Bureau of Land Management
PV Condition Assessment

Uncompahgre Field Office

Submitted on:	April 9, 2025
Submitted to:	Bureau of Land Management
Submitted by:	Ameresco, Inc. 111 Speen Street, Ste. 410 Framingham, MA 01701
Point of Contact:	Greg Caplan VP Federal Business Development gcaplan@ameresco.com 202-650-6214

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1.0 PV Condition Assessment – Uncompahgre Field Office

Perform condition assessments of 26 photovoltaic (PV) systems located in eight western states and determine the appropriate methods for transmitting data from those systems into the contractor's Energy Management Information System. Referred to collectively as PV field work.

1.1 Uncompahgre Field Office

32 kW of photovoltaic generation, with 1 – 30 kW inverter, North Office Building energy meter, and renewable energy meter (all existing)

1.1.a PV condition assessment survey

Provide the following for each of the 26 PV sites described in Subparagraph I. Provide system description including block system diagram, and photographic records. Document PV system components including the following:

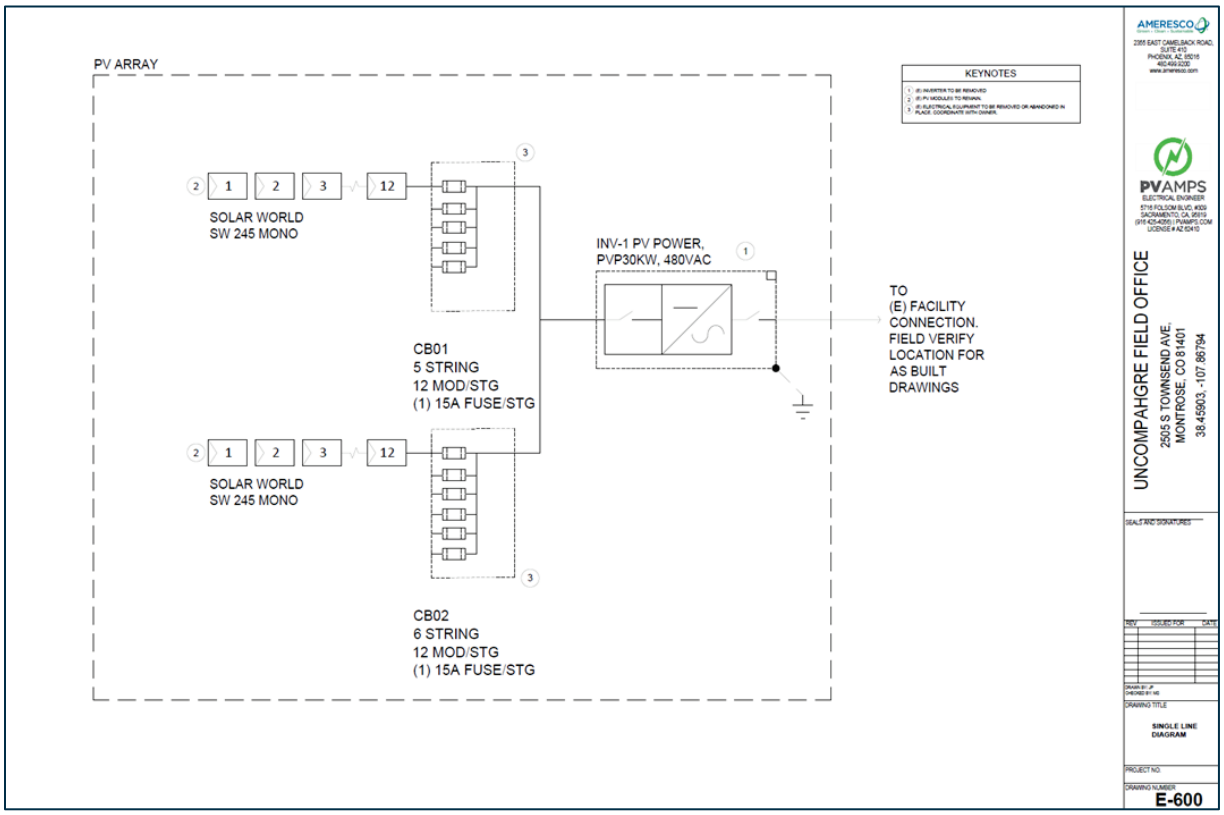


Figure 1: Current PV Configuration at Uncompahgre

i. *Panels: Manufacture, model number, individual panel watts, number of strings, total number of panels, total system watts, expected degradation rate.*

a. Array 1
    i. Manufacturer: Solar World
    ii. M/N: SW 245
    iii. Individual panel watts: 245W
    iv. Number of strings: 11
    v. Total number of panels: 132
    vi. Total system watts: 32 kW DC
b. Expected degradation rate: 19%

ii. *Description of mounting and mounting system, i.e., roof mounted with ballast or rack system, or ground mounted with steel rack system.*

Ground Mounted w/steel racking for both arrays

iii. *Inverter: Include inverter manufacture, model number, the type of interface capabilities of the inverter and whether it is currently connected for remote reading or is capable of being connected for remote reading.*

a. Manufacturer: PV Powered
b. Model number: PVP30kw
    i. CEC efficiency: 93%
c. Serial number: unreadable
d. Communication Interface: RS-485
e. EchoLabs not communicating during our visit

Figure 2: Current communication

iv. AC and DC disconnect, fuses, and circuit breakers. Provide manufacture and disconnect, fuse, and circuit breaker sizes. Verify DC disconnect is DC-rated.

a. Inverter AC Disconnects #1 & #2 (AC Combiner Panels)
    i. Siemens 30A 600VAC - 3 Pole
    ii. Fuses - LITTELFUSE FLSR-30-ID W/INDICATOR, 30 AMP, CLASS RK5, DUAL ELEMENT, FLSR_ID SERIES, 75-600VAC, TIME DELAY, FUSE

b. Main AC Disconnect
    i. Siemens 60A 600VAC - 3 Pole
    ii. Fuses - LITTELFUSE FLSR-60-ID W/INDICATOR, 60 AMP, CLASS RK5, DUAL ELEMENT, FLSR_ID SERIES, 75-600VAC, TIME DELAY, FUSE

c. Array #1 & #2 DC Disconnects
    i. Square D 60A - 600VAC & 600VDC - 3 Pole - Non-Fused
    ii. Disconnects are DC rated

v. Description of rapid shutdown system.

N/A. None present on these systems.

1.1.b Visual Observation of Panels, Exposed Electrical Wire / Insulation / Conduit, Inverters, and Associated Electrical Equipment

Visual observation of the conditions of individual panels, exposed electrical wire/insulation/conduit, inverters, and associated electrical equipment. Photos shall be taken during the survey and included in the site assessment report. Common examples include cracked, damaged, or discolored individual panels, shaded or dirty panels, water intrusion in panel, corrosion and encapsulate yellowing, deteriorated electrical components such as strings, combiner box, disconnects, fuses, cables, conduit, or other exposed equipment, and equipment identified as beyond or near its estimated useful life.

i. *Modules and Array wiring*
   a. PV wire and MC4 connector insulation is fine.
   b. Wire management is very good.

ii. Inverters
   a. Inverter is not operational, electrical tech. spent the day troubleshooting and all were in fatal fault.

iii. AC & DC Disconnects & Fuses
   a. No corrosion or thermal issues present.
   b. DC disconnects need to be cleaned and wasp nests removed.

iv. Conduit & Gutters
   a. No corrosion or thermal issues present.

v. DC Combiners & Strings
   a. No corrosion or thermal issues present.

Figure 3: Wire management and mountings are all very good condition

1.1.c Visual Inspection of Mounting Structure

Visually inspect mounting structure to ensure roof penetrations are properly sealed, supports are structurally sound, and ballast systems are properly aligned.

Figure 4: Uncompahgre site, showing the non-functional inverter

Supports are structurally sound, and ballast system properly aligned.

1.1.d Review and Verify Proper Grounding

Review and verify proper grounding of all metallic surfaces including metallic PV module frames.

Figure 5: Typical grounding at Uncompahgre

System is properly grounded.

1.1.e Verify Wiring, Conductors, and Conduit

Verify wiring, conductors, and conduit are secure.

Wiring, conductors, and conduit were all secure during our two site visits.

1.1.f Verify Safety Markings and Signs

Verify safety markings and signs are installed and are legible.

Fail, site needs new safety markings in accordance with federal and state regulations.

1.1.g Net Metering

Determine whether the PV system is connected to the grid and set up for net metering. Verify net metering is operational.

Net meter is readable, but the inverter is not operational.

1.1.h NEC Code Violations

Identify and document NEC code violations.

Pass, no NEC code violations were present during either of the two site visits.

1.1.i Performance Testing

Performance testing: Provide and report the following:

1. **Date and time.**

   06/25/2024, 8:00 am

2. **Name and contact information of person performing tests/inspection.**

   Chris Carelli, any questions regarding the test should be directed to Tim Mullen, tmullen@ameresco.com 410-507-6603

3. **Time of day and weather conditions.**

   8 am, full sun

4. **Solar irradiance level.**

   230 w/m2

5. **Ambient temperature.**

   75° F

6. **Array temperature.**

   90°F

7. **Open-circuit voltage (Voc) and polarity of each string. (Verify all strings have the same number of modules).**

   a. Polarity

      a. All Strings - Pass

   b. Same Module Count on Strings

      a. Pass

   c. Array #1

      a. Combiner #1

         i. 410v
         ii. 409v
         iii. 410v
         iv. 410v
         v. 409v
         vi. 409v

      b. Combiner #2

         i. 410v
         ii. 410v
         iii. 392v
         iv. 410v
         v. 410v

8. **Short-circuit current (Isc) of each string.**

   8.25 Amps

9. **Confirm inverter is operational.**

   Inverter is not operational

10. **Confirm inverter shuts down if AC utility is disconnected**

    Inverter not operational

11. **Maximum power point current (Imp) for each string. Current measurements for each string should be within 0.1A range of each other assuming consistent weather conditions, and all strings having same tilt and azimuth angle.**
    a. No readings for inverter 1 since this information can only be recorded when inverter is operating.
12. **Check condition of combiner box fuses for inoperable strings.**

    Pass, no blown fuses.
13. **Confirm inverter's power reading using independent meters. Afterwards, inverter power readings may be used for subsequent reporting**.

    Inverters not operational.
14. **Expected standard test condition (STC) power.**

    32.3 kWp
15. **System power output under actual conditions.**

    Inverters are not operational.
16. **Calculate the balance-of-system efficiency.**

    Inverters are not operational.
17. **Compare actual performance to expected STC power.**

    Inverters are not operational.
18. **Total power generated (kWh**).

    Inverters are not operational.
19. **Determine system expected degradation rate based upon manufacturer's literature.**

    Inverters are not operational.
20. **Determine actual system degradation rate.**

    Inverters are not operational.

1.1.j System Comparison and Recommendations

System Comparison and Recommendations:

1. **Determine if additional troubleshooting, including the number of hours required to perform troubleshooting, is necessary to determine why the renewable system is not operating optimally.**

Inverters are not operational; it is recommended that the inverter be removed and replaced as outlined below.

2. **Compare on-site data measurements to manufacturer data.**

Not applicable, inverters are not operational.

3. **Provide recommendations for maintenance, repairs, and improvements to optimize the performance the system based upon site investigation and data analysis. Include a detailed cost estimate of the work required to restore, repair, or upgrade the system based upon recommendations.**

Ameresco recommends that the inoperable inverter be removed and replaced with a Sunny Tri power Core 1 33-US Sunny Tri-power 33kW inverters. We would test all solar panels and any with a short circuit will be bypassed. With the new inverters Ameresco would also install a new NEMA 4 junction box. This fix will make the PV field operational again at which time we can take baseline field readings and provide that data to BLM to compare system performance going forward.

If Ameresco does the inverter upgrade, we will also provide the required safety signage for the site for an additional $400.00.

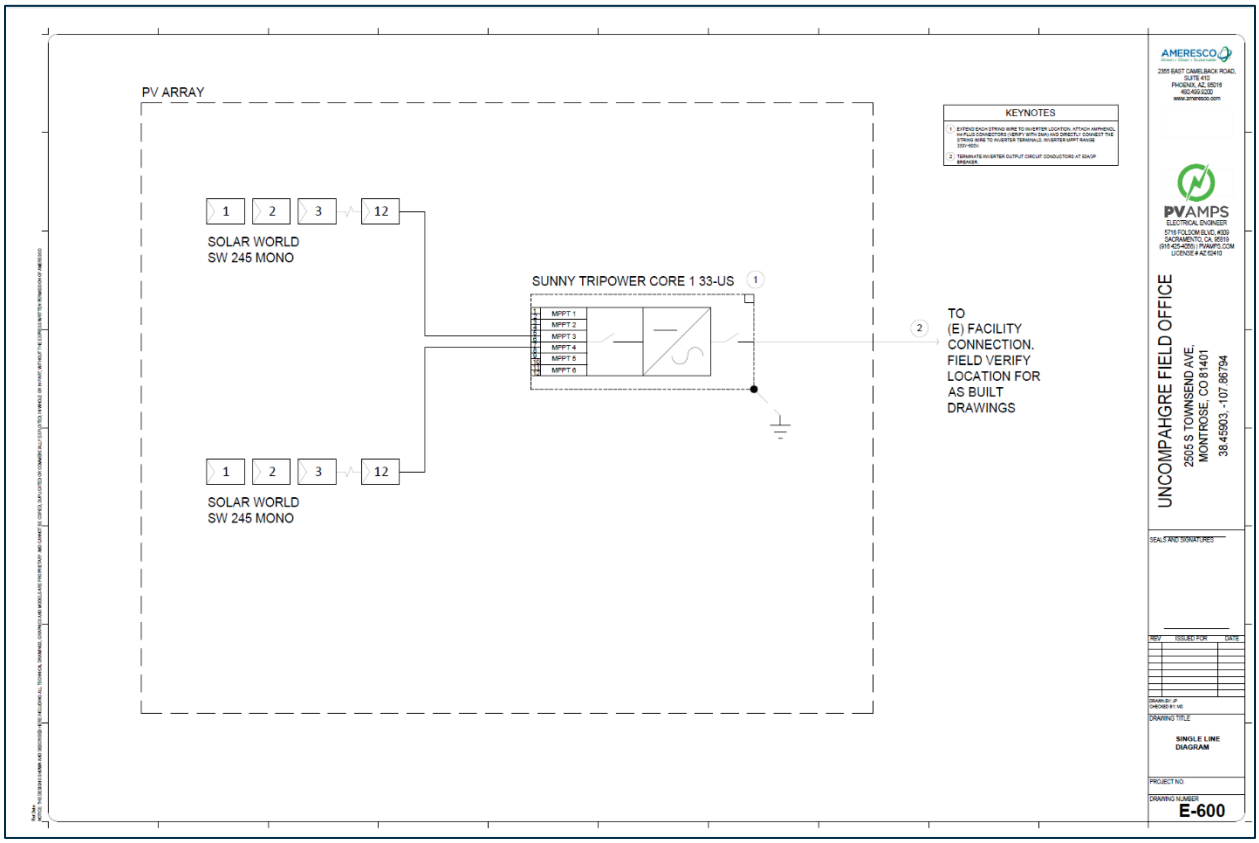


Figure 6: Proposed new inverter configuration.

4. **Provide a projection of the remaining life expectancy of functional components, as well as for the overall system.**

    a. **Solar Panels**

        i. Current panels are 9.5 years old

        ii. Most manufacturers offer **warranties of 25–30 years**, guaranteeing at least **80% of the original efficiency** by the end of the period.

        iii. Many panels continue operating beyond 30 years with reduced efficiency.

    b. **Inverters**

        i. Needs replacing

    c) **Racking and Wiring**:

        i. Typically, last **30+ years** with minimal maintenance.

        ii. Corrosion or weather damage may require minor repairs over time.

    Factors Affecting Lifespan:

    - **Quality of components**: Higher-quality materials and reputable brands last longer.
    - **Environmental conditions**: Harsh weather (extreme heat, humidity, hail, snow) can degrade components faster.
    - **Maintenance**: Regular inspections and cleaning improve longevity.
    - **Installation quality**: Poor installation can lead to premature failure of electrical and structural components.

5. **Include a detailed cost estimate of the work required to restore/repair/upgrade the renewable energy systems, so they are fully functional**.

Table 1: Cost of installing a new inverter

Task	Hours	OT Hours	Qty	Material Description	Material Cost Each	Material Cost Total
Electrician #1	16		1	Sunny Core 1 33kw	$7,500.00	$7,500.00
Electrician #2	16		15	MC4	$3.50	$52.50
	0	0	30	#4 THHN	$2.67	$80.10
	0	0	4	#4 bugs	$27.00	$108.00
	0	0	1	8x8x8 NEMA 4x Junction box	$123.00	$123.00
	0	0	6	1" Liquid Tight	$3.25	$19.50
			2	1" Liquid Tight Connector	$7.52	$15.04
Total	32	0				
DDC Tech Labor	0	0	0		$0.00	$0.00

Subcontractor	Scope	Price	Equipment	Rental Time(month/week)	Cost per unit	Total
		$0.00		0	$0.00	$0.00
		$0.00		0	$0.00	$0.00
		$0.00		0	$0.00	$0.00
		$0.00		0	$0.00	$0.00

Total Hours Str	32					
Total Hours OT	0	ESTIMATED HOURS	TOTAL COSTS		Total Material Cost	$7,898.14
Supervisor Labor	$120.00		$0.00		Equipment Costs	$0.00
Field Tech Labor	$80.00	32	$2,560.00		Subcontractor Costs	$0.00
Field Tech Overtime Labor		0	$0.00		Install Labor	$0.00
			$0.00		Other Labor	$2,560.00
			$0.00		Total Mileage	$0.00
			$0.00		Other Expenses	$0.00
		Cost/ Mile			Overhead	$1,568.72
Mileage	0	1.25	$0.00		Profit	$1,202.69
Air Fare and Expenses	0				Total Bid Price	$13,229.55
Overhead Percentage	15%	15% OH and 10% profit Minimum.				
Profit Percentage	10%					

6. **Report on PV systems and recommendations on work to restore/repair/upgrade them must also evaluate the cost to completely replace the PV system and compare the repair cost to the replacement cost of a similarly sized PV system. The field investigation report may confirm that based on the age of the existing PV array, replacing it may be the most economical solution. If replacement is the conclusion providing a detailed estimate on the cost of the repair of the existing system is not necessary. However, a justification describing the significant deficiencies of the existing system is to be provided.**

Estimated cost of a new 33 kW system is in the ballpark of $140,000.00 to $165,000.00

1.1.k Energy Management System

Reporting to the energy management system.

1. **Detail and describe how electrical generation from each PV system and functional operation information will be transmitted to the contractor's energy management system**.

The PV system at Uncompahgre Field Office will use a Leviton IDAS-A8810-4G-S data acquisition system (DAS) to connect to the existing inverters Modus TCP (Ethernet). Data is collected by the DAS and uploaded periodically to AssetPlanner using a Cradlepoint cellular modem (typically a Cradlepoint S700). The communication between the DAS and AssetPlanner is encrypted. The DAS and cellular modem will be mounted in a NEMA 4 enclosure.

2. **The following information is to be transmitted from each PV site to the contractor's energy management system. The information is to be processed by the energy management system to create PV production reports, allow for comparison of each PV site, and calculation of emissions reduced, and their greenhouse gas equivalents.**

The DAS will provide current electrical energy production reported by each inverter on site. Inverter level metering will include voltage, current and power factor for each phase, as well as any alarms or fault codes generated by the inverter. In addition to the alarms generated by the inverters, AssetPlanner's Analytics Planner module includes a rules engine that includes rules to trigger alerts based on lower than expected production or loss of communication. The rules engine also allows for user define rules using any of the data points monitored by the DAS.

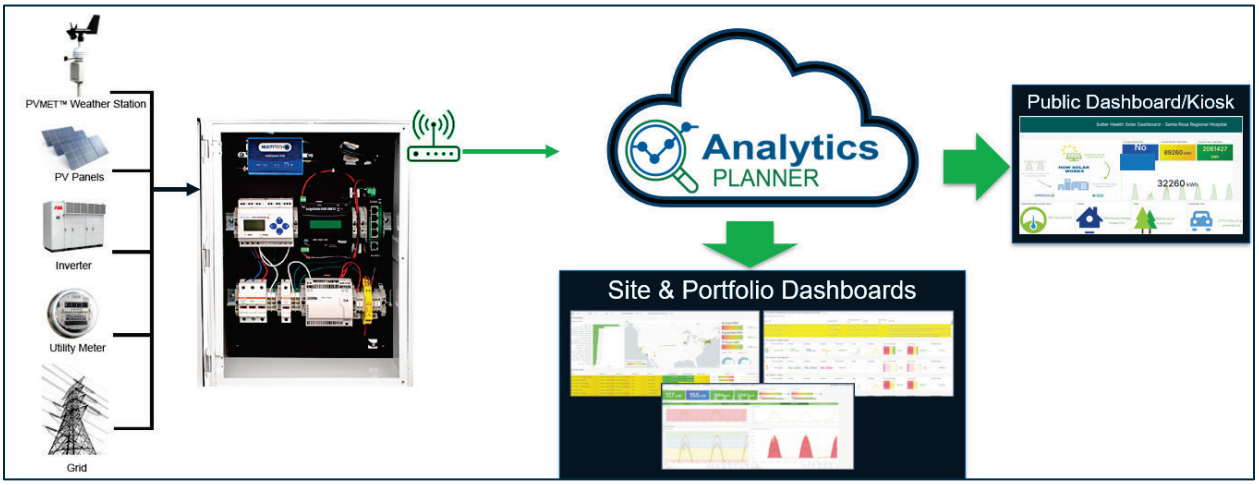


Figure 7: Overview of PV Data Acquisition System and AssetPlanner Analytics Planner for PV Systems

AssetPlanner will create PV production reports and calculate emissions reductions and greenhouse gas equivalents based on metered PV electric energy generation. It also has the site and portfolio level dashboards to monitor the current production and status of the systems and can optionally create public dashboards.

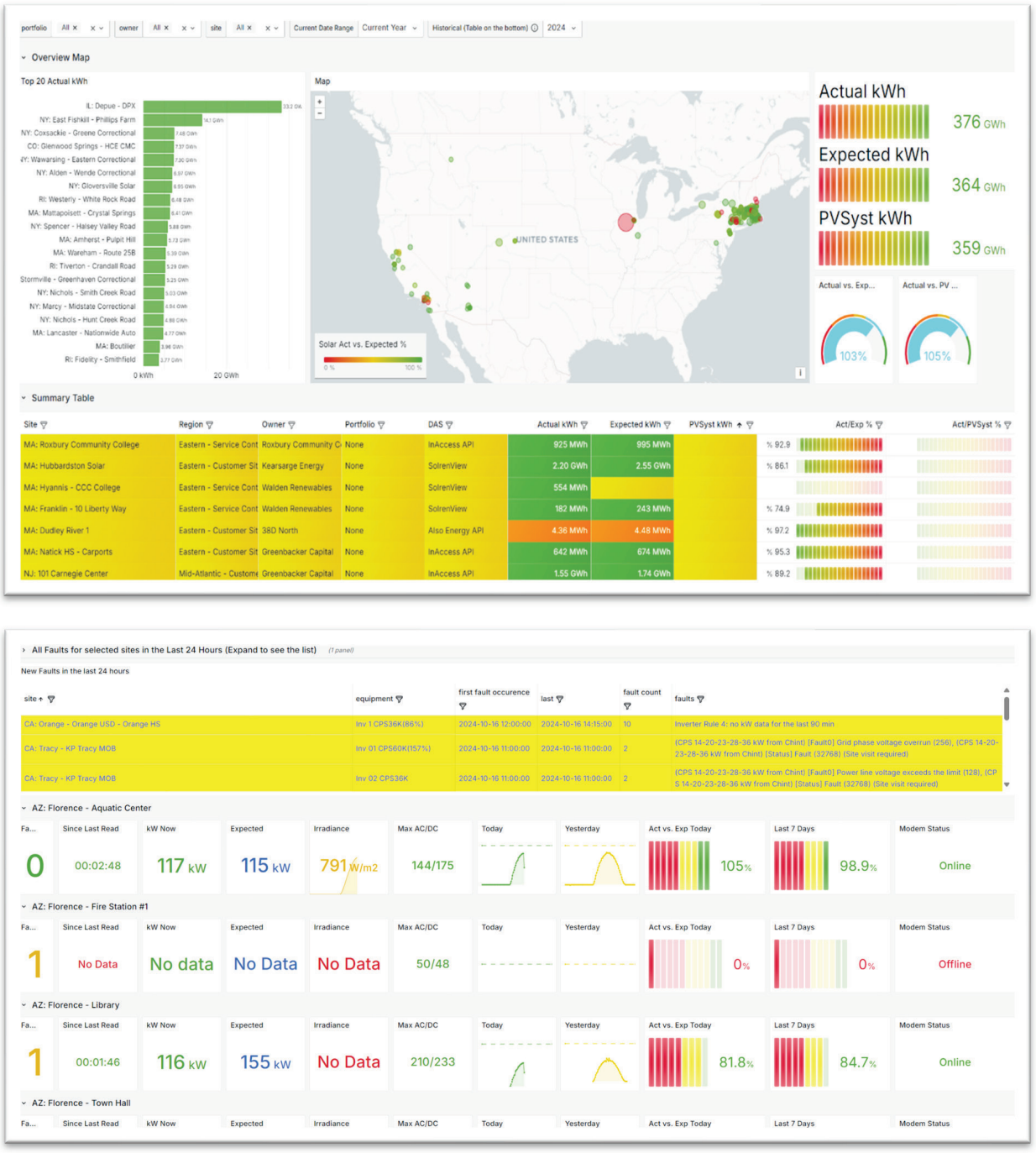


Figure 8: Sample portfolio and site status dashboards from AssetPlanner Analytics Planner for PV Systems

3. **Include a single line diagram showing existing and new components required to enable reporting to the energy management system.**

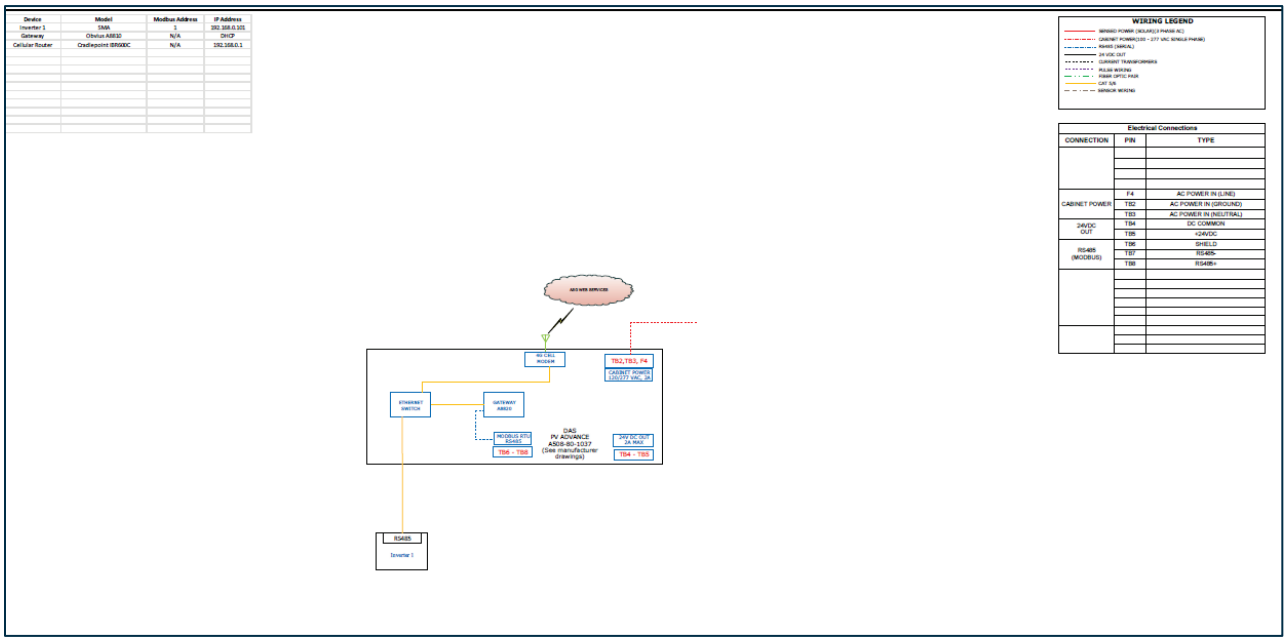


Figure 9: One line diagram of data acquisition system showing existing inverter and electric energy meter

4. **Include a detailed cost estimate of the work required to enable reporting to the energy management system. The cost estimate shall include detailed material breakouts, and labor hours. Use of lump sum costing is not acceptable.**

The estimated cost of hardware and installation labor is $4,838.85 and the estimated annual fees for software subscription and cellular data services are $934. Detailed cost estimates are shown in the following two tables.

Table 2: Estimated DAS Hardware and Installation Costs for PV System Monitoring

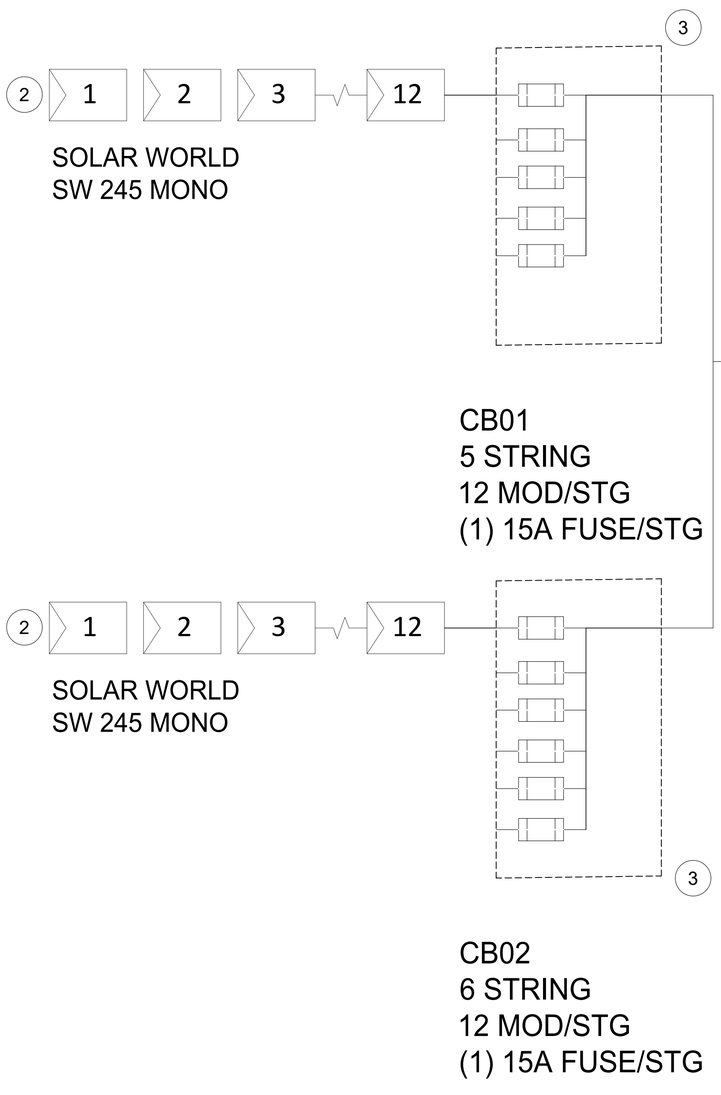
Description	Part Number	Qty	Unit Cost	Total Cost
Data Acquisition System with cell model and enclosure	Leviton IDAS-A8810-4G-S	1	$3,150.00	$3,150.00
Shipping (estimated)		1	$150.00	$150.00
Installation Labor (on-site)	Electrician	8 hours	$71.40	$571.20
Configuration & Commissioning Labor	Building Control Systems Engineer	5 hours	$191.53	$ 957.65
			Total Hardware Installation Cost	**$4,828.85**

Table 3: Estimated Annual Fees for PV System Monitoring

Description	Part Number	Qty	Unit Cost	Total Cost
Annual Subscription Fee for AssetPlanner Analytics Planner Module for DER-PV	AP-AnP-DER-PV	1	$350.00	$350.00
Cellular Data Plan Annual Fee	ASG-Cell-1GB	1	$400.00	$400.00
			Total Annual Fees	**$750.00**

Appendix A: Drawings

PV ARRAY



KEYNOTES

1. (E) INVERTER TO BE REMOVED
2. (E) PV MODULES TO REMAIN.
3. (E) ELECTRICAL EQUIPMENT TO BE REMOVED OR ABANDONED IN PLACE. COORDINATE WITH OWNER.

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LICENSE # AZ 62410

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MONTROSE, CO 81401
38.45903, -107.86794

SEALS AND SIGNATURES

REV	ISSUED FOR	DATE

DRAWN BY: JP
CHECKED BY: MS

DRAWING TITLE

SINGLE LINE DIAGRAM

PROJECT NO.

DRAWING NUMBER

E-600

PV ARRAY

KEYNOTES
(1) EXTEND EACH STRING WIRE TO INVERTER LOCATION. ATTACH AMPHENOL H4 PLUS CONNECTORS (VERIFY WITH SMA) AND DIRECTLY CONNECT THE STRING WIRE TO INVERTER TERMINALS. INVERTER MPPT RANGE 330V-800V.
(2) TERMINATE INVERTER OUTPUT CIRCUIT CONDUCTORS AT 50A/3P BREAKER.

1 2 3 12

SOLAR WORLD
SW 245 MONO

SUNNY TRIPOWER CORE 1 33-US (1)

1 MPPT 1
2
3 MPPT 2
4
5 MPPT 3
6
7 MPPT 4
8
9 MPPT 5
10
11 MPPT 6
12

(2) TO (E) FACILITY CONNECTION. FIELD VERIFY LOCATION FOR AS BUILT DRAWINGS

1 2 3 12

SOLAR WORLD
SW 245 MONO

Plot Date:

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SEALS AND SIGNATURES

REV	ISSUED FOR	DATE

DRAWN BY: JP
CHECKED BY: MS

DRAWING TITLE

SINGLE LINE DIAGRAM

PROJECT NO.

DRAWING NUMBER

E-600

Appendix B: PVsyst Simulation Report

PVsyst - Simulation report

Grid-Connected System

Project: Uncompahgre Montrose Field Office

Variant: Uncompahgre Montrose Field Office v01_2025-03-21

Sheds, single array

System power: 32.3 kWp

Montrose Co. Arpt - United States

Author

PV AMPS (United States)

PVsyst V8.0.6
VC0, Simulation date:
21/03/25 08:43
with V8.0.6

PV AMPS (United States)

Project summary

Geographical Site
Montrose Co. Arpt
United States

Situation

Latitude	38.50 °N
Longitude	-107.90 °W
Altitude	1744 m
Time zone	UTC-7

Project settings

Albedo	0.20

Weather data
Montrose Co. Arpt
NREL NSRD : TMY3

System summary

Grid-Connected System

Sheds, single array

Orientation #1
Fixed plane
Tilt/Azimuth 30 / 0 °

Near Shadings
Linear shadings : Fast (table)

User's needs
Unlimited load (grid)

System information

PV Array		Inverters	
Nb. of modules	132 units	Nb. of units	1 unit
Pnom total	32.3 kWp	Pnom total	30.0 kWac
		Pnom ratio	1.078

Results summary

Produced Energy	48895 kWh/year	Specific production	1512 kWh/kWp/year	Perf. Ratio PR	77.62 %

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General parameters

Grid-Connected System — **Sheds, single array**

Orientation #1

Fixed plane		Sheds configuration		Sizes	
Tilt/Azimuth	30 / 0 °	Nb. of sheds	3 units	Sheds spacing	8.00 m
		Single array		Collector width	3.37 m
		Shading limit angle		Average GCR	42.1 %
		Limit profile angle	18.5 °	Top inactive band	0.02 m
				Bottom inactive band	0.02 m

Models used		Horizon	Near Shadings
Transposition	Perez	Free Horizon	Linear shadings : Fast (table)
Diffuse	Imported		
Circumsolar	separate		

User's needs
Unlimited load (grid)

PV Array Characteristics

PV module

Manufacturer	SolarWorld
Model	SW 245 Mono
(Original PVsyst database)	
Unit Nom. Power	245 Wp
Number of PV modules	132 units
Nominal (STC)	32.3 kWp
Modules	11 string x 12 In series
At operating cond. (50°C)	
Pmpp	28.80 kWp
U mpp	333 V
I mpp	86 A

Inverter

Manufacturer	PV Powered
Model	PVP 30KW-480
(Original PVsyst database)	
Unit Nom. Power	30.0 kWac
Number of inverters	1 unit
Total power	30.0 kWac
Operating voltage	295-500 V
Pnom ratio (DC:AC)	1.08

Total PV power

Nominal (STC)	32 kWp
Total	132 modules
Module area	221 m²

Total inverter power

Total power	30 kWac
Number of inverters	1 unit
Pnom ratio	1.08

Array losses

Thermal Loss factor
Module temperature according to irradiance

Uc (const)	20.0 W/m²K
Uv (wind)	0.0 W/m²K/m/s

DC wiring losses

Global array res.	65 mΩ
Loss Fraction	1.5 % at STC

Module Quality Loss
Loss Fraction 1.5 %

Module mismatch losses
Loss Fraction 2.0 % at MPP

Strings Mismatch loss
Loss Fraction 0.2 %

IAM loss factor
ASHRAE Param.: IAM = 1 - bo (1/cosi -1)
bo Param. 0.05

AC wiring losses

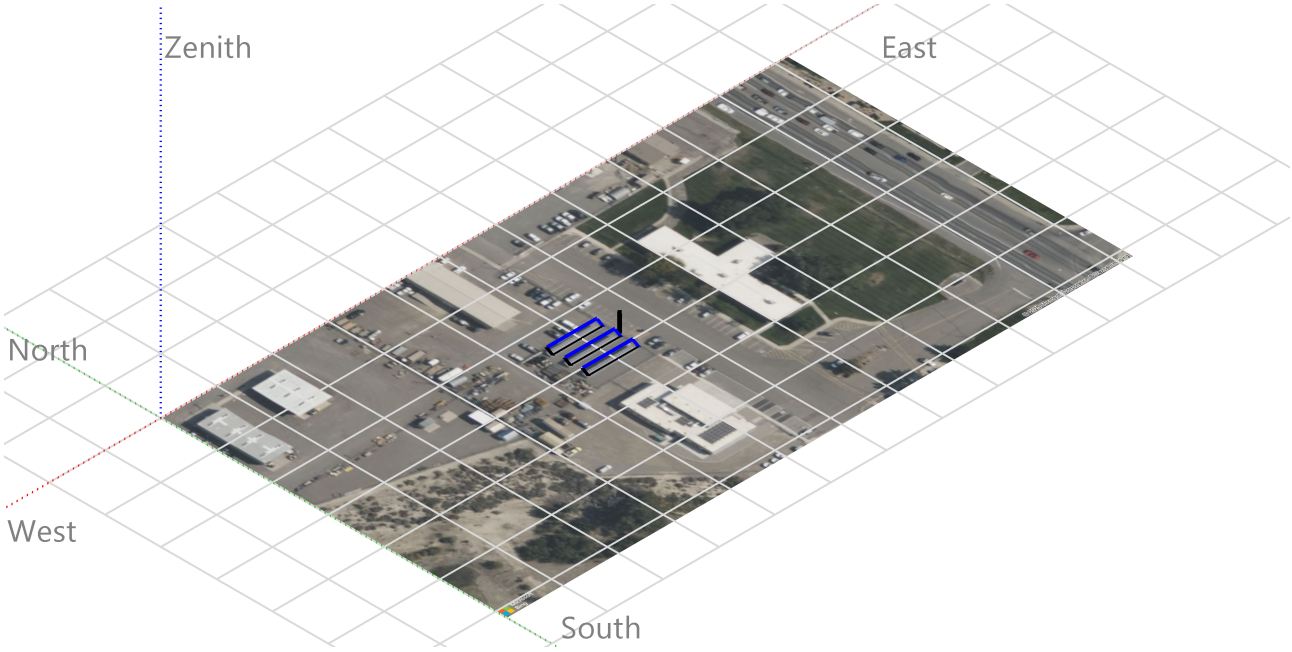
Inv. output line up to injection point

Inverter voltage	480 Vac tri
Loss Fraction	1.00 % at STC
Inverter: PVP 30KW-480	
Wire section (1 Inv.)	Copper 1 x 3 x 6 mm²
Wires length	24 m

PVsyst V8.0.6
VC0, Simulation date:
21/03/25 08:43
with V8.0.6

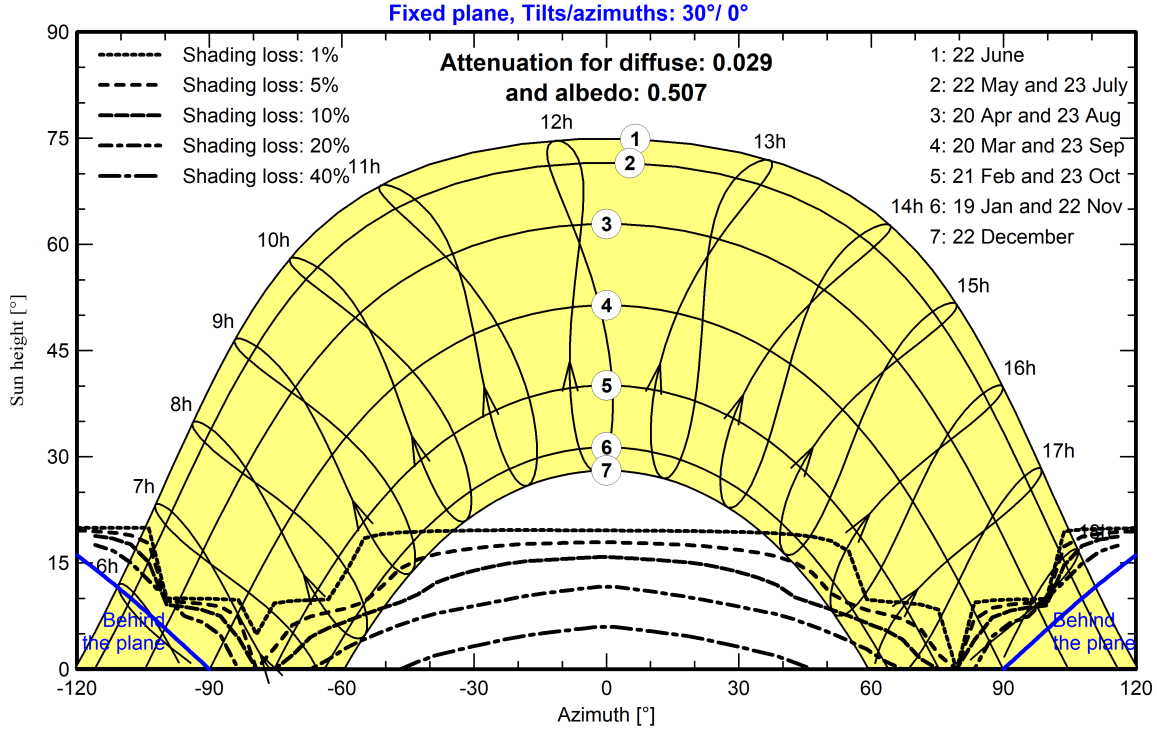
Near shadings parameter

Perspective of the PV-field and surrounding shading scene



Iso-shadings diagram

Orientation #1

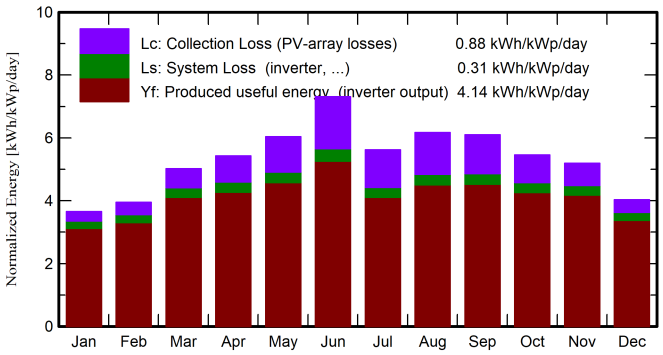


Main results

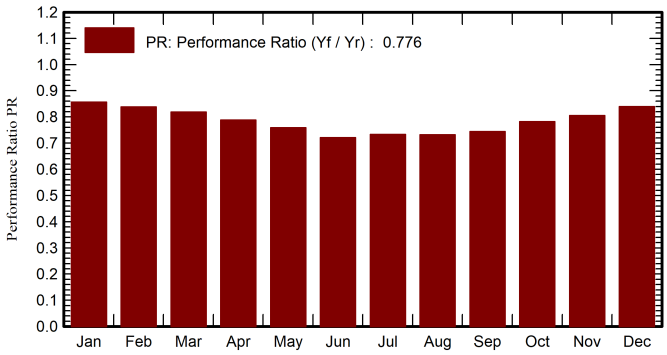
System Production

Produced Energy	48895 kWh/year	Specific production	1512 kWh/kWp/year
		Perf. Ratio PR	77.62 %

Normalized productions (per installed kWp)



Performance Ratio PR



Balances and main results

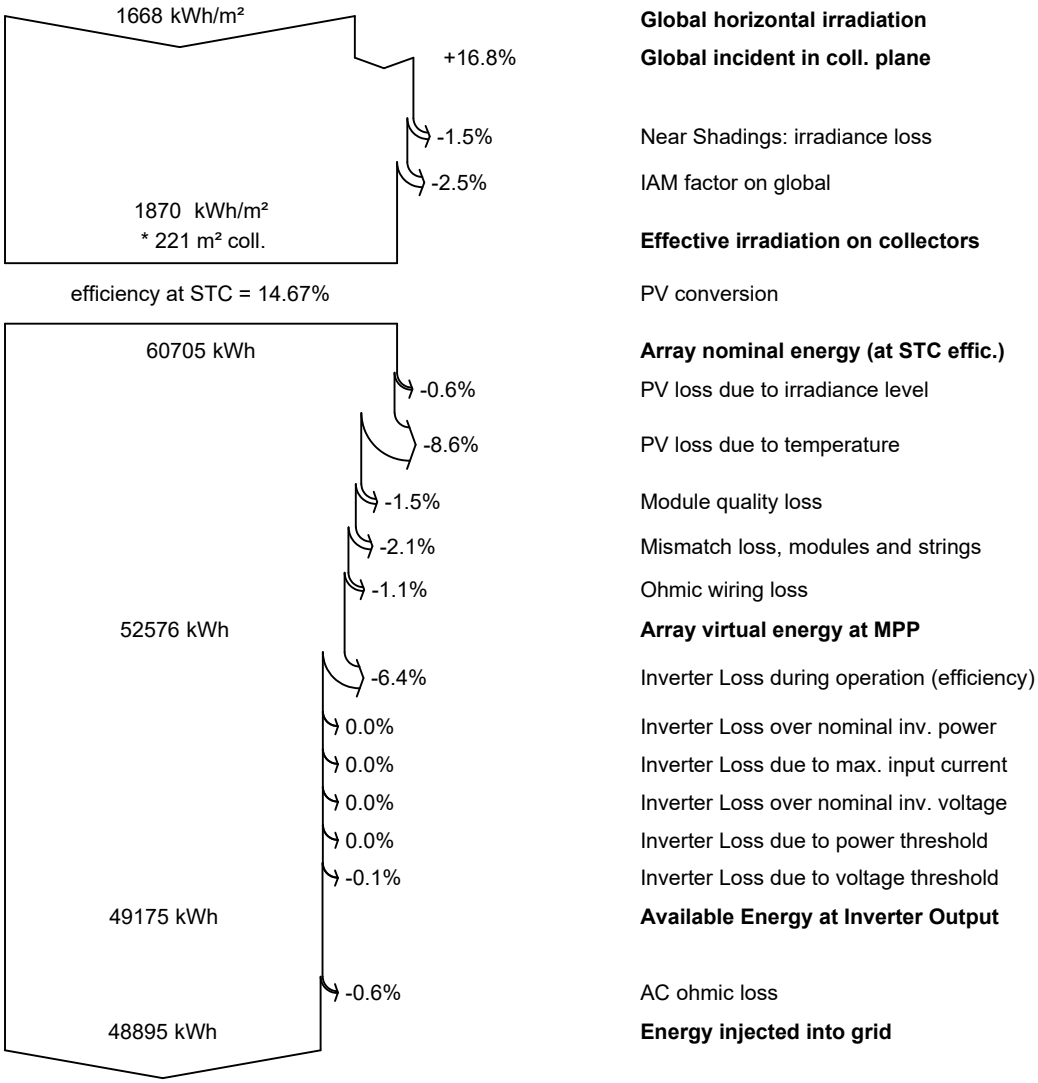
	GlobHor kWh/m²	DiffHor kWh/m²	T_Amb °C	GlobInc kWh/m²	GlobEff kWh/m²	EArray kWh	E_Grid kWh	PR ratio
January	71.5	31.25	-3.60	113.2	108.2	3371	3135	0.856
February	81.3	40.71	1.60	110.6	106.3	3225	2998	0.838
March	127.5	51.21	3.83	155.8	150.2	4432	4122	0.818
April	151.8	59.55	7.28	162.9	156.4	4468	4153	0.788
May	192.2	69.48	15.71	187.2	179.1	4936	4592	0.758
June	235.7	55.85	21.71	219.4	210.5	5493	5110	0.720
July	182.9	72.02	22.05	174.2	166.6	4442	4129	0.733
August	184.7	60.99	21.99	191.4	183.8	4860	4527	0.731
September	154.3	46.87	18.86	182.9	176.2	4723	4399	0.744
October	123.0	37.61	10.60	169.2	163.6	4598	4280	0.782
November	93.3	21.95	4.00	155.9	149.8	4355	4058	0.805
December	70.1	22.28	-2.44	124.9	118.9	3645	3391	0.839
Year	1668.2	569.77	10.17	1947.7	1869.6	52547	48895	0.776

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 V8.0.6
VC0, Simulation date:
21/03/25 08:43
with V8.0.6

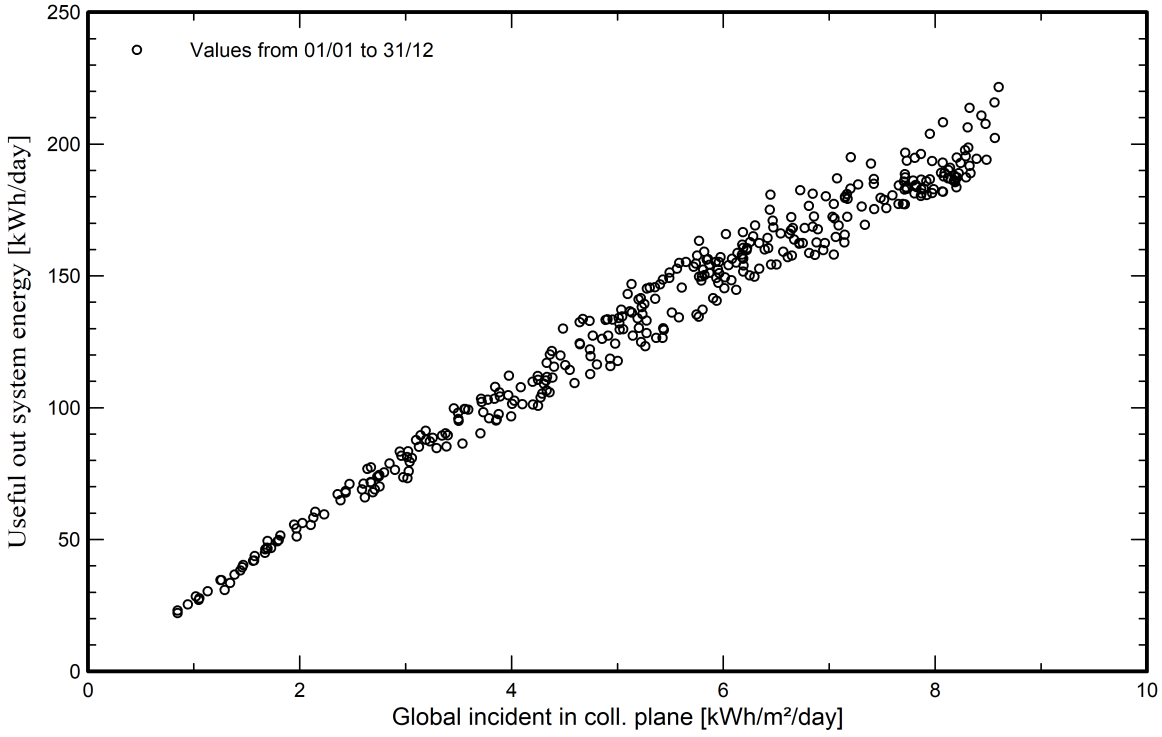
Loss diagram



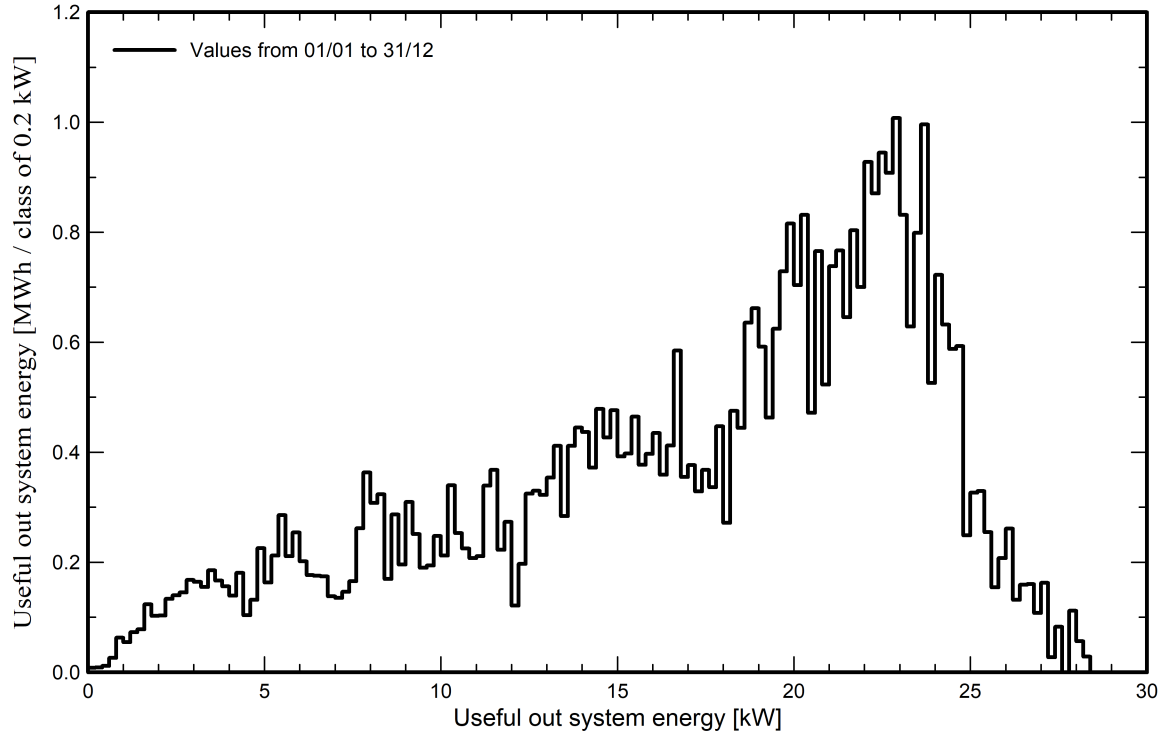
PVsyst V8.0.6
VC0, Simulation date:
21/03/25 08:43
with V8.0.6

Predef. graphs

Daily Input/Output diagram

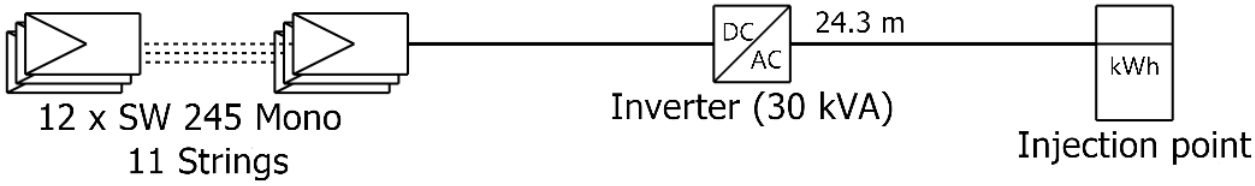


System Output Power Distribution



Single-line diagram

PVsyst V8.0.6
VC0, Simulation date:
21/03/25 08:43
with V8.0.6



PV module	SW 245 Mono
Inverter	PVP 30KW-480
String	12 x SW 245 Mono

	Uncompahgre Montrose Field Office	PV AMPS (United States)
	VC0 : Uncompahgre Montrose Field Office v01_2025-03-21	21/03/25