BEFORE THE
PUBLIC SERVICE COMMISSION OF WISCONSIN

Application for the Certificate of Public Convenience and Necessity of High Noon Solar Energy, LLC to Construct a Solar Electric Generation Facility in the Town of Leeds, Town of Lowville, Town of Arlington, Town of Lowville, and Town of Hampden, Columbia County, Wisconsin	Docket No. 9814-CE-100

DIRECT TESTIMONY OF MICHAEL J. VICKERMAN

ON BEHALF OF RENEW WISCONSIN

Q. Please state your name and business address

A. My name is Michael J. Vickerman, and my business address is 214 N. Hamilton St. Madison, WI 53703.

Q. By whom are you employed, and in what capacity?

A. I am Policy Director for RENEW Wisconsin (RENEW).

Q. On whose behalf are you testifying?

A. I am testifying on behalf of RENEW.

Q. Please describe your educational background.

A. I have a Bachelors of Arts degree in History and Art History from the University of Wisconsin-Madison.

Q. **Please describe your work experience.**

A. I began working for RENEW Wisconsin in October 1991 as its Advance Plan 6 intervention manager. I became RENEW's Executive Director in 1994, and

served in that capacity until 2012. Since then, I have been RENEW's Policy Director. My work with RENEW today focuses on renewable energy policy development at the regulatory, legislative, and municipal level. My professional qualifications are further summarized in Ex.-RENEW-Vickerman-1.

Q. Please describe RENEW.

A. RENEW is a domestic, nonprofit corporation headquartered in Madison that works to advance the renewable energy goals adopted by the State of Wisconsin over the years. Since its founding in 1991, RENEW has worked to increase access to and development of renewable energy sources in Wisconsin to power homes, businesses, and vehicles. To that end, RENEW formulates and advocates for policies and programs to expand the use of solar power, wind power, renewable natural gas, local hydropower, ground-source and air-source heat pumps, energy storage, and electric vehicles.

Q. How does RENEW advance solar power as a general policy matter?

A. In recent years, solar generation has emerged from the margins of the electric power landscape to become a reliable and cost-effective energy resource for a wide variety of applications and circumstances. Solar power's emergence owes much to its remarkable scalability, unmatched by any other generation source today. Many RENEW members are active in solar electric development. They include contractors and consultants specializing in behind-the-meter installations for retail customers, solar arrays directly feeding utility distribution systems, and large-scale solar power plants supplying multiple electric providers. To a degree unmatched by any other state-based organization, RENEW works to increase the

accessibility of solar energy, in all sizes and configurations, to all citizens of the state. In furtherance of that aim, RENEW became the Wisconsin state chapter of the Solar Energy Industries Association in 2020.

Q. What is the purpose of your testimony in this proceeding?

A. The principal purpose of my direct testimony is to discuss the importance of the High Noon Solar and Battery Energy Storage project (High Noon Solar), as a utility-scale source of zero-carbon renewable electricity, to the ongoing transition to replace older fossil generation sources with in-state renewable generation. I will also provide an estimate of the project's likely impact on carbon dioxide emissions attributable to Wisconsin's electric power sector.

Q. Have you prepared any exhibits with your direct testimony?

A. Yes. In addition to Ex.-RENEW-Vickerman-1 referenced above, I am sponsoring the following exhibits:

- Ex.-RENEW-Vickerman-2, RENEW's Solar Project Tracker dated January 2023;
- Ex.-RENEW-Vickerman-3, excerpts from the Commission's 2021 Renewable Portfolio Standard Report issued in July 2022; and
- Ex.-RENEW-Vickerman-4, annual profiles of Wisconsin's electricity sector published by the U.S. Energy Information Administration (EIA) in 2021, 2020, and 2019.

Q. Please describe the advances that utility-scale solar power has achieved in recent years as a base generation source in Wisconsin.

As a component of our public education efforts, RENEW tracks solar development activity occurring in Wisconsin and periodically publishes updates on our website. As indicated in Ex.-RENEW-Vickerman-2, the state is in the early stages of a significant buildout of solar generating capacity. Though the scale of the buildout was modest at first, it has been accelerating since 2020. The largest category of solar power projects—those totaling a minimum of 100 megawatts (MW) of capacity--require a Certificate of Public Convenience and Necessity (CPCN) issued by the Public Service Commission (Commission) before they can proceed to construction. From April 2019 through December 2022, the Commission approved 12 CPCN applications acounting for 2,149 MW of solar generating capacity. Several of these solar project proposals are paired with battery energy storage systems (BESS) designed to provide grid support during the late afternoon and and early evening hours. As of today, three of the solar farms that received CPCN approval—Two Creeks, Point Beach, and Wood County—are fully operational, totaling 400 MW. Over the next 14 months, five additional solar plants with CPCN permits—Badger Hollow, Paris, Grant County, Onion River, and Springfield—should become fully operational. All told, by the close of 2023, the eight solar plants listed above will account for 1,350 MW of capacity, In addition, the Commission approved two applications from Wisconsin Power and Light to construct and operate eight solar plants that had received siting approval from local jurisdictions. All eight plants, totaling 489 MW of capacity, should also be operational by the close of 2023.

Q. How does High Noon Solar fit into the solar buildout underway in Wisconsin?

High Noon Solar is one of six proposed solar generation projects presently undergoing review via the Commission's CPCN process. The other five are Portage (9810-CE-100), Saratoga (9816-CE-100), Northern Prairie (9815-CE-100), Langdon Mills (9818-CE-100), and Elk Creek Solar (9819-CE-100). The combined solar capacity in all six projects total 1,301 MW if approved (see Table 1 below), with High Noon Solar accounting for 300 MW of that total. All in all, I estimate that there are approximately 4,179 MW of utility-scale or front-of-meter solar generation projects in Wisconsin today that are either (1) operational, (2) under construction, (3) permitted but not yet under construction, or (4) under siting review by either the Commission or a local jurisdiction.

Table 1

Solar (and storage) projects undergoing Commission review as of January 2023

Project	**Solar Capacity** (in MW(AC)	**BESS Capacity** (AC capacity except where noted)
Portage	250	137.5 MW/550 MWh
Saratoga	150	52.5 MW/210 MWh
Northern Prairie	101	None
High Noon	300	165 MW/660 MWh
Langdon Mills	200	50 MW/200 MWh
Elk Creek	300	76 MW(DC)
Total	**1,301**	365 MWAC/1,420 MWh + 76 MWDC

Q. How important are in-state sources of utility-scale solar power to the broader policy aims of Wisconsin's energy policy?

A. In RENEW's view, the solar projects listed in Ex.-RENEW-Vickerman-2 will serve the public interest by tilting Wisconsin's renewable generation portfolio, now weighted in favor of out-of-state sources, firmly in the direction of in-state facilities. In docket 5-RF-2021, the Commission staff's 2021 Renewable Portfolio Standard Report contains a breakdown of 2021 renewable generation between in-state and out-of-state sources.[1] In all of 2021, Wisconsin electric providers derived only 39% of their supplies of renewable electricity—two out of every five MWh—from sources located in Wisconsin, while a remarkable 61% of the renewable electricity sold in Wisconsin that year originated from another state. Indeed, according to the same report, more than half (55%) of Wisconsin's renewable electricity came from windpower projects located in Illinois, Iowa, Minnesota and South Dakota, some of which are owned by or are operating under contract to Wisconsin electric providers.[2] This outsourcing of renewable power results in the export of manufacturing opportunities, local government revenues, landowner income, and workforce participation that could otherwise yield direct and indirect economic benefits to Wisconsin communities.

The emergence of solar energy as a reliable, low-cost source of electric power presents an opportunity to build a geographically dispersed portfolio of zero-emission plants within Wisconsin's borders. As noted earlier, this portfolio

[1] See Commission Memorandum, Appendix E, PSC REF# 441273.
[2] See Commission Memorandum, Appendix E, PSC REF# 441273.

has already started to take shape. In south-central Wisconsin, where High Noon Solar would be located, there is sufficient land and transmission infrastructure to accommodate additional bulk sources of solar power, whereupon they would cost-effectively serve rural and urban communities across the state. Solar power at this scale and in this region can contribute substantially to the generation transition underway to fill in the capacity holes created by retiring fossil generating plants planned for later this decade.

Q. How much electricity do you estimate will be generated by this group of projects over their first 10 years of operation?

A. In calculating the future output from these projects, I must make several assumptions regarding their productivity. For the first 27 projects listed in Ex.-RENEW-Vickerman-2, I used a capacity factor of 23%, even though the applications for a substantial portion of these projects assumed higher capacity factors. While that capacity factor may seem conservative, it was selected to internalize the slight degradation factor that will occur over the course of a solar panel's operating life. That degradation factor is assumed to be 0.5%/year, or 5% over a 10-year period. That said, all of the 27 projects in the first group except the 417 kW project serving Superior Water, Light and Power will utilitize single-axis tracking devices to maximize the capture of the solar resource in the early morning and late afternoon hours. Most of these projects will make use of bifacial panels, which should result in increased output in the winter months relative to fixed-mount arrays. With these assumptions in mind, the combined output from the 3,414.9 MW of capacity represented in that group should average 6,880,340

megawatt-hours (MWh) per annum over their first 10 years of operation, for a total of 68,803,400 MWh.

For the second group of projects (Nos. 28-56), I reduced the capacity factor to 22.75% to account for the handful of installations in operation that rely on fixed-mount racking, which is slightly less productive relative to projects that use single-axis tracking devices. However, since most of the solar capacity represented in the second group operates with single-axis tracking devices, the reduction in aggregate output should be slight. With that assumption in mind, the combined output from the 763.9 MW of capacity represented in the second group should average 1,522,376 MWh per annum over the projects' first 10 years of operation, for a total of 15,223,760 MWh.

When the the subtotals from each group are added together, the combined total should average 8,402,716 MWh per year over the projects' first 10 years of operation.

Q. What percentage of Wisconsin power generation do those numbers represent?

A. According to the most recent State Electricity Profile (Ex.-RENEW-Vickerman-4) published by the U.S. Energy Information Administration (EIA), the electric power sector in Wisconsin generated 64,276,480 MWh in 2021. When the estimated 8,402,716 MWh of solar generation is divided by the statewide electric generation total in 2021, that increment of solar power would have accounted for 13% of the electricity produced in Wisconsin that year.

Q. What percentage of Wisconsin electricity sales do those numbers represent?

A. A comparison of the estimated output from the solar projects listed in Ex.-RENEW-Vickerman-2 to Wisconsin electricity sales yields a similar though smaller percentage, as Wisconsin is a net importer of electricity. According to the Commission staff's Renewable Portfolio Standard Report for 2021,[3] annual retail sales reported by Wisconsin electricity providers over the 2018-2020 period averaged 69,181,062 MWh. When the estimated 8,402,716 MWh of solar generation is divided by the the electricity sales average cited above, that increment of solar capacity would have accounted for 12% of the electricity sold in the state of Wisconsin during that three-year period.

To put the above numbers in perspective, in-state solar generation accounted for 0.5% of total electricity sales in Wisconsin in 2021 (364,283 MWh out of 69,537,075 MWh). These numbers also appear in the Commission staff's 2021 Renewable Portfolio Standard Report.[4]

Q. What is your estimate of High Noon Solar's expected contribution to that total?

A. To estimate High Noon Solar's output over its first 10 years, I used a capacity factor of 23%, even though the project will utilize single-axis traking devices and may use bifacial panels, which are more productive than monofacial panels. Assuming a 23% capacity factor, High Noon Solar would produce an average of 604,440 MWh/year over the first 10 years of its operating life, accounting for approximately 7.5% of the solar generation represented by the 56 projects listed in Ex.-RENEW-Vickerman-2.

[3] See Commission Memorandum, Appendix C-4, PSC REF # 441273.
[4] See Commission Memorandum, Appendix E, PSC REF # 441273.

Q. Does the EIA report emissions data attributable to Wisconsin's electricity sector?

A. Yes. EIA'S 2021 profile for Wisconsin tracks carbon dioxide emissions, sulfur dioxide emissions and nitrogen oxide emissions from electricity generators in the state. The profile expresses the emissions both in terms of annual volumes and per-MWh rates. In its most recent state electricity profile of Wisconsin, EIA reports that the state's electricity sector emitted a total of 36,408,000 metric tons of carbon dioxide in 2021.[5] That works out to an emissions rate of 1,246 pounds, or 0.566 metric tons, of carbon dioxide per MWh generated in Wisconsin. The emission rate reported in 2021 is higher than the numbers from the previous two years (1,188 lbs. in 2020[6] and 1,233 lbs. in 2019[7]). I estimate that it will take two more years before the cumulative impact from this wave of solar generation translates into lower CO_2 emissions as reported in EIA's electricity profiles for Wisconsin.

Q. As a zero-carbon source of renewable electricity, how much carbon dioxide would High Noon Solar displace through its operation?

A. If EIA's emission rate of 1,246 lbs./MWh were multiplied by High Noon Solar's expected output over its first 10 years, the project would avoid or displace an average of 342,332 metric tons of CO_2 per year over its first 10 years of operation, all other things being equal. While this is admittedly a crude

[5] See Wisconsin Electricity Profile 2021, Energy Information Administration (https: // www. eia.gov/ electricity/state/Wisconsin/).
[6] See Wisconsin Electricity Profile 2020, Energy Information Administration (https: // www. eia.gov/ electricity/state/archive/2020/Wisconsin/).
[7] See Wisconsin Electricity Profile 2019, Energy Information Administration (https: // www. eia.gov/ electricity/state/archive/2019/Wisconsin/).

methodology that does not take into account expected power plant retirements in the next five years, it is a reasonable approach for producing a ballpark estimate of emissions reductions from a power plant fueled by a noncombustible renewab/le energy source. Moreover, the calculation I provide can be updated each year when EIA publishes a new state electricity profile for Wisconsin, and can be cross-checked with every new iteration of the Strategic Energy Assessment.

Q. How will High Noon Solar contribute to system reliability?

A. Utility-scale solar plants built with single-axis tracking devices are designed to follow the sun's daily path during daylight hours, starting with the first minutes of sunrise and continuing through to the final minutes of sunset. This design feature optimizes the solar plant's ability to capture sunshine in the early morning and in the late afternoon/early evening hours. The latter attribute is particular valuable for utilities that have significant summer peaks, which tend to occur between 3:00 pm and 7:00 pm in those months. Along with 300 MW(AC) of solar generation, High Noon Solar also features a battery energy storage component, which will have a capacity rating of 165 MW(AC). A BESS of that size can store up to 660 MWh of electricity. The battery energy storage system enhances the solar output by storing excess production that occurs in the morning or early afternoon for use later that day. With the capability of providing grid support after sundown, a solar and storage project in ColumbiaCounty will reduce the need for generation from other utility sources during late afternoon peak periods. This particular atttribute

will become more valuable to Wisconsin electricity customers as fossil fuel prices increase, as they have been doing this year.

Q. What is your view on the project's impact on Columbia County's agricultural land base?

A. If approved and constructed, High Noon Solar would have a land footprint between 2,000 and 2,100 acres, sufficient to encompass the arrays and the BESS. According to High Noon Solar witness Jamie Wilson, about 95% of that acreage is presently used for agricultural activity (Direct-HNS-Wilson-9). Columbia County has a total area of 774 square miles, according to its website. [8]

Multiplying 774 by 640, the number of acres in a square mile, results in a total of 495,360 acres of land. Of that total, 304,058 acres were in active cultivation in 2017, according to the U.S. Department of Agriculture's county-by-county census of farms and farming operations from that year.[9] The 304,058-acre total amounts to 61% of the total land area available in Columbia County. I compared the 61% number to the percentages that are typical for other counties in the Midwest. According to a July 2021 analysis put forward by the Great Plains Institute (GPI), titled "The True Land Footprint of Solar Energy," the average percentage of county land use across the Midwest that is dedicated to cultivated agriculture is 42.3% (see Table 1, Ex.-RENEW-Vickerman-3). GPI's analysis

[8] See Columbia County Profile (https:// www. co.columbia.wi.us/ columbiacounty/accounting/AccountingHome/ColumbiaCounty,Wisconsin-CountyProfile/tabid/2843/Default.aspx.

[9] See https: //www. nass.usda. gov/Publications/AgCensus/2017/Online Resources/County Profiles/Wisconsin/cp55021.pdf.

defines cultivated agriculture as "conventional crops, including corn, soybeans, and other fruits, vegetables, and grains. It does not include other forms of agriculture like pasture or grasslands."

Table 1 also shows the average percentage of county land use in existing and queued solar development, which for a Midwest county is 0.23%. For comparison purposes, a project footprint of 2,000 acres works out to about 0.66% of the land area in Columbia County that is currently engaged in cultivated agriculture activity. That low percentage is consistent with Great Plains Institute's conclusion that "current and proposed solar land uses are a fairly minimal percentage of total county land use when compared to other land uses …."

Q. Does RENEW support approval of the High Noon Solar project?

A. Yes. RENEW Wisconsin wholeheartedly supports Commission approval of High Noon Solar. In our view, this project, like other large solar generating facilities that the Commission has approved, would protect human health and the natural environment while strengthening the state's economy. The economic benefits would come in two forms. Initially, during its construction phase, High Noon Solar would create more than 700 well-paying jobs for the state of Wisconsin, according to High Noon Solar witness David Loomis (Direct-HNS-Loomis-4-5). The participation of skilled laborers and apprentices at the job site would increase expenditures and tax revenues for Columbia County and the state of Wisconsin by as much as $90 million in total as project construction proceeds. Second, High Noon Solar will, once energized, provide rental income to participating landowners as well as payments in lieu of taxes to local jurisdictions hosting the

installation. Consistent with Wisconsin's Energy Priorities Law, this project will provide these benefits by converting a locally available, noncombustible renewable energy resource—sunshine---to electricity, and feeding its output into existing power lines. For the foreseeable future at least, electricity generated by High Noon Solar should displace fossil-fueled generation at all times. When High Noon Solar is energized, its output will flow along the existing high capacity transmission lines that today move generation from the Columbia Energy Center near Portage to other parts of the state. The Columbia power plant is set to be retired in 2026.

Q. Does this complete your direct testimony?

A. Yes, it does.