PUC Docket No. E999/CI-14-643
OAH Docket No. 80-2500-31888
Clean Energy Business Coalition
Exhibit No. ______

STATE OF MINNESOTA
OFFICE OF ADMINISTRATIVE HEARINGS
FOR THE MINNESOTA PUBLIC UTILITIES COMMISSION

DOCKET NO. E999/CI-14-643
OAH DOCKET NO. 80-2500-31888

Rebuttal Testimony

of

Christopher Kunkle

SUBMITTED ON BEHALF OF:

WIND ON THE WIRES
MIDWEST RENEWABLE ENERGY ASSOCIATION
SOLAR ENERGY INDUSTRIES ASSOCIATION
(“CLEAN ENERGY BUSINESS COALITION”)

AUGUST 12, 2015

Q: Please state your name, job title, and business address.

A: My name is Christopher Kunkle, and I am a Regional Policy Manager for Wind on the Wires. My business address is 570 Asbury Street, Suite 201, Saint Paul, Minnesota, 55104.

Q: For whom are you testifying?

A: I am testifying on behalf of Wind on the Wires, Midwest Renewable Energy Association and Solar Energy Industries Association (the "Clean Energy Business Coalition").

Q: Have you testified in proceedings in front of the Public Utilities Commission ("PUC") before?

A: I have not.

Q: What is your background and educational experience?

A: I have covered energy policy in five states, including Minnesota, for Wind on the Wires since January 2015. Prior to joining Wind on the Wires, I worked at Cullen Weston Pines & Bach LLP in Madison, Wisconsin, where I was an Energy and Telecommunications Paralegal and Government Affairs Specialist. I have an undergraduate degree from the University of Wisconsin-Madison. My resume is presented as Attachment 1.

Q: What is the purpose of your testimony?

A: In general, my testimony is offered to support adoption of the federal Social Cost of Carbon values (as proposed by the Clean Energy Organizations and the Minnesota Department of Commerce testimony), as the best figure available to account for externalized damage costs of carbon emissions. Proper valuation of the costs associated with the environmental pollution generated by the electricity industry will send the right signals to the market to ramp up industries that can create jobs, strengthen the economy, and help support a cleaner and healthier environment. However, some of the testimony presented misrepresents the role that renewable energy plays in our economy, now and in the future. Specifically, my testimony responds to Peabody Energy Corporation witness Dr. Roger H. Bezdek's testimony that future economic growth requires fossil fuels, and that wind is unreliable, expensive and non-scalable. I understand that the Administrative Law Judge has determined that "[t]estimony regarding the efficacy of renewable energy or renewable energy policy is presumed to be irrelevant" to the issues in this case (Third Prehearing Order, April 16, 2015), however my testimony regarding the efficacy of wind energy is offered only to rebut the factually inaccurate and unsupported statements presented by Dr. Bezdek to support the flawed benefit-cost analysis presented in his testimony.

Q: At page 14 of his direct testimony, Dr. Bezdek states that economic growth requires fossil fuels because they are the only fuels that can provide abundant, affordable energy. Do you agree?

A: No, I do not.

Q: Why not?

A: The Energy Information Administration forecasts the demand for electricity from 2015 to 2040 to increase by 0.8% per year.[1] I would expect fossil fuels will continue to play a role in Minnesota's energy portfolio out to 2040, however, renewables -- specifically wind energy -- are an abundant and affordable energy resource that can and will help meet a growing portion of our state's future energy needs.

As of the end of June 2015, there were 67,870 megawatts of wind installed in 38 states, with 13,600 megawatts of wind under construction in 24 states.[2] Since 2007, wind power has represented 54% of all new generation capacity in the Interior region, which includes Minnesota.[3] In 2014, wind energy generated 181

[1] U.S. Energy Information Administration (EIA), "Annual Energy Outlook 2015 with Projections to 2040," at 24 (April 2015) *available at* http://www.eia.gov/forecasts/aeo/pdf/0383%282015%29.pdf.
[2] American Wind Energy Association (AWEA), "U.S. Wind Industry Second Quarter Report 2015", (July 2015) *available at*: http://awea.files.cms-plus.com/FileDownloads/pdfs/2Q2015%20AWEA%20Market%20Report%20Public%20Version.pdf.
[3] Lawrence Berkeley National Laboratory, "2014 Wind Technologies Market Report", (August 2015) p. 5, *available at:* http://emp.lbl.gov/sites/all/files/lbnl-188167.pdf.

billion kilowatt-hours of energy, which is enough to power approximately 16.7 million homes.[4]

Moreover, it is well-documented that renewable resources in the United States have the potential to provide much more energy than the total electricity demanded by residential, commercial and industrial customers. The National Renewable Energy Laboratories has estimated the technical potential capacity for certain resources, including onshore and offshore wind. Technical potential is "the achievable energy generation of a particular technology given system performance, topographic limitations, environmental, and land-use constraints."[5] Focusing on wind, it has more than 15,000 gigawatts of technical onshore and offshore potential. This amounts to approximately 32,700 terawatt-hours (TWhs) of energy from onshore wind sources and 17,000 terawatt-hours of energy from offshore sources.[6] As the wind industry continues to make technological advancements that improve the capacity factors of wind turbines, I expect these numbers to grow; nonetheless, the 32,700 TWhs well exceeds the total electricity demand in the U.S. EIA's Annual Energy Outlook Report for 2015 estimates the total electricity use in the U.S. in 2013 to be 3,836 terawatt-hours and would

[4] AWEA, "U.S. Wind Industry Annual Market Report, Year Ending 2014", at 11 (2015).
[5] Lopez, A.; Roberts, B.; Heimiller, D.; Blair, N.; Porro, G. "U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis", NREL/TP-6A20-51946. Golden, CO: National Renewable Energy Laboratory, 2012; at 1; *available at:* http://www.nrel.gov.
[6] Lopez, A.; Roberts, B.; Heimiller, D.; Blair, N.; Porro, G. "U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis", NREL/TP-6A20-51946. Golden, CO: National Renewable Energy Laboratory, 2012; at 14, 15 and 20. *available at* http://www.nrel.gov.

increase to 4,797 terawatt-hours by 2040.[7] The extent to which states and utilities take advantage of that potential resource will depend on a variety of economic and market factors. As discussed below, wind is one of the most economic new generation sources available and it will only become increasingly cost-competitive as technology improvements continue.

Market factors that affect wind development include increased demand as states implement plans to comply with the U.S. EPAs emission guidelines for existing stationary sources[8] and new stationary sources,[9] increased coal plant retirements due to age or inability to economically operate, changes in electricity demand, existing and proposed transmission lines, generation integration limitations, fluctuations in and costs of raw materials, public policy uncertainties, and a fundamental power sector shift from a capacity-based energy portfolio to a flexible energy portfolio that emphasizes a cost effective mix of fossil fuel generation, renewables and demand response. As the country moves to this new flexible portfolio, the potential onshore wind -- which is most relevant for Minnesota -- is readily abundant and nearly 7 times larger than the total U.S. electricity demand projected by EIA for 2040.

[7] EIA, "Annual Energy Outlook 2015 with Projections to 2040," at 24 (April 2015) *available at* http://www.eia.gov/forecasts/aeo/pdf/0383%282015%29.pdf.
[8] 40 CFR Part 60 (Aug. 3, 2015).
[9] 40 CFR Part 60, 70, 71 and 98 (Aug. 3, 2015).

In addition to being abundant, wind energy is also affordable. Wind power costs have dropped 90% since the 1980s and fell from approximately $1,500/kW in 2008 to $850-$1,250/kW in recently announced transactions.[10] This drop is due to improvements in technology, materials and increase in competition among US based manufacturing.[11] Without government incentives, wind energy prices are in the 3.7 to 8.1 cents per kilowatt-hour range.[12] This rapid cost decline has translated directly to savings for ratepayers in states that have taken advantage of wind energy. From 2005 to 2010, the states with the top 10 largest amounts of wind generating capacity had rate increases that were 1/3 of the amount of rate increases experienced in the other 40 states.[13] Xcel Energy, Minnesota's largest investor-owned utility has stated publicly that: "Wind energy is a valuable, low-cost substitute for natural gas and other fuels right now. These [wind] projects will reduce customer costs by providing a valuable hedge to rising and volatile fuel prices well into the future."[14] MidAmerican Energy, Iowa's largest investor-owned utility has stated publicly that: "[Wind] continues to be a factor in keeping our customers' electricity rates among the lowest in the nation."[15]

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[10] Lawrence Berkeley National Laboratory, "2014 Wind Technologies Market Report", (August 2015), p. 47, *available at:* http://emp.lbl.gov/sites/all/files/lbnl-188167.pdf.
[11] Lawrence Berkley National Laboratories, "Wind Technologies Report - 2013", at 48 and 50-51 (Sept. 2014).
[12] Lazard, "Lazard's Levelized Cost of Energy Analysis -- Version 8.0," at 2 and 17 (Sept. 2014).
[13] AWEA, "Is Wind Power Holding Electricity Costs Down?," (Jan. 3, 2012).
[14] Dave Sparby, president and CEO of Northern States Power Co.-Minnesota, an Xcel Energy affiliate.(Aug. 2013) *available at: http://www.startribune.com/xcel-seeing-a-good-deal-adds-even-more-wind-power/219411891/* .
[15] Bill Fehrman, president and CEO of MidAmerican Energy. (May 2015) *available at: http://www.midamericanenergy.com/newsroom/aspx/news_print.aspx?id=735.*

When considering affordability, consideration should be given to the impacts wind has on wholesale electric markets. Regional Transmission Operators will dispatch the lowest cost from of generation that will reliably meet the system's demand. Wind resources inject electricity into a wholesale market, displacing generators that operate at higher cost. This directly reduces system-wide production costs of electricity, improving the efficiencies of the market as a whole.

Numerous studies have documented how wind reduces the wholesale market's production costs. The American Wind Energy Association recently issued a paper summarizing 15 studies by state governments, grid operators, and academics that have documented wind energy's role in reducing electricity prices.[16] For example, an analysis in Massachusetts found that the state's renewable initiatives have annual net benefits of $219 million[17] and that the benefits "that accrue to electric customers are nearly two and half times greater than $1.1 billion cost of implementing these initiatives."[18]

A May 2012 report by Synapse Energy Economics found that adding 20 to 40 GW of wind energy and the accompanying transmission capacity in the MISO

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[16] AWEA, "Wind Power's Consumer Benefits," at 4 (Feb. 2014); *available at:* http://awea.files.cms-plus.com/AWEA%20White%20Paper-Consumer%20Benefits%20final.pdf.
[17] "Recent Electricity Market Reforms in Massachusetts: A Report of Benefits and Costs" (July 2011), *available at* http://www.mass.gov/eea/docs/doer/publications/electricity-report-jul12-2011.pdf.
[18] Id. at 29.

region would save a typical household between $63 and $200 per year.[19] As illustrated in Attachment 1.1, this report found that electricity market prices decrease drastically as more wind capacity is added to the MISO system. As the report explains, "Since wind energy 'fuel' is free, once built, wind power plants displace fossil-fueled generation and lower the price of marginal supply—thus lowering the energy market clearing price."[20]

Synapse Energy Economics has performed at least two additional studies that reaffirm these customer benefits. First, Synapse analyzed the PJM Interconnection market, and found that doubling the use of wind energy beyond existing public policy requirements would produce net savings for consumers of $6.9 billion per year.[21]

Second, just last month, Synapse published a study analyzing the impacts of the proposed Clean Power Plan on electricity consumers if each state invested heavily in energy efficiency and renewable energy. Synapse's modeling found that the average household can save $35 per month on its electric bills in the "Clean

[19] Synapse Energy Economics, Inc., "The Potential Rate Effects of Wind Energy and Transmission in the Midwest ISO Region," at 3 (May 22, 2012) http://cleanenergytransmission.org/wp-content/uploads/2012/05/Full-Report-The-Potential-Rate-Effects-of-Wind-Energy-and-Transmission-in-the-Midwest-ISO-Region.pdf.
[20] Id.
[21] Synapse Energy Economics, "The Net Benefits of Increased Wind Power in PJM," (May 2013), *available at* http://cleanenergytransmission.org/uploads/EFC%20PJM%20Final%20Report%20May%209%202013.pdf.

Energy Future"[22] in 2030, as compared to the business-as-usual Reference scenario.[23]

A European literature review also identified a number of studies that have found wind energy tends to drive wholesale electricity market prices downward.[24] As that report explains:

> Wind power normally has a low marginal cost (zero fuel costs) and therefore enters near the bottom of the supply curve. Graphically, this shifts the supply curve to the right, resulting in a lower power price, depending on the price elasticity of the power demand…. When wind power reduces the spot power price, it has a significant influence on the price of power for consumers. When the spot price is lowered, this is beneficial to all power consumers, since the reduction in price applies to all electricity traded – not only to electricity generated by wind power.

Q: The Bezdek testimony characterizes renewable energy as expensive compared to fossil fuels. (*See, e.g*. Direct Testimony at 15). Can you provide an accurate picture of the current, actual, relative costs of wind/renewable energy compared to fossil fuel sources?

A: The most accurate comparison of the relative costs of new wind to new fossil fuel sources can be found in a report prepared by Lazard in September 2014.[25] Lazard typically updates this analysis each fall, so I anticipate this will be updated before

[22] The "Clean Energy Future" scenario includes an additional 217.8 GW of wind nationally, 3.7 GW of which would be located in Minnesota.
[23] Synapse Energy Economics, Inc. "Bill Savings in a Clean Energy Future," (July 2015), *available at http://synapse-energy.com/sites/default/files/Bill-Savings-in-a-Clean-Energy-Future.pdf*
[24] PÖyry, "Wind Energy and Electricity Prices," at pages 11 and 12 http://www.ewea.org/fileadmin/ewea_documents/documents/publications/reports/MeritOrder.pdf.
[25] Lazard, "Lazard's Levelized Cost of Energy Analysis -- Version 8.0," at 2 and 15 (Sept. 2014).

this hearing is completed. A chart on page 8 of the report shows the range of wind prices by region. For the Midwest, Lazard estimates prices for new wind generation to be in the range of $37 to $61 per megawatt-hour. Those prices are also on par with the 2014 Wind Technologies Report, which found that, factoring in a federal production tax credit, the average levelized price of executed wind contracts from 2014 were around $23.50 per megawatt-hour.[26]

In Minnesota, which has an excellent wind resource, I expect that recently executed Power Purchase Agreements (PPAs) for wind power are on the lower end of the Lazard range. In comparison, the lowest cost new fossil fuel generator would be a natural gas combined cycle plant, which Lazard estimates to be $61 to $87 per megawatt-hour followed by new coal with a price range of $66 to $151 per megawatt-hour. The next lowest cost type of generator is nuclear in a range of $92 to $132 per megawatt-hour.

Looking out over the next fifteen years, the cost of wind generation is likely to decrease slightly. The most recent forward-looking projection of wind capital and operating costs can be found in the Department Of Energy's most recent Wind Vision Report. The Wind Vision Report presents potential of land based wind resources into Groups 1 through 5. For the Midwest, the Wind Vision report forecasts that a significant portion of land based potential falls into Groups 3 and

[26] Lawrence Berkeley National Laboratory, "2014 Wind Technologies Market Report", p. viii, *available at:* http://emp.lbl.gov/sites/all/files/lbnl-188167.pdf.

4. The Wind Vision's Report forecasts that capital costs for Groups 3 and 4 will decrease between 2014 and 2030.[27] From 2014 to 2030 the mid-level capital costs for Group 3 are forecasted to decrease $99 per kilowatt-hour, which is approximately 5.7% below 2014 costs. For Group 4, the mid-level capital costs are forecasted to decrease $34 per kilowatt-hour, which is approximately 1.9% below 2014 costs.

The aforementioned cost reductions will continue to make wind an attractive option for states and utilities that need additional energy resources or want to diversify their energy portfolio. While low natural gas prices are driving much of the decision making at the state and utility level, there are many examples of wind PPAs executed in 2013 or 2014 that have average price streams that *begin* below the range of natural gas fuel cost projects, and that remain below even the low-end of EIA gas price forecasts through 2040.[28]

Q: At page 15 of his direct testimony, Dr. Bezdek asserts that renewable energy (including wind) is unreliable. Do you agree?

A: No. Characterizing a resource as unreliable simply because it is variable fails to account for three things. First, a generator's reliability is governed by the North American Reliability Council's regulations to ensure the generator operates

[27] U.S. Department of Energy (DOE), "Wind Vision: A New Era for Wind Power in the United States" at Table H-4, Appendices p. 51 (March 2015) *available at* http://www.energy.gov/eere/wind/maps/wind-vision.

[28] Lawrence Berkeley National Laboratory, "2014 Wind Technologies Market Report", (August 2015), p. 59, *available at:* http://emp.lbl.gov/sites/all/files/lbnl-188167.pdf.

within the defined equipment and electric system limits so that it does not cause instability or failures in the electric system. For utility scale wind turbines, from 2007 to 2012 downtime has dropped 47%.[29]

Second, numerous states are operating with large amounts of wind without reliability issues. Nine U.S. states are currently operating with greater than 12% of their annual electricity generation from wind (Colorado, Idaho, Iowa, Kansas, Minnesota, North Dakota, Oklahoma, Oregon, and South Dakota), with two of them (Iowa and South Dakota) operating with greater than 25% of in-state generation from wind.[30] If wind was unreliable it would not be reaching these levels of penetration.

Third, such a statement fails to account for one of the main reasons for having an integrated power system -- so that all power plants can back up all other power plants. Variability and uncertainty affect all sources of electricity supply and demand, but are largely canceled out by other (variable and uncertain) sources on the grid. As a result, having a dedicated backup source for each source of variability would be highly inefficient and counterproductive, as counteracting that resource's variability would often increase total power system variability. As an analogy, it would be highly inefficient and counterproductive to have a dedicated resource accommodating fluctuations in the electricity demand at an

[29] DOE, "Wind Vision: A New Era for Wind Power in the United States" at ch. 2 p. 51 (March 2015) *available at* http://www.energy.gov/eere/wind/maps/wind-vision.
[30] AWEA, "U.S. Wind Industry Annual Market Report, Year Ending 2014", at 28 (2015).

individual household, as nearly all of those changes are canceled out anyway by other changes on the aggregate grid.

Moreover, having a large pool of flexible resources available on the power system is the most efficient way to accommodate the total power system's variability and uncertainty. Like every other generation resource, wind resources work best as part of a mix of resources on the power system. A major challenge and expense faced by grid operators is how to maintain reliability when individual power plants break down, as all power plants do from time to time. The challenge is particularly great for failures at large fossil and nuclear power plants, which can take enough electricity to supply a large city offline in a fraction of a second. Over the last century, power grid operators have perfected tools for combining hundreds of power plants that are each individually unreliable into a power system that is very reliable. By using most power plants to "back up" all other power plants, grid operators ensure that the lights stay on when even the largest power plant on the grid unexpectedly goes offline. This process works so smoothly that most people are not aware that it occurs.

A 2013 analysis performed by the National Renewable Energy Laboratory (NREL) indicates that higher levels of renewable energy may actually decrease the total cost of operating reserves (i.e. power available on standby), even though the quantity of operating reserves has increased. As I stated above, adding renewable generation displaces the output of the most expensive power plants that are currently operating, freeing those generators up to provide reserves and therefore driving down the cost of reserves.[31] NREL's analysis of the Colorado and Wyoming power system found that the total operating reserve costs actually fell from $32.3 million, at a 25% renewable penetration, to $31.2 million at a 35% renewable penetration, even though the quantity of operating reserves increased.

A 2015 Brattle Group study performed in-depth case studies of the Electric Reliability Council of Texas and Xcel Energy Colorado to see how they integrate high shares of variable renewable energy. Brattle found that ERCOT and Xcel could integrate 40% to 60% of renewable energy into the system using well-established and widely available methods and technologies while maintaining high levels of reliability. Moreover, this integration can be done at a modest share of the total cost of the electric system.[32]

A 2015 NREL study examined possible reliability concerns from the addition of renewables needed to meet the EPA's Clean Power Plan. The report reviewed seven studies of how wind and solar resources with penetration rates from 20% to 50% of annual energy demand have been integrated and their consequential cost

[31] Marissa Hummon, Paul Denholm, Jennie Jorgenson and David Palchak for National Renewable Energy Laboratory, "Fundamental Drivers of the Cost and Price of Operating Reserves", at 31 (July 2013).
[32] Jurgen Weiss, Bruce Tsuchida of The Brattle Group, "Integrating Renewable Energy into the Electricity Grid: Case Studies Showing How System Operators are Maintaining Reliability", at 30-31 (June 2015).

and reliability impacts. NREL noted that all of the studies found that electricity demand could be served at all times.[33]

Finally, in 2014 the Minnesota Department of Commerce released a comprehensive study that found no challenges to integrating 40% wind and solar energy in Minnesota. The analysis included a detailed examination of power system dynamics and other reliability services. The study also found no challenges for accommodating the variability associated with wind and solar providing 50% of electricity in the state, though due to time constraints the study did not include a full analysis of power system dynamics in that case.[34]

Q: Also on page 15, Dr. Bezdek asserts that wind is not scalable. Do you agree?

A: No, I do not.

Q: Why not?

A: As I mentioned before, 38 states already have wind resources operating or have companies producing wind turbine components. Wind power constituted an

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[33] M. Ahlstrom, C. Smith, D. Piwko, D. Lew, A. Bloom, T. Mai, K. Clark and M. Milligan for National Renewable Energy Laboratory, "Relevant Studies for NERC's Analysis of EPA's Clean Power Plan 111(d) Compliance" at 22 (June 2015).

[34] GE Energy Consulting, "Minnesota Renewable Energy Integration and Transmission Study: Final Report", (October 31,2014) *available at* https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={D607FB96-F80C-49EE-A719-39C411D5D7C3}&documentTitle=201411-104466-01.

average of 34% of the total new generating capacity added in the United States each year from 2007 to 2013.[35]

The growth trend marched upwards in 2014, as 4,854 megawatts of generating capacity was installed, four times more than 2013.[36] And in sharp contrast to 2013 and 2014, there has been 1,994 megawatts of wind installed in 2015 through June 30th, with 13,600 megawatts of wind under construction in 24 states.[37]

There are also approximately 12,720 MW of wind projects currently in the MISO interconnection queue, in various stages of study and development. Over 83% of that capacity was added in the past three years, demonstrating the industry's unwavering interest in developing wind projects in the Midwest. These projects, and others that have not yet begun the formal interconnection process, will play an increasing role in meeting the future energy needs of utilities in the Midwest, as load grows, coal plants retire, and customers and states demand cleaner electricity. The wind industry's ability to rapidly deploy to meet periods of high growth demonstrates that wind is indeed scalable.

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[35] DOE, "Wind Vision: A New Era for Wind Power in the United States" at ch. 2 p. 9 (March 2015) *available at* http://www.energy.gov/eere/wind/maps/wind-vision
[36] AWEA, "U.S. Wind Industry Annual Market Report, Year Ending 2014", at 12 (2015).
[37] AWEA, "U.S. Wind Industry Second Quarter Report 2015", (July 2015) *available at*: http://awea.files.cms-plus.com/FileDownloads/pdfs/2Q2015%20AWEA%20Market%20Report%20Public%20Version.pdf

Q: On page 15 of his direct testimony, Dr. Bezdek predicts that the worldwide share of wind and other renewable sources of energy will not measurably grow between now and 2040. What role do you foresee for wind/renewables in the electricity mix in the coming decades?

A: To a large extent the demand for wind energy by 2030 or 2040 will be shaped by the EPA's guidelines for existing and new stationary power plants. As mentioned above, over that time I anticipate utilities will move toward a cleaner, more flexible energy portfolio.

For example, during the development of the new federal Clean Power Plan, the EPA attempted to estimate renewable energy based on a region's current rates. Building on that estimate, the Union of Concerned Scientists (UCS) prepared its own estimate of the amount of renewables that states would use for compliance with the Clean Power Plan out to 2030. The estimate is based on the expectation that states will continue to add renewable energy at rates similar to what they are currently demonstrating. The UCS approach builds on and improves both of the EPA's renewable energy estimates by incorporating the following core components:

- setting a national renewable energy growth rate benchmark based on demonstrated growth in the states from 2009 to 2013;
- assuming full compliance with current state renewable energy standard policies, as set by law, that require certain percentages of electricity to come from renewable sources; and
- accounting for actual and expected renewable energy growth between 2013 and 2017.

UCS estimates[38] that the states in the MISO footprint would need to add wind generation sufficient to generate 213,171 gigawatt-hours of energy. See Attachment 1.2. This includes wind generation that would be used to comply with state renewable energy standards. To give you an idea of the incremental addition of wind generation, the amount of wind generation in the MISO states generated approximately 58,917 gigawatt-hours of energy in 2012.[39] Subtracting that amount from UCS's estimated amount results in a need of 154,254 gigawatt-hours. At a capacity factor of 40% MISO states would add approximately 48,566 megawatts of wind generating capacity above what was in MISO in 2012, which was 12,270 MW.[40]

The National Resources Defense Council (NRDC) also conducted the same analysis the EPA did under its Alternative RE Approach for the draft guidelines that were issued in June 2014, but NRDC used updated cost data from a range of industry and government sources. NRDC found that there is 65% more renewable energy available than the volume the EPA originally estimated.[41] When the

[38] UCS has estimated the amount of wind generation that could be used in the Midcontinent Independent System Operator's (MISOs) footprint (Arkansas, Illinois, Indiana, Iowa, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Montana, North Dakota, South Dakota and Wisconsin) for compliance with the EPAs' Proposed Approach, in the draft guidelines issued on June 2, 2014. The EPA issued final guidelines for existing and new stationary power plants on August 3, 2015. I will present UCS's estimates for the draft guidelines to give an idea of the extent of wind energy that could be added in the MISO footprint by 2030.
[39] EPA, Alternative RE Approach Technical Support Document, Table 1.3 (June 2, 2014).
[40] MISO Informational Forum Presentation, at 32 (January 22, 2013) *available at*: https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/Informational%20Forum/2013/20130122/20130122%20Informational%20Forum%20Presentation.pdf.
[41] EPA Docket No. EPA-HQ-OAR-2013-0602, National Resource Defense Counsel, Comments on the EPA's Proposed Carbon Pollution Emission Guideline for Existing Stationary Sources, Ch. 6-1 (Dec. 1, 2014), *available at*: http://docs.nrdc.org/air/files/air_14120101b.pdf.

potential for distributed solar PV is taken into account, this results in a total increase of 86% above EPA's estimates. In the MISO region, this translates to 286,700 gigawatt-hours[42] of renewable energy, which is 227,798 gigawatt-hours more than the wind energy generated in the MISO states according to the EPA's Technical Support Document for the Alternative RE Approach.[43]

This anticipated growth is not limited to just the United States. According to the Global Wind Energy Council, installations of wind energy systems have grown approximately 23% each year over the past decade, with cumulative global capacity approaching 370 GW at the end of 2014. The GWEC forecasts that Asia, which now dominates the global market for wind, will lead markets with 40-45% of the annual global total going forward, and that cumulative capacity will exceed 665 GW by 2019.[44]

[42] EPA Docket No. EPA-HQ-OAR-2013-0602, National Resource Defense Counsel, Comments on the EPA's Proposed Carbon Pollution Emission Guideline for Existing Stationary Sources, Appendix 6B (Dec. 1, 2014), *available at*: http://docs.nrdc.org/air/files/air_14120101b.pdf. This value includes UCS' total RE estimated for Arkansas, Illinois, Indiana, Iowa, Louisiana, Michigan, Minnesota, Missouri, Mississippi, Montana, North Dakota, South Dakota and Wisconsin.
[43] EPA, Alternative RE Approach Technical Support Document, Table 1.3 (June 2, 2014), *see* "2012 RE*" column.
[44] GWEC global status overview: http://www.gwec.net/global-figures/wind-energy-global-status/.

Q: Bezdek contends that economic growth depends upon increased carbon dioxide emissions. (Direct Testimony at 18-20). Do you agree that an increasing role for renewable energy (and the concomitant reductions in carbon dioxide emissions) would impede economic development?

A: I do not.

Q: Why not?

A: As the analyses described above indicate, increased deployment of renewable energy can actually save homeowners and businesses money, while also providing a valuable hedge against future volatility in fossil fuel prices. Maintaining competitive electric rates is a priority in any reasonable economic development strategy and I firmly believe that the increased usage of renewable energy will help achieve that goal. Beyond the demonstrable savings in electricity costs and protections for ratepayers, the development of renewable energy provides a tremendous opportunity for economic growth, particularly in rural communities.

The Minnesota Department of Employment and Economic Development (MN DEED) recently published a study profiling the state of Minnesota's "Clean Energy Economy". Their comprehensive analysis found that over 15,000 Minnesotans are employed in the clean energy sector. These are high-quality, permanent jobs in the construction, operations and maintenance, transportation, installation, research and development, sales, engineering, and manufacturing sectors, and collectively, they offer salaries 42% higher than the state average. As the MN DEED report demonstrates, these direct jobs have grown significantly over the past decade, which directly correlates with Minnesota's concerted efforts to increase the role of renewable energy in the state through stable policy drivers like the Renewable Energy Standard and the Energy Efficiency Resource Standard.[45]

Today, operating wind farms located in Minnesota provide over $10 million in annual property tax payments to host counties and townships. Cumulatively, Minnesota communities have received over $50 million.[46] In many of the counties with a high density of wind, this revenue makes up a significant portion of their operating budget and helps these counties pay for vital services, invest in infrastructure, and hold the line on property taxes. As renewable energy grows in Minnesota, so will this revenue, resulting in new opportunities for economic growth throughout the state.

In recent years, the wind industry has also become increasingly "American-made". Indeed, in 2005 less than 25% of U.S.-deployed turbines' value was

[45] Minnesota Department of Employment and Economic Development, "Minnesota: Clean Energy Economy Profile, (October 2014), *available at: http://mn.gov/deed/images/MN_CleanEnergyEconomyProfile_FullReport.pdf.*

[46] "Wind Energy Production Tax brings $27.9 million to Worthington and surrounding counties", *Worthington Daily Globe*, (January 2015), *available at: http://www.dglobe.com/news/3662097-wind-energy-production-tax-brings-279-million-worthington-and-surrounding-counties*

manufactured domestically, but today, approximately 60 percent of a wind project's value is now made domestically. The rapid development of this domestic manufacturing infrastructure helps shield the industry from limiting global factors and further underscores the industry's ability to grow --- and grow quickly --- as demand for low-cost, clean wind energy increases.

For many of the reasons enumerated above, I expect that the role of wind energy will grow significantly throughout the Midwest. Because we operate in a regional energy marketplace, if a load-serving entity in Minnesota wants to purchase renewable energy, it does not necessarily need to be physically located in the state. Accordingly, I would argue that if Minnesota does not actively pursue policies intended to attract the in-state development of renewable energy, the state's economy would be adversely affected.

Q: Does this conclude your testimony?

A: Yes.

Attachment 1

CHRIS KUNKLE

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EXPERIENCE

Jan. 15 – Present — Regional Policy Manager – West
Wind on the Wires *(St. Paul, MN)*

- Advance the interests of the wind energy industry with state legislative and regulatory bodies.

Oct. 2011 – Dec. 2014 — Government Relations Coordinator and Energy & Telecommunications Paralegal
Cullen Weston Pines & Bach LLP *(Madison, WI)*

- Represented various environmental, energy, and business clients before the legislative and executive branches.
- Developed and implement comprehensive legislative strategies and public relations campaigns.
- Collaborated with a diverse mix of outside interest groups and non- governmental organizations to accomplish shared policy and/or regulatory goals.
- Encouraged and fostered involvement from Wisconsin supply chain business and other non-traditional stakeholders in the state's political, legislative, and administrative processes.
- Participated in regulatory proceedings at the Public Service Commission of Wisconsin, including attending hearings, preparing and reviewing testimony and other relevant filings, and conducting research.

May 2011 – Oct. 2011 — Intern
Martin Schreiber & Associates *(Madison, WI)*

- Conducted legislative and policy research.
- Coordinated scheduling for and attended important committee proceedings, press events, and individual meetings.

Feb. 2010 – May 2011 — Intern
Wisconsin State Legislature *(Madison, WI)*

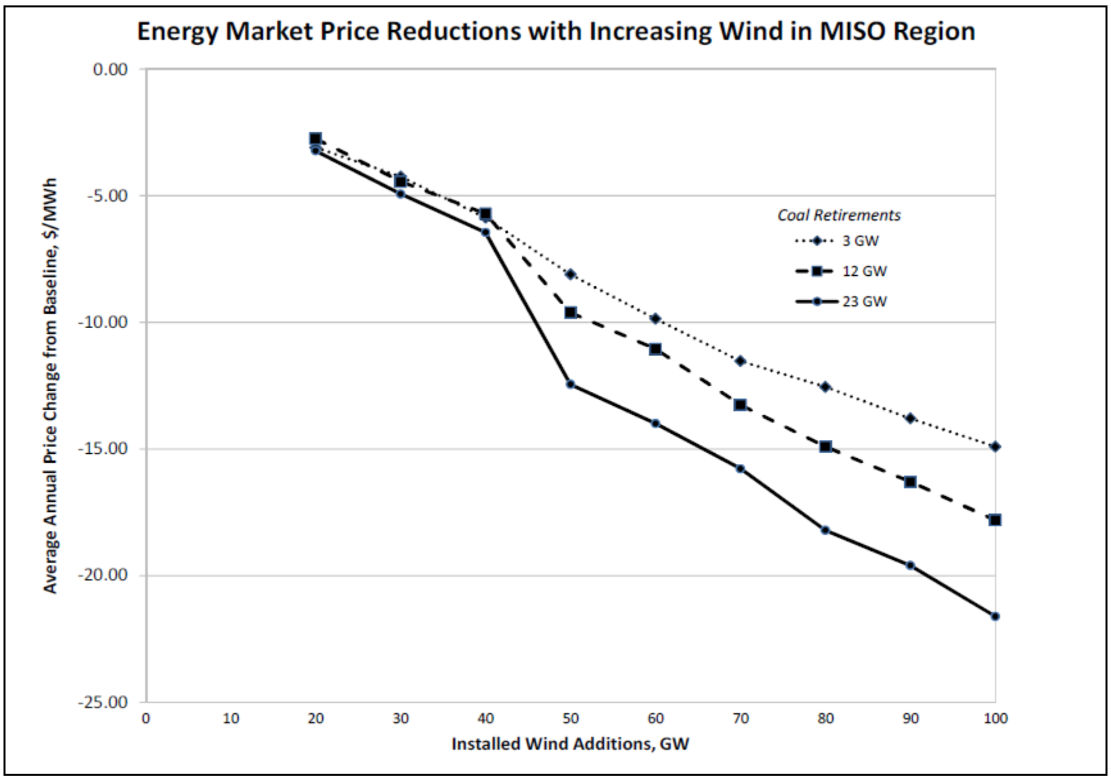
- Conducted legislative and policy research.
- Addressed concerns of constituents, both verbally and in writing.
- Developed office efficiencies designed to streamline administrative processes.

EDUCATION

May 2011 — **University of Wisconsin – Madison**
Bachelor of Arts

PUC Docket No. E999/CI-14-643
OAH Docket No. 80-2500-31888
Clean Energy Business Coalition
Exhibit No. ______

Attachment 1.1: Electricity Market Prices Decline as Wind Capacity is Added, from Synapse Energy Economics, Inc., The Potential Rate Effects of Wind Energy and Transmission in the Midwest ISO Region, at 4 (May 22, 2012), available at http://cleanenergytransmission.org/wp-content/uploads/2012/05/Full-Report-The-Potential-Rate-Effects-of-Wind-Energy-and-Transmission-in-the-Midwest-ISO-Region.pdf



PUC Docket No. E999/CI-14-643
OAH Docket No. 80-2500-31888
Clean Energy Business Coalition
Exhibit No. ______

Attachment 1.2: Forecasts for Wind Generation in MISO States for 2030

		Forecasted Renewable Energy Generation for 2030 (GWh)			
		EPA Proposed Renewables Approach	EPA Alternative RE Approach	UCS Demonstrated Renewables Growth Approach	NRDC RE Market Potential Run
State	**2012***	**2030***	**2030****	**2030[t]**	**2030[tt]**
Arkansas	1660	4,709	4057	8,403	5,031
Illinois	8372	17,818	23706	37,889	93,679
Indiana	3546	7,547	21951	19,643	43,696
Iowa	14183	8,566	30040	21,558	26,671
Louisiana	2430	6,892	1823	14,993	5,777
Michigan	3785	8,056	10862	22,979	41,856
Minnesota	9454	7,889	18647	28,341	21,651
Mississippi	1509	5,458	2506	8,701	82
Missouri	1299	2,764	12075	16,580	4,614
Montana	1262	2,723	10206	4,951	12,327
North Dakota	5280	5,460	14862	7,290	10,013
South Dakota	2914	1,819	19156	5,584	13,808
Wisconsin	3223	6,859	5954	16,259	7,510
TOTALS:	**58,917**	**86,559**	**175,845**	**213,171**	**286,715**
Energy: Delta 2030-2012		**27,642**	**116,928**	**154,254**	**227,798**
Capacity (MW, assuming 40% CF)	**12270[+]**	**24,703**	**50,184**	**60,836**	**81,825**
Delta: 2030 - 2012		**12,433**	**37,914**	**48,566**	**69,555**

* EPA, Alternative RE Approach Technical Support Document, Table 1.3 (June 2, 2014), see "2012 RE*" column

** EPA, Alternative RE Approach Technical Support Document, Table 1.3 (June 2, 2014), see "2029" column

t EPA Docket No. EPA-HQ-OAR-2013-0602, Union of Concerned Scientists, "Comments on the

Proposed Clean Power Plan for Existing Plants", at 41-45, Table 6-1 (Dec. 1, 2014), available at: http://www.ucsusa.org/sites/default/files/attach/UCS-Technical-Comments-on-Clean-Power-Plan_12-1-14.pdf.

tt EPA Docket No. EPA-HQ-OAR-2013-0602, National Resource Defense Counsel, Comments on the EPA's Proposed Carbon Pollution Emission Guideline for Existing Stationary Sources, Appendix 6B (Dec. 1, 2014), available at: http://docs.nrdc.org/air/files/air_14120101b.pdf.

+ MISO Informational Forum Presentation, at 32 (January 22, 2013), available at: https://www.misoenergy.org/Library/Repository/Meeting%20Material/Stakeholder/Informational%20Forum/2013/20130122/20130122%20Informational%20Forum%20Presentation.pdf