Solar Project Development in Virginia

March 2018

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SolUnesco, Bringing Solar Generation to Virginia

Francis Hodsoll and Jon Hillis founded SolUnesco in 2015 based on more than four decades of experience in utility plant management, energy project development, construction, and corporate leadership. Prior to forming SolUnesco, Mr. Hodsoll and Mr. Hillis had already delivered over one gigawatt (GW) of power via several power generation projects. They have also led solar policy and legislative efforts in the mid-Atlantic for the last five years.

A Virginia firm founded by two native Virginians, SolUnesco develops clean, renewable energy projects, leveraging local knowledge and "boots on the ground," SolUnesco coordinates a diverse group of stakeholders, including:

- Connecting rural landowners with new revenue opportunities through sustainable, cost-competitive energy generation; and
- Working with communities to ensure responsible development.

Solar's Benefits to the Community

At SolUnesco, we strive to be good neighbors in the communities where we develop projects. We work with local governments and the local community to design our projects to be a net benefit to communities like yours.

Economic Benefits

Our projects benefit the local communities by providing jobs and increased revenues to the local business community. As an example, an independent economist analyzed the direct and indirect economic activity for two 60-megawatt projects (roughly a four-hundred-acre footprint). His reports (available upon request) demonstrate that both the construction and operations will make a significant economic contribution:

- An estimated one-time pulse of economic activity during its construction phase of up to:
    - Roughly 100 full-time-equivalent jobs;
    - Approximately $5 million in associated labor income; and
    - More than $15 million in additional economic output to the county.
- An ongoing estimated annual economic impact during its operational phase of up to:
    - Seven full-time-equivalent jobs (aggregated across both direct and indirect products and services);
    - $300,000 in associated labor income; and
    - $500,000 in additional economic output to the county.

Local Businesses

Several industries could see an economic benefit from a solar project during construction, such as grading, installation of the racking and panels, stone mining and quarrying, fencing, transportation, architectural services, engineering services, non-store retail, gasoline retail, and full-service restaurants.

Following construction completion, and throughout the operating life of the solar project, solar facilities provide increased jobs and income to several types of local businesses. These businesses include electronic and precision equipment maintenance and repair, landscape and horticultural services, employment services, transportation, equipment rentals, automotive repair and maintenance, full-service restaurants and other food and beverage establishments.

Fiscal Contributions

A solar project would make significant fiscal contributions to your county. We estimate a solar facility would generate a net county revenue of ten to fifteen times that generated by typical agricultural use. This significant net increase includes the impacts these projects have on local Machinery and Tools tax, real property tax (including ending the land use designation where relevant), and account for the reduced state education funding when a county's real property values are increased. Considering that solar facilities have one of the lowest impacts on local communities,[1] we submit that the local net revenue gain from these facilities exceeds any impact to the local community in this county.

Solar Versus Agricultural

The analyses of the 60-megawatt solar facilities demonstrate that these projects will provide the host counties with significantly greater annual economic and fiscal impact than what the same property produces in its current agricultural use, as follows:

- A modest increase in full-time-equivalent jobs in the County.
- Several hundred thousand dollars increase in associated labor income.
- Several hundred thousand dollars increase in additional economic output to Greensville County.
- Between fifty and one hundred thousand in additional net county revenue in the facility's first year of operation.

Property Values

Solar facilities preserve landscape buffers and protect the land from other potentially less desirable uses. Solar facilities are good neighbors: they are quiet, produce no emissions, have low profiles, and safeguard neighbors' views with the preservation of existing trees and other

[1] Fiscal Impact on the County: How Does Solar Compare to Other Land Uses? SolUnesco, posted by Seth Maughan. September 2017.

vegetations and planting indigenous vegetation where appropriate. Some of our projects are removing junk and repairing the viewshed and thereby significantly improving the aesthetic quality of the neighborhood.

Solar: Safe, Clean & Environmentally Friendly

SolUnesco seeks to be a good neighbor, and we will work with the county and the local community to adjust our design to preserve the agricultural heritage of the land and protect neighbors' current views. In the identification of potential sites for solar facilities, we conduct a thorough assessment of the electricity infrastructure's capabilities and co-located site characteristics. In the development of the specific design and engineering, we conduct extensive public consultation supported by environmental studies, cultural resources studies, engineering studies and other related analyses.

Heath, Safety, and Environmental Facts

- **Benefits –** Solar energy provides many benefits to the environment and helps reduce carbon emissions. It is a clean, renewable source of power.
- **Emissions** – Solar panels are safe and do not pose any risk to the neighboring community, as they do not produce heat, emissions, or radiation.
- **Wildlife** – Virginia's state permitting process requires both desktop and field surveys to determine the potential for significant adverse impacts to threatened and endangered species of plants or wildlife. If these surveys identify potential adverse impacts, the state permitting process governs the development of mitigation plans to minimize impact. The design of these systems avoids areas with specific topographical characteristics as well as sensitive environmental areas, such as wetlands. Typically, site attributes result in open spaces within the solar system footprint that provide natural habitats for native wildlife. Further, our designs incorporate the planting of naturally occurring plants. Within the solar facility footprint, local permitting requirements typically require the solar facility to protect these native plant species and habitats for the operational life of the system.
- **Birds –** Photovoltaic (PV) panels used on the East Coast do not create heat and will not harm birds flying over, or even landing on top of, the panels. However concentrated solar power (CSP) facilities in the western US deserts reflect sunlight off parabolic mirrors, and the focused beam of sunlight can harm or kill birds. Eastern US climate conditions and land characteristics render this technology uneconomic. Further, industry experts question the future viability of CSP in the United States given the dramatic reductions in photovoltaic pricing.[2]
- **Solar Resources –** Solar is a renewable resource harnessed when available. Solar panels do not affect the photosynthesis of adjacent vegetation.

[2] Ivanpah's Problems Could Signal the End of Concentrated Solar in the U.S. MIT Technology Review, by Richard Martin. March 2016.

- **Water –** Water is not required for operations. Minimal water use may be necessary for controlling dust during construction and for periodic panel washing, which usually occurs once or twice per year. Solar PV systems are one of the least water-intensive methods of generating electricity according to a Harvard Kennedy School study.[3]
- **Noise –** Unlike other power generation facilities, solar projects generate power with few or no moving parts and therefore make very little noise. During construction, local permits govern the hours and other construction practices to minimize impacts to the local community.
- **Light –** Solar projects do not require lighting during normal operations. Security lighting is designed to face inward and downward, away from neighboring properties.
- **Cultural Resources –** Virginia's state permitting process ensures that solar facilities protect cultural resources. If field surveys discover state designated, cultural resources, the state requires that the solar facility avoid the area or mitigate. The state's permitting process may compel the solar facility to provide vegetation and other screening or require the solar facility to conduct extensive archaeological data recovery.

Manufacturing, Construction, and Operations Safety

Solar panels pose no danger from toxic materials during project construction, operation, or post-operation. The manufacturing process of crystalline silicon PV cells does require the use of a small amount of toxic material. The federal government regulates these manufacturing facilities, protecting workers through strict Occupational Safety and Health Administration (OSHA) workplace regulations. PV solar panels manufacturing encapsulates all these material within a glass and metal frame that has been constructed to withstand severe weather (e.g., hail of up to one inch in diameter falling at a rate of 50 miles per hour [mph], hurricane winds up to 140 mph). In May 2017, a Denver area hailstorm struck the National Renewable Energy Laboratory (NREL) with golf-ball-sized hail.[4] In the storm's aftermath, NREL inspected the damage and found only one broken panel out of the 3,000 panels at the site. At the end of a generating system's useful life, state and local government permits and landowner agreements require that the panels be removed from the site and disposed of in accordance with all local, state, and federal regulations.

- **Manufacturing –** OSHA regulations control and limit worker exposure to toxic chemicals during the manufacturing process.
- **Construction –** OSHA regulations require that contractors performing construction activities compile and maintain a Material Safety Data Sheets (MSDS) book of all materials used on projects during construction. The data sheets have specific instructions for cases of

[3]Water Consumption of Energy Resource Extraction, Processing, and Conversion. Energy Technology Policy Innovation Policy Research Group, by Erik Mielke, Laura Diaz Anadon, and Venkatesh Narayanamurti. October 2010.

[4]Massive Hail Storm Takes on Over 3,000 Solar Panels and Loses, CBS Denver, by Chris Spears. May 2017.

exposure. Insurance companies also require construction contractors to create and implement company safety programs, develop project-specific safety plans and procedures to ensure safe product handling, and provide emergency procedures in case of exposure to hazardous elements.

- **Operations –** Panels are sealed, and the negligible amount of toxic elements poses no danger. Hail and wind are the primary concern, and the panels are designed to withstand a high level of these events. If a weather event damaged a panel, remote monitoring instantly notifies the operations center that a panel had failed, and repair operations quickly remove and replace the panel(s).

- **Decommissioning –** At the end of a generating system's useful life, state and local government permits and landowner agreements require that the panels be removed from the site and disposed of in accordance with all local, state, and federal regulations. As part of the local permit, the solar facility prepares a detailed decommissioning plan based on final engineering to ensure that at the end of its useful life, the owners properly remove all components and restore the site for the original use. Before construction, the solar facility presents the decommissioning plan to the county for review. The plan includes a detailed decommissioning process, cost estimates, and commitments on financial security. We recommend that our county permit require that we completely restore the site within 12 months of the solar project's end of life.

- **Fire Hazards –** May 2017, the NC Clean Energy Technology Center published a white paper in response to the potential for fire caused by solar panels. This paper stated that the, "concern over solar fire hazards should be limited because only a small portion of materials in the panels are flammable, and those components cannot self-support a significant fire".[5] State and local governments require that the construction of solar projects conforms to the codes and standards established by the Institute of Electrical and Electronics Engineers (IEEE). Misinformation has led to the belief that emergency responders will not respond to fires involving solar panels. This is not, and has never been, the case for ground-mounted arrays used with utility-scale solar developments. (Several years ago, in a widely publicized case, firefighters in New Jersey refused to put out a warehouse fire with solar panels on the roof.[6] An investigation of the incident concluded that the responders were not properly trained in situations involving solar panels. Rooftop installers in the solar industry have since addressed this by providing training seminars for fire departments.)

Stormwater Quantity Management

Virginia Stormwater Management Program (VSMP) regulations require that all ground-mounted solar facilities greater than 5 MWs prepare a Storm Water Management Plan. We expect that a given solar facility will maintain or improve hydrologic (water) characteristics relative to

[5] Health and Safety Impacts of Solar Photovoltaics, North Carolina State University, NC Clean Energy Technology Center. May 2017.

[6] Dietz & Watson warehouse blaze: solar panels hampered firefighting, officials say, NJ Advance Media for NJ.com, by Seth Augenstein. September 2013.

agricultural land use. However, VSMP (Part IIB) requires that solar facilities address the following requirements:

1. For concentrated stormwater discharges to manmade, restored, or natural stormwater conveyance systems:
    a. 9VAC25-870-66.B - Channel Protection – The project would conform to this provision that generally requires a reduction of flows from the predevelopment condition for the one-year storm event.
    b. 9VAC25-870-66.C - Flood Protection – Stormwater conveyance systems would be reviewed to assess whether the water system currently experiences localized flooding during the 10-year storm event. Depending on the assessment and compliance strategy, the post-development peak flow would generally be either confined within the system to avoid localized flooding or released at a rate less than the predevelopment rate.
2. 9VAC25-870-66.D - Increased volumes of sheet flow (thin, shallow water movement over the ground) "must be identified and evaluated for potential impacts on down-gradient (downward-sloping) properties or resources" to ensure they do not "cause or contribute to erosion, sedimentation, or flooding of down-gradient properties or resources."

Erosion and Sediment Control

During construction, the project would comply with 9VAC25-840 of the Virginia Administrative Code, Erosion and Sediment Control (ESC) regulations. The design and operations will institute and maintain perimeter controls in accordance with state laws and regulations. A detailed Stormwater Pollution Prevention Plan (SWPPP) would be developed for the site to govern all site construction. By rule, site crews will manage daily site construction activities in accordance with the SWPPP and the Construction General Permit (CGP).

Solar Proliferation: Limited to a Few Percent of Available Land

As is the case with all forms of land use, supply, demand, and regulation would determine the amount of land utilized. Based on utility projections and a solar project's requirement to cost-effectively interconnect to the grid, we estimate that solar will employ less than two to three percent of a specific county's available farmland. It would likely be significantly less than this amount. To the extent solar converts productive farmland or timberland to renewable energy generation, the demand for agricultural uses would determine whether farmers convert other unused agrarian land to farming. To wit, a solar energy facility would not utilize a scarce

resource, which is a primary factor in why such projects make economic sense. Low-cost land is a reason why solar generation is competitive with other forms of electrical generation.

Given that over the last two years, Virginia's solar farms have utilized multiple hundreds of acres of agricultural land, we understand the concern about the potential for ongoing loss of farmland. However, this should not be an issue, as there are natural limits placed on the feasibility of solar power generation projects. For example, the electrical system places a natural cap on the total amount of solar capacity. The transmission lines can only handle so much supply of electricity, and the infrastructure limits the amount of total solar generation that could be installed. According to best estimates, less than one percent of the land across the entire Commonwealth of Virginia could ever be taken up by solar. The most aggressive build-out of solar in the Dominion Virginia utility's long-term plan would require even less space than the best estimates—a mere half percent of all the designated agricultural land in the state of Virginia.

Solar Industry Growth in Virginia

An increasing number of companies are committing to purchase renewable energy to power their operations. They are investing and locating their operations in areas where they could obtain solar power. As a result, the solar industry has been rapidly developing in Virginia, bringing job growth and economic investment.

According to the 2017 Solar Foundation's National Solar Jobs Census, Virginia experienced a solid 10% growth in solar jobs from 2016 to 2017. Virginia's growth in solar jobs stands in contrast to a nearly four percent decrease in solar jobs on a national level. The 2017 Solar Jobs Census identified 3,565 Virginia solar jobs, which are defined as more than half of an employee's time being devoted to a solar industry function. In addition, Virginia has seen tremendous growth over the past few years in the amount of solar power generation facilities in operation. Today, the industry has put into service or is currently constructing, over 400 megawatts (MW), in comparison to less than 30 MW in service at the end of 2015.

Solar energy's competitive price compared to other electrical generation sources and the corporate preferences for non-polluting electricity have driven, and will continue to drive, Virginia solar industry's growth. In its latest integrated resource plan (IRP), Dominion determined that solar energy produces the lowest-cost electricity, and solar generation avoids the pricing risks found in fossil fuels. In this current legislative session, leadership from both sides advanced legislation that recognizes the benefits of solar and instructs the state regulator to advance the deployment of solar generation by authorizing up to twenty times the current solar generating capacity currently in operation.

Nationally, the top ten corporate users of solar energy include Target, Wal-Mart, Apple, Costco, Kohl's, IKEA, and Macy's. Every week, 7.3 million people visit a solar-powered Wal-Mart.

Tech companies, including Amazon Web Services, Microsoft, and Facebook, have also entered into solar purchase agreements. In Virginia, data centers provide significant economic growth opportunities, so this is another promising market for solar energy. The city of Ashburn, Virginia

has historically been the epicenter for Virginia data centers, but the hub for new data centers will likely be moving south. Two subsea data cables, known as MAREA and BRUSA, are rated at 160 terabits per second and bring their data to the United States through Virginia Beach. The massive increase in data capacity and the demand for data centers throughout Virginia provide a foundation for future growth in data centers.

Economics, fossil fuel's environmental impacts and the demand from leading businesses are propelling the growth in solar generation in Virginia and throughout the globe. We are highly confident that the demand for solar in Virginia will grow substantially in the coming years.

Federal Support for Solar

Solar benefits from the federal government's 30% investment tax credit. Given all taxpayers contribute to this benefit, counties may wish to consider how best to receive economic and fiscal benefits from this federal government support. Solar facilities will only be able to deliver a return on the taxpayer funds to the local community if they can successfully navigate the local permitting and in addition, the state and federal permitting and the utility interconnection process.

Further, the US federal government supports all forms of energy. Prosperity and quality of life rely on sound energy policies. Historically, the federal government has subsidized fossil fuels at levels far outweighing the solar tax exemption.[7] Today, the federal government continues to provide significant subsidies to fossil fuels while supporting solar and other renewable energy resources. According to an Oil Change International report from October 2017, "U.S. taxpayers continue to foot the bill for more than $20 billion in fossil fuel subsidies each year".[8] Permanently available tax expenditures for fossil fuels in 2016 were $7.4 billion, versus the $1.1 billion for renewable energy. Many experts contend that our Middle East military engagement aims to provide for secure supplies of oil to our global allies and minimize the destabilizing risks from energy price volatility.

The Technology: Simple, Modular and Durable

Current, state of the art solar facilities employ single-axis tracking technology, with solar panels mounted on a framework that tracks the movement of the sun during the day. This utilizes a simple modular design, consisting of the single-axis tracking racking system, mounted panels, inverters to convert direct current (DC) to alternating current (AC) power, transformers that boost the voltage, and meters, safety switches, and wire combiners. The remaining components of the facility include a permanent security fence, gravel maintenance roads, stormwater facilities, and erosion and sediment control facilities. In addition, to the technology's low profile,

[7] Testimony: Federal Support for Developing, Producing, and Using Fuels and Energy Technologies, Congressional Budget Office, by Terry Dinan. Presented March 2017.

[8] Dirty Energy Dominance: Dependent on Denial – How the U.S. Fossil Fuel Industry Depends on Subsidies and Climate Denial, Oil Change International, by Janet Redman. October 2017.

vegetation buffers will be planted where needed to screen adjacent landowners or public rights of way - roads.

From an aerial view, a ground-mounted solar project will appear as long rows of solar panels mounted on posts and horizontal supports. The solar panel arrays will be less than 10 feet tall.

Solar Arrays and Panels

Typically, each array consists of several dozen rows, with each row containing 80 portrait-oriented solar panels running north-south and each panel measures 78 inches by 39 inches or two meters by one meter (Figure A). (Some racking manufacturers allow for half or three-quarters sized rows.) The solar panels are mounted on single-axis tracking steel tubes powered by a motor with 24 volts of direct current (VDC). For each row, typically one small, dedicated solar panel powers the motor (Figure B). Depending on the slope and other site constraints, the solar facility's design will space the rows between 15 feet and 20 feet apart (Figure C). Driven "H" piles spaced 25 feet apart support the rows of panels and tracking steel tubes (Figure D). Manufacturers design their racking systems to withstand 100 miles per hour (mph), three-second-wind gust (ASCE 7-10). The entire array is a self-grounding structure.

Figure A. Array of solar panels, oriented north-south.

Figure B. Self-powered controller with one small, dedicated solar panel per row.

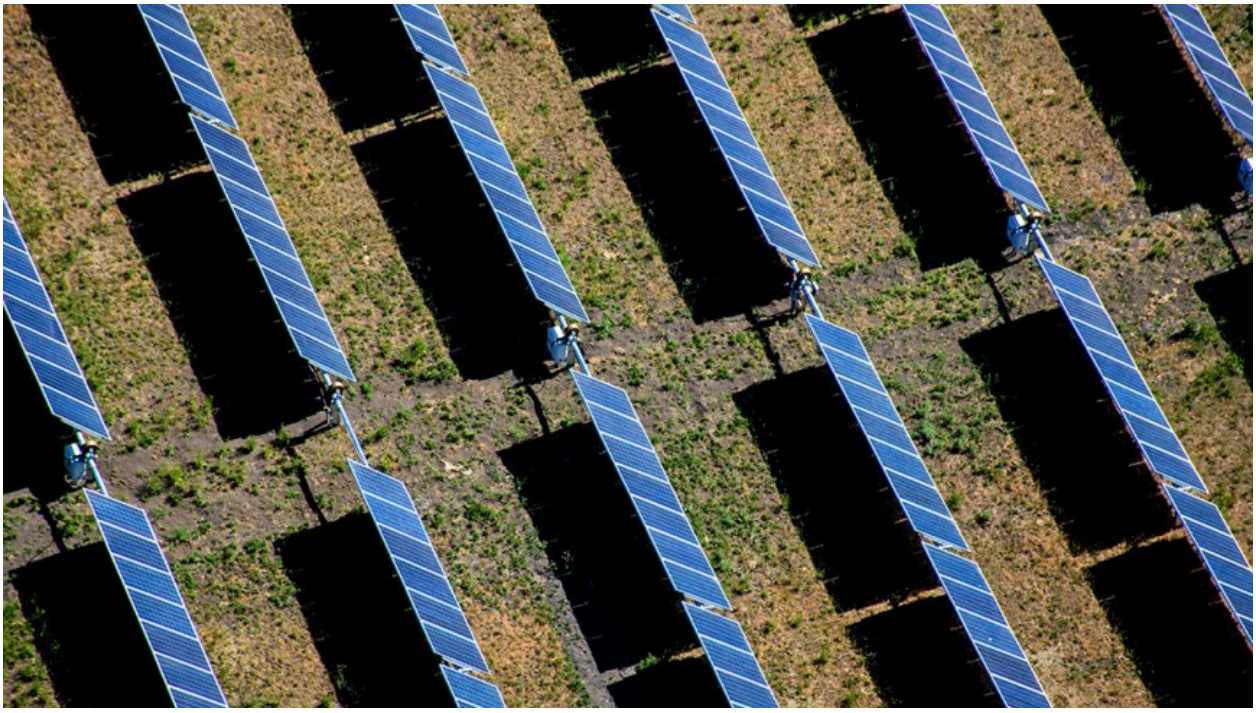

Figure C. Rows are spaced 15 to 20 feet apart, as required to address slope concerns.

Figure D. Array of solar panels, oriented north-south.

Inverters

Inverters convert the direct current (DC) power produced by the solar panels to alternating current (AC) power that is used in homes and businesses. Inverters, measuring approximately 19 feet long by seven feet tall by three feet deep (Figure EFigure E), are installed on concrete pads throughout the project. Solar facilities' designs locate the Inverters away from the project perimeter and adjacent properties.

Figure E. Inverters are spaced throughout the project to convert the DC power to AC power.

Other Components

- **Electrical –** Power generated from panels is combined into lines and run through polyvinyl chloride (PVC) conduit installed below the surface of the ground as required by the National Electrical Code (NEC).
- **Perimeter Fencing –** Six- to seven-foot chain link fencing, as required for security, are installed within the vegetation buffer area. The vegetative buffers will screen the fencing from adjacent property owners and public right of ways.
- **Access Roads –** Maintenance roads are installed between rows of arrays to provide access for periodic maintenance and repairs.
- **Stormwater Control –** Stormwater management facilities and erosion and sediment control facilities are designed based on the analyses ground water control analyses required by extensive state and local permitting requirements. These facilities are designed based on final site layout and engineering.
- **Vegetation Buffers –** Vegetative buffers and setbacks are designed based on local consultation and zoning requirements. The vegetative buffers consist of existing or new trees and vegetation and are typically installed where the solar site abuts neighboring property owners and public rights of way. We recommend that local permitting require that the solar facility maintain the vegetative buffers and setbacks.