Applicant Exhibit 36

**BEFORE**
**THE OHIO POWER SITING BOARD**

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| In the Matter of the Application of Birch Solar 1, LLC for a Certificate of Environmental Compatibility and Public Need to Construct a Solar-Powered Electric Generation Facility in Allen and Auglaize Counties, Ohio. | ) ) ) ) ) | Case No. 20-1605-EL-BGN |

# DIRECT TESTIMONY OF

**Thomas H. Cleveland**
**Solar Health and Safety Expert**

**on behalf of**
**Birch Solar 1, LLC**

**May 4, 2022**

/s/ *Christine M.T. Pirik*
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**1. Please state your name, current title, and business address.**

My name is Thomas H. Cleveland. I am an experienced solar engineer with a broad background in many aspects of solar energy, and photovoltaics ("PV") in particular. I have a full-time position as a Solar Engineer at a small energy engineering firm in Raleigh, NC, however, I am presenting this testimony as a private consultant with expertise on the health and safety impacts of photovoltaics. My business address is 4141 Laurel Hills Rd. Raleigh, NC.

**2. Please summarize your educational background and professional experience.**

I obtained Bachelor of Science and Master's degrees in mechanical engineering from North Carolina State University. Following graduation, my professional career started with 12 years at the North Carolina Solar Center, since renamed the North Carolina Clean Energy Technology Center, an extension and engagement center at North Carolina State University. When I started at the university there was no utility-scale solar industry and I worked on a wide range of solar energy projects including installing demonstration PV systems, testing solar equipment, developing codes and standards, and teaching undergraduate and professionals. A few years later, developers in North Carolina began to install large numbers of 5 megawatt ("MW") solar PV facilities and soon the state had installed more photovoltaic capacity than any state other than California. Photovoltaics, especially at this scale, were unfamiliar to the communities near the many new solar facilities, and many of those communities had questions about the technology and its potential to harm public health or the environment. Many of those questions found their way to me as the lead solar engineer at the solar center at the state university. I answered the questions that I could and began researching the questions I did not have answers for. Over several years I built a deep expertise on the potential health and safety impacts of photovoltaics and was the lead author of the widely-referenced 2017 North Carolina State University white paper on the topic. In mid-2017, I left the university and joined a non-profit energy engineering firm conducting interconnection commissioning of utility-scale solar and battery facilities for utilities in North and South Carolina. In this role, I inspect the construction quality of the alternating current ("AC") portions of the facility and test the facility for compliance with performance requirements in its interconnection

agreement. Over the past 5 years I have been the lead engineer for the (interconnection) commissioning of over 60 PV facilities and 4 battery energy storage facilities. In addition to this full-time solar engineer position, I privately serve as an expert on the health and safety of photovoltaics. Over the past 8 years, I have served as an expert witness on the health and safety of photovoltaics at over 175 land use permit hearings in 9 states. A copy of my resume is attached to my testimony as Attachment THC-1.

**3. On whose behalf are you offering testimony?**

I am testifying on behalf of Birch Solar 1, LLC ("Applicant" or "Birch Solar"), which is seeking to develop the proposed Birch Solar facility ("Project") in Allen and Auglaize Counties, Ohio.

**4. What is the purpose of your testimony?**

The purpose of my testimony is to provide additional context, support, and clarification for Birch Solar's Application for a Certificate of Environmental Compatibility and Public Need ("Certificate"), filed in Case No. 20-1605-EL-BGN on February 12 and 17, 2021, as supplemented,[1] and further supplemented by responses to data requests that were received from and filed in the docket ("Application"). Specifically, my testimony addresses the potential for environmental, health, and safety impacts from photovoltaic modules (panels).

My testimony, together with the other witnesses for Birch Solar testifying in this case, supports approval by the Board of Birch Solar's application for a Certificate to construct the Project.

**5. Please describe the history of your involvement with the Birch Solar Project?**

My involvement with the Birch Solar Project began in December 2021.

**6. Have you reviewed the Certificate conditions recommended by the Board's Staff on pages 50 through 58 of their Report of Investigation issued on October 20, 2021**

[1] The Application was initially filed on February 12 and 17, 2021, and subsequently supplemented on: March 25, 2021; March 31, 2021; April 5, 2021; October 5, 2021; February 9, 2022; February 17, 2022; and May 4, 2022.

**("Staff Report")?**

Yes I have.

**7. Are you aware that the Applicant has accepted the Certificate conditions recommended by the Board's Staff in the Staff Report and has committed to comply with those conditions as part of its Certificate issued in this case?**

Yes. That is my understanding.

**8. Are you aware of the types of modules the Applicant has committed to using for this Project?**

Yes. The Applicant has committed to use crystalline silicon modules from a Tier I manufacturer that have passed the Toxic Characteristic Leaching Procedure ("TCLP") test.

**9. What is the TCLP test?**

TCLP stands for Toxic Characteristic Leaching Procedure. Federal waste management laws (Resource Recovery and Conservation Act["RCRA"]) require that PV modules, like any other commercial/industrial waste, be disposed of properly, which first requires that the waste be identified as either hazardous or non-hazardous waste. The method for determining whether a specific model of PV modules is hazardous or non-hazardous waste is the TCLP test. This test was developed by the United States Environmental Protection Agency ("U.S. EPA") to simulate landfill conditions and determine if the waste leaches unsafe levels of 8 toxic metals and 32 organic compounds. In the TCLP test, samples from a PV module are broken into pieces smaller than a centimeter and tumbled in an acid bath for several days. The tested PV module passes the test if the level of all 8 toxic metals and all 32 organic compounds in the acid solution are under the thresholds defined by the TCLP test standard.

**10. What does it mean when the Applicant says only modules that pass the TCLP test will be used for the Project?**

This means that before purchasing any specific model of PV module the Project will require that the model pass a TCLP test at an approved testing laboratory. Modules that

have passed a TCLP test are defined as non-hazardous waste and may be disposed of in a regular landfill, also called a sanitary landfill or an engineered landfill. This means that if all the PV modules at the Project are disposed of in a regular landfill, they would not harm groundwater or other local water sources. While all modules at the Project could be disposed of in a landfill, it is worth noting that the Project has committed to recycling all solar modules, including any modules damaged during construction, operations, and all modules at the end of life/decommissioning. Consistent with Condition 42 of the Staff Report, the Applicant has committed that, if it is unable to recycle the modules at the end of their useful life, retired panels marked for disposal will be sent to an engineered landfill with various barriers.

**11. Based upon the Applicant's commitment to the type of module to be used for the Project, is it possible to determine the nature of the probable environmental impact of the facility?**

Yes.

**12. Based upon the Applicant's commitment to the type of module to be used for the Project, together with the conditions in the Staff Report, does the facility represent the minimum adverse environmental impact on those resources considering the state of available technology and the nature and economics of the various alternatives, and other pertinent considerations?**

Yes.

**13. Are your opinions and conclusions in your testimony made with a reasonable degree of professional certainty?**

Yes.

**14. Does this conclude your testimony?**

Yes. However, I reserve the right to update my testimony to respond to any further testimony, reports, and/or evidence submitted in this case.

**CERTIFICATE OF SERVICE**

The Ohio Power Siting Board's e-filing system will electronically serve notice of the filing of this document on the parties referenced in the service list of the docket card who have electronically subscribed to these cases. In addition, the undersigned certifies that a copy of the foregoing document is also being served upon the persons below this 4th day of May, 2022.

*/s/ Christine M.T. Pirik*
Christine M.T. Pirik (0029759)

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# Attachment THC -1
# Thomas H. Cleveland
# Resume

DICKINSON WRIGHT PLLC

# Thomas (Tommy) H. Cleveland, P.E.

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## ***Education & Training***

North Carolina State University, Mechanical Engineering M.S. 2004
North Carolina State University, Mechanical Engineering B.S., Business Mgmt. minor 2001 - Summa Cum Laude
Lumberton Sr. High School, Lumberton, NC, 1997 – Valedictorian

Professional Engineer (P.E.), North Carolina (#033711) since 2007, South Carolina (#37453) since 2019, and VA (#402063889), OH (PE.86943), and FL (#91941) since 2021.

## ***Professional Experience***

*Solar PV Engineer, Advanced Energy, Raleigh, NC, April 2017–Present*

- One of 3 lead engineers on a team of 11 conducting interconnection commissioning of utility scale photovoltaic systems for Duke Energy and other utilities
- Lead engineer conducting interconnection commissioning of several MW-scale PV plus Battery Energy Storage Systems (BESS) for Duke Energy and electric cooperative utilities
- Responsible for commissioning of several projects in various stages of commissioning at a time
- Review of single line diagram for compliance with interconnection agreement and required interconnection and construction standards.
- Evaluation of utility-scale solar PV facilities to assess the quality of design, construction, and operation for electric utility interconnection commissioning
- Writing detailed engineering report of required, completed, and recommend corrections for PV facility to complete the interconnection commissioning process
- Technical support to engineers and contractors to determine optimal correction solutions
- Approval of all correction work, both via photos and in-person
- Review of settings in site protection system (recloser control) and site power/energy meter for each PV facility
- Developed spreadsheet to facilitate consistent review of SEL-651 and SEL-751 recloser control settings
- Lead commissioning test of distribution-connected utility-scale PV facilities, which includes approving inverter and recloser settings, confirming meter and recloser phasing, 3-phase and 1-phase anti-islanding testing, and testing of inrush mitigation systems.
- Engineering analysis and concise presentation of results to customers
- Failure investigation of commercial PV facility
- One of 2 or 3 trainers of Annual 4-hour Duke Energy Training on Interconnection Commissioning for developers and contractors building utility-scale PV systems in Duke Energy territory in North and South Carolina (2018, 2019, 2020)

*Solar Energy Engineer (various progressive titles), North Carolina Solar Center/NC Clean Energy Technology Center, North Carolina State University, 2005-April 2017*

- Lead solar engineer at the Center (2008-2017)
- Conducted detailed PV + storage feasibility study for community solar project for a NC municipal utility, included development of battery control model to optimize storage size and validate value production – resulted in constructed project owned by the utility without utilizing tax credits
- Provided quality assurance and technical support to development of in-house training program of solar farm construction for a leading regional utility-scale photovoltaic EPC firm
- Guided design of prototype residential Plug and Play PV system and collected AHJ feedback (Department of Energy SunShot project)

- Led design and development of ISO-17025 accredited solar thermal collector testing lab, only the 5th in U.S.
- Co-led stakeholder process to develop Template Solar Development Ordinance for North Carolina
- Designed and installed PV field performance monitoring system, conducted performance analysis
- Conducted renewable energy site assessments for commercial, industrial, and institutional clients
- Presented to local government officials, community leaders, and general public on solar energy
- Provided technical support to a wide variety of energy consumers and stakeholders across NC

*Expert Witness, Private consultant for over 30 solar developers, 2012-Present*

- Provided expert testimony for over 100 utility-scale solar photovoltaic projects throughout the United States (8 states), analyzing (among other things) potential health, safety, glare, or environmental impacts of these projects.
- Conducted glare impact analyses and studies for approximately 20 utility-scale photovoltaic system near public and military airports.
- Conducted site-specific studies of EMF and sound impacts

*Instructor of 1-Day Continuing Education Course on Solar Energy for Professional Engineers, UNC-Charlotte, Fall 2015, 2016, 2017*

- Developed all course content for this 8-hour in-person course
- Course provides introduction to solar energy in North Carolina today for working engineering professionals. The course covers solar energy resource, photovoltaic technology, photovoltaic products, system design, state and federal policy, grid interconnection, project economics, and more
- Based on great attendance and student feedback, twice invited back to teach course for additional year

*Instructor of EA 522 PV Design and Installation, College of Natural Resources, North Carolina State University, 2019-Present*

- Developed all course content for this new three credit hour online course
- Course covers many aspects of photovoltaic design and installation including energy use, solar resource, system design, utility tariffs, estimating, economics, and more
- Course is required for the Certificate in Renewable Energy Assessment and Development

*Instructor of ET 220 Solar Photovoltaic Assessment, Department of Forestry and Environmental Resources, North Carolina State University, 2014-Present*

- Developed all course content for this new three credit hour online course
- Course covers all aspects of photovoltaic site assessment including energy use, solar resource, system design, utility tariffs, estimating, economics, and more
- Course is optional course for an Environmental Technology and Management degree
- Course is required for a Renewable Energy Assessment minor

*Instructor of MAE 421 Design of Solar Energy Systems, Mechanical and Aerospace Engineering Department of North Carolina State University, 2009-2014*

- Instructor of the solar energy engineering course, MAE 421, in the NC State University Mechanical and Aerospace Engineering department
- The course was offered during the spring semester and typically had 30 to 50 undergraduate and up to twelve graduate engineering students
- Previously co-instructor of the course for two years (2007, 2009)

*Research Assistant, North Carolina Solar Center, North Carolina State University, 2003–2005*

- Developed and validated a TRNSYS simulation model of a unique solar thermal concentrating collector
- Assisted with the installation of photovoltaic systems ranging in capacity from 1 kW to 5 kW

## ***Selected Publications***

"Balancing Agricultural Productivity with Ground-Based Photovoltaic Development", NCCETC/NCSU white paper, August 2017, https://nccleantech.ncsu.edu/wp-content/uploads/Balancing-Ag-and-Solar-final-version-update.pdf

"Health and Safety Impacts of Photovoltaics", NCCETC/NCSU white paper, May 2017, https://nccleantech.ncsu.edu/wp-content/uploads/Health-and-Safety-Impacts-of-Solar-Photovoltaics-2017_white-paper-1.pdf

"Community Solar (+ Storage) Program Design for Fayetteville Public Works Commission", NCSU/NCCETC report, March 2017, (Public version) https://nccleantech.ncsu.edu/wp-content/uploads/FPWC_CommunitySolar_Public_Version.pdf

T. Cleveland, "What is Solar?", NCSU Cooperative Extension & NCCETC factsheet, October 2016, https://content.ces.ncsu.edu/what-is-solar

T. Cleveland, H. Tsai, "Charlotte-Mecklenburg Schools Roadmap to 100% Renewable Electricity" & "Durham Public Schools Roadmap to 100% Renewable Electricity", NCCETC, February 2016

T. Cleveland, A. Huang, "Plug and Play Residential PV System Innovation and Demonstration", Solar Power International Conference 2015

T. Cleveland, "*Make Solar Energy Economical*", recorded video lecture for E102: Grand Challenges of Engineering course at NC State University, January 2015

T. Cleveland, M. Clark, "*Template Solar Ordinance for North Carolina",* Solar Power International Conference 2014

T. Cleveland, et al, "Template Solar Energy Development Ordinance for North Carolina", NCCETC & NCSEA, December 2013, www. go.ncsu.edu/template-solar-ordinance

M. Sheehan, T. Cleveland, "*Updated Recommendations for Federal Energy Regulatory Commission Small Generator Interconnection Procedures Screens*", Solar America Board for Codes and Standards Study Report, 64 p., July 2010, www.solarabcs.org/about/publications/reports/ferc-screens/pdfs/ABCS-FERC_studyreport.pdf

T. Cleveland, et al, "*Optimizing Solar Thermal Resource Use at Commercial Buildings*", Solar 2010 – ASES National Solar Energy Conference 2010, 6 p., May 2010, www.ases.org/papers/101.pdf

T. Cleveland, "*Description and Performance of a TRNSYS Model of the Solargenix Tracking Power Roof$_{TM}$*", Solar 2005 – ASES National Solar Energy Conference, 6 p.

T. Cleveland, K. Creamer, & Dr. R. Johnson, "*Energy Metering of Solar Domestic Hot Water Systems for Inclusion in Green Power and Renewable Portfolio Standards Programs*", Solar 2004 – ASES National Solar Energy Conference 2004, 6 p.

T. Cleveland, "*Effective Energy Metering of Solar Domestic Hot Water Systems for Inclusion in Green Power and Renewable Portfolio Standards*", Master's Thesis, North Carolina State University, Raleigh, 191 p., April 2004, http://repository.lib.ncsu.edu/ir/handle/1840.16/1152

## ***Synergistic Activities***

- Member of IEEE 1547 Conformity Assessment Steering Committee
- Member of International Code Council (ICC) Renewable Energy Membership Advisory Council (REMAC) (2015-2018)
- Member of the Board of Directors of the Solar Rating and Certification Corporation (SRCC) (2009-2015)
- Solar America Board for Codes and Standards (Solar ABCs) steering committee (2009-2013)

Summary: Testimony - Direct Testimony of Thomas H. Cleveland electronically filed by Christine M.T. Pirik on behalf of Birch Solar 1, LLC