BEFORE THE STATE OF WASHINGTON
ENERGY FACILITY SITING EVALUATION COUNCIL

In the Matter of the Application of: Scout Clean Energy, LLC, for Horse Heaven Wind Farm, LLC, Applicant.	DOCKET NO. EF-210011 REBUTTAL TESTIMONY AND ATTACHMENTS OF GREGORY POULOS ON BEHALF OF SCOUT CLEAN ENERGY

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REBUTTAL TESTIMONY AND ATTACHMENTS OF GREGORY POULOS

ON BEHALF OF

SCOUT CLEAN ENERGY

EXH-1031_R

JUNE 30, 2023

I. INTRODUCTION AND QUALIFICATIONS:

Q. Please state your name, occupation, and business address.

A. Gregory Steve Poulos, CEO and Principal Atmospheric Scientist, ArcVera Renewables, 1301 Arapahoe Street, Suite 105, Golden, CO 80401.

Q. What are your job duties and responsibilities in that role?

A. Aside from the administrative and leadership duties of the CEO position, I oversee the technical and scientific aspects of our professional advisory services related to wind energy resource assessment of wind farms, globally. I have direct knowledge of the details of scientific, technical, analysis, and quantitative aspects of wind energy resource assessment, and have, and continue to, work on wind energy resource assessment and advancing new methods within the field of wind energy resource assessment.

Q. What is your educational and professional background?

A. I have worked as a technical expert in wind farm analysis for 15 years, working on several hundred wind farms, globally, including prospecting, data analysis, measurement placement and configuration, siting optimization, energy analysis, scenario analysis and recommendations, performance benchmarking, advanced wind flow modeling, due diligence, third-party certification, bankable energy assessment and operational forensic analysis of wind farm performance. This includes personal experience with tens of thousands of megawatts of utility scale wind plants within a firm that has worked on over 60% of the operating wind turbines in the United States. I hold a BS in Meteorology from Cornell University, and a MS and PhD in Atmospheric Science from Colorado State University, having worked at Los Alamos National Laboratory and the National Center for Atmospheric Research, including a 10-year period as an entrepreneur and research scientist. I am currently on the International Electrotechnical Commission committee (61400-15) which determines

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industry standards for wind energy resource assessment. A summary of my education and professional experience is included as an exhibit to my testimony.

Q. When were you first engaged in this matter?

A. I originally encountered the Horse Heaven project in 2007, when it was part of the wind farm development portfolio of Clipper Windpower, and I had taken the role as the head of wind energy resource that same year.

Q. Are you familiar with the Horse Heaven project? If so, how?

A. I am very familiar with Horse Heaven, having been in charge of the installation of meteorology towers at the site at Clipper Windpower, including site visits, and subsequently after leaving Clipper Windpower doing reports for a technical consulting firm named V-Bar through 2012. The project was revived in 2016 by Scout Clean Energy for whom I, and others at ArcVera Renewables, have done independent technical consulting on the Project as requested since that time.

Q. For whom are you testifying and what is the purpose of your testimony?

A. My testimony is on behalf of Scout Clean Energy, intended to provide additional information or explanation related to the Project's layout and turbine configuration relative to industry standard and common processes. Specifically, I am testifying to provide a response to aspects of the testimony of Tri-Cities C.A.R.E.S. witnesses SimonWind (Richard Simon), Dean Apostol, and David Sharp.

II. REBUTTAL TESTIMONY:

Q. Can you provide a brief description of how a wind or solar project layout is developed?

A. Wind farm development differs from solar farm development in many ways, most generally because the areal footprint of most solar farms is smaller because the resource (solar radiation) is not impacted by the solar panels themselves; in a wind farm, because slower wind moves downstream behind a wind turbine, wind turbines

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are spaced far enough apart to recover enough wind speed to optimize energy production. That being said, the development of a wind and solar farm layout has a number of similar steps including, in short:

- Determining that a particular location on the electricity grid has favorable attributes for development. This is part of a so-called "fatal flaw" analysis, including wind or solar resource, land availability, grid access or anticipated access, state and local policy incentives, environmental/wildlife/land-use constraints, etc.
- Leasing of lands or being granted permission to use lands.
- Taking at least one year of local on-site measurements (up to two measurement location for solar, and up to several or even tens of measurements locations for wind energy) and resource modeling and reporting. This part of the process is relevant to the technical analysis required to write industry standard bank-ready reports and for site optimization and technology selection, aiming for the lowest cost of energy (LCOE) Calculating LCOE requires financial modeling and is very sensitive due to the nature of competition and post-construction electricity market participation. All of these analyses are completed for a given target nameplate capacity of the entire complex e.g., for wind 300 MW; for solar 300 MW AC.
    - For wind, this nomenclature refers to the maximum possible output of the wind turbine or wind farm expressed in megawatts [MW] for utility scale projects, generally reached between 10 and 14 meters per second of wind speed at hub height and called "rated power". For solar, this refers to the alternating current output of the solar modules after being inverted from direct current (DC) to alternating current (AC) expressed as kilowatts [kW AC "kWac"] or megawatts [MW AC

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"MWac"]. Solar farms can be referred to in MW DC terms or MW AC terms, and typically the MW DC value is 1.1 to 1.3 times that of the MW AC value. Since the wind does not always blow and the sun does not always shine at sufficient intensity to operate at full capacity projects are characterized by their energy production (as would reach the grid at the point of interconnect or end user) as a percent of total possible capacity factor or so-called net capacity factor. The maximum value, which is seldom reached for a variety of technical reasons (e.g., electrical transmission losses, wake losses, etc.), is 100% net capacity factor which, in the examples above would mean producing 300 MW of wind or solar energy every moment of every day on an annual basis. On an annualized basis wind farm net capacity factors are generally or can be economical in the range of 25% or higher, with a few exceptions. For solar energy, net capacity factors in the 20's% are common. The economic feasibility of a given wind or solar farm depends on many factors, including energy production, cost of equipment and installation, operations and maintenance costs, power prices, financial incentives, the cost of capital, location on the grid and other factors.

- Environmental, waterways, construction, electrical engineering/grid, geotechnical/civil, terrain/soil/ground surface suitability, investigations and constraints from zoning ordinances
- Prepare a buildable area polygon within which wind turbines and solar panels can be sited based on information in previous steps (this is often completed early in the process, then refined many times as information is collected and different lands are utilized)

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- Design a wind or solar array layout according to industry standards.
    - For wind energy, based on the winds and constrained area, optimize the wind turbine type and model, string orientation and positions, to maximize energy production and minimize LCOE. For a 300-MW nameplate capacity wind farm, and individual wind turbines of 3-MW, 100 turbines would be placed optimally. If the wind turbines are 5-MW, then only 60 turbines are required.
    - For solar energy, based on the solar radiation characteristics and constrained area optimize the module and inverter type, racking system, tilt angle (fixed, single-axis, dual-axis), ground cover ratio etc.) to maximize energy production and minimize LCOE. For a 300-MW AC (three hundred million watts) nameplate capacity solar farm, several hundred thousand solar panels would be placed optimally.
- Array designs for wind turbines are commonly between two and four rotor diameters side-by-side within wind turbine strings and between seven and 16 rotor diameters string-to-string, with some variation. The Horse Heaven array conforms to these norms, with 2+ rotor diameter side-by-side spacing and 10-12 rotor diameter string spacing.

Q. Was the Horse Heaven project developed in this same way?

A. Yes. All of these steps have been performed by Scout Clean Energy in concert with cross-checking and analysis by myself as part of ArcVera Renewables, other third-party consultants, and prior to 2007, with respect to the proposed wind energy portion of Horse Heaven. I have not been directly involved in the solar energy or battery storage portion of the Project.

Q. Based on your existing knowledge of the project and review of the application materials, is there anything unusual about how the Horse Heaven project layout and wind turbine configuration has been proposed, or any deviation from industry best practices?

A. No.

Q. Have you reviewed the direct testimony of Richard Simon submitted by Tri-Cities C.A.R.E.S.?

A. Yes, I have.

Q. Do you agree with the conclusions in Mr. Simon's analysis? Why or why not?

A. In several instances, no, and I believe his analysis omits several important points. I'll take them in the order presented in Mr. Simon's pre-filed direct testimony.

On page 3, lines 4-6, of Mr. Simon's testimony, regarding wind turbine technology, it is proposed that it would be unprecedented for permitting agencies to issue open ended permits for a wind farm, if multiple turbine positions are under consideration. I am aware of numerous instances where permitting agencies, such as the Federal Aviation Administration, have issued authorizations for a variety of wind turbine array positions within a given project envelope. As noted earlier, wind turbine positions are chosen to optimize the energy production and economics (LCOE) based on the specific characteristics of a given turbine model (its rotor diameter being very critical, as spacing depends on norms based on rotor diameter). Given the competitive nature of energy development, procurement of expensive equipment, and of post-construction operations in the energy markets, it is not unusual whatsoever for numerous wind turbine models, and therefore wind turbine array configurations, to be under consideration within a given project envelope until permitting is complete and the projects are financed. A final decision regarding the purchase of the wind turbines for this Project, of course depends on getting EFSEC approval, an approach which I do not find unusual.

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On page 3 of his testimony, Mr. Simon makes several statements about the large size of the Project. The size of the Project is above average and consistent with the trend toward larger wind farms as the desire to transition to clean electricity production accelerates. Larger wind farms generate more clean energy with added economy of scale. So, contrary to Mr. Simon's statement, Shepards Flat wind farm, near Arlington, Oregon, is 50 miles away, nearly 1,000 MW and has been operating for many years. Pattern Energy is currently constructing the 3,500-MW SunZia wind farm in New Mexico. Our firm is engaged with numerous clients in the US and globally that are pursuing onshore wind farms of 500-2,000 MW nameplate capacity. There are numerous wind farm clusters near or above the size of Horse Heaven. In addition, many wind farms or clusters of wind farms overlook or are in the vicinity of large populations. The heavily built-out Altamont Pass wind farm complex in California, for example, overlooks the city of Livermore. Similarly, the San Gorgonio Pass wind farm and nearby wind farms, with hundreds of wind turbines collectively, are situated near Palm Springs and North Palm Springs, California (nearly 500,000 population).

On page 3, line 19, Mr. Simon discusses the wind resource potential of the Project. In this section it is unclear to what "data" Mr. Simon is referring within the Project footprint as I don't believe he has authorization to utilize any of the proprietary data now owned by the Applicant to make such calculations. Nevertheless, we (consistent with my experience with this and other renewable energy developers) can be assured that the Applicant would not be seeking EFSEC approval for a > $1 Billion dollar project unless its analysis deemed it a worthy investment, as with any renewable energy developer-owner-type client of our company. In all my years of experience, I have never heard of a developer investing in and seeking project approval for a project that it did not consider, by way of

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proprietary and customary financial modeling, financially viable. Moreover, given the extremely sensitive nature of project economics in the industry, it would be inappropriate to share information of this nature unless authorized by the Applicant. The Applicant owns the data from which all such analyses as in this section are created, and all derived products for which they paid. Mr. Simon confirms here that the escarpment is a high wind resource location within the Project footprint. I concur with that assessment and that is why wind turbines are sited primarily on or near the escarpment.

Mr. Simon notes that his projected energy for the Project is lower than wind farms located in Montana, Wyoming, and the Upper Midwest. Mr. Simon neglects to mention that there is a corresponding cost for long-distance transmission from those distant locations to this part of the electricity grid that increases project expenses and that would reduce economic viability despite higher wind speed. This is to be expected given that the wind resource is lower. Nevertheless, there are many wind farms in Washington and Oregon with similar or lower energy production as measured by capacity factor (these data are available for free on the Department of Energy, Energy Information Administration website). I conclude that the energy productivity of the Project is consistent with expectations for the region.
Similarly, on page 8, line 10, Mr. Simon asserts that the Project may not be economically viable. The economics of wind farm development are highly protected by wind farm owners due to the competitive nature of the energy business. Unless it is within the purview of EFSEC to judge the financial decisions on behalf of a private entity, I don't believe comment on this aspect is warranted in the case where it is out of a given expert's area of expertise.

On page 9, line 1, Mr. Simon makes contentions about limited grid availability. I understand that the Project has completed studies that ensure that its

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power can be absorbed by the grid following standards and requirements of generator interconnection processes. I know that the Project comprises a significant solar and battery storage component; taken together the wind profile alone will not define the energy generation profile because solar and battery storage are also present and alter the energy output profile by season substantially. If the Project is producing more than 850 MW of energy at any given time, the batteries can absorb the excess, only to inject it at a later time, when needed by the grid. Thus, with batteries and solar energy, the Project energy production will project a much different annual energy generation profile than if it were only wind.

On page 9, line 18, Mr. Simon discusses the potential impact of the Project on Nine Canyon. It is common for new wind farms to produce wakes and many clusters of wind farms have been built over time across the United States and in the Pacific Northwest. I do not find the building of one wind farm that impacts another unusual.

Q. Have you reviewed the direct testimony of Dean Apostol submitted by Tri-Cities C.A.R.E.S.?

A. Yes, I have.

Q. Do you agree with the conclusions in Mr. Apostol's analysis? Why or why not?

A. Most of Mr. Apostol's testimony is outside my area of expertise, so I am unable to comment on whether his analysis adheres to industry standards for most of the document. However, in some instances, Mr. Apostol testifies about certain aspects of the wind turbine layout or would impact the wind turbine layout, which is within my expertise and I will comment on those areas.

Pages 1-4 of Mr. Apostol's testimony consist mainly of general information regarding scenery and visual impact. This is a helpful list and may or may not be applicable to the Project, depending on the observer. I have observed in my time in the industry that many people prefer wind turbines over smoke stacks, and consider

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them beautiful and elegant – a hopeful sign of progress and a visual sign that they are participating in actions that make the world a better place. That is not so say that some individuals do not share this sentiment.

On page 5, line 20, Mr. Apostol "recommend[s]" that "[w]hile it is not likely possible to avoid all visual impacts given the size and nature of the proposed facilities, it is probable that a design could be done that retains significant renewable energy production, while reducing visual/scenic impacts to a level that most of the community would find to be acceptable." I agree with the statement that it is not possible to avoid all visual impacts. And then, by logic, there will always be some visual impact if any wind farms are built. The Nine Canyon wind project began operations in 2008 with even closer proximity to the Tri-Cities. It seems logical that another wind farm or several wind farms could also be built without undue impact on the local populace if situated at a similar or further distance away as Nine Canyon, even accounting for the fact that modern day wind turbines have somewhat larger dimensions. A sole focus on visual impact seems undue, given early points herein regarding the careful analysis that must also be undertaken in many different technical areas, including ensuring that the array design meets industry standards and is optimized on the lands of the participating landowners, to make a successful project. It is my understanding that issues related to economic viability are not a factor in EFSEC's decision process.

On page 22, Mr. Apostol suggests Scout did not consider topography or "cluster[ing] or group[ing]" turbines to "create visual order." As stated earlier in this rebuttal, the process of determining where to place wind turbines on the landscape is definitively focused on topography and its relationship to the local meteorology, specifically the wind speed on a given topographic feature or within a given area. So yes, topography was crucially considered, as wind speed patterns are almost always

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strongly related to topography relative to the frequency of the wind rose and site-specific meteorological details (wind speed variations of 0.1 m/s are important, so small topographic variations affect the energy production and therefore economics of the wind farm substantially), among many other factors. Mr. Simon points out that best resource is along the escarpment and that is why the majority of the wind turbines are located there. For its winds, the escarpment is in the heart of the Project, in the sense that the windier the location the more energy production on a per wind turbine basis.

The wind farm itself is a cluster of wind turbines, organized in a clear manner that follows the contours of topography and highest wind speed, with varied wind turbine strings of different length, breaking up long strings, unlike Nine Canyon which has tightly spaced near-linear organization. The use of white colored wind turbines is most common in the industry. Given the rather uniform dominant west to southwesterly (or northeasterly) wind direction 2/3 of the time it is expected that the wind turbines will present a common profile as they spin and generate energy.

On page 23, Mr. Apostol provides his opinion of the "most obvious" way to reduce the visual impacts by "build[ing] fewer turbines, removing those closest to the most viewers." I note from the maps in the ASC that there are only 4 wind turbines sited unobstructed on the escarpment near Benton City, which is the closest area with residents, while the remainder of the wind turbines are behind the escarpment further out of view in that area. All other wind turbines are further from populated areas than the Nine Canyon wind project, with the exception of the wind turbines in the immediate vicinity of Nine Canyon wind project itself. Removing wind turbines that have been carefully sited based on wind resource and other factors would only serve to reduce the energy production of the Project, impacting financial calculations and feasibility.

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Mr. Apostol then suggests that "[d]esigners could take their cues from the high and low areas along the ridgeline, leaving the higher places undeveloped, while clustering turbines (perhaps more densely) in the lower places or gaps." This approach would be highly non-standard and is incompatible with industry practice, whereby wake losses and wind farm-atmosphere interaction energy losses are minimized to maximize energy production, within given constraints, and while seeking the lowest cost of energy (see also the earlier brief description of the process). Wind speeds are less favorable in such locations, and clustering wind turbines increases wake losses, reducing energy production. While I agree that visual impacts are unavoidable, it is also true that the area in which wind turbines can be placed is limited to the Project lands and the wind speeds within those lands, given the need to create a viable Project. The wind turbine locations chosen are optimized within those constraints.

Q. Have you reviewed the direct testimony of David Sharp submitted by Tri-Cities C.A.R.E.S.?

A. Yes, I have.

Q. Do you agree with the conclusions in Mr. Sharp's analysis? Why or why not?

A. Most of Mr. Sharp's testimony is outside my area of expertise, and it is unclear to what degree Mr. Sharp has expertise in wind farm technical analysis and wind turbine siting thus I am unable to comment on how his analysis adheres to industry standards for most of the document. However, in some instances, Mr. Sharp testifies about certain aspects of the wind turbine layout or factors that would impact the wind turbine layout, which is within my expertise and I will comment on those areas.

As to his contention at page 2, lines 10-16, the wind turbine layouts represented in the ASC adhere to industry practice and were designed to optimize the wind farm for viability within lands and constraints. I know this because our firm,

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among other third-party consultants with similar expertise, were employed in this regard. Presenting detailed energy production (and or related financial information or modeling) information would be highly unusual in a competitive landscape, and is closely held information for all developers and their investors that I work with worldwide.

On page 2, line 17, Mr. Sharp includes a litany of complaints. In my view the complaints are unfounded, for the following reasons:

- Revealing specific details and point measured data that shows proprietary wind speed information is not an accepted practice in the profession due to its critical role in understanding energy production from a complex, and therefore its competitive position in the industry.
- The 1,150-MW wind farm is clearly described and mapped, showing individual turbine locations on maps within the ASC.
- Capacity applications have been applied for separately and are unnecessary for the EFSEC application to the best of my knowledge. A developer would not spend the money required to develop a near $2 billion wind/solar/battery facility unless they had clear guidance that the power could access and be sold at a competitive price on the grid, in my experience.
- If the goal of the legislature includes generating clean electricity, then this Project fits that requirement.

On page 2 at line 25 through page 3, Mr. Sharp conveys that wind speed considerations are paramount in the development of a wind farm. That is true. The Project was designed with that notion squarely in mind, along with many other factors, as described earlier in this document. Mr. Sharp apparently does not consider the fact that wind turbine technology has evolved and become more efficient over time, rendering large swaths of the United States, that 10-15 years ago were not

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economical to develop, now economical. Such is the case here, and around the world. With this in mind, even though the wind speed of Washington in general, and this location in particular, is lower than other parts of the United States (e.g., much of the Midwest), it is also true that many areas, due to advancing technology and innovation, are now economic (that is, they can be designed to generate electricity at a low enough levelized cost of energy to be competitive within a given market while also remaining economically viable).

On page 4, Mr. Sharp states the Northwest utilities need the power when demand is highest, such as on very cold days, stating: "very cold days are generally calm". The data do not support this view. Examination of the on-site wind data from a meteorological tower with five years of data on the escarpment, shows that on the coldest 1% of days, the overall wind speeds are reduced by 10% from the annual average and strong enough to produce energy, and are by no means calm. Thus, the Horse Heaven wind farm can be productive on very cold days, and will be further supplemented by solar energy and battery storage, improving the timeliness and dispatchability of the energy produced at Horse Heaven.

On page 5, at line 23 (and repeated on page 14, line 6), Mr. Sharp claims the Project's nameplate capacity of 1,150 MW is unsupported. This statement is not supported by the record. The Project nameplate capacity is clearly described in Section 2.15 of the ASC and tabulated and described in Table 2.15.1. Phases 1 and 2 comprise 1150 MW of nameplate capacity of wind turbines and solar modules.

The nameplate capacities are:

- Phase 1: 650 MW (comprising 350 MW of wind turbine nameplate, and 300 MW (ac) of solar nameplate.
- Phase 2 (alternative A): 500 MW (comprising 250 MW of wind turbine nameplate, and 250 MW (ac) of solar nameplate.

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- Phase 2 (alternative B): 500 MW of wind turbine nameplate.

Phases 1 & 2 also would be supplemented with a total of 300 MW (1200 MW-hr) of battery storage. This is not considered energy generation as it is energy storage, and batteries to not count toward nameplate capacity.

In total, if both phases were completed, the Project would comprise a cumulative nameplate capacity of 1,150-MW, comprising either (Phase 1 and Phase 2, alternative A) 600-MW of wind and 550-MWac of solar nameplate capacity or (Phase 1 and Phase 2, alternative B) 850-MW of wind nameplate and 300-Mwac of solar nameplate. This information is consistent with the work our firm has completed as a third-party independent technical firm.

Since nameplate capacity of 1150 MW represents the maximum power that could be produced at any time by a given wind turbine or solar module, and the sun does not always shine and the wind does not always blow sufficiently fast to generate full power, it is not true that less nameplate could be built in this region with the given wind and solar resource, and meet the desired injection limit. Thus, the combined wind, solar, and battery storage approach taken has merit with respect to seeking to maximize clean energy production and the timeliness of that energy delivery, while ensuring economic viability.

Sharp returns to statements regarding the unnecessary nature of 1,150 MW total nameplate capacity when the injection limit is 850 MW frequently throughout the testimony; but what he apparently doesn't realize is that greater nameplate capacity can be installed and its output controlled (by battery storage and other means) so as not to exceed injection limits. Overbuilding nameplate capacity is a common renewable energy development strategy to help ensure project viability. In addition, it is my understanding that the Applicant can always build less generation capacity than is permitted.

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Much of the rest of Mr. Sharp's testimony repeats his prior points, which have been addressed above, or are in areas that are outside of my area of expertise. There are some subsequent comments however, that I can comment on.

Mr. Sharp's testimony at pages 36-46 addresses the fact that wind turbine parts break (like all mechanical devices), that fires will need to be fought among the wind turbines, that humans will at times pass by or operate farms around the wind turbines, that the wind turbines are placed in favorable areas for wind energy production, that the part of the Horse Heaven Project is in the vicinity of the Nine Canyon wind project, that the wind turbines could generate extra dust, that they will have visual impact, and that ice can build up on the blades and be thrown. These are common issues throughout the wind industry and rarely negatively affect human health. Compared with other cold season locations, the Horse Heaven icing frequency is low, and I note that Nine Canyon has operated since 2008 in this very environment. This list is hardly new and has not prevented the installation of thousands of wind turbines in the United States.

DATED: June 30, 2023.

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