechange/downloads/dataannex.zip EPA's analyses of the various bills do not uniformly report CO_2 prices for each year as EIA does. The closest year to 2013 reported for all runs is 2015.