SOLAR FEASIBILITY STUDY

Prepared For: Earth Conservancy

Solar Feasibility Study for Abandoned Mines

LaBella
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MARCH 2023

Earth Conservancy

Table of Contents

List of Appendices

Summary

Earth Conservancy retained LaBella Associates, DPC ("LaBella") to conduct a solar feasibility study assessing solar photovoltaic (PV) development opportunities on their approximately 6,000 acres ("Project Site") of abandoned mine land in the southernmost portion of the Wyoming Valley in Luzerne County, Pennsylvania. The area under consideration for redevelopment includes approximately 4,492 acres ("Project Area") of abandoned mine land that is not currently developed to redevelop the land for solar development.

To identify the "fatal flaws" that exist within the Project Area, LaBella performed a desktop review of publicly available data and records, conducted a one-day site visit, and incorporated recent communication with various regulatory agencies to identify potential development roadblocks.

Earth Conservancy also requested a buildable area assessment based on the identified physical, biological, regulatory, and engineering constraints, as well as the feasibility of solar development on abandoned mine lands. Based on the desktop screening, approximately 757 acres with light or medium degree of grading were found to be suitable for solar redevelopment. The buildable area can increase up to 1,667 acres with heavy grading.

Due to the uncertain degree of funding Earth Conservancy will receive for grading and reclaiming the Project Area, LaBella has undertaken PVsyst energy production assessment for two scenarios:

1 Distributed generation solar development (e.g., 5 Megawatts alternating current, MW_{AC}) on contiguous buildable areas where only light to moderate grading is anticipated

2 Utility scale solar development (e.g., 114 MW_{AC}) on areas that need to undergo significant regrading to create a large enough, contiguous buildable area.

These two scenarios roadmap distinct types of solar redevelopment opportunities within the Earth Conservancy's land holdings: community solar, the development of which are not yet permitted by the Commonwealth of Pennsylvania (State), and utility scaled solar, the development of which will be shaped by the successful securing of grants for regrading and reclamation. These grading and reclamation plans for solar redevelopment will require field verification of the following site constraints: topography, structural stability of the previously mined areas at risk for surface subsidence, remediation of historical mining contaminants, and surface waterbodies that may have been created or traverse underground amidst the uneven terrain.

Despite the constraints, the abandoned mine lands present an ideal siting opportunity for community- and utility-scaled solar development. The targeted siting on potentially thousands of acres of previously mined land allows the Project to likely garner significant community support and establishes the Project's candidacy for the development of both community and utility-scaled solar. It remains to be seen what legislation develops from Pennsylvania's entry into community solar and how Pennsylvania-New Jersey-Maryland (PJM) Interconnection's two-year pause will impact the Project.

1. Project Description

Earth Conservancy is looking to develop their land holdings for multiple community-scaled and potential utility-scaled solar energy generation facilities ("Project"). The Project would seek to repurpose approximately 757-1,664 acres of the Earth Conservancy's land holdings for solar redevelopment. The entire Project Area of 4,492 total acres is located within the municipalities of Newport Township, Hanover Township, Conyngham Township, Plymouth Township, Sugar Notch Borough, the City of Nanticoke, Warrior Run Borough, Wilkes Barre Township, Plymouth Borough, Plains Township, Laurel Run Borough, Ashley Borough, and Jenkins Township, Luzerne County, Pennsylvania. Most of the Project Area falls within an Environmental Justice Area, according to PADEP (see Figure 1).

The Project Area primarily consists of abandoned anthracite mineland. It is primarily forested, with some open fields, shrubland, and ponds. Additionally, some areas of the Project Area are more developed, such as the Earth Conservancy Compost Facility.

Old landfills are typically an ideal brownfield site type for solar redevelopment. A historic landfill called Nanticoke Landfill has been found in the northern portion of the Project Area, adjacent to the Newport Township Lake (see Figure 1 or REC 26 in the Enhanced Environmental Risk Screening Report). However, this feature is a strip mine that was then utilized for refuse disposal. The mine/landfill appears to have filled with water, resulting in three distinct pond areas that are unsuitable for solar development. Additionally, the landfill is located directly adjacent to a cemetery, which would be subject to historic preservation review prior to solar development.

Some of the Earth Conservancy lands have been reclaimed, while others still have large culm piles and depressions that are characteristic of abandoned mine lands. The Project Area is characterized by many steep slopes, particularly within the forested and non-reclaimed areas (see Figure 2).

- "Light/Medium Grading" – This approach looked at relatively contiguous buildable areas within the Project Area that do not have extreme grading requirements. These areas total approximately 757 acres and consist of 20 buildable area polygons ranging from 11 to 106 acres apiece.
- "Heavy Grading" – The other approach consists of all buildable areas within the Project Area regardless of the heavy grading requirements, to help optimize the solar facility capacity. These areas total approximately 1,664 acres and the areas that need heavy grading would be better served for solar development with grants or funding provided for grading and/or reclaiming land within the Project Area.

These two grading approaches offer a range of buildable areas that will inform Earth Conservancy's decision-making in the face of uncertainty of obtaining grants for grading and land reclamation and their implementation. Based on these assessments, the buildable area for Earth Conservancy's preliminary design consideration will likely fall between:

- 757 acres (Light/Medium Grading)
- 1,664 acres (Heavy Grading)

Multiple solar developers have approached Earth Conservancy about potential solar redevelopment opportunities at the Project Area. Earth Conservancy is considering the feasibility of multiple distributed generation solar facilities and/or a single utility-scale facility. LaBella has evaluated the scenarios of potential 5 MW_{AC} projects, in anticipation of a State policy adoption that allows community solar development, as well as a 114-MW_{AC} utility scale solar project, which would be enabled by funding for mine reclamation and/or regrading on significant portions of the Project Area.

2. Feasibility – Scenario 1: Distributed Generation/Community Scale Solar

LaBella evaluated the following resources for the Project Site in the context of currently existing regulations and the community solar legislation that is coming, which has yet to be adopted. Under the Alternative Energy Portfolio Standards Act of 2004 (AEPS, Act 213) -- distributed generation facilities of 3 to 5 MW with special conditions are allowed for interconnection and renewable energy credits in Pennsylvania. Pennsylvania's community solar legislation, House Bill 1161, seeks to expand the distributed generation potential in the State by establishing subscriber programs by which electric consumers can choose to purchase 100% local solar energy. The House Bill 1161 passage is critical to redevelopment of the Earth Conservancy's land holdings for community solar facilities that can interconnect to the local electrical infrastructure managed by UGI Utilities, Inc. (see Figure 3).

2.1 Buildable Area Assessment

Among 20 buildable area polygons with light or medium grading needs (for methodology, see a separate 2022 report prepared for Earth Conservancy called Critical Issues Analysis, Buildable Area Assessment 2022) -- LaBella selected two sites of contiguous buildable polygons – in the southeastern portion of the Project Area, between Warrior Run and Sugar Notch -- for community solar development consideration (see Figure 4A). The western site of mostly scrub shrubland encompasses 47.0 acres, and the eastern site of mostly grassland encompasses approximately 32.5 acres. These sites pose suitable conditions for community solar scale development based on topography (no greater than 10% average slope) and proximity to existing utility infrastructure.

These sites contain mostly buildable areas that require minimal grading, tree clearing, and environmental remediation (see Figures 4B and 4C). The only exception is the western polygon, which contains three medium risk recognized environmental conditions (RECs) that are associated with historic mining operations. These medium risk RECs were identified due to the presence of mining structures. There is the potential for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), heavy metals, and polychlorinated biphenyls (PCBs) to be present in these areas, which could require remediation activities to be completed prior to solar development. Remediation of these compounds, particularly PCBs, can be expensive and time-consuming. Additionally, there are two mapped mine shaft entrances within the two distributed generation/community solar buildable areas. Geotechnical investigation of these areas is recommended to ensure that undermining has not compromised the geotechnical integrity of the area.

The sites also contain no cultural resources and floodplains in addition to a few wetlands and soils characterized by hydric (wetness indicator) and prime farmland ratings. These sites of buildable

polygons could accommodate multiple 5 MW_{AC} community solar facilities that can accommodate pile driven solar modules (fixed tilt or trackers), with modest site preparation and permitting hurdles. They are, however, not within an Environmental Justice Area as defined by the PADEP (see Figures 1 and 4C).

2.2 Production Modelling and Interconnection Assessment

Solar photovoltaic (PV) distributed generation is typically identified as a facility with a maximum power capacity of up to 20 MW_{AC} (alternating current) which can be connected to local electrical distribution circuits that operate at voltages up to 34,500 volts (34.5 kV).

Guidance for buildable land area to accommodate an array to provide 1 MW_{AC} of power is 6 to 7 acres. Therefore, a 20 MW_{AC} facility will require approximately 120 to 140 acres of buildable area.

Near the land under the administration of Earth Conservancy, the local utility operator is UGI Utilities, Inc. (UGI). The electrical distribution system operates at a voltage of 13.8 kV in the regions of Newport Township, Naticoke City, Hanover Township, and Plymouth Township For reference, Figure 4 indicates the location of UGI's main 13.8 kV overhead distribution lines in the vicinity of Earth Conservancy administered land. At the operating voltage of 13.8 kV, based on typical wire sizes installed by utilities, a maximum of 10 MW_{AC} will usually be connected to a specific feeder routed from a distribution substation. Such a facility can be installed on 60 to 70 acres of buildable land.

Two sites between Warrior Run and Sugar Notch have been identified as preferred locations for distributed generation level solar arrays. The western site covers an area of 47.0 acres, and the eastern site covers 32.5 acres. As part of the feasibility, it is assumed that the sites to be utilized will be restored as necessary to provide a topography where slopes will be no greater than 10%.

LaBella has designed preliminary layouts utilizing bifacial modules installed on a single-axis tracking support system. Bifacial modules are solar PV cells that can generate current from the front and rear surfaces when illuminated from direct and reflected irradiation. This can lead to additional energy generation of between 4 to 6% greater than a similar monofacial (front-only sensitive) module.

To maximize the generated energy from the array, bifacial modules will be installed on a single-axis tracking racking system. As the terminology states, a single-axis tracking system supports modules on a racking system that rotates the modules in an east-to-west single-axis following the path of the sun. The tracking system increases energy output above a fixed-tilt system by approximately 5 to 8%.

The proposed layout on the western site of Warrior Run (see Figure 4D), comprises 11,440 PV modules, each with a direct current (DC) power rating of 585 W. This equates to a total DC power capacity of 6,692.4 kWp (kilowatts peak).

Based on the Pennsylvania Public Utility Commission's uniform standards for small customer-generators limiting interconnections to 5 MW (5,000 kW) of AC power, the preliminary design includes inverter (DC to AC) equipment and step-up voltage transformers to export up to this power level. The

western site could potentially hold up to 10 MW_{AC} and thereby could be split for two DG interconnection applications.

An energy production simulation for the proposed array was performed using PVsyst software. The analysis predicts the generated energy in kWh that would be injected into the local grid on a monthly and yearly timescale. PV Modules and inverter equipment are selected based on current materials available in the market.

The energy production simulation includes user criteria to define conditions at the specific site. The data includes:

- Orientation of the array;
- Historical weather data for the location;
- Horizon data that identifies potential topographical obstructions (hillsides, mountains, etc.) that may cause shading from direct sunlight at various times of day and year;
- Conditions which may cause generated energy losses, such as:
    - Thermal constraints;
    - Module efficiency degradation;
    - Soiling caused by module surface obstructions like snow or dirt and dust;
    - Unavailability of system for maintenance;
    - Etc.

The results of the simulation for the 5 MW_{AC} solar PV facility predicted yearly energy injected to the local utility grid at 9,940 MWh in the initial year of operation. The energy production report for the 5 MW_{AC} community scale solar array is included in Appendix B PVsyst Report 1.

It is proposed that the power from the solar PV facility be interconnected to the local utility electrical distribution circuit at Main Street, Warrior Run Area. An application to interconnect the facility will need to be submitted to UGI. The Project would be reviewed as a level 2 small distributed customer-generator project under the uniform standards established by the Pennsylvania Public Utility Commission. UGI will perform an initial review and if necessary, a System Impact Study to determine the practicality to interconnect the distributed generation source and any modifications and/or upgrades required to the distribution circuit and/or local substation.

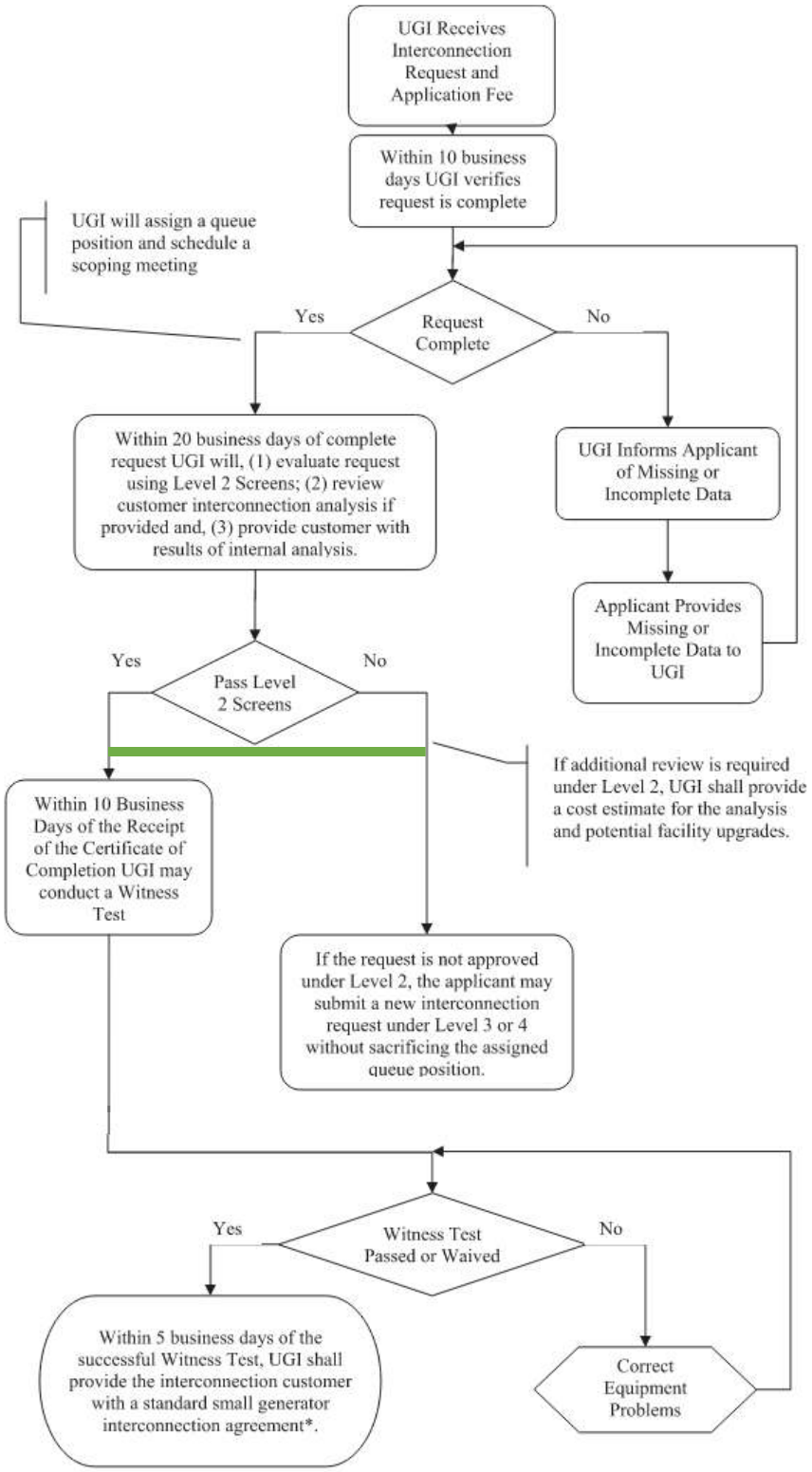
Under current legislation in Pennsylvania, small solar facilities qualify for compensation under the State's Alternative Energy Portfolio Standard. Each 1,000 kWh of energy generated creates a solar renewable energy credit (SREC) or alternative energy credit (AEC). State law requires electric utilities and alternative electric suppliers to purchase a proportion of their energy from renewable or alternative sources. AECs are bought and sold on an open market, and prices are determined by supply and demand.

Costs for the permitting and construction have been fluctuating over the last 24 months. Typical construction and permit costs for a 5 MW_{AC} facility are approximately $1.30 - $1.50 per watt direct current (W_{DC}) excluding interconnection and extensive site preparation costs (significant grading, etc.). For the proposed Warrior Run design, an opinion of probable cost is in the region of $8.7 to $10 M. For Sgarlett site, an opinion of probable cost is in the region of $8.7 to $10 M.

2.3 UGI Interconnection Overview

As of January 2023, UGI is accepting new interconnection applications for new small generator distributed energy facilities. A proposed PV facility incorporating DC/AC inverters and 5MW or less in AC capacity is covered as a level 2 application and review, in a sequence outlined on the next page. Initial costs for a submitted application are $250 + $1/kW of AC capacity. Therefore, for a 5-MW_{AC} project, the application fee would be $5,250. Additional fees may be charged if UGI decides that more studies are required. This is likely a fixed fee that is not reimbursable if the cost of studies come in under the application fee. Interconnection study is completed at the position of green line in the process flowchart in Diagram 1.

Diagram 1: UGI Interconnection Level 2 Review Process including Witness Test



3. Feasibility – Scenario 2: Utility Scale Solar

Utility-scale solar development of typically greater than 20 MW_{AC} is currently permitted in Pennsylvania and does not hinge upon any pending State legislation like community solar currently is. However, the approval of a large-scale energy generation facility is dependent on Pennsylvania's electrical grid regional operator called PJM and its 2022 two-year moratorium on interconnection applications, including the deferral on the review of new projects until the end of 2025. This extended interconnection study timeline for new solar projects may be well aligned with Earth Conservancy's upfront reclamation and regrading efforts that would be necessary to render large contiguous areas suitable for utility scale solar redevelopment eventually. This scenario explores the possibility of a greater than 20-MW_{AC} solar development within an Environmental Justice Area as defined by PADEP.

3.1 Buildable Area Assessment

In the event significant regrading becomes financially feasible with grant opportunities, LaBella evaluated a cluster of three large contiguous buildable sites for a utility-scale solar development in the western portion of the Project Area (see Figure 5A). Between Glen Lyon and Wanamie, this cluster sized approximately 533 acres total encompasses historically mined area that has since become a mix of scrub shrubland and forests on varied terrain marked by steep slopes. If cleared and regraded, this site presents the largest contiguous area most suitable for utility scale solar development based on: topography requiring a lesser amount of grading, avoidance of sensitive community resources like parks and reservoirs, and proximity to existing utility infrastructure (see Figure 5B).

However, due to the size of these areas in a historical mining setting, there are some environmental remedial and geotechnical risks (see Figure 5B). The southwest site contains two high risk Recognized Environmental Conditions (RECs): a former cleaning plant located directly south of the Earth Conservancy composting yard and a production area associated with drift mining on the southern boundary of the site. The easternmost site contains three environmental REC areas: one high risk area where transformers were formerly located, one medium risk area associated with drift mining, and one medium risk area where faulting was observed. The northwest site contains two medium REC areas associated with plane mining and a former engine house. All REC areas pose a risk for VOC, SVOC, heavy metals, and PCB contamination. A discussion of these risks is included above in Section 2.1. These areas are recommended to be avoided or remediated for solar redevelopment.

It is important to note that all three utility-scale solar sites are in areas where historical mining operations have been recorded. In particular, REC 15 (as identified in the Enhanced Environmental Risk Screening) shows the presence of faulting which is indicative of unstable geotechnical conditions. It is recommended that geotechnical investigations be conducted in these three sites to ensure that undermining has not compromised the geotechnical integrity of the area. Additionally, more than half of this site contains steep slopes that exceed 20%, according to publicly available LiDAR data. A topographic survey is needed to better estimate the amount of land with steep slopes to be regraded for solar redevelopment.

Aside from these inherent remedial, geotechnical, and steep slope risks -- the site is mostly clear of typical significant site constraints (see Figure 5C). The biggest biological and regulatory site constraint

is associated with the Middle Branch Newport Creek, which has a large forest wetland, hydric soils, and floodplains. There are also minimal prime farmland soils within this site.

3.2 Production Modelling and Interconnection Assessment

Utility-scale solar PV utilizes multiple arrays that are interconnected typically identified as a facility with a typical power capacity of up to 50 MW_{AC} or higher which can be connected to area transmission systems that operate between 69 kV and 230 kV.

Near the land under the administration of Earth Conservancy, the local utility operator is UGI. The electrical distribution system operates at a voltage of 13.8 kV in the regions of Newport Township, Naticoke City, Hanover Township, and Plymouth Township. For reference, Figure 3 indicates the location of UGI's main 13.8 kV overhead distribution lines in the vicinity of Earth Conservancy administered land. At the operating voltage of 13.8 kV, based on typical wire sizes installed by utilities, a maximum of 10 MW_{AC} will usually be connected to a specific feeder routed from a distribution substation. In this case, 10 MW_{AC} can be installed on 60 to 70 acres of buildable land.

Three land parcels in Newport Township have been identified to accommodate the solar arrays. The parcels have been identified as:

- South-west site 234.5 acres;
- North-west site 119.1 acres;
- North-east site 179.5 acres

As part of the feasibility, it is assumed that the sites to be utilized will be restored as necessary to provide a topography where slopes will be no greater than 10%.

The proposed layouts for the three utility-scale sites in Newport Township (see Figure 5D), comprises:

- South-west site 115,804 modules;
- North-west site 52,104 modules;
- North-east site 80,704 modules

This equates to a total of 248,612 modules, each with a DC power rating of 585 W. The total DC power capacity is 145,438 kWp.

For utility-scale facilities, larger inverters are utilized that are located 'centrally' to specific arrays to reduce losses due to voltage drop in cabling. Based on the typical ranges of ratios for DC capacity to AC capacity, the AC power delivered will be 114 MW (114,000 kW).

The simulation results in 206,670 MWh of energy produced by the combined arrays in the initial year of operation. The energy production report for the utility-scale solar array is included in Appendix B PVsyst Report 2.

Groups of inverters generating the power from the arrays of modules at each site will be connected in a radial configuration at medium voltage (typically 34.5 kV) and routed back to a dedicated electrical substation which will step-up the voltage to the level of the transmission lines. A 69 kV transmission

line is routed south from Hunlock Creek to the main UGI electrical substation at West Slate Street in Nanticoke. The power generated by the utility-scale PV system will be connected to the transmission line from the customer substation through a set of high-voltage switchgear.

Large utility-scale interconnections are administered through the transmission system operator, PJM. Interconnection applications for large-scale generation have a typical duration of 12 to 18 months depending on the complexity of the project. PJM has initiated a moratorium (soft pause) on existing applications in 2022, and it is expected that new applications will not be entertained until likely 2026.

Revenues from utility-scale generation are dictated by wholesale prices regulated by the Federal Energy Regulatory Commission (FERC). The current market rate for the PJM region is approximately $51/MWh.

Typical costs for the permitting and construction of a utility-scale solar PV facility are in the region of $1.05 - $1.15 per W_{DC} excluding extensive site preparation costs (significant grading, etc.). For the proposed Wanamie Area development, an opinion of probable cost is in the region of $152 to $167M.

4. Focus Areas – Sgarlett and Truesdale

Distributed generation/community- and utility-scaled solar development scenarios at the Project Site were evaluated and discussed in Sections 2 and 3, respectively. However, significant grading and tree clearing is required across much of the Project Site to make it attractive for future solar development. As part of this feasibility study, LaBella evaluated two additional areas that were previously identified by the Earth Conservancy as potential solar redevelopment areas: Sgarlett and Truesdale.

4.1 Sgarlett Area

The distributed generation site evaluated is in the Sgarlett Area, located along the southern boundary of the Project Area (see Figure 6A). This site encompass approximately 45 acres and consists of mostly grassland with minimal wooded areas (see Figure 6B). This site is also within a PADEP EJ area, and approximately 26.4 acres of buildable area are within the site (see Figure 6C). The Sgarlett Area was previously a site of interest with a private developer and was identified as a potential distributed generation/community solar site. A distribution circuit (operated by UGI Utilities Inc.) is located along the adjacent roadway. The operating voltage of the line would be considered preferable for electrical interconnection of a proposed 5-MW_{AC} generating facility.

A 5-MW_{AC} distributed generation/community scale tracker system array was modeled in PVsyst to simulate estimated energy production. The proposed layout on the Sgarlett site (see Figure 6D), comprises 11,492 PV modules, each with a direct current (DC) power rating of 585 W. This equates to a total DC power capacity of 6,723 kWp.

The results of the simulation for the 5 MW_{AC} solar PV facility predicted yearly energy injected to the local utility grid at 9,830 MWh in the initial year of operation. The energy production report for the Sgarlett solar array is included in Appendix B PVsyst Report 3.

Within a PADEP EJ area, the Sgarlett Area would be best targeted for a community solar array once such development is permitted by the State.

Typical construction and permit costs for a 5 MWAC facility are approximately $1.30 - $1.50 per watt direct current (W_{DC}) excluding interconnection and extensive site preparation costs (significant grading, etc.). For the proposed Sgarlett site, an opinion of probable cost is in the region of $8.75 to $10.1 M.

4.2 Truesdale Area

The utility-scale development site evaluated is in the Truesdale Area on the southeastern boundary of the Project Area (see Figure 7A). The combined sites cover approximately 150 acres and was a historically intensive mining area, most of which has been reclaimed according to Earth Conservancy. This area has not received the private developer interest that the Sgarlett area has in the past, mainly due to interconnection issues. However, the Truesdale Area is relatively free of tree cover and would require less mine reclamation and/or grading than other areas within the Project Area (see Figure 7B). We estimate approximately 96 acres of buildable area within the 150-acre site. No portion of the Truesdale Area is located within a PADEP EJ area (see Figure 7C).

Interconnection options are more limited with the nearest transmission line located approximately 0.5 miles to the north of the site. The electrical system operates at a voltage of 230 kV.

LaBella developed an energy production model for the Truesdale area, which indicated that a tracker system array could generate up to 42.5-MW_{AC} within the 150-acre area.

The proposed layouts for the two sites in the Truesdale Area (see Figure 7D), comprise:

- East site 90,168 modules
- West site 5,564 modules

This equates to a total of 95,732 modules, each with a DC power rating of 585 W. The total DC power capacity is 56,000 kWp.

The simulation results predict that 85,900 MWh of energy will be produced by the combined arrays in the initial year of operation. The energy production report for the utility-scale solar array is included in Appendix B PVsyst Report 4.

As a proposed utility-scale solar development, the interconnection will be made to the electrical transmission system administered by PJM. PJM currently has a moratorium deferring any new applications for interconnections until the current backlog is cleared. The current reported date that the moratorium will be lifted is in 2026, which means that projects accepted would then have to complete all electrical and other studies and would be highly unlikely to be available for interconnection until 2027 or 2028 at the earliest. This timeline may align with the Earth Conservancy's reclamation efforts and would allow time for private developers to determine if interconnection issues with this area can be overcome.

Typical costs for the permitting and construction of a utility-scale solar PV facility is in the region of $1.05 - $1.15 per W_{DC} excluding extensive site preparation costs (significant grading, etc.). For the proposed Truesdale Area development, an opinion of probable cost is in the region of $58.8 to $64.4M.

5. Policy and Incentives

Redevelopment incentives for abandoned mine land exist at the federal, state, and local/regional levels. These policies recognize the environmental benefit of restoring and repurposing former mine lands and other contaminated areas. The US Environmental Protection Agency (EPA) has gone one step further, specifically recommending renewable energy projects as a suitable re-use of these areas, most notably in its RE-Powering America's Land initiative. Bipartisan Infrastructure Law (BIL) (Pub. L. No. 117-58), or the Infrastructure Investment and Jobs Act (IIJA), allocated funding for abandoned mine reclamation as administered by the Office of Surface Mining Reclamation and Enforcement (OSMRE). This funding is managed at the state level by way of Abandoned Mine Land (AML) programs under the Department of Environmental Protection in Pennsylvania.

With respect to public policy, it should be noted that Pennsylvania's current lack of legislative framework to promote solar adoption or standardize interconnection requirements is a barrier to large-scale solar development. This is compounded by PJM's recent imposition of a two-year solar moratorium to process existing interconnection applications. The following legislative actions are presently pending – enactment of these bills would indicate a more favorable environment for solar developers:

- House Bill (HB) 1080 and Senate Bill (SB) 501: Both bills propose increases to the current 0.5% solar carve-out or goal under the existing Alternative Energy Portfolio Standard (AEPS). The AEPS establishes state-wide goals for renewable electricity generation or procurement.
- SB 300: This bill proposes a significant increase in the existing AEPS solar adoption goal from 0.5% to 10% across both large-scale and distributed installation categories.
- HB 1555 and SB 472: Both bills establish provisions for a community solar program that would allow renters, and others who are unable to install solar on their property, to participate in solar installations by purchasing an array subscription or "share" for electric bill credits.
- HB 1161: This bill establishes a provision for electric utilities to adopt a subscription service for customers to purchase solar power, much like a community solar model but administered wholly by utilities (Glabicki 2022).

5.1 Funding Analysis

The grant and loan programs included in the table below have been identified as potential resources for financial assistance, technical support, or coordination. It is worth noting that many solar incentive and AML redevelopment fund programs have been charged with addressing environmental justice and climate change impact inequities. LaBella recommends incorporating these considerations in any financing applications to best position projects for success. Thorough analysis

and alignment of selected projects must be carefully evaluated to determine the eligibility and competitiveness within each grant program. Other grant programs could be utilized for additional non-solar development project components such as economic development funds for development of new warehouse facilities or infrastructure funds for delivering water or wastewater to a new development. Combining multiple grant opportunities to leverage private funds is recommended.

Funding Program (Funding Agency)	Description	Eligible Applicants	Maximum Grant Request	Local Match	Application Due Date	Link
Clean Energy Demonstration Program on Current and Former Mine Land (USDOE Office of Clean Energy Demonstrations)	Provide financial support to solar and other renewable energy projects situated on abandoned mine lands. Funding priority will be given to projects that provide a benefit to low income or other historically underserved communities	Will be stipulated in competitive solicitation	Will be stipulated in competitive solicitation	Will be stipulated in competitive solicitation	Anticipated 2023	Clean Energy Demonstration Program on Current and Former Mine Land | Department of Energy
Energy Improvements in Rural or Remote Areas (USDOE Office of Clean Energy Demonstrations)	Improve the resilience, reliability, and affordability of energy systems in communities across the country with 10,000 or fewer people	Higher ed, Non-profit, For-profit, Tribal, State and local, Consortia	$10,000,000	20% for higher-ed, nonprofit, state, local, tribal; 50% others	Concept Paper April 14, 2023; Application June 28, 2023	Energy Improvements in Rural or Remote Areas | Department of Energy
Brownfield Multipurpose, Assessment, RLF, and Cleanup (MARC) Grant (USEPA)	Grants for assessment, cleanup, and revolving loan funds	States, Tribes, Municipalities, Authority, Council	Multipurpose: $800,000 Assessment: $500,000 RLF: $1,000,000 Cleanup: $2,000,000	None	Anticipated November 2023	https://www.epa.gov/brownfields/multipurpose-assessment-rlf-and-cleanup-marc-grant-application-resources
Public Works and Economic Adjustment Assistance Programs (EDA - Economic Development Administration)	Provides strategic investments on a competitive merit basis to support economic development, foster job creation, and attract private investment in economically distressed areas. Leverage existing regional assets and support the implementation of economic development strategies that advance new ideas and creative approaches to advance economic prosperity in distressed communities	Municipalities, Local Development Districts, Non-profits, Higher Ed	Implementation: $3,000,000	30-50% based on demographics	Rolling Application Period - open	Funding Opportunities | U.S. Economic Development Administration (eda.gov)
Rural Energy for America Program Renewable Energy Systems & Energy Efficiency Improvement Guaranteed Loans & Grants (USDA Rural Development)	Guaranteed loan and grant funding to agricultural producers and rural small businesses for renewable energy systems or energy efficiency measures.	Agricultural producers, small businesses	Loan up to 75% of project costs Grants up to 40% of project costs	Loan 25% Grant 60%	Rolling Application Period - open	https://www.rd.usda.gov/programs-services/energy-programs/rural-energy-america-program-renewable-energy-systems-energy-efficiency-improvement-guaranteed-loans
Business & Industry Loan Guarantees (USDA Rural Development)	Provides loans guarantees to lenders for their loans to rural businesses.	Lenders provide loans to non-profit, for-profit, cooperatives, Tribes, public bodies, individuals	Low interest loans	None	Rolling Application Period - open	Business & Industry Loan Guarantees | Rural Development (usda.gov)
Community Development Block Grant (PA DCED)	CDBG grants have been used to prepare site for future renewable energy installations. Must have benefit for Low-and moderate-income households.	Municipalities	Entitlement: ~$250,000 Competitive: $100,000	None	Entitlement: Sep Competitive: January	https://dced.pa.gov/programs/community-development-block-grant-cdbg/
AML/AMR Abandoned Mine Land and Acid Mine Drainage Grant Program (PA Bureau of Abandoned Mine Reclamation)	Projects specific to pre-1977 AML with no previous remediation and listed on the inventory. Projects shall primarily focus on the reclamation of AML, abatement of AMD through reclamation, and/or treatment of AMD through the construction, operation, and/or maintenance of an AMD treatment facility.	Municipalities, Conservation districts, Watershed associations	Project limit not identified	None listed, projects encouraged to leverage other funds.	Three Rounds in 2023: Due March 6, July 3, October 2	NEW! AML/AMD Grant Program (pa.gov)

Funding Program (Funding Agency)	Description	Eligible Applicants	Maximum Grant Request	Local Match	Application Due Date	Link
Abandoned Mine Land Economic Revitalization (PA Bureau of Abandoned Mine Reclamation)	Eligible sites include unreclaimed sites, previously reclaimed AML lands and waters, lands adjacent to unreclaimed or previously reclaimed AML lands and waters; currently permitted Title V sites are not eligible. PA state selected sites for reclamation with development OR reclamation for potential development.	State-selected projects meet eligible criteria. Sub-recipients include state, tribal, local government, economic development organizations, local communities, and non-government organizations.	Project limit not identified	None listed, projects encouraged to leverage other funds.	Contact BAMR office with eligible projects	Abandoned Mine Land Economic Revitalization (AMLER) Program (pa.gov)
BIL AML Bipartisan Infrastructure Line Abandoned Mine Land (PA Bureau of Abandoned Mine Reclamation)	Hazards resulting from legacy coal mining that pose a threat to public health, safety, and environment, water supply restoration, coal AML emergencies. Specific to Pre-1977 and inventoried. Eligible projects protect public, restore land and water resources, water supply restoration projects. Differs from AML funding in that standalone Priority 3 projects are eligible, AMD projects not part of a qualified hydrologic unit are eligible.	States and Tribes with AML Programs	Project limit not identified	None listed, projects encouraged to leverage other funds.	Contact BAMR office with eligible projects	What does the Infrastructure Investment and Jobs Act mean for OSMRE's AML Program? | Office of Surface Mining Reclamation and Enforcement
ARISE - Appalachian Regional Initiative for Stronger Economies (ARC - Appalachian Regional Commission)	To drive large-scale, regional economic transformation through multi-state collaborative projects across Appalachia. Align with ARC Strategic Goals and Priorities	Multi-State Teams: Municipalities, Local Development Districts, Non-profits, Higher Ed within ARC Region	Implementation: $10,000,000; Study: $500,000	Distressed: 20%; At-Risk: 30%; Transitional: 50%; Competitive: 70%	Rolling Application Period - open	Appalachian Regional Initiative for Stronger Economies - Appalachian Regional Commission (arc.gov)
POWER - Partnerships for Opportunity and Workforce and Economic Revitalization (ARC - Appalachian Regional Commission)	To help ARC communities and regions affected by job losses in coal: projects that will produce diverse economic outcomes, are identified under economic development plans, have diverse stakeholders	Municipalities, Local Development Districts, Non-profits, Higher Ed within ARC Region	Implementation: $1,500,000; Study $50,000	Distressed: 20% match; At-Risk: 30%; Transitional: 50% match; Competitive: 70%	April 19, 2023	POWER Initiative 2022 Request for Proposals (arc.gov)
Area Development Program (ARC - Appalachian Regional Commission)	ARC Region for critical infrastructure and business and workforce development. Align with ARC Goals and Priorities. Workforce training, basic skills, workforce assessments, economic development plans and strategies, child care and early childhood education, telecommunications, job related infrastructure, leadership, business development, necessary public infrastructure, educational excellence, local government assistance demonstrations, or rural health and mental health initiatives	Municipalities/Non-profits within ARC Region	Implementation: $500,000; Study $50,000	50% match	Anticipated August 2023	Area Development Program - Appalachian Regional Commission (arc.gov)

5.2 Opportunities for Grant Funding

Clean Energy Demonstration Program on Current and Former Mine Land (CEDP-CFML)

The US Department of Energy is currently developing the Clean Energy Demonstration Program on Current and Former Mine Land (CEDP-CFML) to provide financial support to solar and other renewable energy projects situated on abandoned mine lands. The DOE requested guidance from various stakeholders on program terms in 2022 and is expected to issue a solicitation for project proposals sometime in 2023. As of March 15, 2023, applications have not yet opened. Funds priority will be given to projects that provide a benefit to low income or other historically underserved communities as defined by the Justice40 initiative, an environmental justice Executive Order to accrue 40% of the benefits from certain federal funds to peoples historically burdened or marginalized by pollution. One measure of need is the EPA EJScreen's Environmental Justice (EJ) Indexes. Another measure is the Qualified Census Tract list maintained by the US Department of Housing and Urban Development (HUD).

Though the proposed development parcels themselves are not located within an 80-100 percentile EPA EJ index, 2022 HUD Qualified Census Tract, or low-income area – two nearby areas are: tract 2180 in Korn Krest and tract 2141 in Nanticoke. These areas are designated as Low-Income Housing Tax Credit Qualified Census Tracts where 1) at least 50% of households have incomes less than 60% of the Area Median Gross Income, or 2) have a high poverty rate at or exceeding 25%. It is also notable that most of the Project Area is within PADEP EJ Areas, as the definition of disadvantaged communities need the State's input in administering the federal funds. Project proposals that emphasize how clean energy benefits will accrue to these communities may have the greatest potential for funding. Under a community solar approach with a typical 5 MW_{ac} system size or smaller, partnership with local organizations such as Neighbor Works of Northeastern Pennsylvania may help identify homeowners and others who may benefit as energy off-take subscribers as they are located within the same utility service area as the sited solar projects.

Updates on the status of the CEDP-CFML program can be found at the Office of Clean Energy Demonstrations homepage, still under development since the program's inception in 2021.

Energy Improvements in Rural or Remote Areas (USDOE Office of Clean Energy Demonstrations)

The Energy Improvements in Rural or Remote Areas (ERA) program is a new program funded by the Infrastructure Investment and Jobs Act, commonly referred to as the Bipartisan Infrastructure Law (BIL), authorizing DOE to invest $1 billion in energy improvements in rural or remote areas. The program will provide financial investment, technical assistance, and other resources to advance clean energy demonstrations and energy solutions that are replicable and scalable and aims to fund community driven clean energy projects with three specific goals:

- Deliver measurable benefits to energy customers in rural or remote areas by funding replicable energy projects that lower energy costs, improve energy access and resilience, and/or reduce environmental harm;

- Demonstrate new rural or remote energy system models using climate-resilient technologies, business structures that promote economic resilience, new financing mechanisms, and/or new community engagement best practices; and
- Build clean energy knowledge, capacity, and self-reliance throughout rural America.

The program is designed to enable citizens in rural or remote communities to realize material benefits as the result of investment in their energy infrastructure. These benefits can include: lower energy costs, improved energy access, economic resilience, and environmental protection from adverse impacts of historic energy generation. To take advantage of this funding program, the project must incorporate community engagement best practices and demonstrate measurable benefits to energy customers. This program may be best suited to development such as community solar.

Economic Development Agency

Public Works and Economic Adjustment Assistance Program investments help facilitate the transition of communities from being distressed to becoming competitive by developing key public infrastructure, such as:

- Technology based facilities;
- Multi-tenant manufacturing facilities;
- Business and industrial parks;
- Telecommunications and development facilities;
- Water and sewer system improvements;
- Business incubator facilities;
- Skill-training facilities; and
- Brownfield redevelopment.

A redevelopment project that includes economic development features can be considered for EDA funding. EDA supports bottom-up strategies that build on regional assets to spur economic growth and resiliency. EDA encourages its grantees throughout the country to develop initiatives that present new ideas and creative approaches to advance economic prosperity in distressed communities. EAA Assistance to Coal Communities (ACC) supports communities that have been negatively impacted by changes in the coal economy.

Brownfield Multipurpose, Assessment, RLF, and Cleanup (MARC) Grant

The Environmental Protection Agency (EPA) administers multiple brownfield redevelopment programs, which include lands defined as “mine-scarred.” As part of LaBella’s Critical Issues Analysis, 55 areas of potential environmental concern related to former mining activities were identified. As such, the site may be well suited for brownfield clean up funds with the goal of site stabilization. Though funds are limited, Targeted Brownfields Assessments can be requested at no cost from EPA Region 3 by non-profit entities with undisputed site control of the project areas in question.

EPA brownfield grant funding maximums are probably more appropriate to the smaller DG/community solar sized projects. The Earth Conservancy has already been very successful securing both EPA brownfield cleanup grants and job training grants (8 grants combined since 2013). Consideration to apply for either a site-specific brownfield assessment grant to investigate at a particular site, for example, the Warrior Run Area that had REC's which require follow-up or apply for a community-wide site assessment grant to look at multiple sites. It is also worth noting that EPA Brownfield Cleanup grants, can be used to fund clearing and grubbing work at a site. Due to the time required to apply for, secure, and perform EPA brownfield grant funded projects, a phasing plan would be needed for sites requiring additional investigation and cleanup.

Funding award criteria also weigh environmental justice considerations as in the case of DOE CEDP-CFML funds. EPA also strongly weighs municipal and state support for any proposed redevelopment assessment assistance. It is recommended preliminary letters of intent to support solar development be obtained at the local municipal and state level should this assessment request be submitted to EPA.

Beyond assessment funds, brownfield clean up grants are available valued at up to $500,000 per application. Depending on the area and assessment findings, applications may be multipurpose and used on more than one site or combined with Job Training funds. Given the location of the suggested community solar development areas, it may be worthwhile to develop solar projects with job training in mind to support local jobs and provide training benefits to residents in the low-income Korn Krest census tract. The Earth Conservancy's work with the Appalachian Regional Commission may be parlayed into future discussions regarding workforce development. Solar installations require mechanics, electricians, equipment operators, and often temporary laborers and apprentices to assist with materials handling and other lower-skilled activities. Community-based partnerships with job training programs or "hire local" mandates can ensure nearby residents can benefit from local solar construction, further bolstering project support across a broad range of stakeholders.

Community Development Block Grant

The Department of Housing and Urban Development HUD's Community Development Block Grant (CDBG) program has been used to prepare sites for future renewable energy installations. This resource is suited for one or more Community Solar projects with a focus on benefits accrued to low- and moderate-income households. CDBG funds are administered at the municipality level – a list of administrators is available at Pennsylvania's Department of Community and Economic Development CDBG website.

PA Bureau of Abandoned Mine Land Reclamation

BAMLR is responsible for resolving abandoned mine land (AML) problems such as mine fires, mine subsidence, dangerous highwalls, open shafts and portals, mining impacted water supplies and other hazards which have resulted from past coal mining practices. The below programs apply to lands and waters which were mined for coal or affected by mining and abandoned or left in an inadequate reclamation status prior to 1977. Eligibility requires that no remediation has occurred since that time by any parties, BAMLR maintains listing of eligible sites and recommends coordination with regional specialists prior to application submission. With the long-term pipeline of

the new federal source of funding to the PA AMLAMD the Earth Conservancy might choose to establish a multiyear funding request plan for phased cleanup and renewable redevelopment of different sites based on readiness, lead times, and available resources. At present, BAMLR is administering the following funding programs:

- AML/AMR Abandoned Mine Land and Acid Mine Drainage Grant Program: The new PA AML/AMD Grant Program that began in the fall of 2022 will continue with three more application rounds in 2023. A total of at least $96 million is available under the 2023 AML/AMD Grant Program, with at least $32 million available to award in each of the three grant program rounds.
- AMLER Abandoned Mine Land Economic Revitalization: Eligible sites include unreclaimed sites, previously reclaimed AML lands and waters, lands adjacent to unreclaimed or previously reclaimed AML lands and water. Currently permitted Title V sites are not eligible. PA state selected sites for reclamation with development or reclamation for potential development.
- BIL AML Bipartisan Infrastructure Line Abandoned Mine Land: The Infrastructure Law provides a total of $11.3 billion ($725 million annually for 15 years) in abandoned mine land grant funding at the Department of the Interior to eligible states and tribes “to help communities eliminate dangerous environmental hazards and pollution caused by past coal mining while creating jobs and providing opportunities to revitalize coal communities.” According to the federal announcement “these reclamation projects enable economic revitalization by rehabilitating hazardous land so that it can be used for recreational facilities or other economic redevelopment uses like advanced manufacturing and renewable energy deployment being funded by this DOE program.”

ARC Area Development Grant

Continuing with the success the Earth Conservancy has realized with ARC grant funding, a selected project could be advanced to ARC Area Development Infrastructure Grant to support development of access roads, site utilities, and other components. The ARC grant program encourages consultation with regional representatives to discuss competitiveness of applications. The applications require a lengthy narrative and the processing of the application is lengthy, typically at least nine months, but the awards can be leveraged with other programs to support critical development.

ARC POWER Grant

The POWER grant provides benefit to coal impacted communities and requires analysis of the impact of the close of coal related industry. The grant promotes projects that will produce diverse economic outcomes, are identified under economic development plans, have diverse stakeholder. Eligible projects are required to demonstrate benefit to multiple stakeholders and drive future economic development.

5.2 Relevant Incentives for Private Developers

To support discussions with private developers, the following incentives and grant programs can be considered.

Solar Renewable Energy Certificates (SREC)

A future financial benefit attributable to the project may include Solar Renewable Energy Certificates (SREC) value. Under Pennsylvania's current policy, SREC's may be generated and traded within the State to help meet Utility obligations to generate or buy green electricity under the Alternative Energy Portfolio Standard (APS). 1 SREC equals 1 Megawatt-Hour (MWh) of solar energy. SREC's have a useful life of 3 years, after which they are ineligible for sale or trade. The current trading value of SREC's is in the $40 range, which is subject to ongoing market fluctuations. LaBella recommends consultation with local project developers most familiar with the nascent Pennsylvania solar market for the best accounting of future economic benefits associated with the proposed projects.

USDA Rural Development Programs

U.S. Department of Agricultural (USDA) Rural Development provides guaranteed loan financing and grant funding to farmers and rural small businesses. Given the Project Area is located outside of any farm land, small businesses may apply in eligible rural areas, wherever portions of the Project Area are located. Two potential program options are noted below:

- Rural Energy for America Program Renewable Energy Systems & Energy Efficiency Improvement Guaranteed Loans & Grant: The program provides guaranteed loan financing and grant funding to agricultural producers and rural small businesses for renewable energy systems or to make energy efficiency improvements.
- Business & Industry Loan Guarantees: The program provides loan guarantees to lenders in rural areas for business and industry loans.

The Inflation Reduction Act

Tax benefits for investors with tax burdens are often a substantial source of interest and support in financing solar project development. It is worth noting the IRA's recent provision to allow for direct-pay tax credits for municipalities or non-profit entities with no tax burden. Applicants may apply and receive the IRA benefit for a period of 5 years. The tax credit is currently valued at 30% of the cost of eligible solar project expenses through 2032. Credit value decreases to 26% in 2033 and to 22% in 2034. The value of the credit may be further increased 10% by siting the solar facility in a designated energy community – an area impacted by the fossil fuel industry or otherwise located on a brownfield. The proposed Community Scale Solar sites examined may meet the definition of "energy community-located" based on historical mining activities.

6. Limitations and Risk

Historical mining operations within the recommended sites for DG/community solar and utility scale solar pose risks to future solar development. The presence of drift, slope, and shaft mines within these proposed areas could potentially affect how these arrays are constructed (driven pile support versus ballasted system) or could result in settlement or ground collapse. Significant settling or ground collapse would damage the solar array or could result in worker injury during installation. For this reason, a geotechnical investigation is recommended for both the distributed generation/community solar parcels and utility scale solar parcels with a particular focus on former mining areas.

Environmental RECs within the buildable area parcels are a concern as well. As part of the due diligence process, it is likely that most or all of the RECs identified will require that a Phase II Environmental Site Assessment (ESA) be conducted. If the contaminants of concern listed above in Sections 2.1 and 3.1 are observed, there is the potential that environmental remediation would need to be conducted within these areas prior to the start of solar development. As stated above, environmental remediation (particularly PCBs) can be a time-consuming and costly process. However, if environmental concerns are identified in these areas as part of the due diligence process, they can likely be omitted from the buildable area and solar development can move forward outside of the REC (Recognized Environmental Condition) areas.

The presence of wetlands and streams within the buildable areas also represents a risk to solar development. Proper identification of the extent and type of these surface water bodies is critical in determining the constructability and permitting timelines of proposed projects. However, the disturbed nature of the site may lead the surface waterbodies to flow underground where the areas have been deeply mined. Construction within these environmentally sensitive areas requires proper solar site design and competent construction to avoid negative impacts to the natural environment.

Steep slopes are also a risk to solar site development. Solar arrays are typically constructed within areas that have slopes of 10% or less but can be constructed on slopes of up to 20%. The buildable areas selected were identified in part because of their contiguous areas that have slopes of 20% or less. However, grading is likely required to create contiguous areas where slopes are 20% or less to make them attractive to solar developers. This process can be time-consuming and costly, but could receive funding under the Targeted Brownfield Assessments, Clean Up, Multipurpose and Job Training Grants described above in Section 3.

Development and interconnection of community solar-scale PV arrays is contingent upon the results of a system impact study (SIS) by the local utility company (UGI Utilities Inc.) that analyzes the potential safety and system stability impact of the energy resource on the system equipment and connected customers. Often, SIS results require system modifications and/or additions or power capacity reduction, all of which can have a financial effect on any project.

7. Conclusions

As of March 2023, the Project Area is primarily suited for distributed generation (DG) facilities of 3 to 5 MW_{AC} under AEPS. The higher viability for DG facilities is due to the limited availability of contiguous buildable areas – mostly constrained by the uneven terrain that is the result of the historical mining activities. For a 5-MW_{AC} solar development, LaBella recommends at least two sites encompassing at a minimum of 25 acres with limited vegetation clearing, grading, and environmental remediation required: Warrior Run and Sgarlette Areas. These sites also have relatively easy access to the local utility UGI Utilities Inc.'s interconnection infrastructure. If the community solar program is permitted in Pennsylvania, such DG development plans would become much more financially viable and attractive as community solar facilities to private developers.

Portions of the Project Area could also be suitable for utility scale solar development with significant grading and remediation to create a much larger contiguous buildable area near a point of interconnection to the electric grid. LaBella recommends at least two sites – Wanamie and Truesdale Areas -- if the funding for mineland reclamation and site preparation for solar development is made available during the Pennsylvania-New Jersey-Maryland (PJM) Interconnection's moratorium.

Additionally, trackers that reorient with the sun's position to optimize energy production over the course of a day are the solar panel technology of choice over fixed tilt solar modules that are immobile. Another technological aspect that can boost production is bifacial modules that can generate current from the front and rear surfaces when illuminated from direct and reflected irradiation. Both solar facility sizes (5 - 10 and 42 - 114 MW_{AC}) explored under Distributed Generation and Utility Scale development scenarios assumed bifacial modules supported on tracking systems, albeit different racking manufacturers.

Avoidance or clean-up of environmental remedial concerns will be pivotal since there are limited financially feasible options for ballasted trackers that would prevent ground disturbance. But if needed, energy production optimization can be sacrificed for the benefit of maximizing buildable area with ballasted fixed tilt panels over where ground disturbance is not permitted. Technological advances are rapid in this field, and reevaluation of appropriate modules is recommended if a solar development project is still ongoing several years after this report.

The Project would benefit from pursuing grants and other funding opportunities to assist with remediating abandoned mine land and grading the Project Area to increase buildable acreage. Due to the Justice40 Initiative, 40% of federal funding for abandoned mine lands will be allocated to disadvantaged communities and environmental justice areas. This may make it beneficial to attempt to site the solar development within environmental justice areas in the Project Area. The Project would also benefit from undertaking more extensive remediation and regrading projects as the PJM interconnection queue restarts for new projects in 2026.

LaBella recommends the next steps for the targeted redevelopment areas:

- topographical survey;
- geotechnical investigation including soil settlement study;

- full wetland/stream delineation and habitat surveys, if necessary;
- full Phase I Environmental Site Assessment of remedial concerns;
- further research into the abandoned mine lands remediation plans and schedules and into possible funding opportunities for reclaiming, grading, and developing abandoned mine lands; and
- early engagement with the electric utilities, host communities, applicable regulatory agencies, and private developers.

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APPENDIX A – FIGURES

DALLAS
LAKE
KINGSTON
WEST WYOMING
WYOMING
EXETER
JENKINS
SWOYERSVILLE
FORTY FORT
ROSS
LEHMAN
COURTDALE
LUZERNE
PLAINS
PRINGLE
JACKSON
LARKSVILLE
EDWARDSVILLE
WILKES-BARRE
PLYMOUTH
HUNLOCK
HANOVER
LAUREL RUN
ASHLEY
NANTICOKE
Nanticoke Landfill, REC 26
SUGAR NOTCH
WARRIOR RUN
UNION
NEWPORT
BEAR CREEK
FAIRVIEW
NUANGOLA
SHICKSHINNY
RICE
CONYNGHAM
SLOCUM
WRIGHT
SALEM
DORRANCE
DENNISON

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Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 1 2 Miles

1 in = 1.25 miles

Legend

- Municipal Boundary
- Project Area
- PADEP Environmental Justice Area
- Landfill

Sources:
1. Project Area: Created by LaBella using information provided by the Client. 2022.
2. Basemap: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community 2020

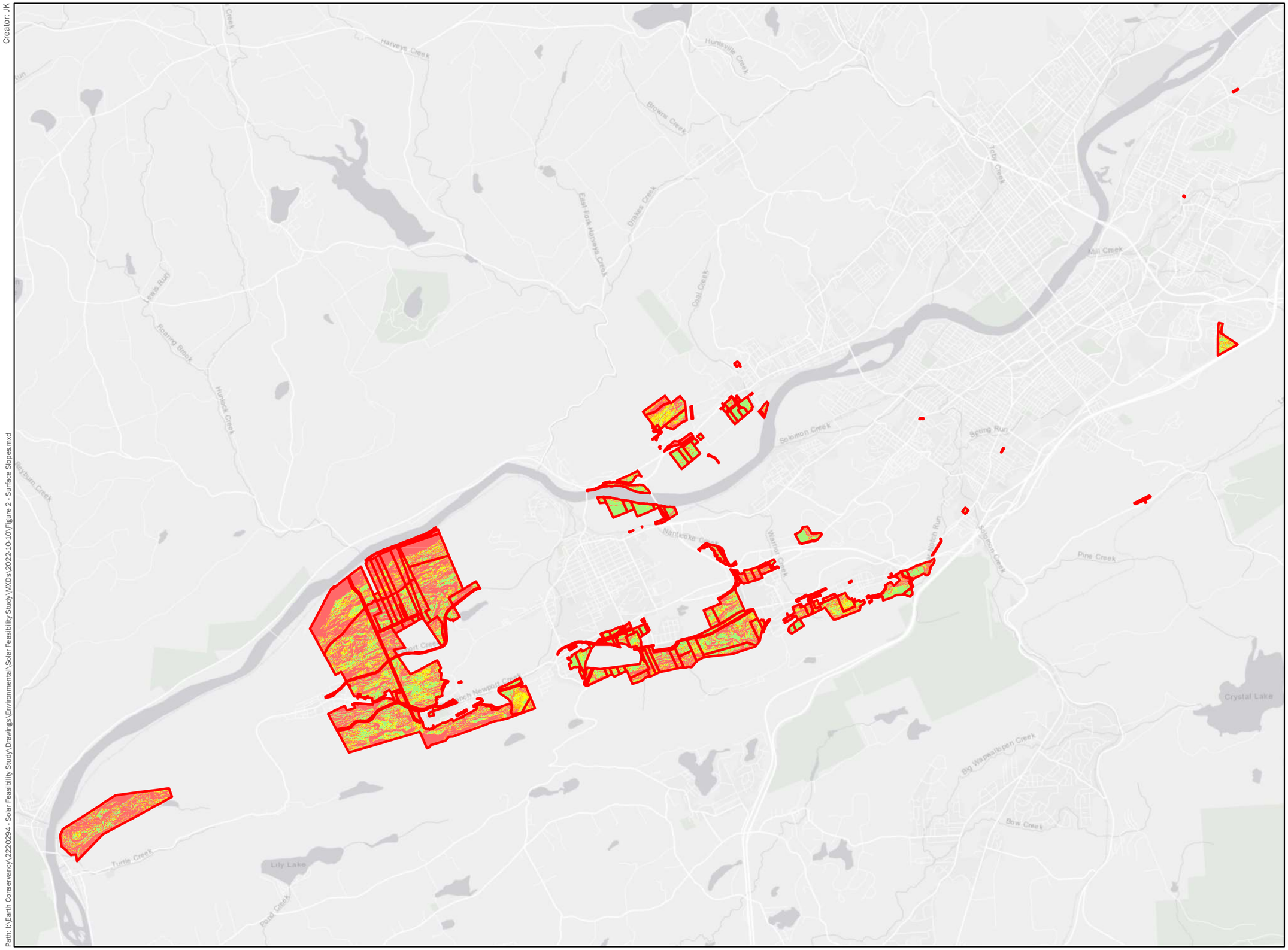
Municipalities, PADEP Environmental Justice Areas, and Landfill

FIGURE 1

LaBella Project No: 2220294
Date: October 2022

Creator: JK

Path: I:\Earth Conservancy\2220294 - Solar Feasibility Study\Drawings\Environmental\Solar Feasibility Study\MXDs\2022-10-10\Figure 2 - Surface Slopes.mxd



LaBella
Powered by partnership.

Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 1 2 Miles

1 in = 1.25 miles

Legend

Project Area

Percent Slope

Pct_Slope

- <10
- 10 - 15
- 15 - 20
- ≥20

Sources:
1. Project Area: Created by LaBella using information provided by the client 2022.
2. Basemap: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community 2020
3. Surface Slopes: Derived from USGS Lidar data, 2018.

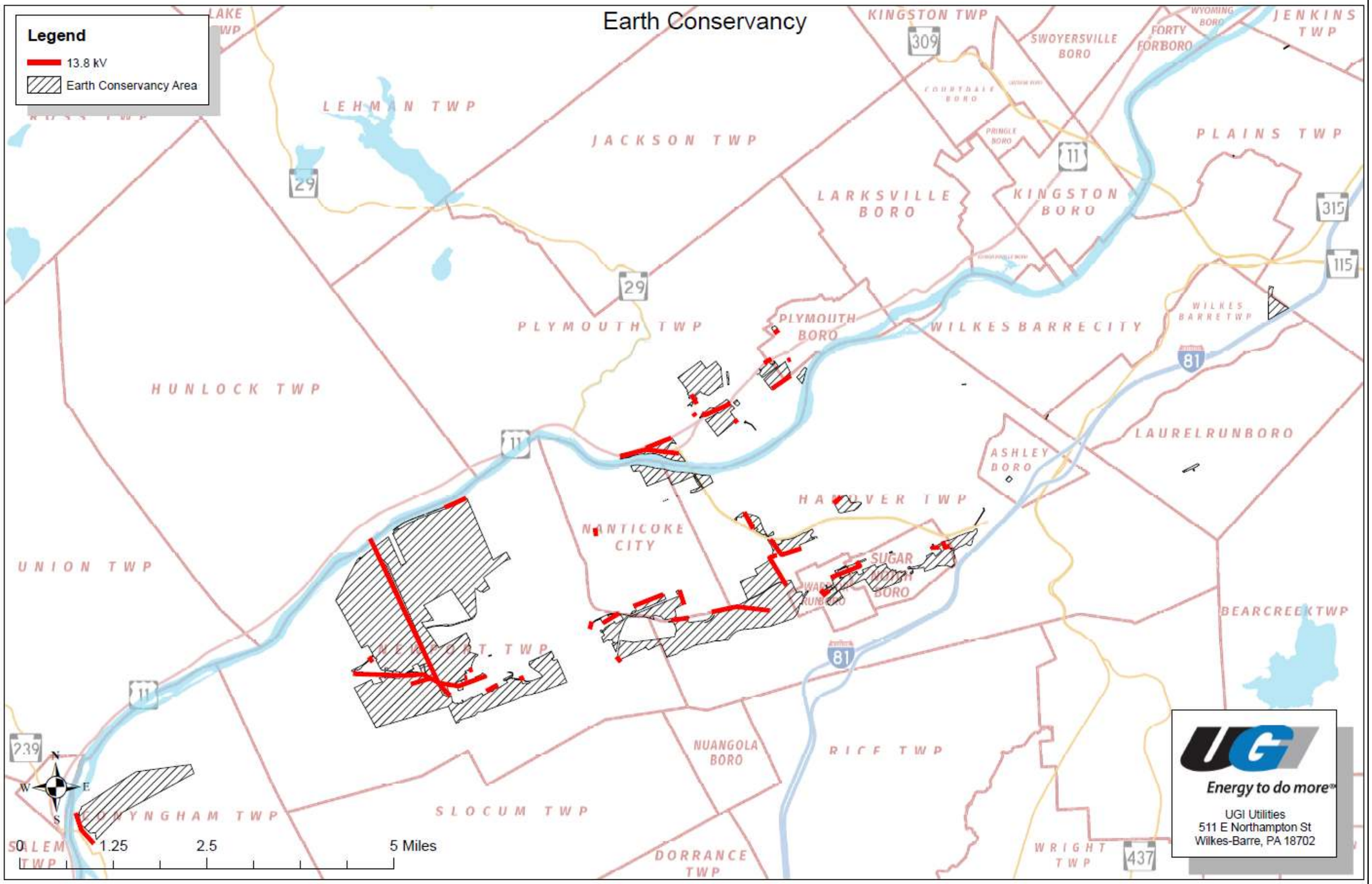
Surface Slopes

FIGURE 2

LaBella Project No: 2220294
Date: May 2022

Creator: LW

Path: I:\Earth Conservancy\2220294 - Solar Feasibility Study\Drawings\Environmental\Solar Feasibility Study\MXDs\2023-03-17\Figure 3 - UGI 13.8 kV Electrical Lines.mxd



Energy to do more

UGI Utilities
511 E Northampton St
Wilkes-Barre, PA 18702

LaBella
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Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 250 500 Feet

1 in = 500 feet

Sources:
1. Solar Sites: Created by LaBella using information provided by the Client. 2022.
2. Electrical Lines: UGI

UGI 13.8 kV Electrical Lines

FIGURE 3

LaBella Project No: 2220294
Date: March 2023

Creator: CF Reviewer: LW

Path: I:\Earth Conservancy\2220294 - Solar Feasibility Study\Drawings\Environmental\Solar Feasibility Study\MXDs\2023-03-17\FIGURE 4A - Warrior Run Area - Aerial Imagery.mxd

LaBella
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Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 250 500 Feet

1 in = 500 feet

Legend

Solar Sites

Sources:
1. Solar Sites: Created by LaBella using information provided by the Client. 2022.
2. Basemap: Microsoft Corporation. 2022. Maxar. 2022. CNES. 2022. Distribution Airbus DS.

Warrior Run Area - Aerial Imagery

FIGURE 4A

LaBella Project No: 2220294
Date: March 2023

LaBella
Powered by partnership.

Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 250 500 Feet

1 in = 500 feet

Legend

Solar Sites

Remotely-Sensed WOUS

Ephemeral Stream

PEM/PSS

PFO

PUB/PEM

Important Farmland

Farmland of statewide importance

Not prime farmland

RECs

Recognized Environmental Conditions

High Risk

Medium Risk

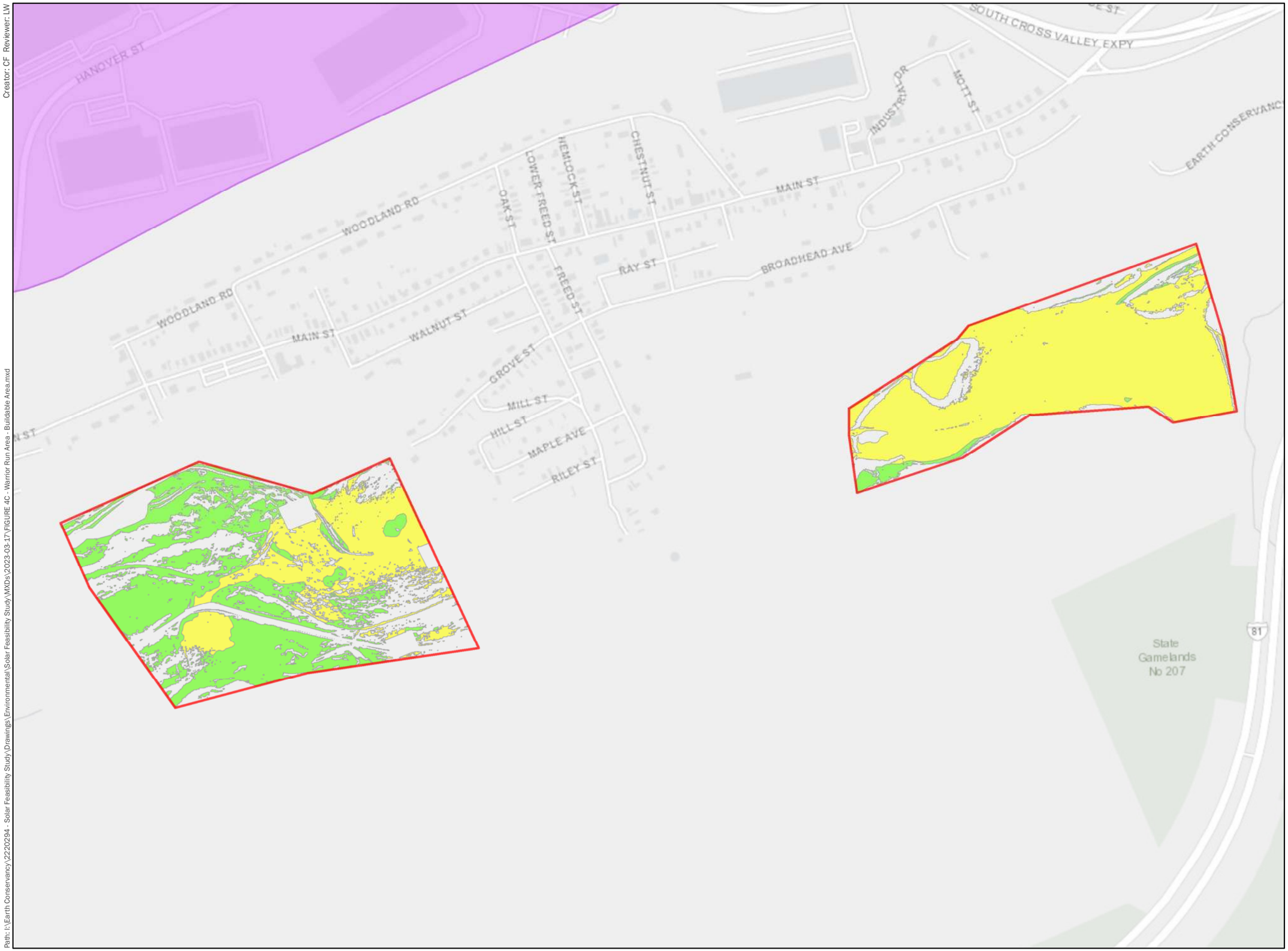
Low Risk

Sources:
1. Solar Sites: Created by LaBella using information provided by the Client. 2022.
2. Basemap: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community 2020
3. Wetlands and Streams: Created by LaBella using remote sensing. 2022.

Warrior Run Area - Site Constraints

FIGURE 4B

LaBella Project No: 2220294
Date: March 2023



LaBella
Powered by partnership.

Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 250 500 Feet

1 in = 500 feet

Legend

- Solar Sites
- Buildable Area
- Buildable Forest Area
- Environmental Justice Area

Sources:
1. Solar Sites & Buildable Areas: Created by LaBella using information provided by the Client. 2022.
2. Basemap: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community 2020

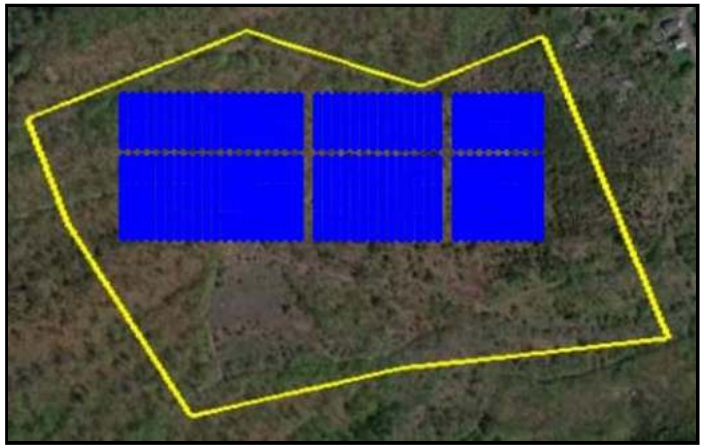
Warrior Run Area - Buildable Area

FIGURE 4C

LaBella Project No: 2220294
Date: March 2023

Creator: CF Reviewer: LW

Path: I:\Earth Conservancy\2220294 - Solar Feasibility Study\Drawings\Environmental\Solar Feasibility Study\MXDs\2023-03-17\FIGURE 4C - Warrior Run Area - Buildable Area.mxd



Tracker Modeling - 5MW-AC

Tracker Modeling - 10 MW-AC

Source: https://www.nextracker.com/2019/09/nextracker-expands-solar-tracker-offering-with-launch-of-nx-gemini/

Tracker Racking Example - Nextracker NX Gemini™ 2 Portrait Tracker

LaBella
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Earth Conservancy

Solar Feasibility Study
Luzerne County, PA

N

Legend

Project Area

Sources:
1. Project Area: Created by LaBella using Critical Issues Analysis definitions, 2022.
2. Basemap: LaBella Simulation Report (2022). PVSyst Photovoltaic Software (Version 7.2.18) [Computer software]. PVSyst.

Warrior Run Area

Western Site Only

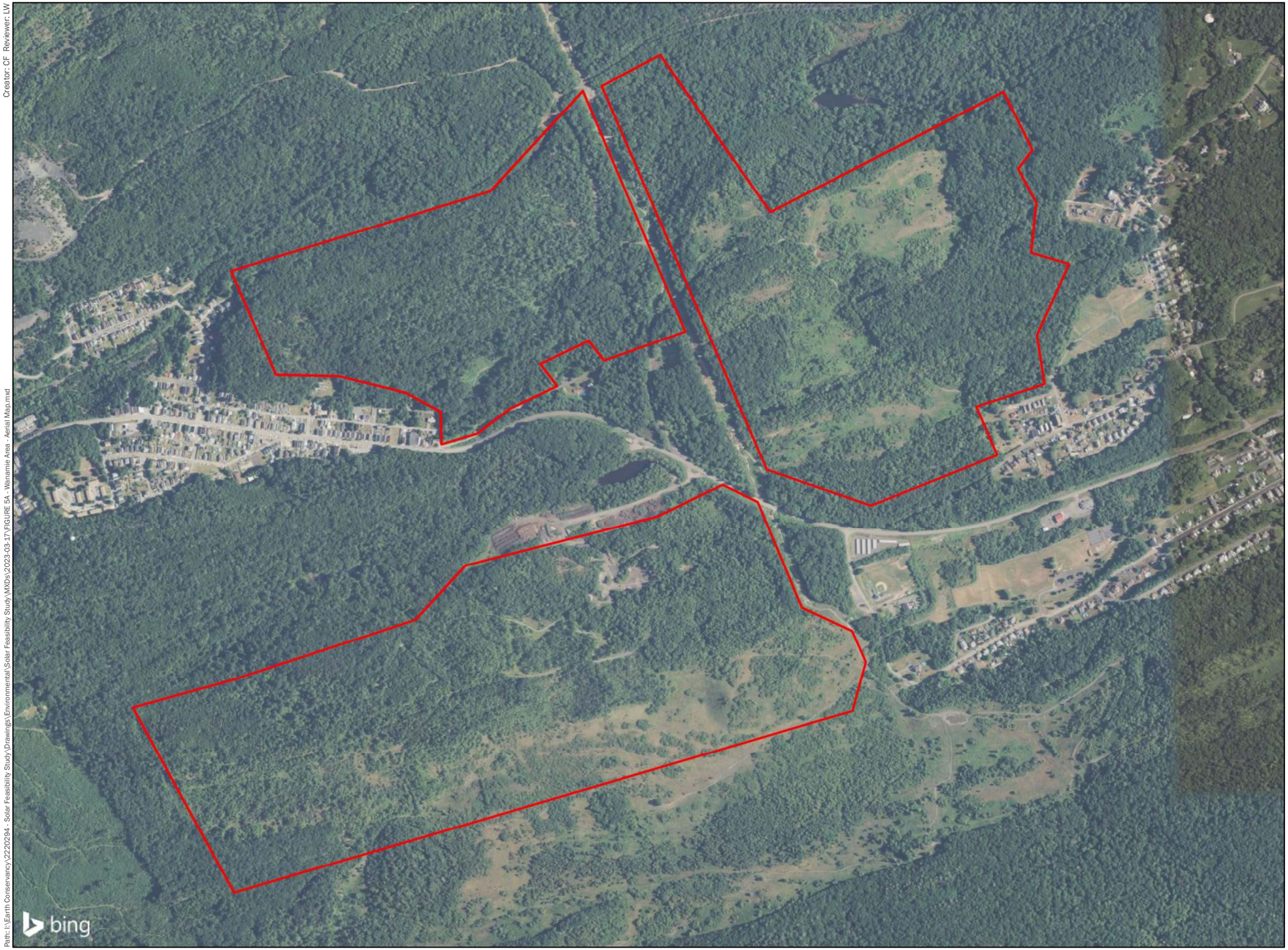
Preliminary Layout

FIGURE 4D

LaBella Project No: 2220294
Date: October 2022

Creator: CF Reviewer: LW

Path: I:\Earth Conservancy\2220294 - Solar Feasibility Study\Drawings\Environmental\Solar Feasibility Study\MXDs\2023-03-17\FIGURE 5A - Wanamie Area - Aerial Map.mxd



LaBella
Powered by partnership.

Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 375 750 Feet

1 in = 750 feet

Legend

Solar Sites

Sources:
1. Solar Sites: Created by LaBella using information provided by the Client, 2022.
2. Basemap: Microsoft Corporation. 2022. Maxar. 2022. CNES. 2022. Distribution Airbus DS.

Wanamie Area - Aerial Imagery

FIGURE 5A

LaBella Project No: 2220294
Date: March 2023

LaBella
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Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 375 750 Feet

1 in = 750 feet

Legend

- Solar Sites

NWI-Mapped Wetlands

- Freshwater Pond
- Riverine
- PUB/PFO
- PUB/PEM
- PUB
- PSS
- PFO
- PEM/PSS
- PEM
- Intermittent Stream

Important Farmland

- All areas are prime farmland
- Farmland of statewide importance
- Not prime farmland

Recognized Environmental Conditions

- High
- Medium
- Low

Sources:
1. Solar Sites: Created by LaBella using information provided by the Client. 2022.
2. Basemap: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community 2020
3. Remotely-Sensed WOUS: Created by LaBella using remote sensing. 2022.

Wanamie Area - Site Constraints

FIGURE 5B

LaBella Project No: 2220294
Date: March 2023

Creator: CF Reviewer: LW

Path: i:\Earth Conservancy\2220294 - Solar Feasibility Study\Drawings\Environmental\Solar Feasibility Study\MXDs\2023-03-17\FIGURE 5C - Wanamie Area - Buildable Area.mxd

LaBella
Powered by partnership.

Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 375 750 Feet

1 in = 750 feet

Legend

- Solar Sites
- Buildable Area
- Buildable Forest Area
- Environmental Justice Area

Sources:
1. Solar Sites & Buildable Areas: Created by LaBella using information provided by the Client. 2022.
2. Basemap: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community 2020

Wanamie Area - Buildable Area

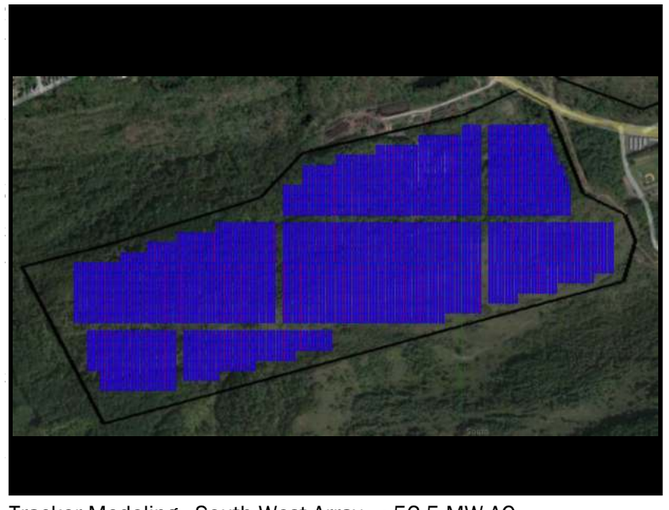
FIGURE 5C

LaBella Project No: 2220294
Date: March 2023

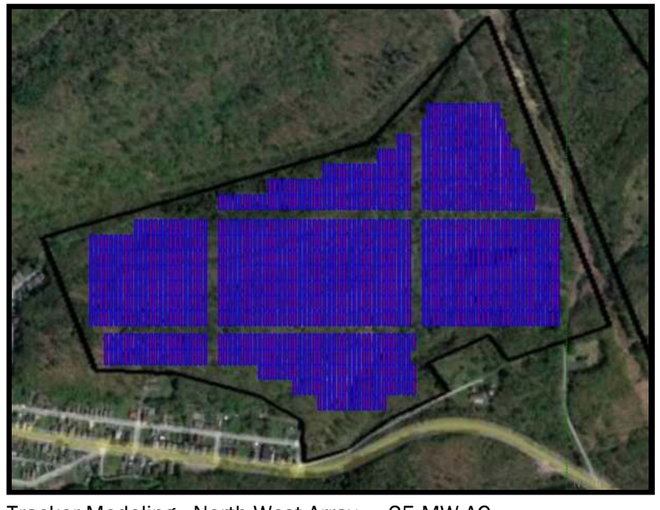
Tracker Modeling - Full Array - ~114 MW-AC

Source: https://gamechangesolar.com/news/gamechange-solar-2-portrait-tracker-chosen-for-high-load-oregon-project-with-bifacial-modules

Tracker Racking Example - GameChange GeniusTracker™ 2 Portrait



Tracker Modeling - South West Array - ~52.5 MW-AC



Tracker Modeling - North West Array - ~25 MW-AC

Tracker Modeling - North East Array - ~36 MW-AC

LaBella
Powered by partnership.

Earth Conservancy

Solar Feasibility Study
Luzerne County, PA

N

Legend

Project Area

Sources:
1. Project Area: Created by LaBella using Critical Issues Analysis definitions, 2022.
2. Basemap: LaBella Simulation Report (2022). PVSyst Photovoltaic Software (Version 7.2.18) [Computer software]. PVSyst.

Wanamie Area

Preliminary Layout

FIGURE 5D

LaBella Project No: 2220[illegible]
Date: October 2022

Creator: CF Reviewer: LW

Path: I:\Earth Conservancy\2220294 - Solar Feasibility Study\Drawings\Environmental\Solar Feasibility Study\MXDs\2023-03-17\Sgarlett\FIGURE 6A - US Aerial Map.mxd

LaBella
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Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 150 300 Feet

1 in = 300 feet

Legend

Solar Sites

Sources:
1. Solar Sites: Created by LaBella using information provided by the Client. 2023.
2. Basemap: Microsoft Corporation. 2023. Maxar. 2022. CNES. 2022. Distribution Airbus DS.

Sgarlett Area
-
Aerial Imagery

FIGURE 6A

LaBella Project No: 2220294
Date: March 2023

LaBella
Powered by partnership.

Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 150 300 Feet

1 in = 300 feet

Legend

- Solar Sites

NWI-Mapped Wetlands

- Freshwater Pond
- Riverine
- PUB/PFO
- PUB/PEM
- PUB
- PSS
- PFO
- PEM/PSS
- PEM
- Intermittent Stream

Important Farmland

- All areas are prime farmland
- Farmland of statewide importance
- Not prime farmland

Recognized Environmental Conditions

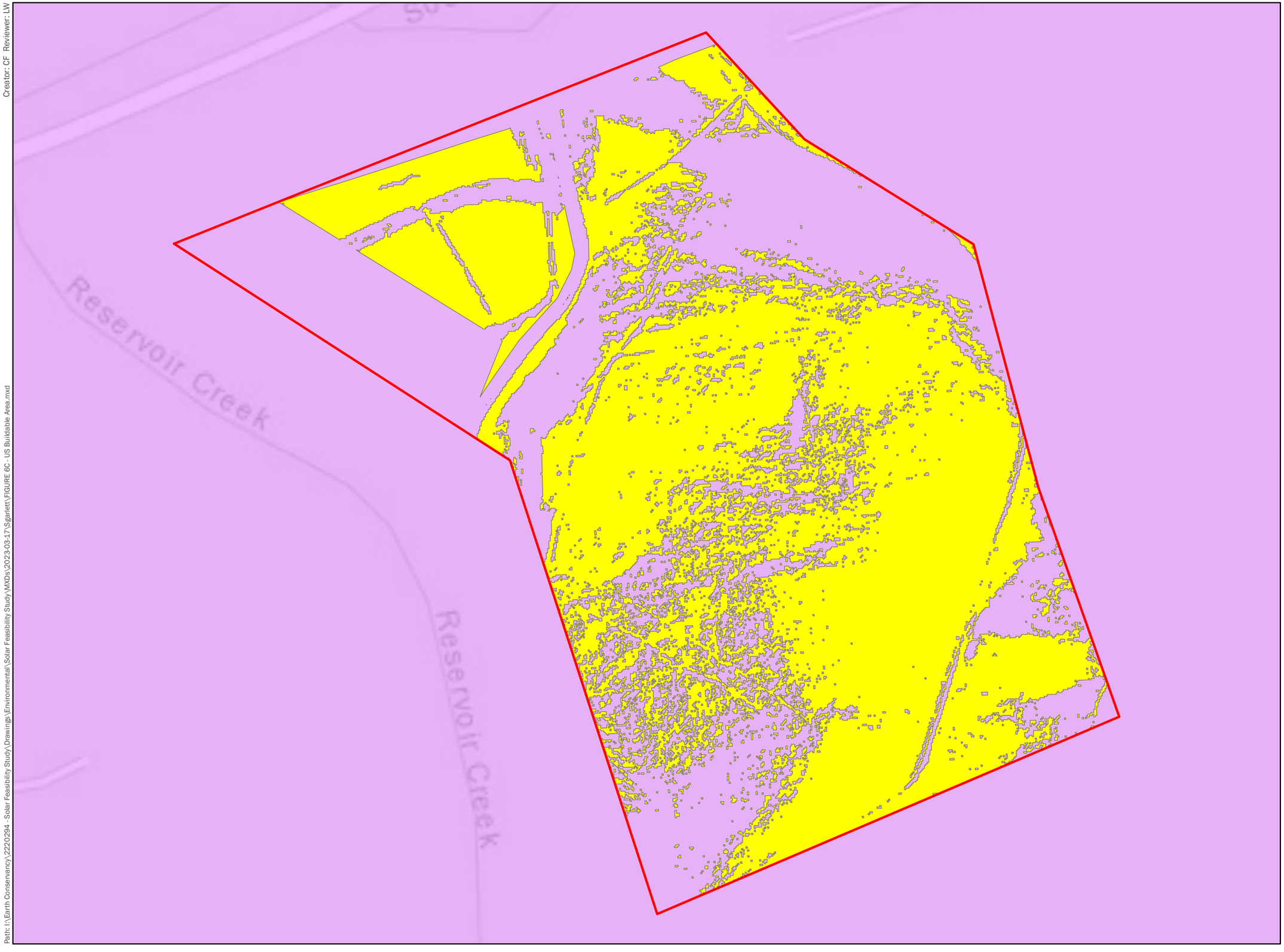
- High
- Medium
- Low

Sources:
1. Solar Sites: Created by LaBella using information provided by the Client, 2023.
2. Basemap: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community 2020.

Sgarlett Area - Site Constraints

FIGURE 6B

LaBella Project No: 2220294
Date: March 2023



LaBella
Powered by partnership.

Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 100 200 Feet

1 in = 200 feet

Legend

- Solar Sites
- Buildable Area
- Environmental Justice Area

Sources:
1. Solar Sites & Buildable Areas: Created by LaBella using information provided by the Client. 2022.
2. Basemap: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community 2020

Sgarlett Area - Buildable Area

FIGURE 6C

LaBella Project No: 2220294
Date: March 2023

Creator: CF Reviewer: LW

Path: I:\Earth Conservancy\2220294 - Solar Feasibility Study\Drawings\Environmental\Solar Feasibility Study\MXDs\2023-03-17\Sgarlett\FIGURE 6C - US Buildable Area.mxd

Creator: CF Reviewer: LW

Path: I:\Earth Conservancy\2220294 - Solar Feasibility Study\Drawings\Environmental\Solar Feasibility Study\MXDs\2023-03-17\Sgarlett\Figure 6D - Sgarlett Area - Preliminary Layout.mxd

LaBella
Powered by partnership.

Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 100 200 Feet

1 in = 200 feet

Legend

Solar Sites

Sources:
1. Solar Sites and Layout: Created by LaBella using information provided by the Client. 2023.

Sgarlett Area
-
Preliminary Layout

FIGURE 6D

LaBella Project No: 2220294
Date: March 2023

Creator: CF Reviewer: LW

Path: I:\Earth Conservancy\2220294 - Solar Feasibility Study\Drawings\Environmental\Solar Feasibility Study\MXDs\2023-03-17\Truesdale\FIGURE 7A - US Aerial Map.mxd

LaBella
Powered by partnership.

Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 250 500 Feet

1 in = 500 feet

Legend

Solar Sites

Sources:
1. Solar Sites: Created by LaBella using information provided by the Client. 2022.
2. Basemap: Microsoft Corporation. 2022. Maxar. 2022. CNES. 2022. Distribution Airbus DS.

Truesdale Area
-
Aerial Imagery

FIGURE 7A

LaBella Project No: 2220294
Date: March 2023

LaBella
Powered by partnership.

Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 250 500 Feet

1 in = 500 feet

Legend

- Solar Sites

NWI-Mapped Wetlands

- Freshwater Pond
- Riverine
- PUB/PFO
- PUB/PEM
- PUB
- PSS
- PFO
- PEM/PSS
- PEM
- Intermittent Stream

Important Farmland

- All areas are prime farmland
- Farmland of statewide importance
- Not prime farmland

Recognized Environmental Conditions

- High
- Medium
- Low

Sources:
1. Solar Sites: Created by LaBella using information provided by the Client, 2023.
2. Basemap: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community 2020

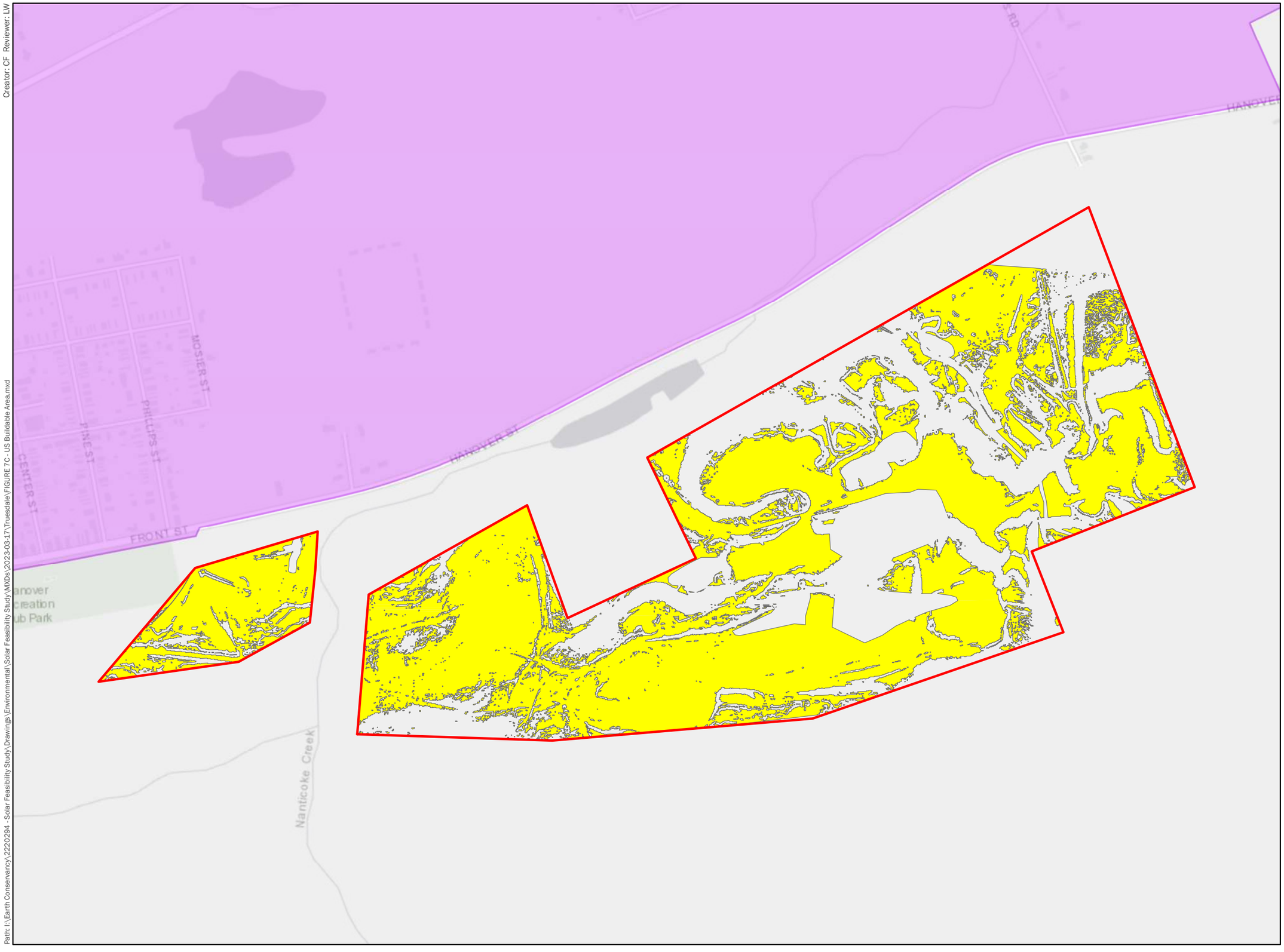
Site Constraints

FIGURE 7B

LaBella Project No: 2220294
Date: March 2023

Creator: CF Reviewer: LW

Path: I:\Earth Conservancy\2220294 - Solar Feasibility Study\Drawings\Environmental\Solar Feasibility Study\MXDs\2023-03-17\FIGURE 7B - Truesdale Area - Site Constraints.mxd



Creator: CF Reviewer: LW

Path: I:\Earth Conservancy\2220294 - Solar Feasibility Study\Drawings\Environmental\Solar Feasibility Study\MXDs\2023-03-17\Truesdale\FIGURE 7C - US Buildable Area.mxd

LaBella
Powered by partnership.

Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 250 500 Feet

1 in = 500 feet

Legend

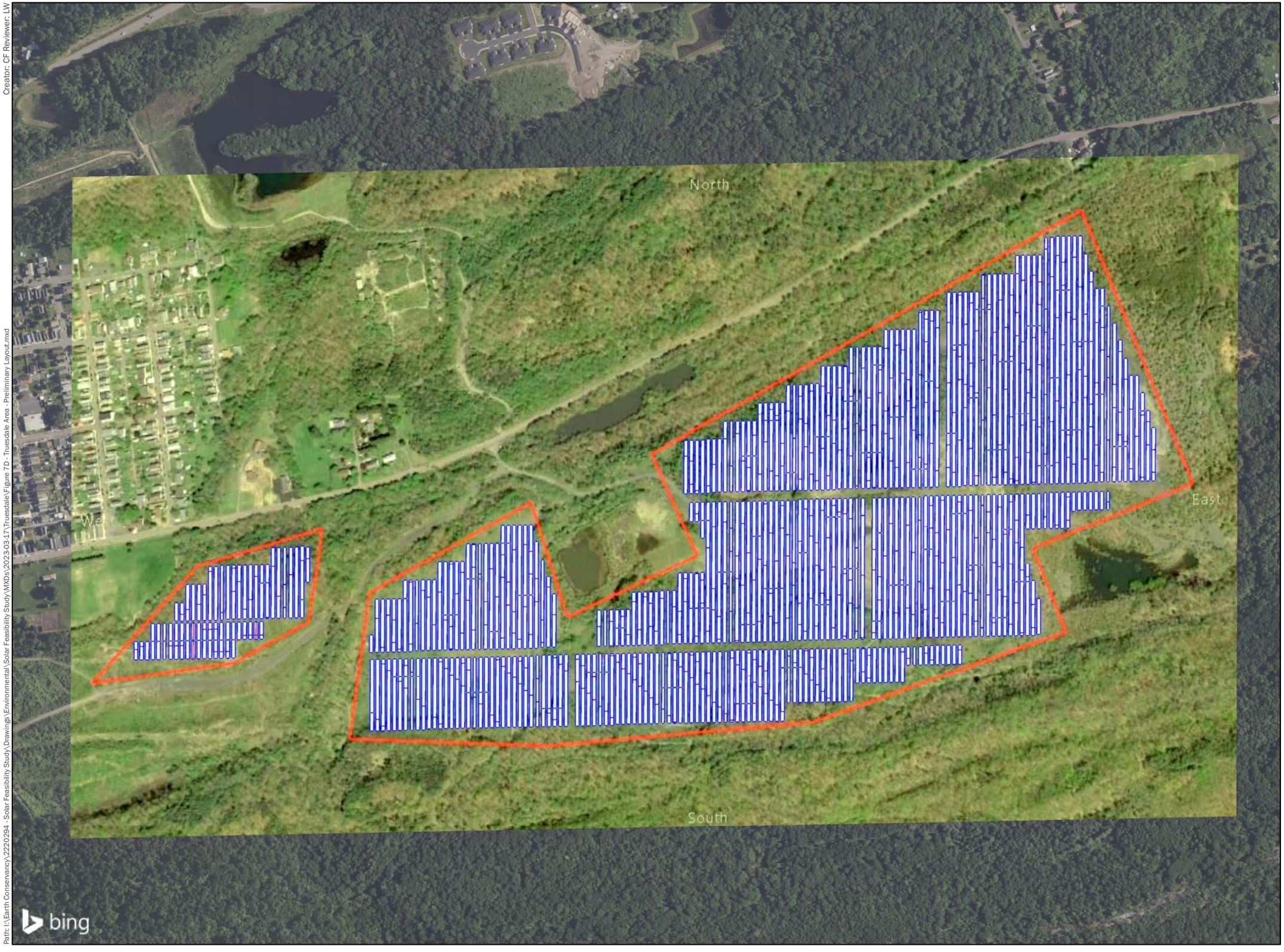
- Solar Sites
- Buildable Area
- Environmental Justice Area

Sources:
1. Solar Sites & Buildable Areas: Created by LaBella using information provided by the Client. 2023.
2. Basemap: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community 2020

Truesdale Area - Buildable Area

FIGURE 7C

LaBella Project No: 2220294
Date: March 2023



Creator: CF Reviewer: LW

Path: I:\Earth Conservancy\2220294 - Solar Feasibility Study\Drawings\Environmental\Solar Feasibility Study\MXDs\2023-03-17 Truesdale\Figure 7D - Truesdale Area - Preliminary Layout.mxd

LaBella
Powered by partnership.

Earth Conservancy

Solar Feasibility Study

Luzerne County, PA

N

0 250 500 Feet

1 in = 500 feet

Legend

Solar Sites

Sources:
1. Solar Sites and Layout: Created by LaBella using information provided by the Client. 2023.

Truesdale Area - Preliminary Layout

FIGURE 7D

LaBella Project No: 2220294
Date: March 2023

APPENDIX B – PVsyst Reports

Version 7.2.18

PVsyst - Simulation report 1

Grid-Connected System

Project: Earth Conservancy Ashley PA

Variant: Community Scale 5MW

Tracking system

System power: 6692 kWp

Wanamie - United States

Author

LaBella Associates (United States)

PVsyst V7.2.18
VC1, Simulation date:
10/10/22 08:27
with v7.2.18

Project summary

Geographical Site
Wanamie
United States

Situation

Latitude	41.17 °N
Longitude	-76.06 °W
Altitude	241 m
Time zone	UTC-5

Meteo data
Wanamie
Meteonorm 8.0 (1991-2005), Sat=3% - Synthetic

Monthly albedo values

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Albedo	0.25	0.25	0.25	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20

System summary

Grid-Connected System

Tracking system

PV Field Orientation
Orientation
Tracking plane, horizontal N-S axis
Axis azimuth 0 °

Tracking algorithm
Astronomic calculation

Near Shadings
Linear shadings

System information

PV Array

Nb. of modules	11440 units
Pnom total	6692 kWp

Inverters

Nb. of units	20 units
Pnom total	5000 kWac
Pnom ratio	1.338

User's needs
Unlimited load (grid)

Results summary

Produced Energy	10 GWh/year	Specific production	1485 kWh/kWp/year	Perf. Ratio PR	81.37 %

Table of contents

PVsyst V7.2.18
VC1, Simulation date:
10/10/22 08:27
with v7.2.18

General parameters

Grid-Connected System

Tracking system

PV Field Orientation

Orientation		Tracking algorithm		Trackers configuration	
Tracking plane, horizontal N-S axis		Astronomic calculation		Nb. of trackers	220 units
Axis azimuth	0 °			Identical arrays	
				Sizes	
				Tracker Spacing	10.0 m
				Collector width	4.79 m
				Ground Cov. Ratio (GCR)	47.9 %
				Phi min / max.	-/+ 90.0 °
				Shading limit angles	
				Phi limits	+/- 61.3 °

Models used

Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon		Near Shadings	User's needs
Average Height	5.0 °	Linear shadings	Unlimited load (grid)

Bifacial system

Model: 2D Calculation unlimited trackers

Bifacial model geometry		Bifacial model definitions	
Tracker Spacing	10.00 m	Ground albedo	0.20
Tracker width	4.79 m	Bifaciality factor	80 %
GCR	47.9 %	Rear shading factor	5.0 %
Axis height above ground	2.10 m	Rear mismatch loss	10.0 %
		Shed transparent fraction	0.0 %

PV Array Characteristics

PV module

Manufacturer	Trina Solar
Model	TSM-585NEG19RC.20
(Custom parameters definition)	
Unit Nom. Power	585 Wp
Number of PV modules	11440 units
Nominal (STC)	6692 kWp
Modules	440 Strings x 26 In series
At operating cond. (50°C)	
Pmpp	6197 kWp
U mpp	939 V
I mpp	6596 A

Inverter

Manufacturer	Sungrow
Model	SG250-HX
(Original PVsyst database)	
Unit Nom. Power	250 kWac
Number of inverters	20 units
Total power	5000 kWac
Operating voltage	500-1450 V
Pnom ratio (DC:AC)	1.34

Total PV power

Nominal (STC)	6692 kWp
Total	11440 modules
Module area	30928 m²
Cell area	28858 m²

Total inverter power

Total power	5000 kWac
Number of inverters	20 units
Pnom ratio	1.34

Array losses

Array Soiling Losses
Loss Fraction 3.0 %

Thermal Loss factor
Module temperature according to irradiance
Uc (const) 29.0 W/m²K
Uv (wind) 0.0 W/m²K/m/s

DC wiring losses
Global array res. 1.5 mΩ
Loss Fraction 1.0 % at STC

LID - Light Induced Degradation
Loss Fraction 0.1 %

Module Quality Loss
Loss Fraction -0.8 %

Module mismatch losses
Loss Fraction 0.5 % at MPP

Strings Mismatch loss
Loss Fraction 0.3 %

IAM loss factor
Incidence effect (IAM): Fresnel, AR coating, n(glass)=1.526, n(AR)=1.290

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.999	0.987	0.962	0.892	0.816	0.681	0.440	0.000

System losses

Unavailability of the system
Time fraction 0.8 %
3.0 days,
3 periods

Auxiliaries loss
constant (fans) 300 W
0.0 kW from Power thresh.

AC wiring losses

Inv. output line up to MV transfo
Inverter voltage 800 Vac tri
Loss Fraction 1.03 % at STC
Inverter: SG250-HX
Wire section (20 Inv.) Copper 20 x 3 x 120 mm²
Average wires length 127 m

AC losses in transformers

MV transfo
Grid voltage 20 kV
Operating losses at STC
Nominal power at STC 6625 kVA
Iron loss (night disconnect) 13.25 kW
Loss Fraction 0.20 % at STC
Coils equivalent resistance 3 x 0.87 mΩ
Loss Fraction 0.90 % at STC

PVsyst V7.2.18
VC1, Simulation date:
10/10/22 08:27
with v7.2.18

Horizon definition

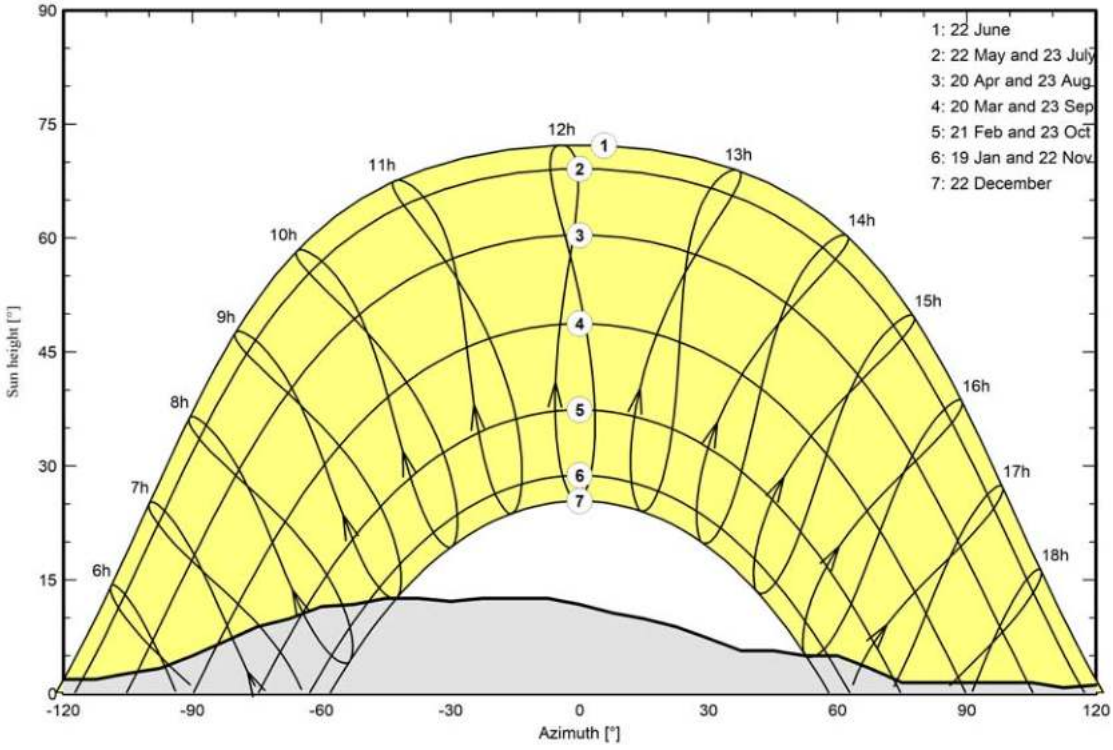
Horizon from PVGIS Sugar Notch PA

Average Height	5.0 °	Albedo Factor	0.86
Diffuse Factor	0.92	Albedo Fraction	100 %

Horizon profile

Azimuth [°]	-180	-165	-158	-150	-143	-135	-128	-120	-113	-105	-98	-90	-83	-75
Height [°]	0.8	0.8	0.4	0.8	0.4	1.5	1.5	1.9	1.9	2.7	3.4	5.0	6.9	8.8
Azimuth [°]	-68	-60	-53	-45	-38	-30	-23	-8	0	8	15	23	30	38
Height [°]	9.9	11.5	11.8	12.6	12.6	12.2	12.6	12.6	11.8	10.7	9.9	8.8	7.3	5.7
Azimuth [°]	45	53	60	68	75	105	113	128	158	165	173	180		
Height [°]	5.7	5.0	5.0	3.4	1.5	1.5	0.8	1.5	1.5	1.1	1.1	0.8		

Sun Paths (Height / Azimuth diagram)

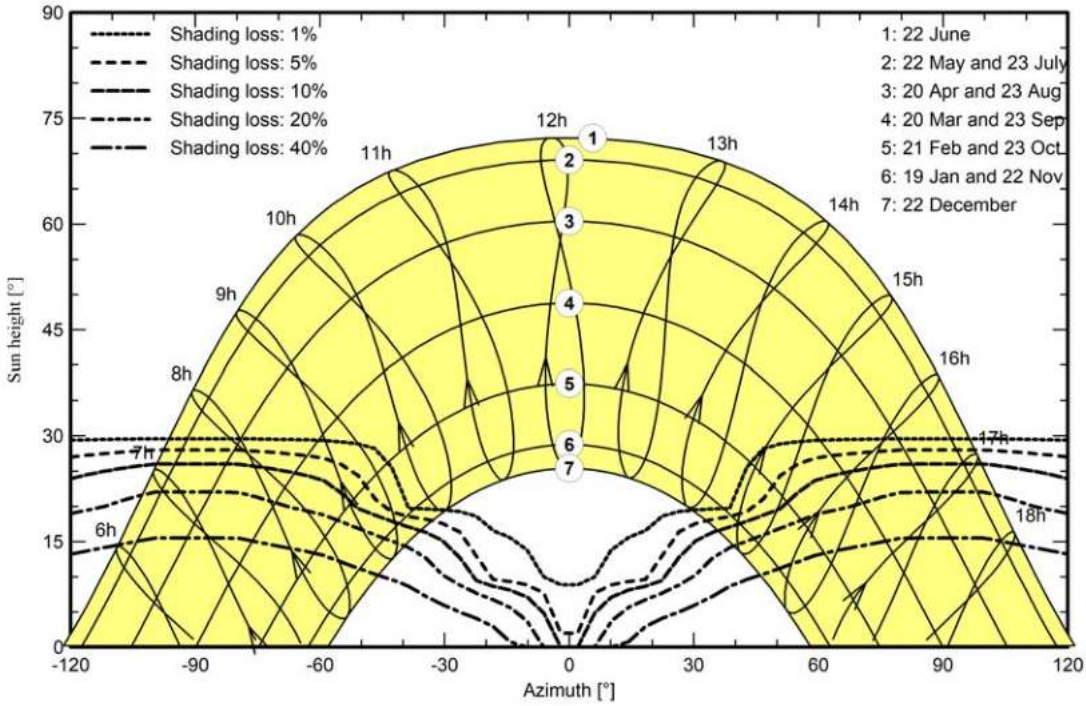


Near shadings parameter

Perspective of the PV-field and surrounding shading scene

Iso-shadings diagram

Orientation #1



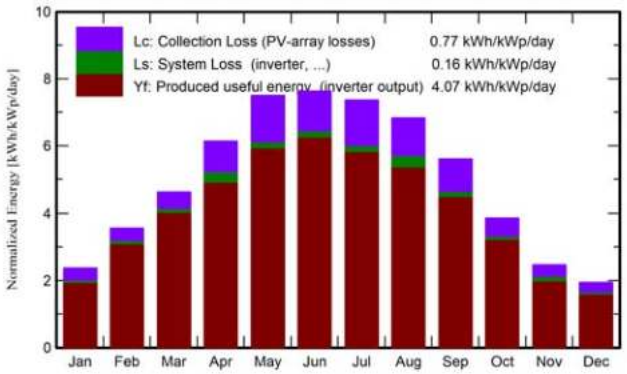
PVsyst V7.2.18
VC1, Simulation date:
10/10/22 08:27
with v7.2.18

Main results

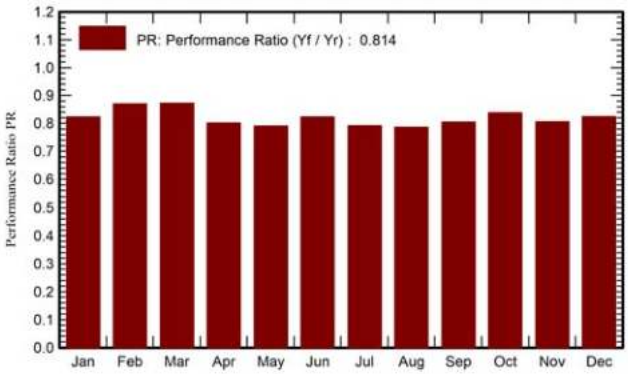
System Production

Produced Energy	10 GWh/year	Specific production	1485 kWh/kWp/year
		Performance Ratio PR	81.37 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

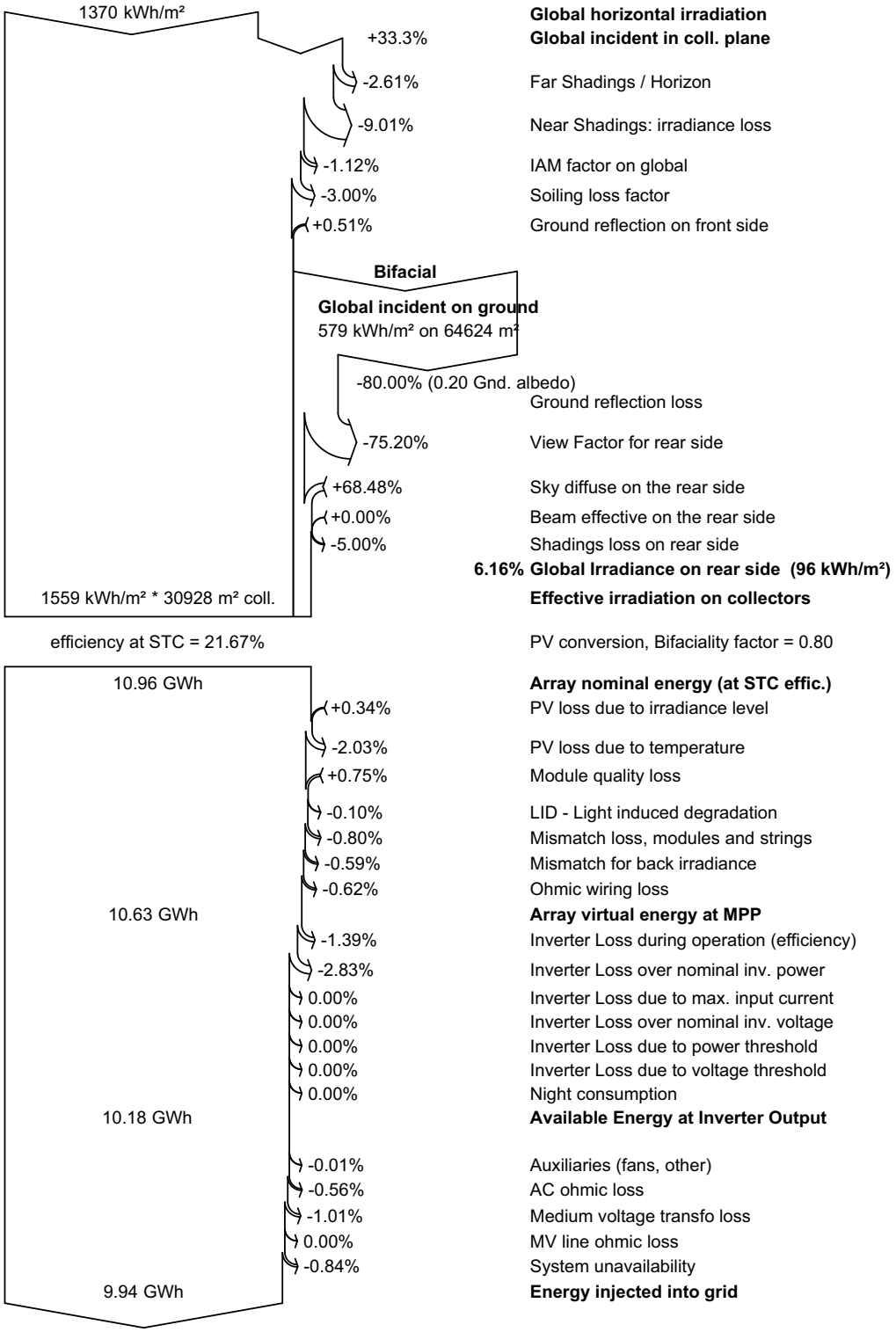
	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray GWh	E_Grid GWh	PR ratio
January	51.9	26.85	-3.27	73.5	57.0	0.420	0.405	0.823
February	72.5	36.76	-1.94	99.7	82.5	0.599	0.581	0.870
March	109.8	60.58	3.00	143.4	121.6	0.862	0.838	0.873
April	138.7	68.81	9.87	184.2	158.7	1.051	0.988	0.801
May	173.1	74.53	16.22	232.7	203.4	1.269	1.232	0.791
June	179.0	91.69	20.20	228.9	202.9	1.297	1.260	0.823
July	175.1	80.44	23.16	228.5	201.1	1.247	1.211	0.792
August	159.1	74.09	22.00	211.9	185.1	1.187	1.115	0.786
September	121.9	60.96	17.94	168.4	141.0	0.934	0.907	0.805
October	88.8	46.10	11.66	119.7	99.6	0.692	0.671	0.838
November	55.4	32.34	5.46	74.2	59.2	0.427	0.400	0.805
December	44.7	25.38	0.16	60.3	47.0	0.346	0.332	0.824
Year	1369.8	678.54	10.44	1825.3	1559.1	10.333	9.940	0.814

Legends

GlobHor	Global horizontal irradiation	EArray	Effective energy at the output of the array
DiffHor	Horizontal diffuse irradiation	E_Grid	Energy injected into grid
T_Amb	Ambient Temperature	PR	Performance Ratio
GlobInc	Global incident in coll. plane		
GlobEff	Effective Global, corr. for IAM and shadings		

PVsyst V7.2.18
VC1, Simulation date:
10/10/22 08:27
with v7.2.18

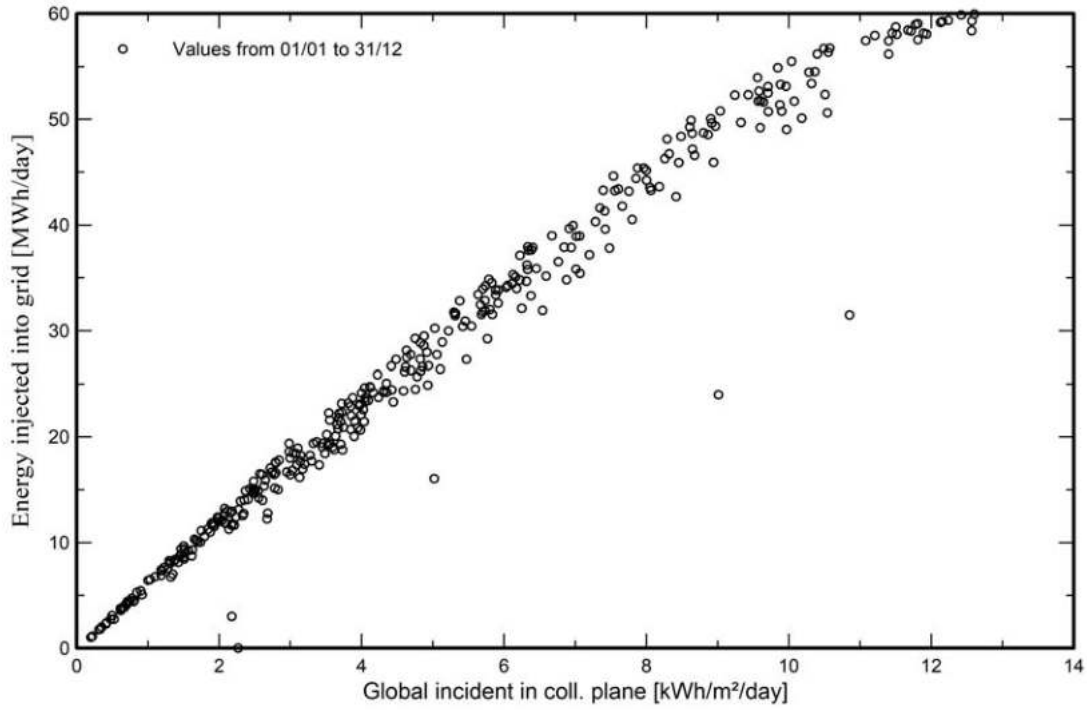
Loss diagram



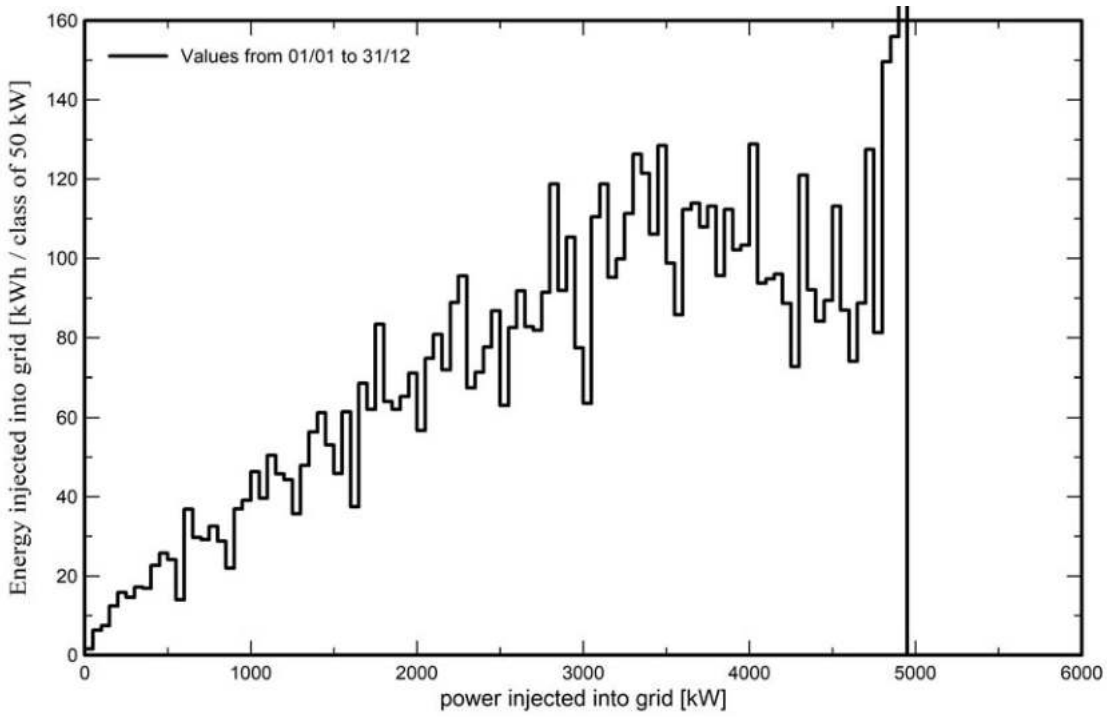
PVsyst V7.2.18
VC1, Simulation date:
10/10/22 08:27
with v7.2.18

Special graphs

Daily Input/Output diagram



System Output Power Distribution



Version 7.2.18

PVsyst - Simulation report 2

Grid-Connected System

Project: Earth Conservancy Util Scale Ashley PA

Variant: Util Scale #1

Tracking system

System power: 145.4 MWp

Wanamie - United States

Author

LaBella Associates (United States)

PVsyst V7.2.18
VC0, Simulation date:
10/10/22 13:39
with v7.2.18

Project summary

Geographical Site
Wanamie
United States

Situation
Latitude 41.17 °N
Longitude -76.06 °W
Altitude 241 m
Time zone UTC-5

Meteo data
Wanamie
Meteonorm 8.0 (1991-2005), Sat=3% - Synthetic

Monthly albedo values

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Albedo	0.25	0.25	0.25	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20

System summary

Grid-Connected System

Tracking system

PV Field Orientation
Orientation
Tracking plane, horizontal N-S axis
Axis azimuth 0 °

Tracking algorithm
Astronomic calculation

Near Shadings
Linear shadings

System information
PV Array
Nb. of modules 248612 units
Pnom total 145.4 MWp

Inverters
Nb. of units 177 units
Pnom total 114.0 MWac
Pnom ratio 1.276

User's needs
Unlimited load (grid)

Results summary

Produced Energy 207 GWh/year
Specific production 1421 kWh/kWp/year
Perf. Ratio PR 78.16 %

Table of contents

General parameters

Grid-Connected System

Tracking system

PV Field Orientation

Orientation		Tracking algorithm		Trackers configuration	
Tracking plane, horizontal N-S axis		Astronomic calculation		Nb. of trackers	4846 units
Axis azimuth	0 °			Identical arrays	
				Sizes	
				Tracker Spacing	10.00 m
				Collector width	4.79 m
				Ground Cov. Ratio (GCR)	47.9 %
				Phi min / max.	-/+ 60.0 °
				Shading limit angles	
				Phi limits	+/- 61.2 °

Models used

Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon

Average Height 4.1 °

Near Shadings

Linear shadings

User's needs

Unlimited load (grid)

Bifacial system

Model 2D Calculation
unlimited trackers

Bifacial model geometry		Bifacial model definitions	
Tracker Spacing	10.00 m	Ground albedo	0.20
Tracker width	4.79 m	Bifaciality factor	80 %
GCR	47.9 %	Rear shading factor	5.0 %
Axis height above ground	2.10 m	Rear mismatch loss	10.0 %
		Shed transparent fraction	0.0 %

PV Array Characteristics

PV module

Manufacturer	Trina Solar
Model	TSM-585NEG19RC.20
(Custom parameters definition)	
Unit Nom. Power	585 Wp
Number of PV modules	167908 units
Nominal (STC)	98.23 MWp

Inverter

Manufacturer	Sungrow
Model	SG2500-HV-20
(Original PVsyst database)	
Unit Nom. Power	2500 kWac
Number of inverters	31 units
Total power	77500 kWac

Array #1 - SW Array

Number of PV modules	115804 units	Number of inverters	21 units
Nominal (STC)	67.75 MWp	Total power	52500 kWac
Modules	4454 Strings x 26 In series		
At operating cond. (50°C)		Operating voltage	800-1300 V
Pmpp	62.73 MWp	Max. power (=>25°C)	2750 kWac
U mpp	939 V	Pnom ratio (DC:AC)	1.29
I mpp	66774 A		

Array #2 - NW Array

Number of PV modules	52104 units	Number of inverters	10 units
Nominal (STC)	30.48 MWp	Total power	25000 kWac
Modules	2004 Strings x 26 In series		

PV Array Characteristics

Array #2 - NW Array

At operating cond. (50°C)

Pmpp	28.22 MWp
U mpp	939 V
I mpp	30044 A

Operating voltage	800-1300 V
Max. power (=>25°C)	2750 kWac
Pnom ratio (DC:AC)	1.22

Array #3 - NE Array

PV module

Manufacturer	Trina Solar
Model	TSM-585NEG19RC.20
(Custom parameters definition)	
Unit Nom. Power	585 Wp
Number of PV modules	80704 units
Nominal (STC)	47.21 MWp
Modules	3104 Strings x 26 In series
At operating cond. (50°C)	
Pmpp	43.71 MWp
U mpp	939 V
I mpp	46535 A

Inverter

Manufacturer	Sungrow
Model	SG250-HX
(Original PVsyst database)	
Unit Nom. Power	250 kWac
Number of inverters	146 units
Total power	36500 kWac
Operating voltage	500-1450 V
Pnom ratio (DC:AC)	1.29

Total PV power

Nominal (STC)	145438 kWp
Total	248612 modules
Module area	672112 m²
Cell area	627129 m²

Total inverter power

Total power	114000 kWac
Number of inverters	177 units
Pnom ratio	1.28

Array losses

Array Soiling Losses

Loss Fraction 3.0 %

Thermal Loss factor

Module temperature according to irradiance

Uc (const) 29.0 W/m²K

Uv (wind) 0.0 W/m²K/m/s

LID - Light Induced Degradation

Loss Fraction 0.1 %

Module Quality Loss

Loss Fraction -0.8 %

Module mismatch losses

Loss Fraction 0.5 % at MPP

Strings Mismatch loss

Loss Fraction 0.3 %

IAM loss factor

Incidence effect (IAM): Fresnel, AR coating, n(glass)=1.526, n(AR)=1.290

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.999	0.987	0.962	0.892	0.816	0.681	0.440	0.000

DC wiring losses

Global wiring resistance 0.071 mΩ

Loss Fraction 1.0 % at STC

Array #1 - SW Array

Global array res. 0.15 mΩ

Loss Fraction 1.0 % at STC

Array #2 - NW Array

Global array res. 0.34 mΩ

Loss Fraction 1.0 % at STC

Array #3 - NE Array

Global array res. 0.22 mΩ

Loss Fraction 1.0 % at STC

System losses

Unavailability of the system

Time fraction	0.8 %		
	3.0 days,		
	3 periods		

Auxiliaries loss

constant (fans)	300 W
0.0 kW from Power thresh.	

AC wiring losses

Inv. output line up to MV transfo

Inverter voltage	550 Vac tri
Loss Fraction	14.23 % at STC

Inverters: SG2500-HV-20, SG250-HX

Wire section (177 Inv.)	Copper 177 x 3 x 120 mm²
Average wires length	127 m

AC losses in transformers

MV transfo

Grid voltage	34.5 kV

Operating losses at STC

Nominal power at STC	143984 kVA
Iron loss (night disconnect)	95.99 kW/Inv.
Loss Fraction	0.20 % at STC
Coils equivalent resistance	3 x 0.06 mΩ/inv.
Loss Fraction	0.90 % at STC

Horizon definition

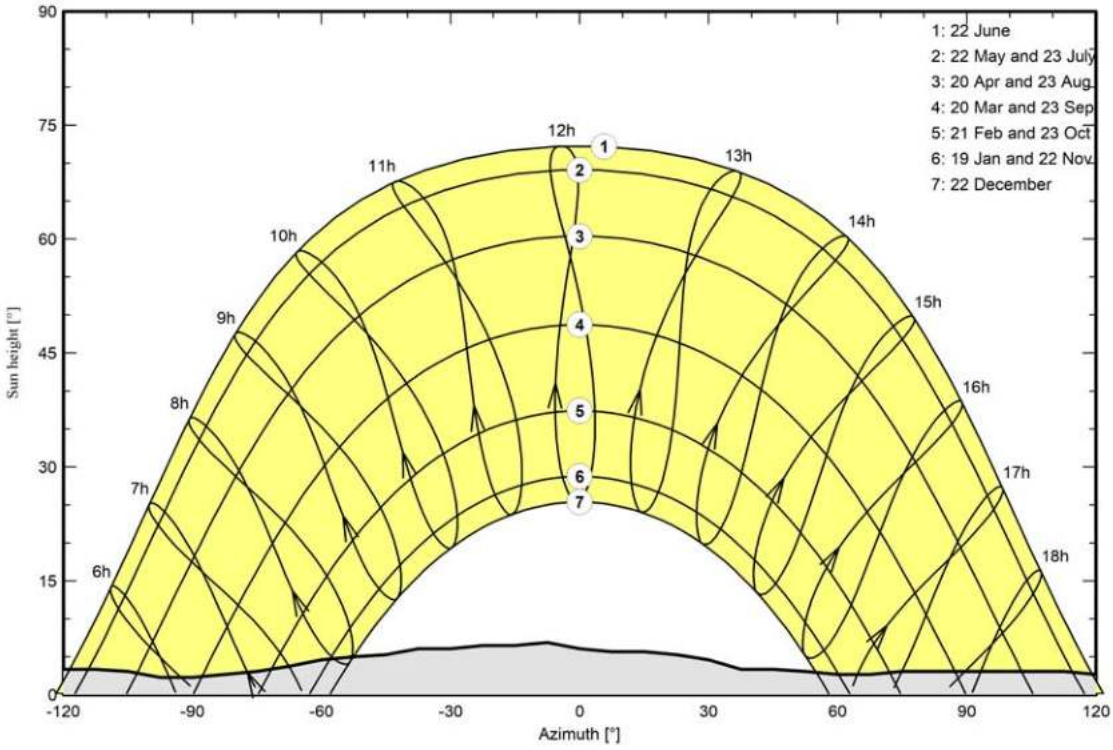
Horizon from PVGIS Newport Twp PA

Average Height	4.1 °	Albedo Factor	0.84
Diffuse Factor	0.96	Albedo Fraction	100 %

Horizon profile

Azimuth [°]	-180	-173	-165	-150	-143	-135	-128	-120	-113	-105	-98
Height [°]	3.1	2.7	5.3	5.3	5.0	5.0	4.2	3.4	3.4	3.1	2.3
Azimuth [°]	-90	-83	-75	-68	-60	-53	-45	-38	-30	-23	-15
Height [°]	2.3	2.7	3.1	3.8	4.6	5.0	5.3	6.1	6.1	6.5	6.5
Azimuth [°]	-8	0	8	15	23	30	38	45	53	60	68
Height [°]	6.9	6.1	5.7	5.7	5.3	4.6	3.4	3.4	3.1	2.7	2.7
Azimuth [°]	75	113	120	128	135	143	150	158	173	180	
Height [°]	3.1	3.1	2.7	2.7	3.4	4.2	4.2	3.8	3.1	3.1	

Sun Paths (Height / Azimuth diagram)

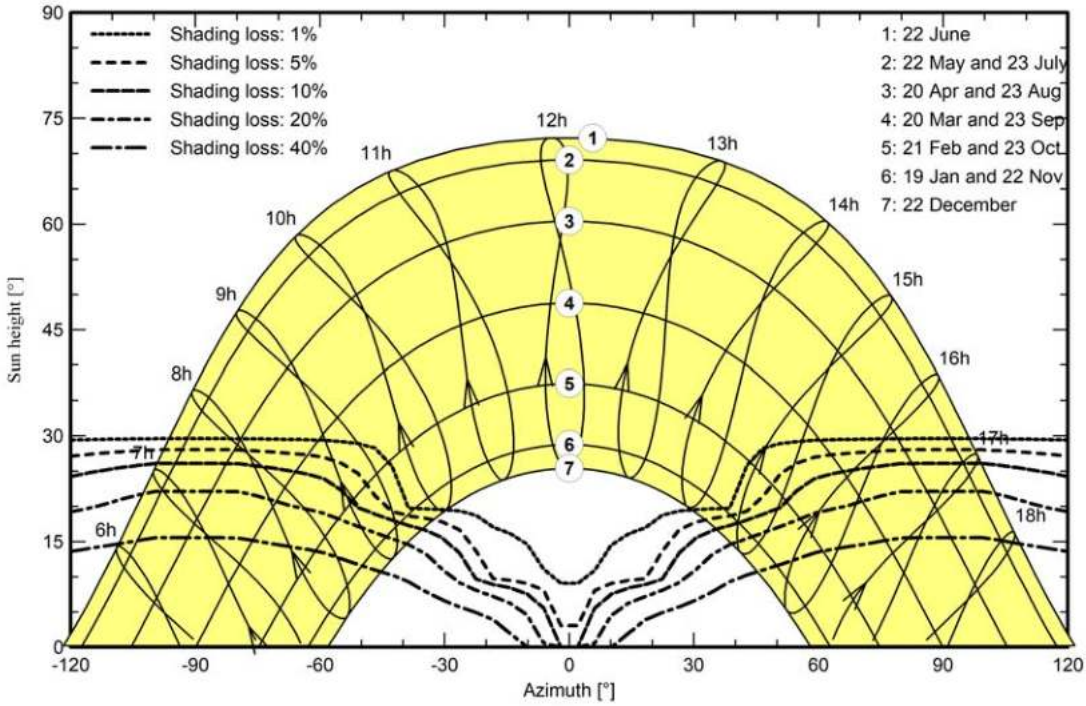


Near shadings parameter

Perspective of the PV-field and surrounding shading scene

Iso-shadings diagram

Orientation #1

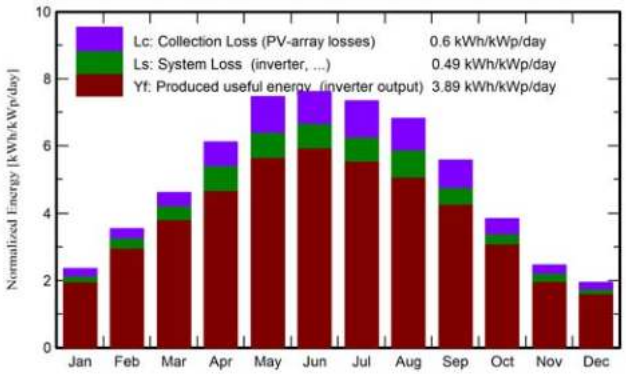


Main results

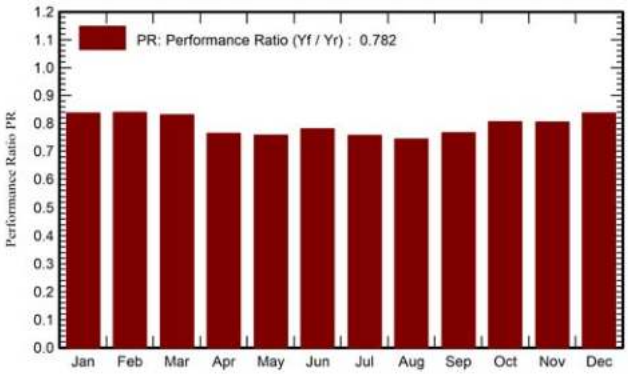
System Production

Produced Energy	207 GWh/year	Specific production	1421 kWh/kWp/year
		Performance Ratio PR	78.16 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray GWh	E_Grid GWh	PR ratio
January	51.9	26.85	-3.27	73.1	60.6	9.65	8.89	0.837
February	72.5	36.76	-1.94	99.3	84.8	13.34	12.11	0.839
March	109.8	60.58	3.00	142.9	123.9	19.11	17.26	0.831
April	138.7	68.81	9.87	183.4	160.9	23.68	20.40	0.765
May	173.1	74.53	16.22	231.7	205.1	28.95	25.54	0.758
June	179.0	91.69	20.20	228.3	205.1	29.15	25.93	0.781
July	175.1	80.44	23.16	227.7	203.1	28.29	25.07	0.757
August	159.1	74.09	22.00	211.2	187.2	26.56	22.86	0.744
September	121.9	60.96	17.94	167.3	143.1	20.81	18.68	0.767
October	88.8	46.10	11.66	119.2	101.9	15.33	13.96	0.806
November	55.4	32.34	5.46	74.0	62.1	9.69	8.66	0.805
December	44.7	25.38	0.16	60.1	49.6	7.89	7.31	0.837
Year	1369.8	678.54	10.44	1818.0	1587.5	232.45	206.67	0.782

Legends

GlobHor	Global horizontal irradiation
DiffHor	Horizontal diffuse irradiation
T_Amb	Ambient Temperature
GlobInc	Global incident in coll. plane
GlobEff	Effective Global, corr. for IAM and shadings
EArray	Effective energy at the output of the array
E_Grid	Energy injected into grid
PR	Performance Ratio

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10/10/22 13:39
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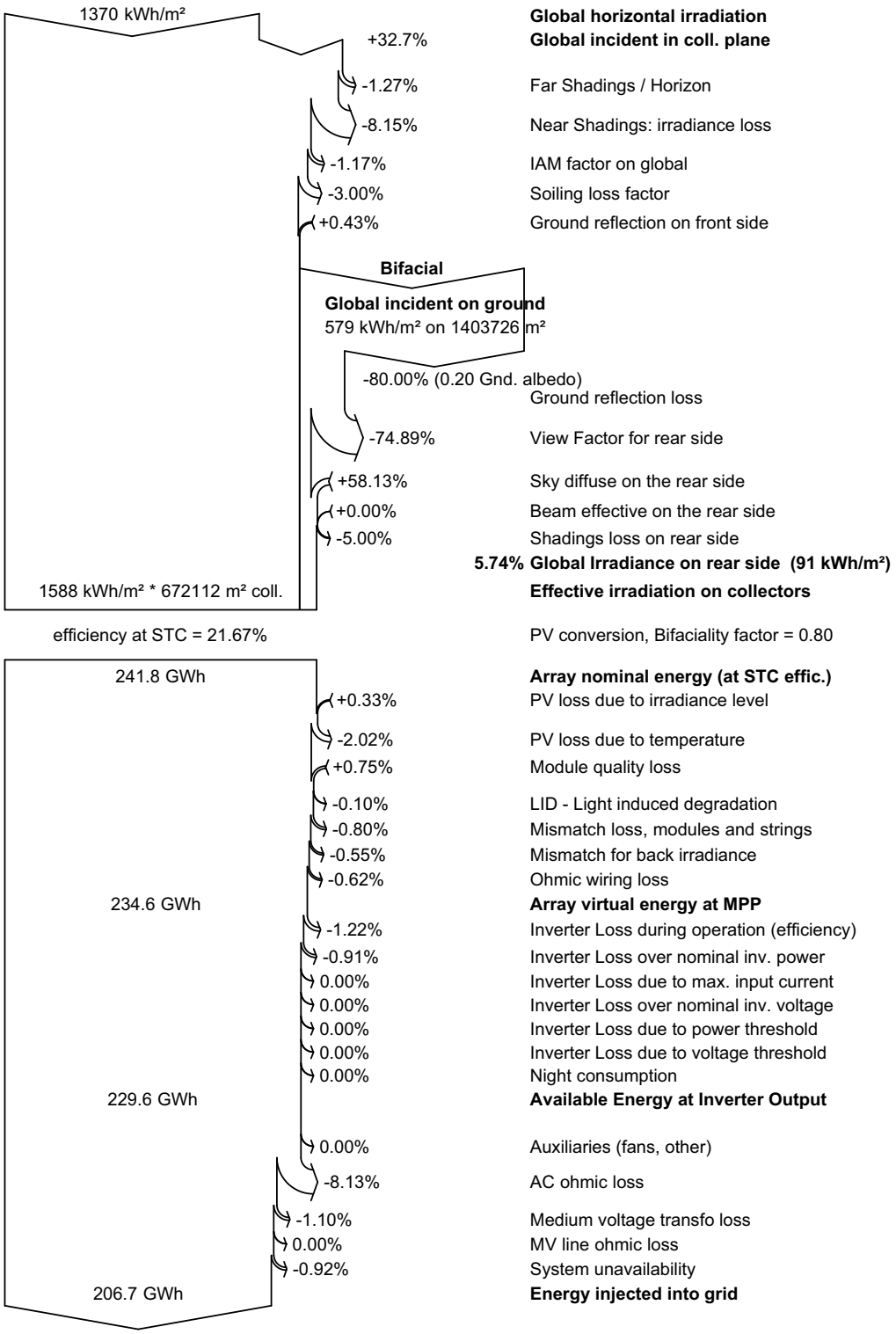
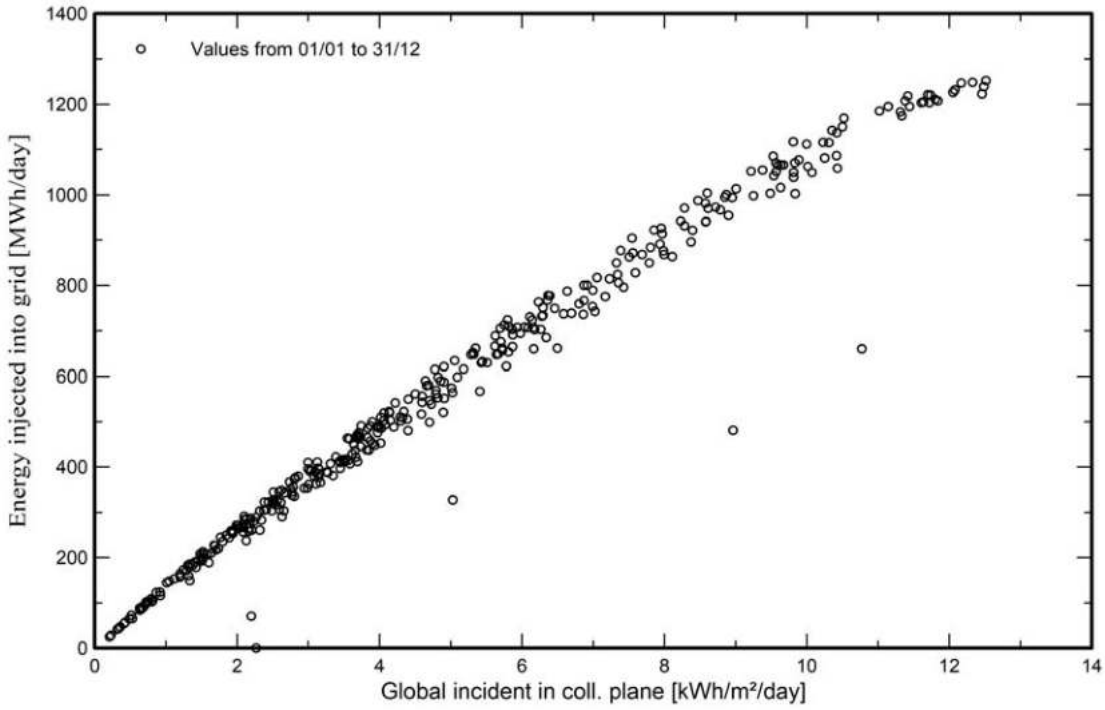
Loss diagram

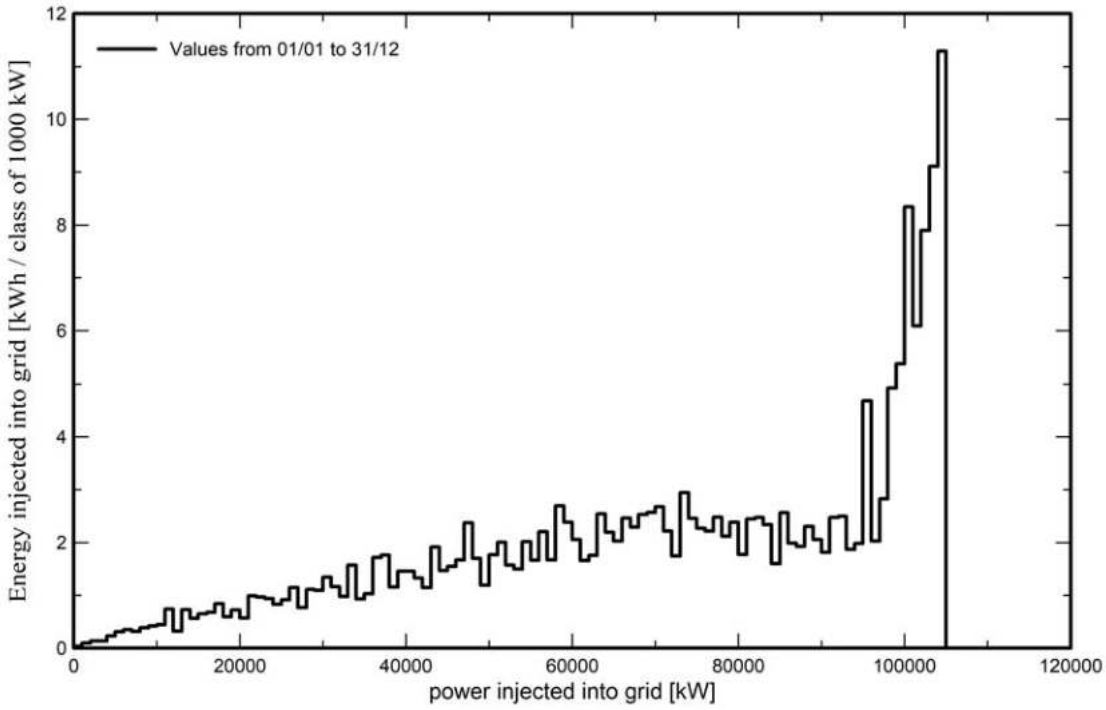


Special graphs

Daily Input/Output diagram



System Output Power Distribution



Version 7.2.18

PVsyst - Simulation report 3

Grid-Connected System

Project: Earth Conservancy Sgarlett PA

Variant: Community Scale 5MWAC

Tracking system

System power: 6723 kWp

Wanamie - United States

Author

LaBella Associates (United States)

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VC1, Simulation date:
20/10/22 15:35
with v7.2.18

Project summary

Geographical Site
Wanamie
United States

Situation
Latitude 41.17 °N
Longitude -76.06 °W
Altitude 241 m
Time zone UTC-5

Meteo data
Wanamie
Meteonorm 8.0 (1991-2005), Sat=3% - Synthetic

Monthly albedo values

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Albedo	0.25	0.25	0.25	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20

System summary

Grid-Connected System

Tracking system

PV Field Orientation
Orientation
Tracking plane, horizontal N-S axis
Axis azimuth 0 °

Tracking algorithm
Astronomic calculation

Near Shadings
Linear shadings

System information
PV Array
Nb. of modules 11492 units
Pnom total 6723 kWp

Inverters
Nb. of units 20 units
Pnom total 5000 kWac
Pnom ratio 1.345

User's needs
Unlimited load (grid)

Results summary

Produced Energy 10 GWh/year | Specific production 1462 kWh/kWp/year | Perf. Ratio PR 80.11 %

Table of contents

General parameters

Grid-Connected System

Tracking system

PV Field Orientation

Orientation		Tracking algorithm		Trackers configuration	
Tracking plane, horizontal N-S axis		Astronomic calculation		Nb. of trackers	223 units
Axis azimuth	0 °			Identical arrays	
				Sizes	
				Tracker Spacing	10.0 m
				Collector width	4.79 m
				Ground Cov. Ratio (GCR)	47.9 %
				Phi min / max.	-/+ 90.0 °
				Shading limit angles	
				Phi limits	+/- 61.2 °

Models used

Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon
Average Height 5.7 °

Near Shadings
Linear shadings

User's needs
Unlimited load (grid)

Bifacial system
Model 2D Calculation
unlimited trackers

Bifacial model geometry		Bifacial model definitions	
Tracker Spacing	10.00 m	Ground albedo	0.20
Tracker width	4.79 m	Bifaciality factor	80 %
GCR	47.9 %	Rear shading factor	5.0 %
Axis height above ground	2.10 m	Rear mismatch loss	10.0 %
		Shed transparent fraction	0.0 %

PV Array Characteristics

PV module

Manufacturer	Trina Solar
Model	TSM-585NEG19RC.20
(Custom parameters definition)	
Unit Nom. Power	585 Wp
Number of PV modules	11492 units
Nominal (STC)	6723 kWp
Modules	442 Strings x 26 In series
At operating cond. (50°C)	
Pmpp	6225 kWp
U mpp	939 V
I mpp	6626 A

Inverter

Manufacturer	Sungrow
Model	SG250-HX
(Original PVsyst database)	
Unit Nom. Power	250 kWac
Number of inverters	20 units
Total power	5000 kWac
Operating voltage	500-1450 V
Pnom ratio (DC:AC)	1.34

Total PV power

Nominal (STC)	6723 kWp
Total	11492 modules
Module area	31068 m²
Cell area	28989 m²

Total inverter power

Total power	5000 kWac
Number of inverters	20 units
Pnom ratio	1.34

Array losses

Array Soiling Losses
Loss Fraction 3.0 %

Thermal Loss factor
Module temperature according to irradiance
Uc (const) 29.0 W/m²K
Uv (wind) 0.0 W/m²K/m/s

DC wiring losses
Global array res. 1.5 mΩ
Loss Fraction 1.0 % at STC

LID - Light Induced Degradation
Loss Fraction 0.1 %

Module Quality Loss
Loss Fraction -0.8 %

Module mismatch losses
Loss Fraction 0.5 % at MPP

Strings Mismatch loss
Loss Fraction 0.3 %

IAM loss factor
Incidence effect (IAM): Fresnel, AR coating, n(glass)=1.526, n(AR)=1.290

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.999	0.987	0.962	0.892	0.816	0.681	0.440	0.000

System losses

Unavailability of the system
Time fraction 0.8 %
3.0 days,
3 periods

Auxiliaries loss
constant (fans) 300 W
0.0 kW from Power thresh.

AC wiring losses

Inv. output line up to MV transfo
Inverter voltage 800 Vac tri
Loss Fraction 1.03 % at STC
Inverter: SG250-HX
Wire section (20 Inv.) Copper 20 x 3 x 120 mm²
Average wires length 127 m

AC losses in transformers

MV transfo
Grid voltage 20 kV
Operating losses at STC
Nominal power at STC 6656 kVA
Iron loss (night disconnect) 13.31 kW
Loss Fraction 0.20 % at STC
Coils equivalent resistance 3 x 0.87 mΩ
Loss Fraction 0.90 % at STC

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Horizon definition

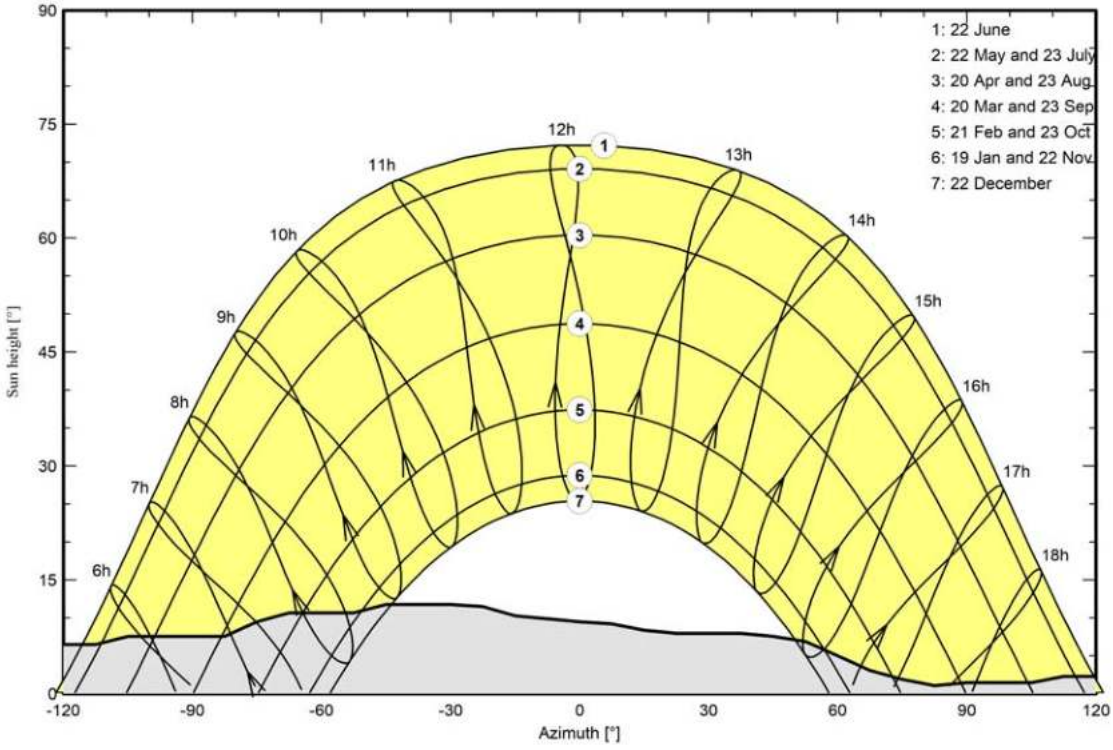
Horizon from PVGIS Newport Twp

Average Height	5.7 °	Albedo Factor	0.83
Diffuse Factor	0.91	Albedo Fraction	100 %

Horizon profile

Azimuth [°]	-180	-173	-165	-158	-150	-143	-135	-113	-105	-83	-75	-68	-53
Height [°]	1.9	1.9	1.5	1.5	1.1	0.4	6.5	6.5	7.6	7.6	9.5	10.7	10.7
Azimuth [°]	-45	-30	-23	-15	-8	0	8	15	23	38	45	53	60
Height [°]	11.8	11.8	11.5	10.3	9.9	9.5	9.2	8.4	8.0	8.0	7.6	6.9	5.0
Azimuth [°]	68	75	83	90	105	113	128	135	143	150	165	173	180
Height [°]	3.1	1.9	1.1	1.5	1.5	2.3	2.3	1.9	2.3	1.9	1.9	2.3	1.9

Sun Paths (Height / Azimuth diagram)



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20/10/22 15:35
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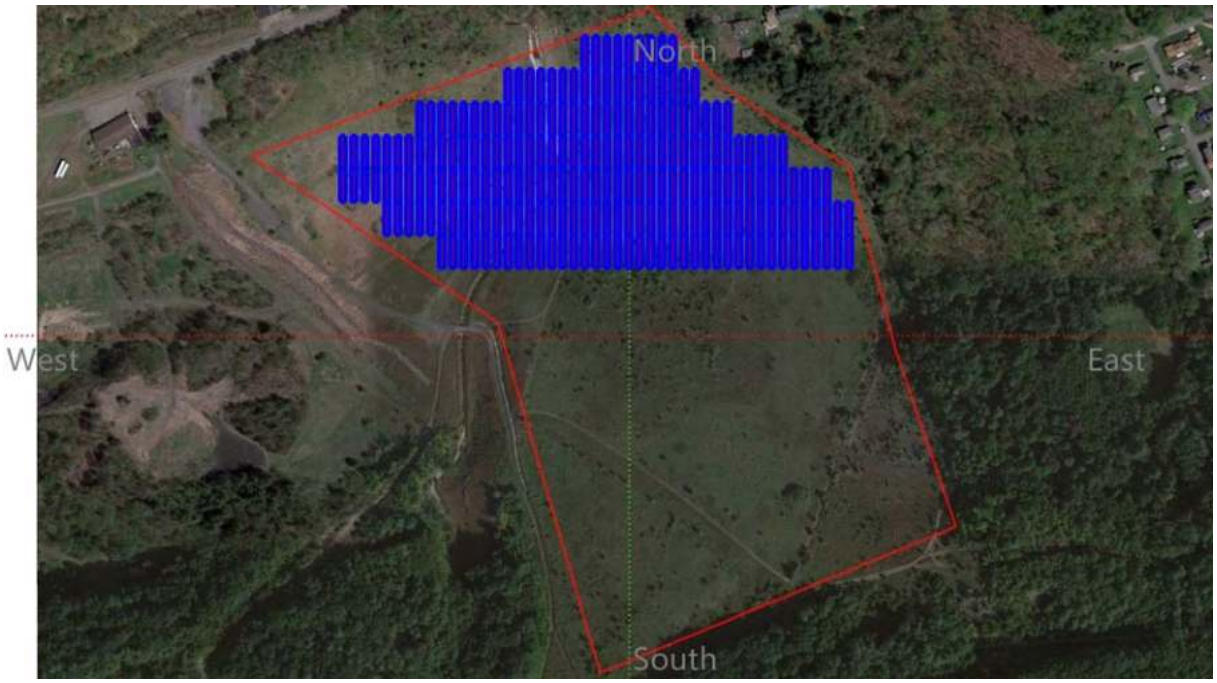
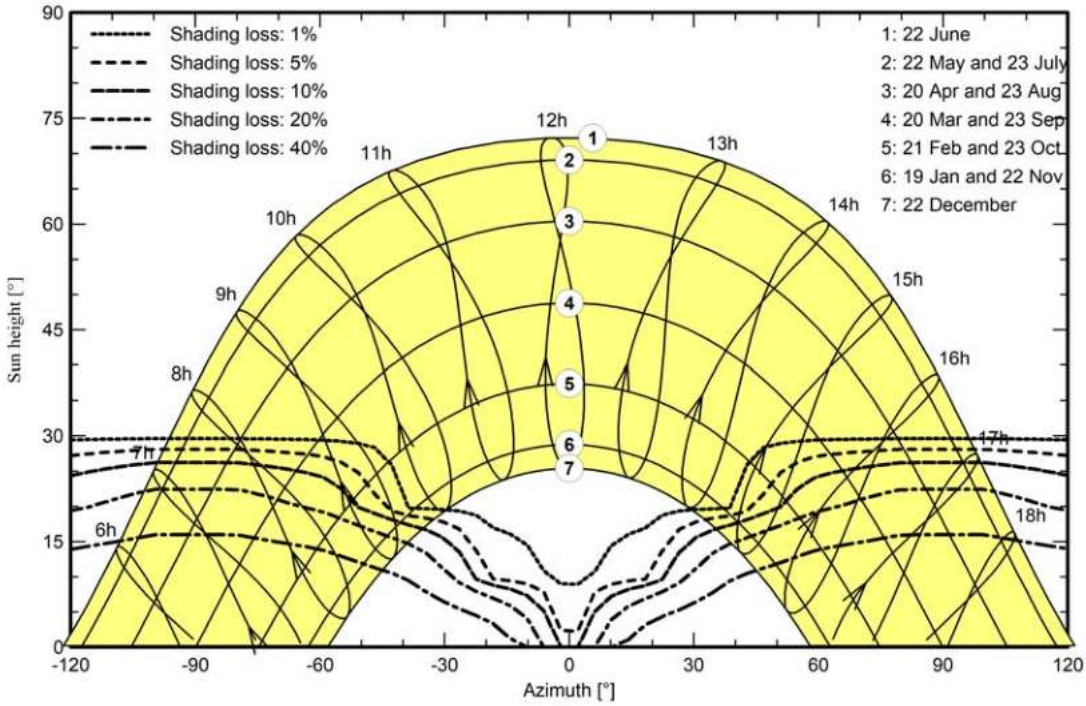
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1



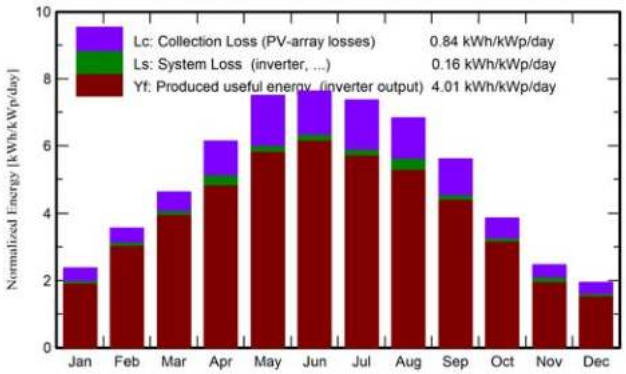
PVsyst V7.2.18
VC1, Simulation date:
20/10/22 15:35
with v7.2.18

Main results

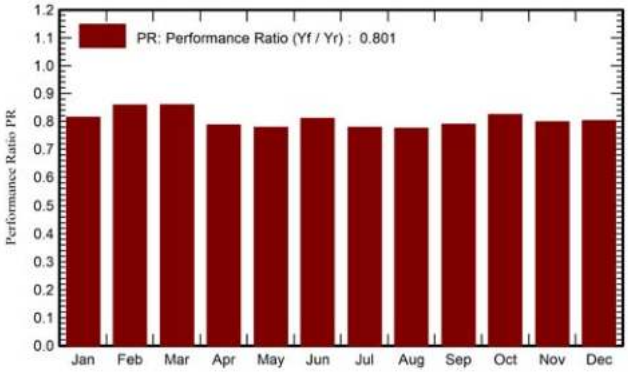
System Production

Produced Energy	10 GWh/year	Specific production	1462 kWh/kWp/year
		Performance Ratio PR	80.11 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m²	kWh/m²	°C	kWh/m²	kWh/m²	GWh	GWh	ratio
January	51.9	26.85	-3.27	73.5	56.4	0.417	0.402	0.814
February	72.5	36.76	-1.94	99.7	81.4	0.594	0.575	0.858
March	109.8	60.58	3.00	143.4	119.7	0.854	0.829	0.860
April	138.7	68.81	9.87	184.2	156.2	1.038	0.976	0.788
May	173.1	74.53	16.22	232.7	200.5	1.255	1.218	0.779
June	179.0	91.69	20.20	228.9	199.9	1.283	1.247	0.811
July	175.1	80.44	23.16	228.5	197.9	1.232	1.196	0.778
August	159.1	74.09	22.00	211.9	182.7	1.176	1.105	0.776
September	121.9	60.96	17.94	168.4	138.5	0.922	0.894	0.790
October	88.8	46.10	11.66	119.7	98.0	0.684	0.663	0.824
November	55.4	32.34	5.46	74.2	58.7	0.426	0.398	0.798
December	44.7	25.38	0.16	60.3	45.7	0.339	0.325	0.803
Year	1369.8	678.54	10.44	1825.3	1535.5	10.220	9.830	0.801

Legends

GlobHor	Global horizontal irradiation
DiffHor	Horizontal diffuse irradiation
T_Amb	Ambient Temperature
GlobInc	Global incident in coll. plane
GlobEff	Effective Global, corr. for IAM and shadings
EArray	Effective energy at the output of the array
E_Grid	Energy injected into grid
PR	Performance Ratio

Version 7.2.18

PVsyst - Simulation report 4

Grid-Connected System

Project: Earth Conservancy Util Scale Truesdale PA

Variant: Util Scale #1

Tracking system

System power: 56.00 MWp

Wanamie - United States

Author

LaBella Associates (United States)

PVsyst V7.2.18
VC0, Simulation date:
20/10/22 15:53
with v7.2.18

Project summary

Geographical Site
Wanamie
United States

Situation

Latitude	41.17 °N
Longitude	-76.06 °W
Altitude	241 m
Time zone	UTC-5

Meteo data
Wanamie
Meteonorm 8.0 (1991-2005), Sat=3% - Synthetic

Monthly albedo values

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Albedo	0.25	0.25	0.25	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20

System summary

Grid-Connected System

Tracking system

PV Field Orientation
Orientation
Tracking plane, horizontal N-S axis
Axis azimuth 0 °

Tracking algorithm
Astronomic calculation

Near Shadings
Linear shadings

System information

PV Array

Nb. of modules	95732 units
Pnom total	56.00 MWp

Inverters

Nb. of units	17 units
Pnom total	42.50 MWac
Pnom ratio	1.318

User's needs
Unlimited load (grid)

Results summary

Produced Energy	86 GWh/year	Specific production	1534 kWh/kWp/year	Perf. Ratio PR	84.37 %

Table of contents

General parameters

Grid-Connected System

Tracking system

PV Field Orientation

Orientation		Tracking algorithm		Trackers configuration	
Tracking plane, horizontal N-S axis		Astronomic calculation		Nb. of trackers	1841 units
Axis azimuth	0 °			**Sizes**	
				Tracker Spacing	10.0 m
				Collector width	4.79 m
				Ground Cov. Ratio (GCR)	47.9 %
				Phi min / max.	-/+ 60.0 °
				Shading limit angles	
				Phi limits	+/- 61.2 °

Models used

Transposition	Perez
Diffuse	Perez, Meteonorm
Circumsolar	separate

Horizon

Average Height 4.5 °

Near Shadings

Linear shadings

User's needs

Unlimited load (grid)

Bifacial system

Model 2D Calculation
unlimited trackers

Bifacial model geometry		Bifacial model definitions	
Tracker Spacing	10.00 m	Ground albedo	0.20
Tracker width	4.79 m	Bifaciality factor	80 %
GCR	47.9 %	Rear shading factor	5.0 %
Axis height above ground	2.10 m	Rear mismatch loss	10.0 %
		Shed transparent fraction	0.0 %

PV Array Characteristics

PV module

Manufacturer	Trina Solar
Model	TSM-585NEG19RC.20
(Custom parameters definition)	
Unit Nom. Power	585 Wp
Number of PV modules	95732 units
Nominal (STC)	56.00 MWp

Inverter

Manufacturer	Sungrow
Model	SG2500-HV-20
(Original PVsyst database)	
Unit Nom. Power	2500 kWac
Number of inverters	17 units
Total power	42500 kWac

Array #1 - East Array

Number of PV modules	90168 units	Number of inverters	16 units
Nominal (STC)	52.75 MWp	Total power	40000 kWac
Modules	3468 Strings x 26 In series		
At operating cond. (50°C)		Operating voltage	800-1300 V
Pmpp	48.84 MWp	Max. power (=>25°C)	2750 kWac
U mpp	939 V	Pnom ratio (DC:AC)	1.32
I mpp	51992 A		

Array #2 - West Array

Number of PV modules	5564 units	Number of inverters	1 unit
Nominal (STC)	3255 kWp	Total power	2500 kWac
Modules	214 Strings x 26 In series		
At operating cond. (50°C)		Operating voltage	800-1300 V
Pmpp	3014 kWp	Max. power (=>25°C)	2750 kWac
U mpp	939 V	Pnom ratio (DC:AC)	1.30
I mpp	3208 A		

PV Array Characteristics

Total PV power

Nominal (STC)	56003 kWp
Total	95732 modules
Module area	258807 m²
Cell area	241486 m²

Total inverter power

Total power	42500 kWac
Number of inverters	17 units
Pnom ratio	1.32

Array losses

Array Soiling Losses
Loss Fraction 3.0 %

Thermal Loss factor
Module temperature according to irradiance
Uc (const) 29.0 W/m²K
Uv (wind) 0.0 W/m²K/m/s

LID - Light Induced Degradation
Loss Fraction 0.1 %

Module Quality Loss
Loss Fraction -0.8 %

Module mismatch losses
Loss Fraction 0.5 % at MPP

Strings Mismatch loss
Loss Fraction 0.3 %

IAM loss factor
Incidence effect (IAM): Fresnel, AR coating, n(glass)=1.526, n(AR)=1.290

0°	30°	50°	60°	70°	75°	80°	85°	90°
1.000	0.999	0.987	0.962	0.892	0.816	0.681	0.440	0.000

DC wiring losses

Global wiring resistance 0.18 mΩ
Loss Fraction 1.0 % at STC

Array #1 - East Array

Global array res.	0.20 mΩ
Loss Fraction	1.0 % at STC

Array #2 - West Array

Global array res.	3.2 mΩ
Loss Fraction	1.0 % at STC

System losses

Unavailability of the system
Time fraction 0.8 %
3.0 days,
3 periods

Auxiliaries loss
constant (fans) 300 W
0.0 kW from Power thresh.

AC wiring losses

Inv. output line up to MV transfo
Inverter voltage 550 Vac tri
Loss Fraction 2.20 % at STC

Inverter: SG2500-HV-20
Wire section (16 Inv.) Copper 16 x 3 x 2500 mm²
Average wires length 127 m

Inverter: SG2500-HV-20
Wire section (1 Inv.) Copper 1 x 3 x 120 mm²
Wires length 127 m

AC losses in transformers

MV transfo
Grid voltage 34.5 kV

Operating losses at STC

Nominal power at STC	55443 kVA
Iron loss (night disconnect)	36.96 kW/Inv.
Loss Fraction	0.20 % at STC
Coils equivalent resistance	3 x 0.15 mΩ/inv.
Loss Fraction	0.90 % at STC

Horizon definition

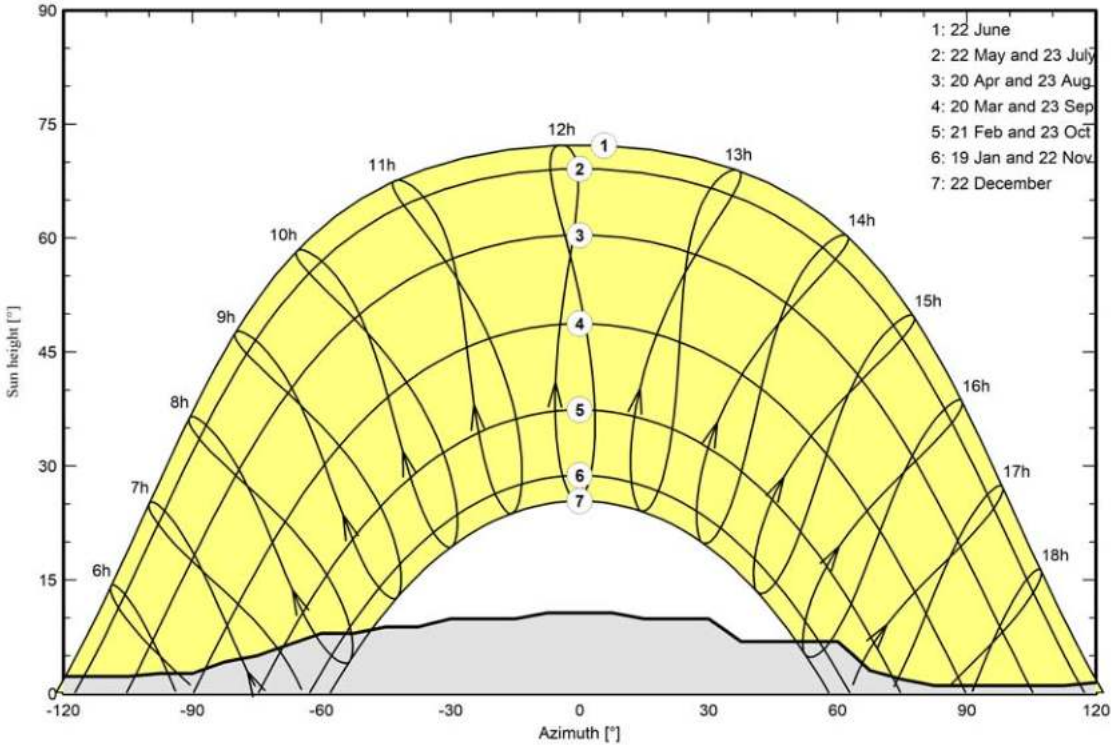
Horizon from PVGIS Truesdale

Average Height	4.5 °	Albedo Factor	0.85
Diffuse Factor	0.96	Albedo Fraction	100 %

Horizon profile

Azimuth [°]	-180	-173	-158	-150	-143	-135	-105	-98	-90	-83	-75	-68
Height [°]	1.5	1.5	0.8	0.8	0.4	2.3	2.3	2.7	2.7	4.2	5.0	6.5
Azimuth [°]	-60	-53	-45	-38	-30	-15	-8	8	15	30	38	60
Height [°]	8.0	8.0	8.8	8.8	9.9	9.9	10.7	10.7	9.9	9.9	6.9	6.9
Azimuth [°]	68	75	83	113	120	128	135	143	150	158	173	180
Height [°]	3.1	1.9	1.1	1.1	1.5	1.5	1.9	1.5	2.3	1.9	1.9	1.5

Sun Paths (Height / Azimuth diagram)

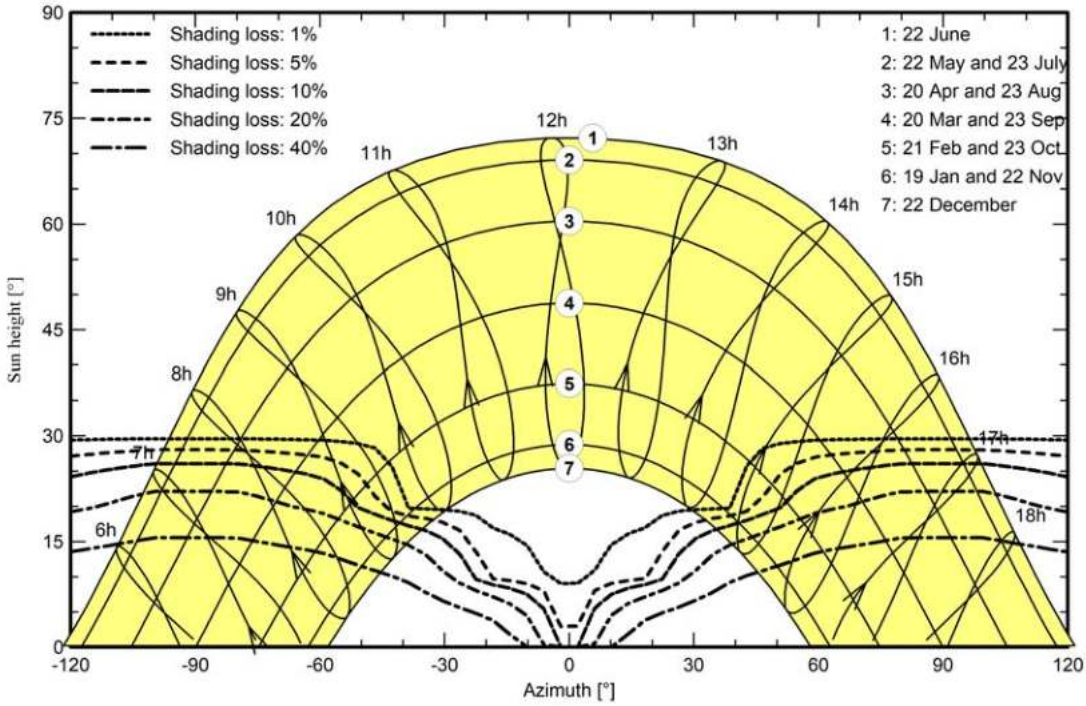


Near shadings parameter

Perspective of the PV-field and surrounding shading scene

Iso-shadings diagram

Orientation #1

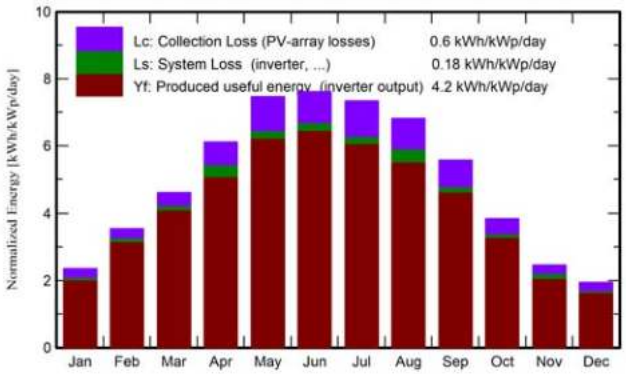


Main results

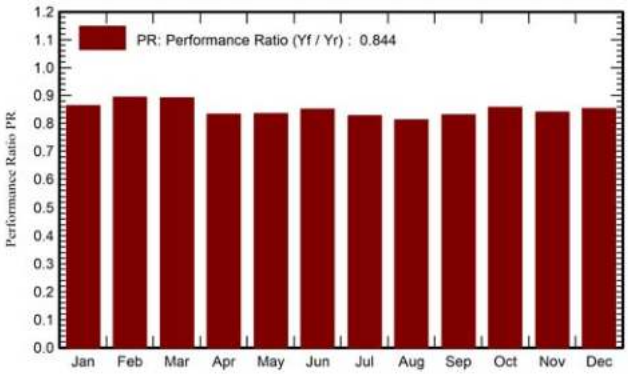
System Production

Produced Energy	86 GWh/year	Specific production	1534 kWh/kWp/year
		Performance Ratio PR	84.37 %

Normalized productions (per installed kWp)



Performance Ratio PR



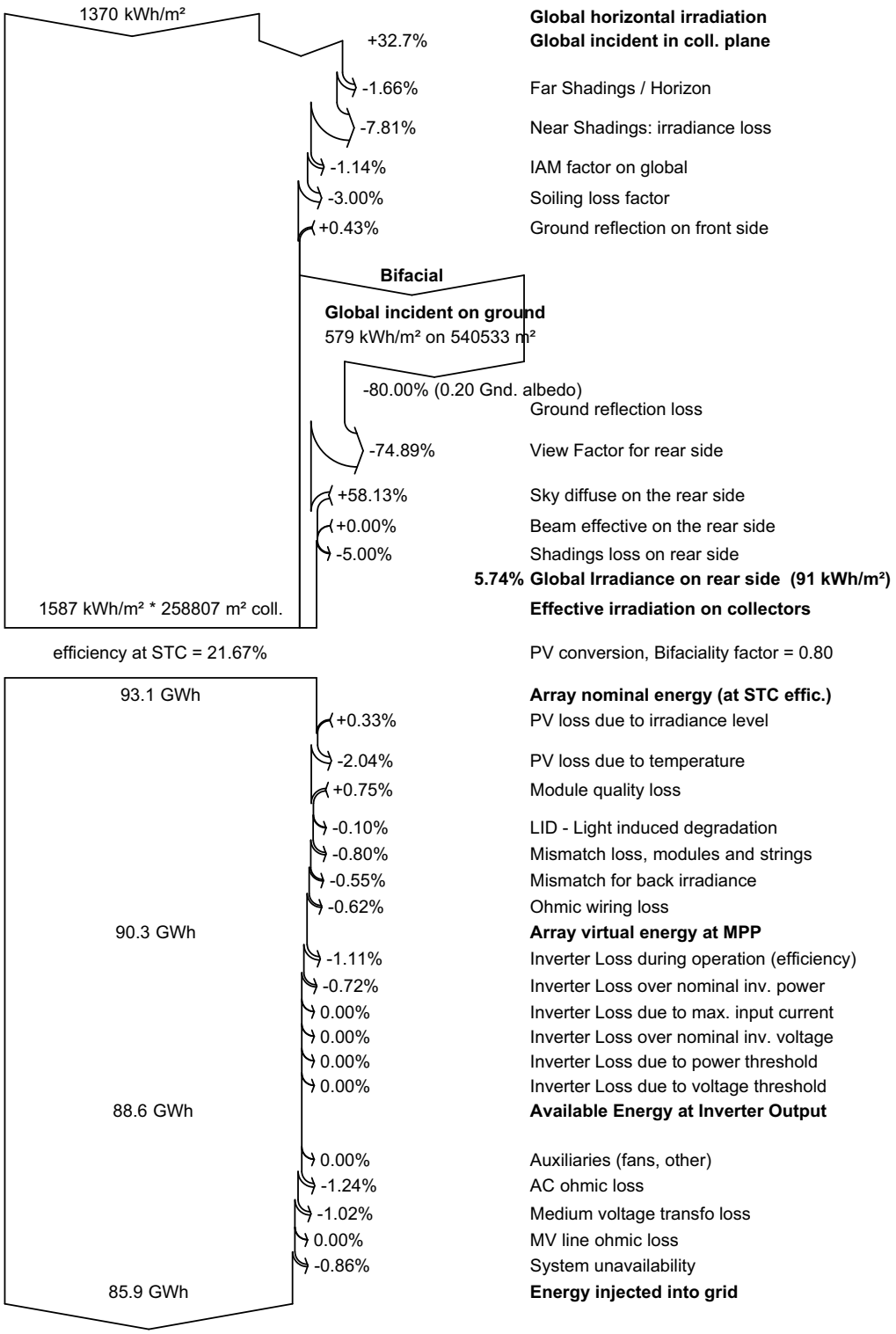
Balances and main results

	GlobHor	DiffHor	T_Amb	GlobInc	GlobEff	EArray	E_Grid	PR
	kWh/m²	kWh/m²	°C	kWh/m²	kWh/m²	GWh	GWh	ratio
January	51.9	26.85	-3.27	73.1	59.6	3.65	3.53	0.864
February	72.5	36.76	-1.94	99.3	84.8	5.14	4.97	0.894
March	109.8	60.58	3.00	142.9	124.2	7.38	7.14	0.892
April	138.7	68.81	9.87	183.4	161.2	9.15	8.55	0.832
May	173.1	74.53	16.22	231.7	205.6	11.23	10.83	0.835
June	179.0	91.69	20.20	228.3	205.4	11.26	10.88	0.851
July	175.1	80.44	23.16	227.7	203.5	10.93	10.55	0.827
August	159.1	74.09	22.00	211.2	187.6	10.28	9.60	0.812
September	121.9	60.96	17.94	167.3	143.3	8.05	7.78	0.830
October	88.8	46.10	11.66	119.2	102.0	5.91	5.72	0.858
November	55.4	32.34	5.46	74.0	61.8	3.71	3.48	0.840
December	44.7	25.38	0.16	60.1	48.4	2.97	2.87	0.853
Year	1369.8	678.54	10.44	1818.0	1587.5	89.65	85.90	0.844

Legends

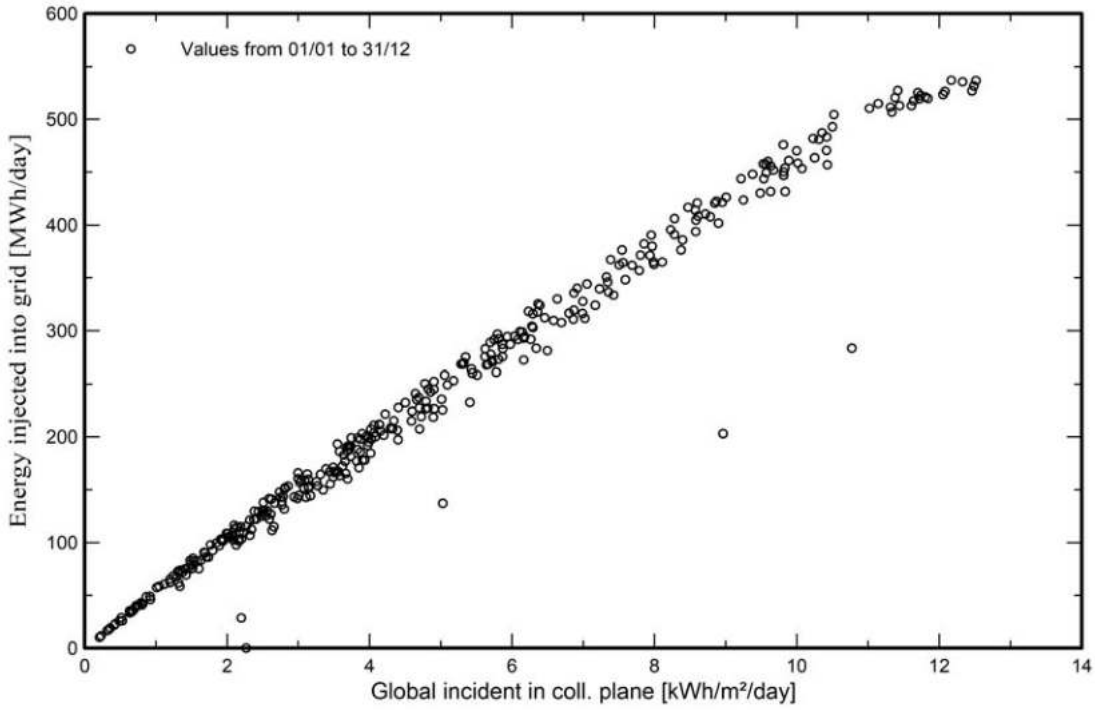
GlobHor	Global horizontal irradiation
DiffHor	Horizontal diffuse irradiation
T_Amb	Ambient Temperature
GlobInc	Global incident in coll. plane
GlobEff	Effective Global, corr. for IAM and shadings
EArray	Effective energy at the output of the array
E_Grid	Energy injected into grid
PR	Performance Ratio

Loss diagram

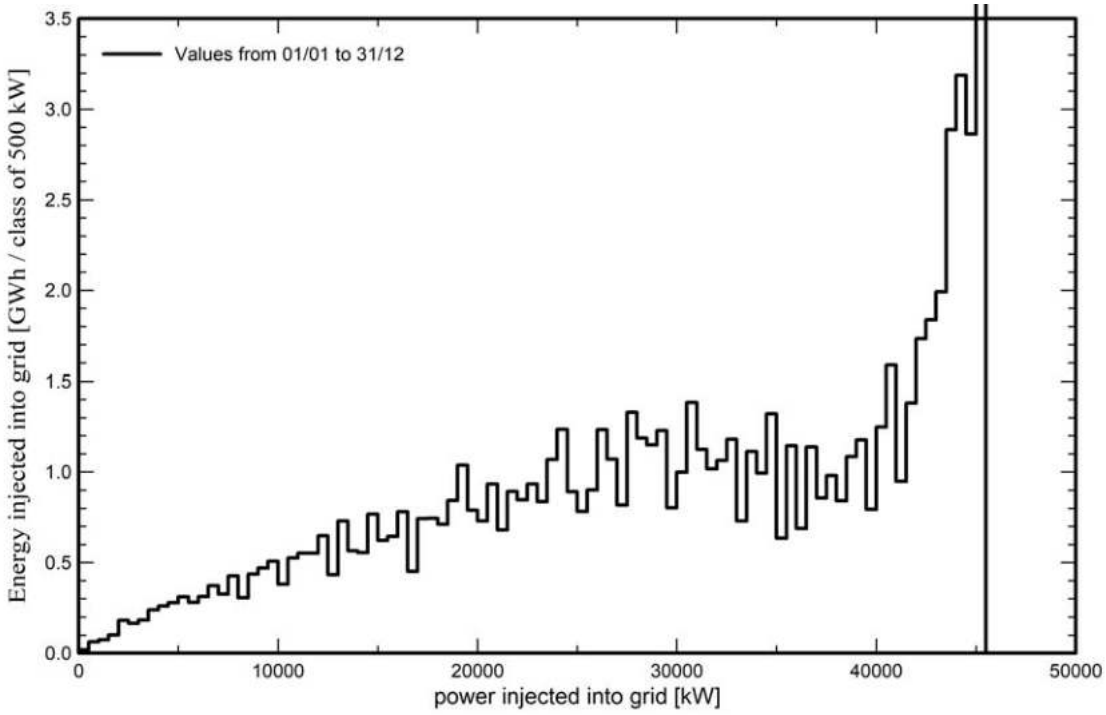


Special graphs

Daily Input/Output diagram

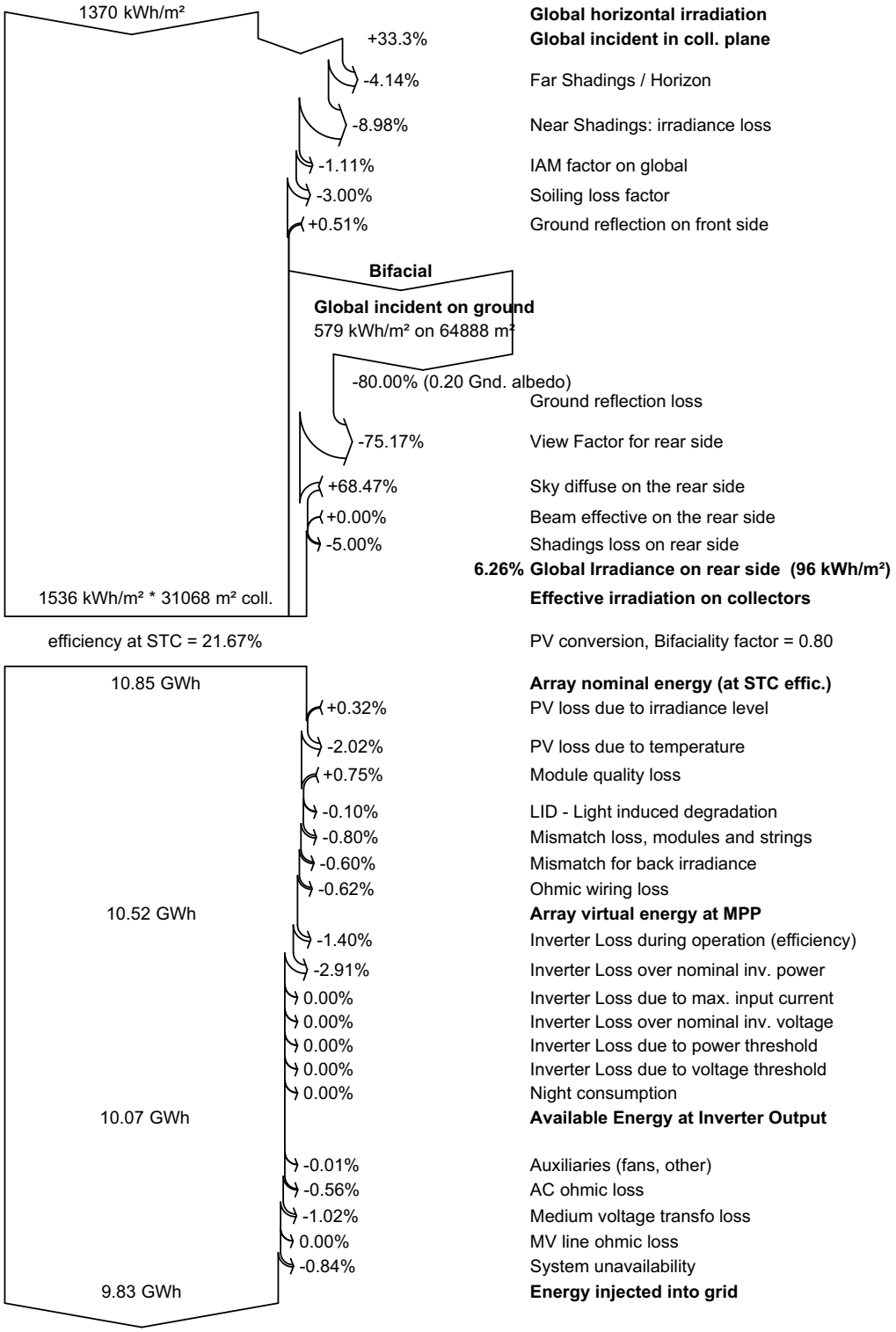


System Output Power Distribution



PVsyst V7.2.18
VC1, Simulation date:
20/10/22 15:35
with v7.2.18

Loss diagram



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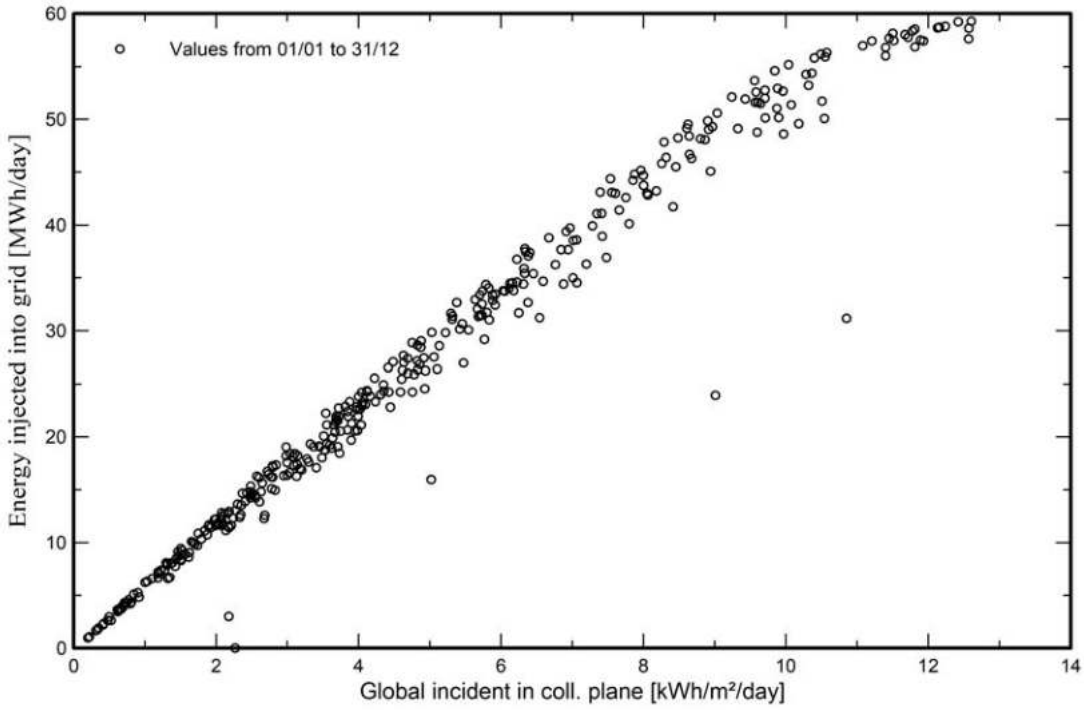
Special graphs

Daily Input/Output diagram



System Output Power Distribution