UNHCR

United Nations High Commissioner for Refugees

FEASIBILITY & DESIGN REPORT

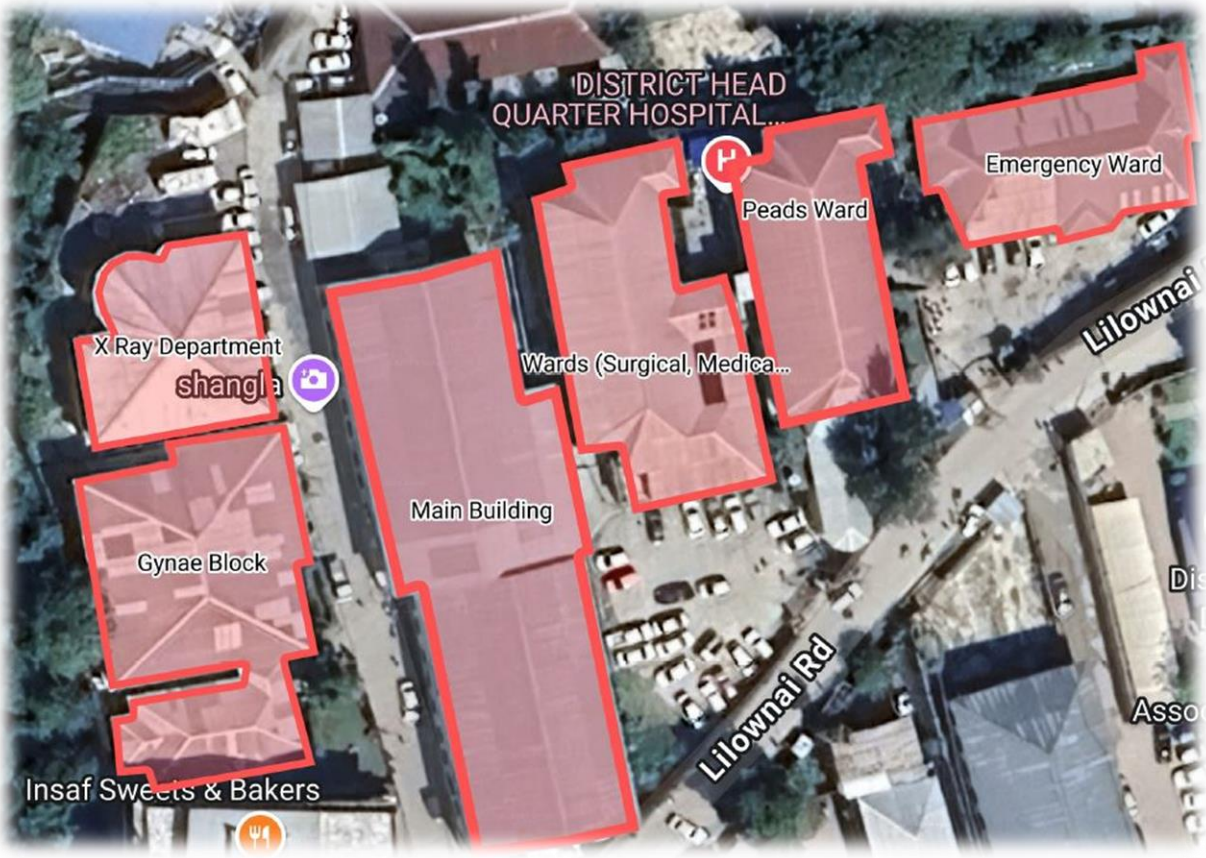

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Table of Contents

DISTRICT HEADQUARTER HOSPITAL SHANGLA

Energy Assessment Report

1. Introduction to the Facility:

This report presents the findings and recommendations from the load survey conducted at DHQ Shangla, Alpuri. The primary objective of the task was to evaluate the energy consumption patterns across the hospital and to design a suitable solar energy system to meet its power needs. This report include a detail assessment of existing electrical loads, identification of critical power requirements, and analysis of energy usage to develop a sustainable and efficient solar solution for various buildings in the hospital complex.

The location, address and an overview of the facility are provided in the following table.

GPS Coordinates:	34.92015, 72.63240	
Address: Alpuri, District Shangla, Khyber Pakhtunkhwa		
Facility Overview		
Type: Hospital	No of Rooms: 89	No of Beneficiaries:

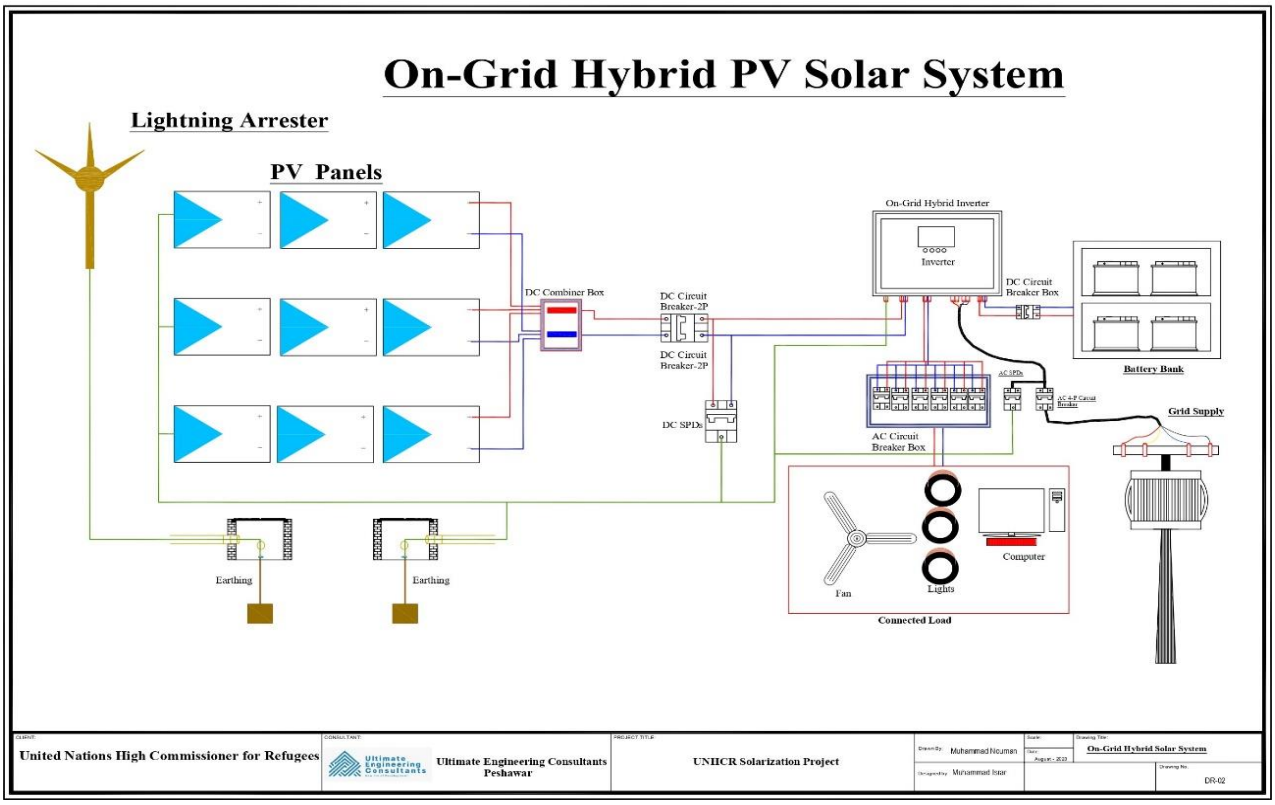
2. Technical Details:

2.1 Existing Electricity Arrangements:

Grid Supply Available: Yes	Voltage: 380 V (value measured on site)	Connection: 3 Phase Energy Meter
Back Up System: Peads Ward Only	Generator: Yes	Solar System: Installed only for Peads Ward
Net Metering available: No	Net Metering Required: No (Heavy Load Shedding)	

2.2 System Configuration:

Single Line Diagram



4. Main Building

4.1 Segregated Load Details of Main Building:

Load at Main Building						
S.No	**Appliances Name**	**Grid Connected Load**			**Non-Critical/ Solar Connected Load**	**Critical/ Battery Connected Load**
		Watt per App	**Quantity**	**Total Load**		
1	No. of Fans	80	45	3,600	3,600	3,600
2	No. of LED Lights	15	145	2,175	2,175	2,175
3	No. of Tube Lights	35	60	2,100	2,100	2,100
4	Dithermal	2000	2	4,000	4,000	
5	PCs	500	11	5,500	5,500	5,500
6	Token Machine	700	1	700	700	700
7	Vaccine Freezer	80	6	480	480	480
8	Refrigerator	400	6	2,400	2,400	2,400
9	AC 1.5 Ton	2000	6	12,000	12,000	
10	OT Lights	200	5	1,000	1,000	1,000
11	OT Table	400	5	2,000	2,000	2,000
12	Diathermia	400	2	800	800	
13	Cardiac Monitor	150	5	750	750	750
14	Trade Mill	100	1	100	100	
15	Camera System	1500	1	1,500	1,500	1,500
16	LCD	200	2	400	400	400
17	Small Printer	500	5	2,500	2,500	2,500
	Total Load in Watts			42,005	42,005	22,405
	Total Load in Kilo Watts			**42.005**	**42.005**	**22.405**

4.3 Installation location of major equipment: PV, Inverter, and Battery

Solar PV (Shutter Rooftop)

Inverter and Battery (Hall Corridor near the Main Panel)

4.5 Software Simulation Report of Main Building:

HelioScope

Annual Production Report produced by Engr. Rizwan Kamal

Main Block (OPD, OT, Labs, Blood Bank, CCU & Admin) DHQ Shangla, 34.920254500072, 72.63255444722893

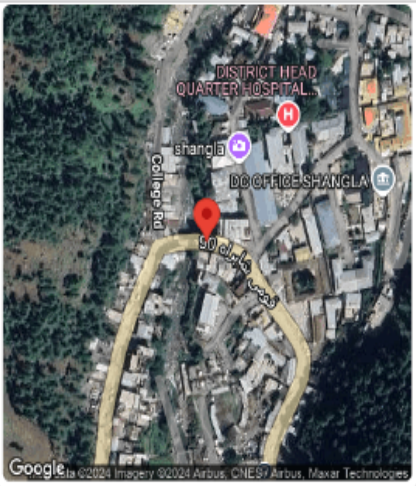
Report

Project Name	DHQ Shangla
Project Address	34.920254500072, 72.63255444722893
Prepared By	Project Manager Engr. Rizwan Kamal

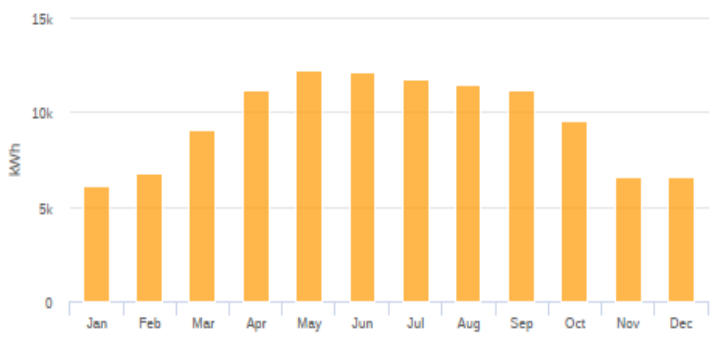
System Metrics

Design	Main Block (OPD, OT, Labs, Blood Bank, CCU & Admin)
Module DC Nameplate	74.2 kW
Inverter AC Nameplate	90.0 kW Load Ratio: 0.82
Annual Production	115.0 MWh
Performance Ratio	82.2%
kWh/kWp	1,549.3
Weather Dataset	TMY, 10km Grid, Meteonorm 8 (meteonorm_v8)
Simulator Version	c178221cb0-1b9fef948f-f3a2a03fdc-52f35772ad

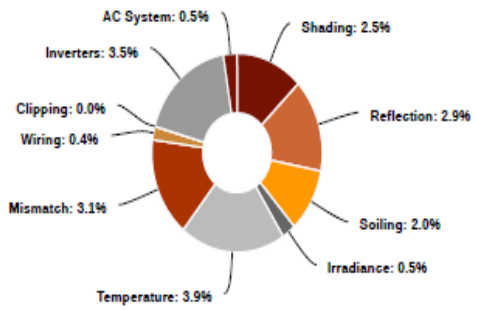
Project Location



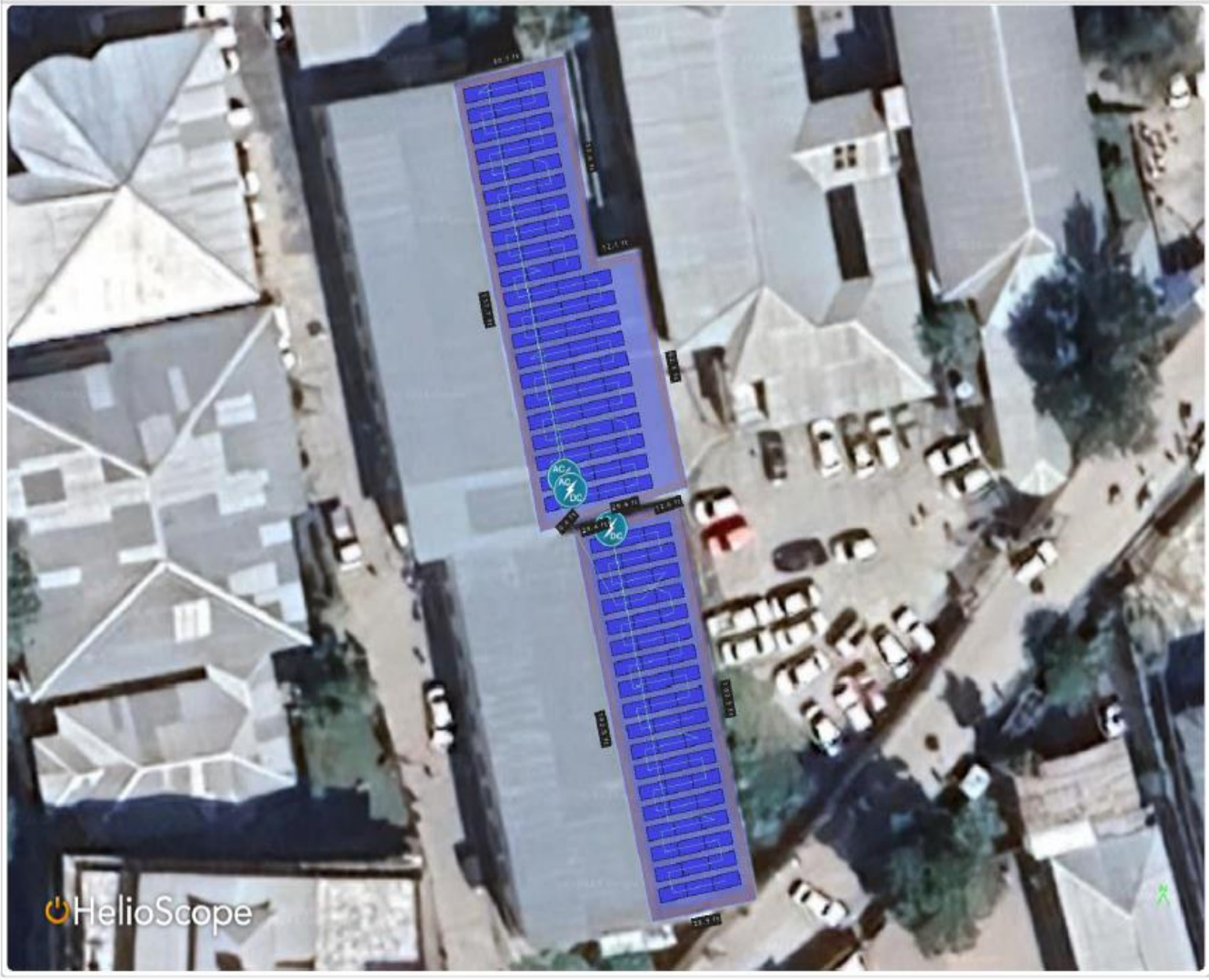
Monthly Production



Sources of System Loss

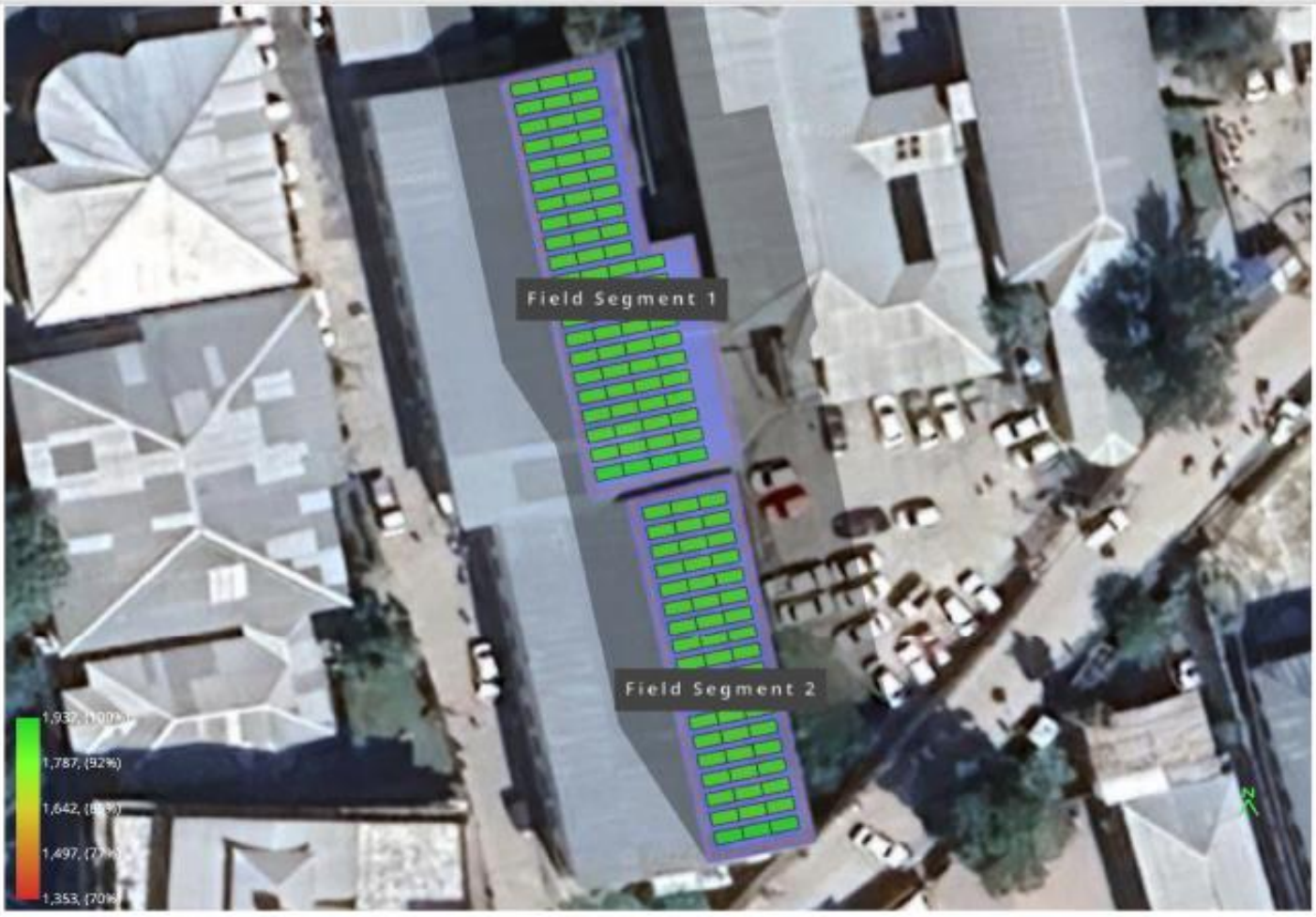


Detailed Layout2



Main Block (OPD, OT, Labs, Blood Bank, CCU & Admin) DHQ Shangla, 34.920254500072, 72.63255444722893

Shading Heatmap



Shading by Field Segment

Description	Tilt	Azimuth	Modules	Nameplate	Shaded Irradiance	AC Energy	TOF[2]	Solar Access	Avg TSRF[2]
Field Segment 1	Module: 18.0°	Module: 168.0°	74	42.9 kWp	1,837.9kWh/m²	66.5 MWh[1]	97.5%	97.5%	95.1%
Field Segment 2	Module: 18.0°	Module: 168.0°	54	31.3 kWp	1,838.5kWh/m²	48.5 MWh[1]	97.5%	97.5%	95.2%
Totals, weighted by kWp			**128**	**74.2 kWp**	**1,838.2kWh/m²**	**115.0 MWh**	**97.5%**	**97.5%**	**95.1%**

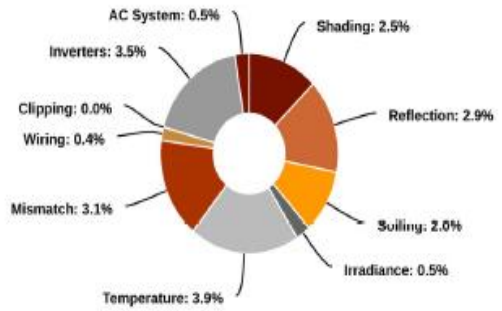
[1] approximate, varies based on inverter performance
[2] based on location Optimal POA Irradiance of 1,932.2kWh/m² at 31.2° tilt and 180.7° azimuth

Solar Access by Month

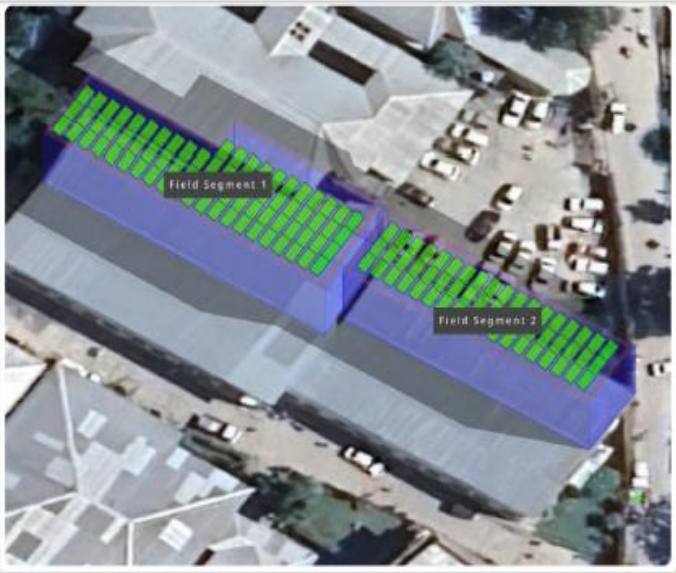
Description	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
Field Segment 1	92%	97%	99%	99%	99%	99%	99%	99%	99%	98%	94%	90%
Field Segment 2	92%	97%	99%	99%	99%	99%	99%	99%	99%	98%	94%	90%
Solar Access, weighted by kWp	**92.1%**	**97.3%**	**98.5%**	**98.8%**	**98.8%**	**98.8%**	**98.7%**	**98.8%**	**98.9%**	**98.1%**	**94.5%**	**90.4%**
AC Power (kWh)	6,117.2	6,828.3	9,099.3	11,189.0	12,280.1	12,147.4	11,816.0	11,456.8	11,245.2	9,563.5	6,687.3	6,589.8

Monthly Production

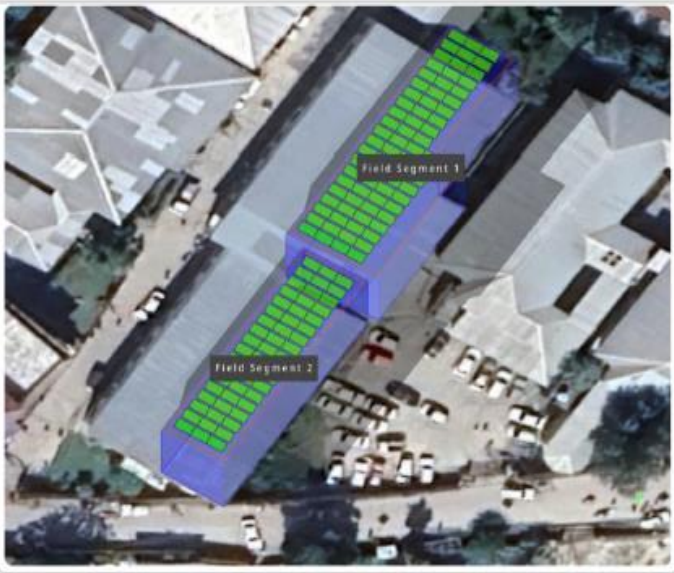
Sources of System Loss



Southwestern Angle



Southeastern Angle



5. Emergency Block:

5.1 Segregated Load Details of Emergency:

Load at Emergency Block						
S.No	**Appliances Name**	**Grid Connected Load**			**Non-Critical/ Solar Connected Load**	**Critical/ Battery Connected Load**
		Watt per App	**Quantity**	**Total Load**		
1	No. of Fans	80	25	2,000	2,000	2,000
2	No. of LED Lights	15	110	1,650	1,650	1,650
3	No. of Tube Lights	35	4	140	140	140
4	X-Ray Machine	2500	1	2,500	2,500	
	Total Load in Watts			6,290	6,290	3,790
	Total Load in Kilo Watts			**6.29**	**6.29**	**3.79**

5.3 Installation location of major equipment: PV, Inverter, and Battery

Solar PV (Shutter Rooftop at PEADS Ward)

Inverter and Battery (Hall Corridor near the DB)

5.5 Software Simulation Report of Emergency Block:

HelioScope — Annual Production Report produced by Engr. Rizwan Kamal

Emergency Block DHQ Shangla, 34.920254500072, 72.63255444722893

Report

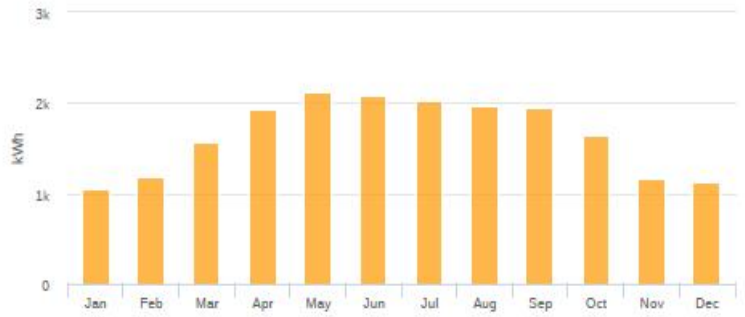
Project Name	DHQ Shangla
Project Address	34.920254500072, 72.63255444722893
Prepared By	Project Manager Engr. Rizwan Kamal

System Metrics

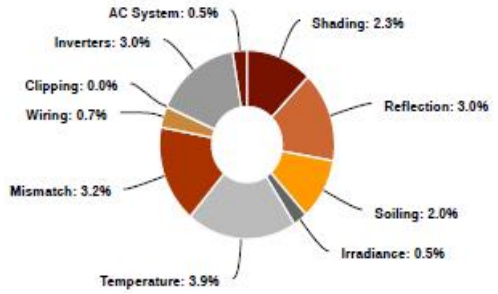
Design	Emergency Block
Module DC Nameplate	12.8 kW
Inverter AC Nameplate	12.0 kW Load Ratio: 1.06
Annual Production	19.85 MWh
Performance Ratio	82.5%
kWh/kWp	1,555.3
Weather Dataset	TMY, 10km Grid, Meteonorm 8 (meteonorm_v8)
Simulator Version	3097d51578-e23caf56b1-8d54507a91-e6f1079e7f

Project Location

Monthly Production



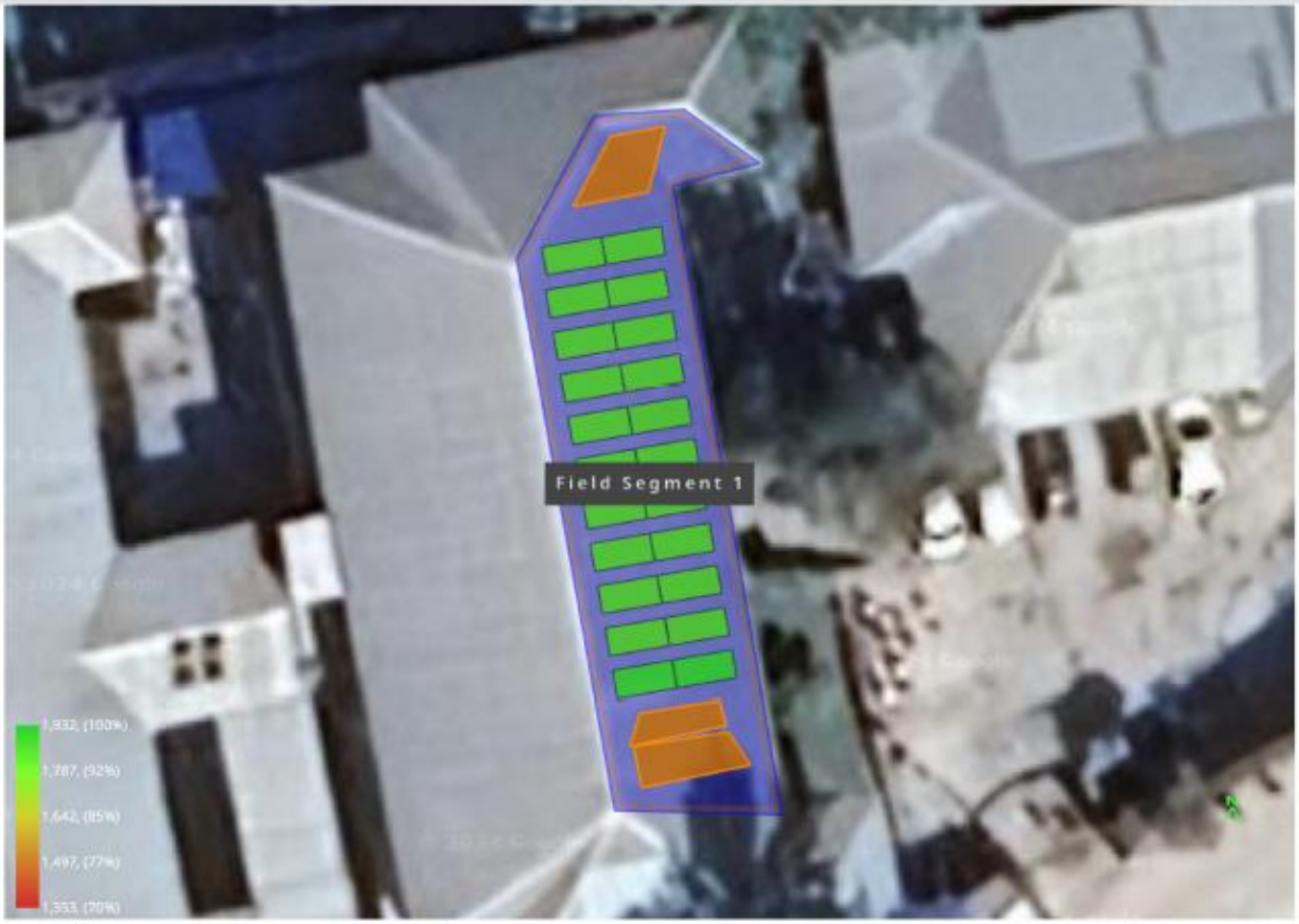
Sources of System Loss



Detailed Layout2

Emergency Block DHQ Shangla, 34.920254500072, 72.63255444722893

Shading Heatmap



Shading by Field Segment

Description	Tilt	Azimuth	Modules	Nameplate	Shaded Irradiance	AC Energy	TOF[2]	Solar Access	Avg TSRF [2]
Field Segment 1	Module: 18.0°	Module: 170.0°	22	12.8 kWp	1,841.8kWh/m²	19.8 MWh[1]	97.6%	97.7%	95.3%
Totals, weighted by kWp			**22**	**12.8 kWp**	**1,841.8kWh/m²**	**19.8 MWh**	**97.6%**	**97.7%**	**95.3%**

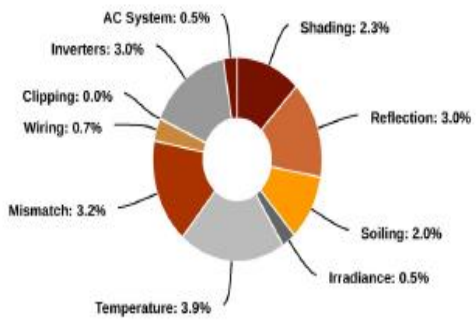
[1] approximate, varies based on inverter performance
[2] based on location Optimal POA Irradiance of 1,932.2kWh/m² at 31.2° tilt and 180.7° azimuth

Solar Access by Month

Description	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
Field Segment 1	92%	98%	99%	99%	99%	99%	99%	99%	99%	98%	95%	90%
Solar Access, weighted by kWp	**92.4%**	**97.6%**	**98.7%**	**98.9%**	**98.9%**	**98.9%**	**98.9%**	**98.9%**	**99.1%**	**98.4%**	**95.0%**	**89.5%**
AC Power (kWh)	**1,058.0**	**1,183.0**	**1,572.8**	**1,930.0**	**2,117.9**	**2,094.8**	**2,035.3**	**1,975.2**	**1,939.3**	**1,654.8**	**1,161.8**	**1,122.8**

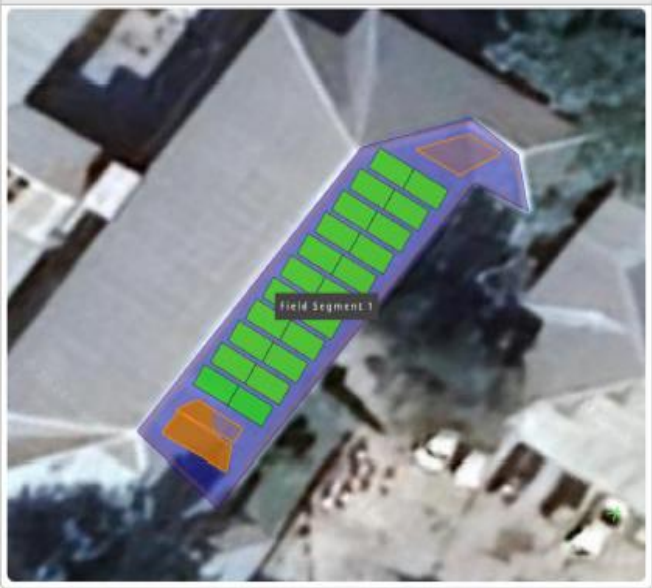
Monthly Production

Sources of System Loss



Southwestern Angle

Southeastern Angle



6. Wards:

6.1 Segregated Load Details of Surgical Ward:

Load at Surgical Ward						
S.No	**Appliances Name**	**Grid Connected Load**			**Non-Critical/ Solar Connected Load**	**Critical/ Battery Connected Load**
		Watt per App	**Quantity**	**Total Load**		
1	No. of Fans	80	30	2,400	2,400	2,400
2	No. of LED Lights	15	110	1,650	1,650	1,650
3	No. of Tube Lights	35	10	350	350	350
	Total Load in Watts			4,400	4,400	4,400
	Total Load in Kilo Watts			**4.4**	**4.4**	**4.4**

6.3 Segregated Load Details of Dental Ward:

Load at Dental Ward						
S.No	**Appliances Name**	**Grid Connected Load**			**Non-Critical/ Solar Connected Load**	**Critical/ Battery Connected Load**
		Watt per App	**Quantity**	**Total Load**		
1	No. of Fans	80	15	1,200	1,200	1,200
2	No. of LED Lights	15	55	825	825	825
3	No. of Tube Lights	35	5	175	175	175
4	Dental Unit	300	2	600	600	600
5	Dental X-Ray Machine	2000	1	2,000	2,000	
	Total Load in Watts			4,800	4,800	2,800
	Total Load in Kilo Watts			**4.8**	**4.8**	**2.8**

6.5 Segregated Load Details of Medical Ward:

Load at Medical Ward						
S.No	**Appliances Name**	**Grid Connected Load**			**Non-Critical/ Solar Connected Load**	**Critical/ Battery Connected Load**
		Watt per App	**Quantity**	**Total Load**		
1	No. of Fans	80	30	2,400	2,400	2,400
2	No. of LED Lights	15	85	1,275	1,275	1,275
3	No. of Tube Lights	35	10	350	350	350
	Total Load in Watts			4,025	4,025	4,025
	Total Load in Kilo Watts			**4.025**	**4.025**	**4.025**

6.7 Installation location of major equipment: PV, Inverter, and Battery

Solar PV (Shutter Rooftop of Wards)

Inverter and Battery (Near the Main DB)

6.11 Software Simulation Report of Wards:

HelioScope — Annual Production Report produced by Engr. Rizwan Kamal

Wards (Surgical, Medical & Dental) DHQ Shangla, 34.920254500072, 72.63255444722893

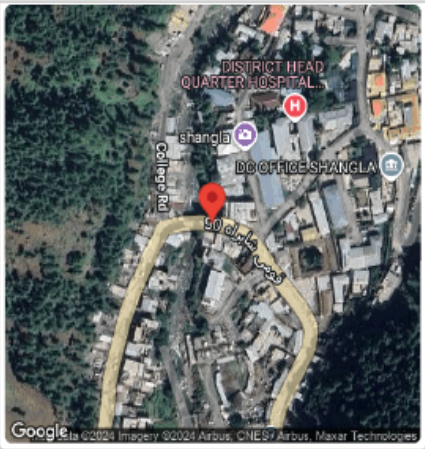
Report

Project Name	DHQ Shangla
Project Address	34.920254500072, 72.63255444722893
Prepared By	Project Manager Engr. Rizwan Kamal

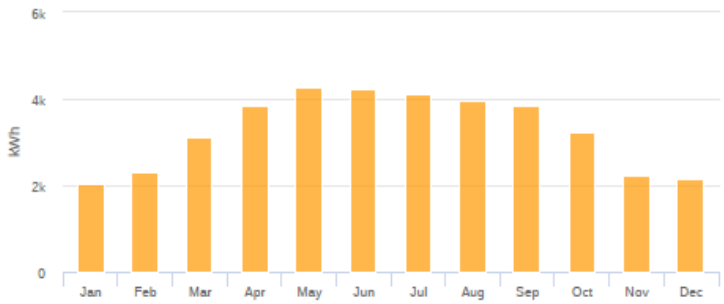
System Metrics

Design	Wards (Surgical, Medical & Dental)
Module DC Nameplate	25.5 kW
Inverter AC Nameplate	24.0 kW Load Ratio: 1.06
Annual Production	39.45 MWh
Performance Ratio	82.9%
kWh/kWp	1,546.0
Weather Dataset	TMY, 10km Grid, Meteonorm 8 (meteonorm_v8)
Simulator Version	3097d51578-e23caf56b1-8d54507a91-e6f1079e7f

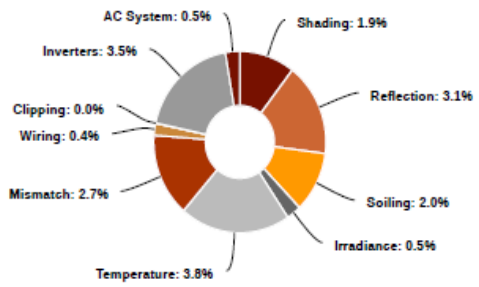
Project Location



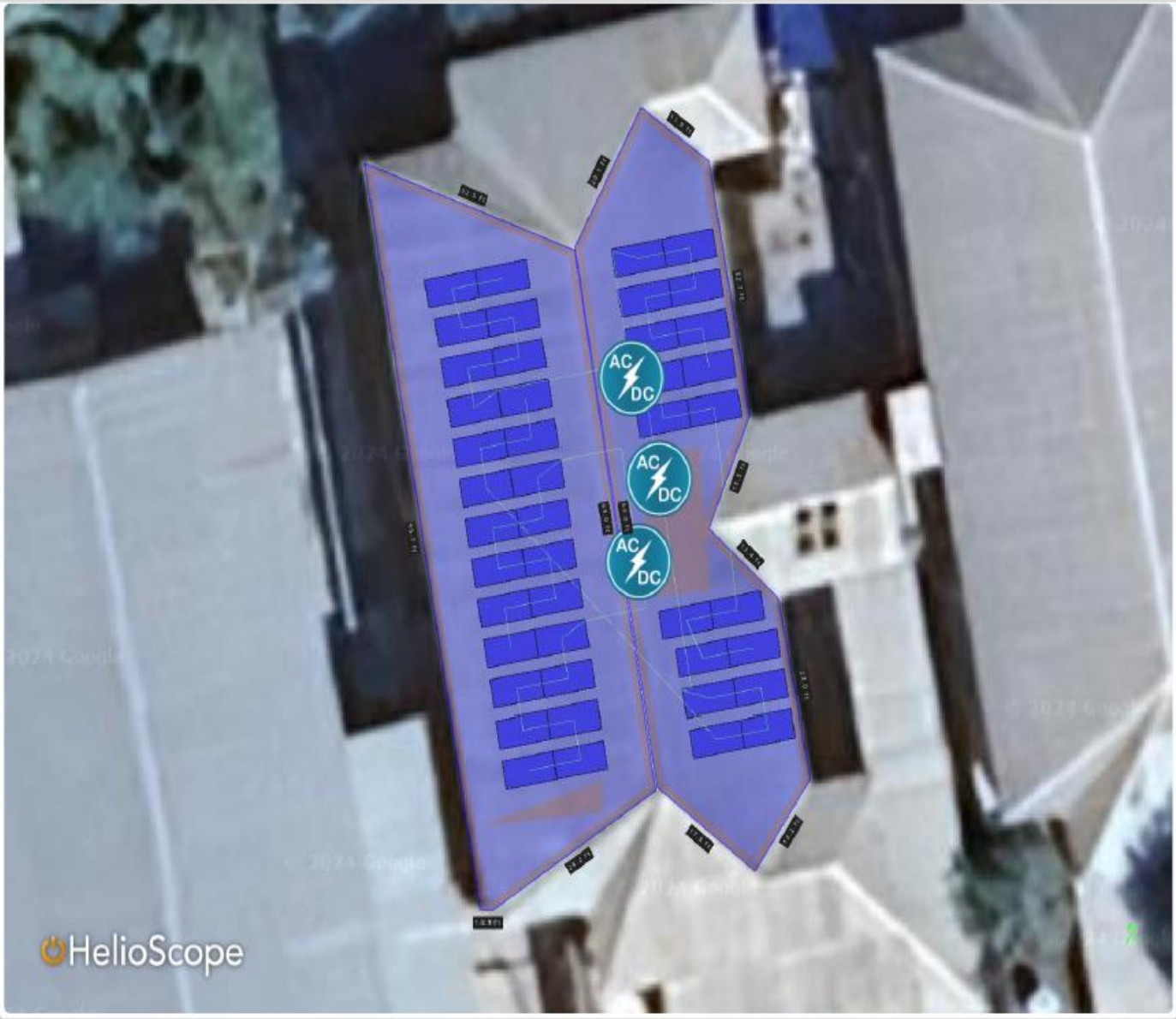
Monthly Production



Sources of System Loss

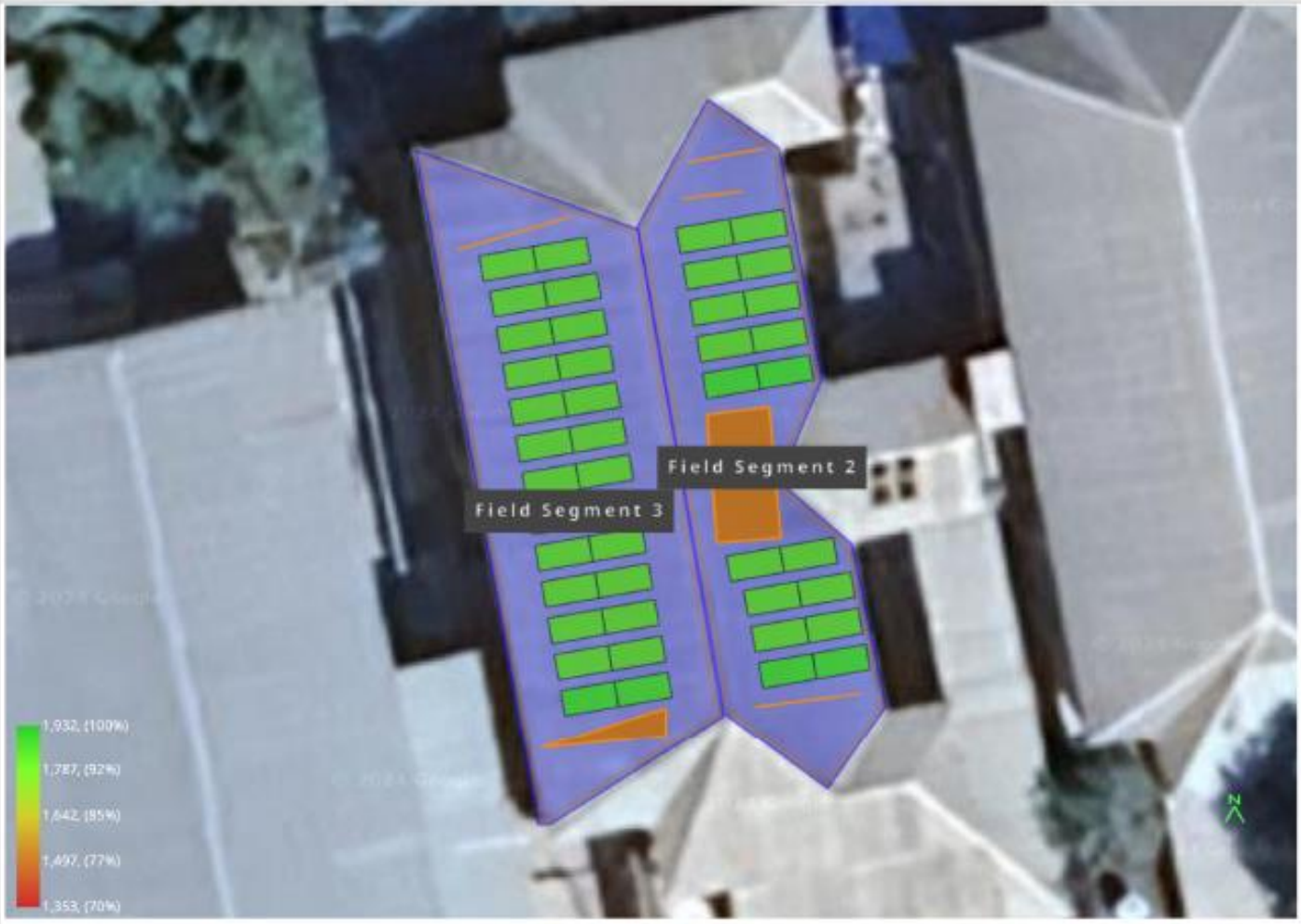


Detailed Layout2



Wards (Surgical, Medical & Dental) DHQ Shangla, 34.920254500072, 72.63255444722893

Shading Heatmap



Shading by Field Segment

Description	Tilt	Azimuth	Modules	Nameplate	Shaded Irradiance	AC Energy	TOF[2]	Solar Access	Avg TSRF [2]
Field Segment 2	Module: 15.0°	Module: 170.0°	18	10.4 kWp	1,832.5kWh/m²	16.2 MWh[1]	96.5%	98.3%	94.8%
Field Segment 3	Module: 15.0°	Module: 170.0°	26	15.1 kWp	1,826.5kWh/m²	23.3 MWh[1]	96.5%	97.9%	94.5%
Totals, weighted by kWp			**44**	**25.5 kWp**	**1,829.0kWh/m²**	**39.5 MWh**	**96.5%**	**98.1%**	**94.7%**

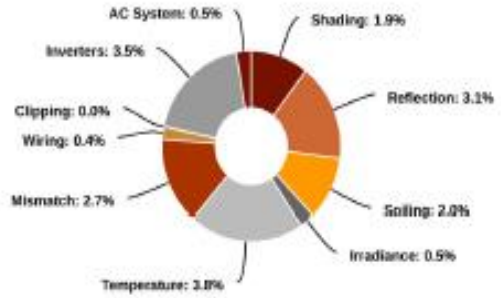
[1] approximate, varies based on inverter performance
[2] based on location Optimal POA Irradiance of 1,932.2kWh/m² at 31.2° tilt and 180.7° azimuth

Solar Access by Month

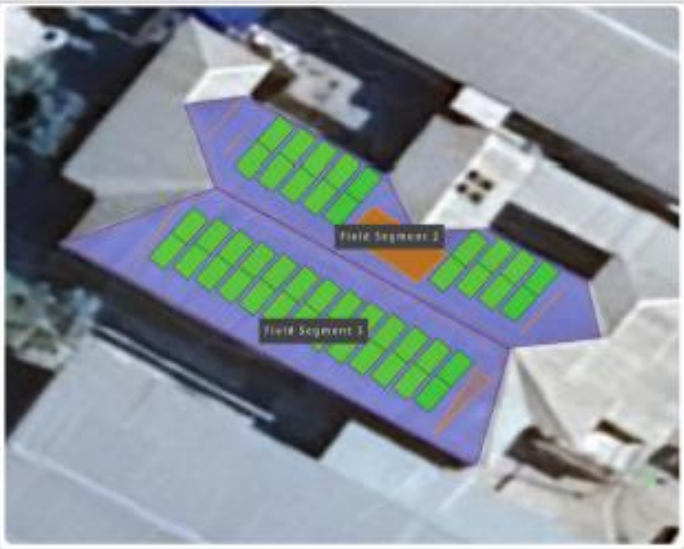
Description	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
Field Segment 2	94%	98%	99%	99%	99%	99%	99%	99%	99%	99%	96%	92%
Field Segment 3	93%	98%	99%	99%	99%	99%	99%	99%	99%	99%	95%	90%
Solar Access, weighted by kWp	**93.3%**	**98.0%**	**99.0%**	**99.2%**	**99.2%**	**99.2%**	**99.1%**	**99.2%**	**99.3%**	**98.6%**	**95.6%**	**91.0%**
AC Power (kWh)	**2,049.0**	**2,313.3**	**3,116.7**	**3,855.8**	**4,271.8**	**4,247.0**	**4,112.8**	**3,964.0**	**3,848.3**	**3,245.9**	**2,253.2**	**2,176.8**

Monthly Production

Sources of System Loss



Southwestern Angle



Southeastern Angle

7. Gynae and Labour Room:

7.1 Segregated Load Details of Gynae and Labour Room:

Load at at Gynae and Labour Room						
S.No	**Appliances Name**	**Grid Connected Load**			**Non-Critical/ Solar Connected Load**	**Critical/ Battery Connected Load**
		Watt per App	**Quantity**	**Total Load**		
1	No. of Fans	80	30	2,400	2,400	2,400
2	No. of LED Lights	15	95	1,425	1,425	1,425
3	Refrigerator	300	1	300	300	300
4	Small Ultra Sound Machine	500	1	500	500	
5	Incubator	500	3	1,500	1,500	
6	Microwave Oven	3000	1	3,000	3,000	
7	Suction Machine	250	2	500	500	500
8	Sterilizer	2000	2	4,000	4,000	
	Total Load in Watts			13,625	13,625	4,625
	Total Load in Kilo Watts			**13.625**	**13.625**	**4.625**

7.3 Installation location of major equipment: PV, Inverter, and Battery

Solar PV (Shutter Rooftop at Gynae Block)

Inverter and Battery (Hall Corridor near the Main DB in Gynae Block)

7.5 Software Simulation Report of Gynae and Labour Room:

HelioScope

Annual Production Report produced by Engr. Rizwan Kamal

Gynae DHQ Shangla, 34.920254500072, 72.63255444722893

Report

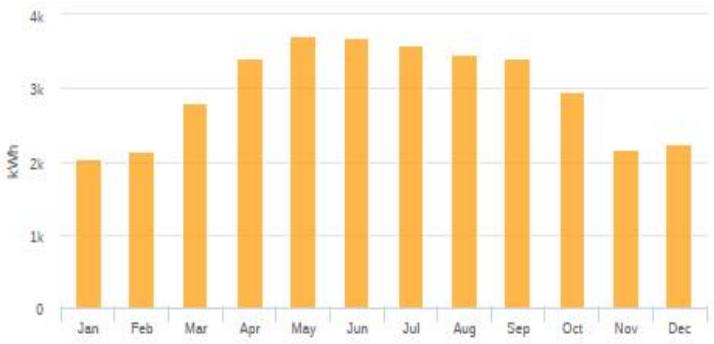
Project Name	DHQ Shangla
Project Address	34.920254500072, 72.63255444722893
Prepared By	Project Manager Engr. Rizwan Kamal

System Metrics

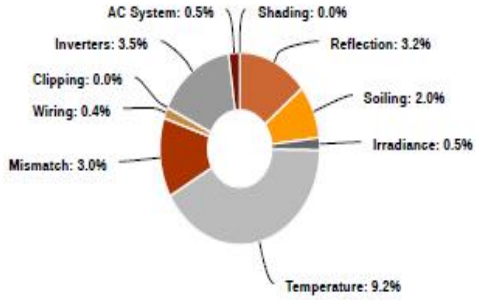
Design	Gynae
Module DC Nameplate	23.8 kW
Inverter AC Nameplate	30.0 kW Load Ratio: 0.79
Annual Production	35.67 MWh
Performance Ratio	79.5%
kWh/kWp	1,500.1
Weather Dataset	TMY, 10km Grid, Meteonorm 8 (meteonorm_v8)
Simulator Version	3097d51578-e23caf56b1-8d54507a91-e6f1079e7f

Project Location

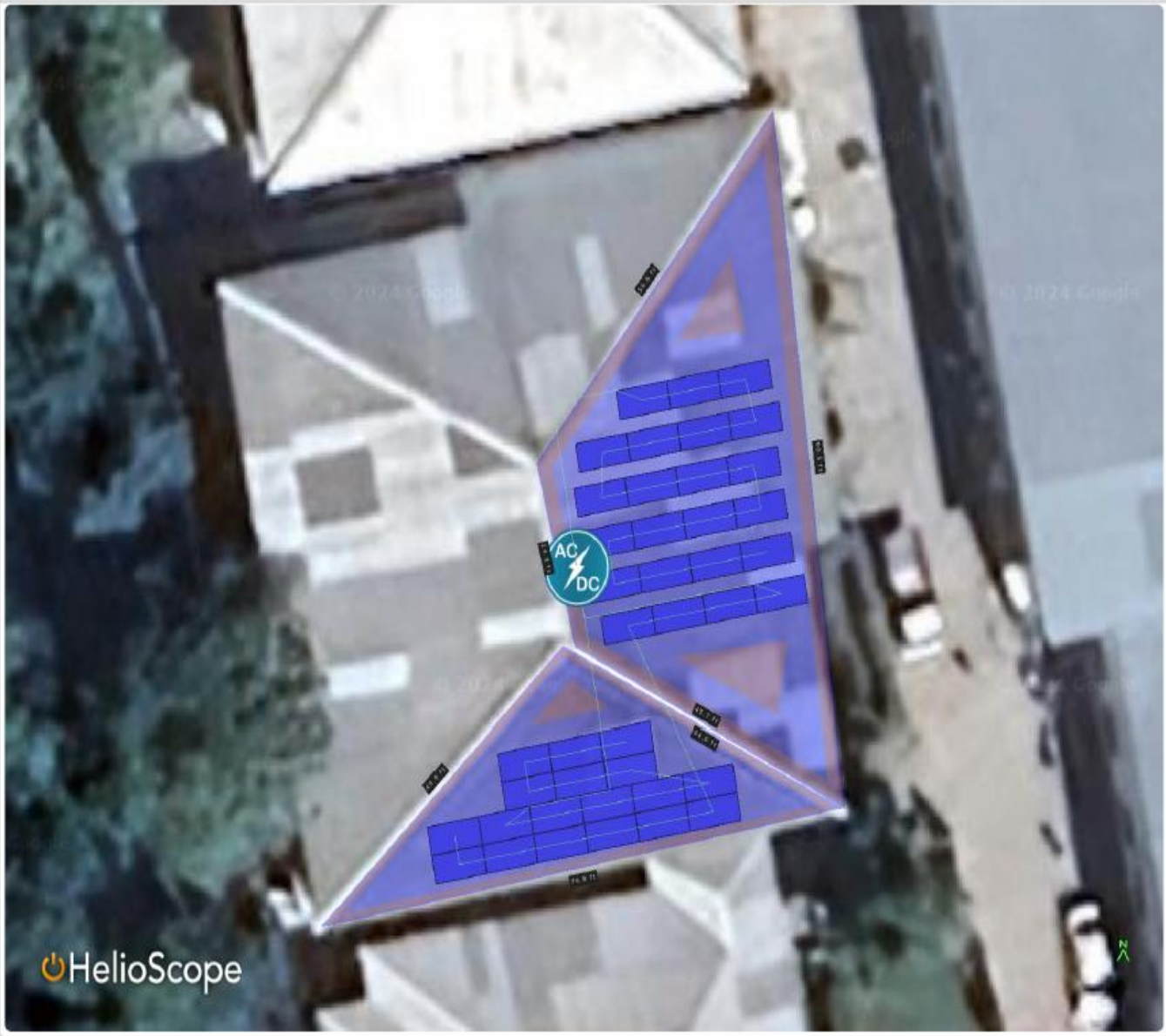
Monthly Production



Sources of System Loss

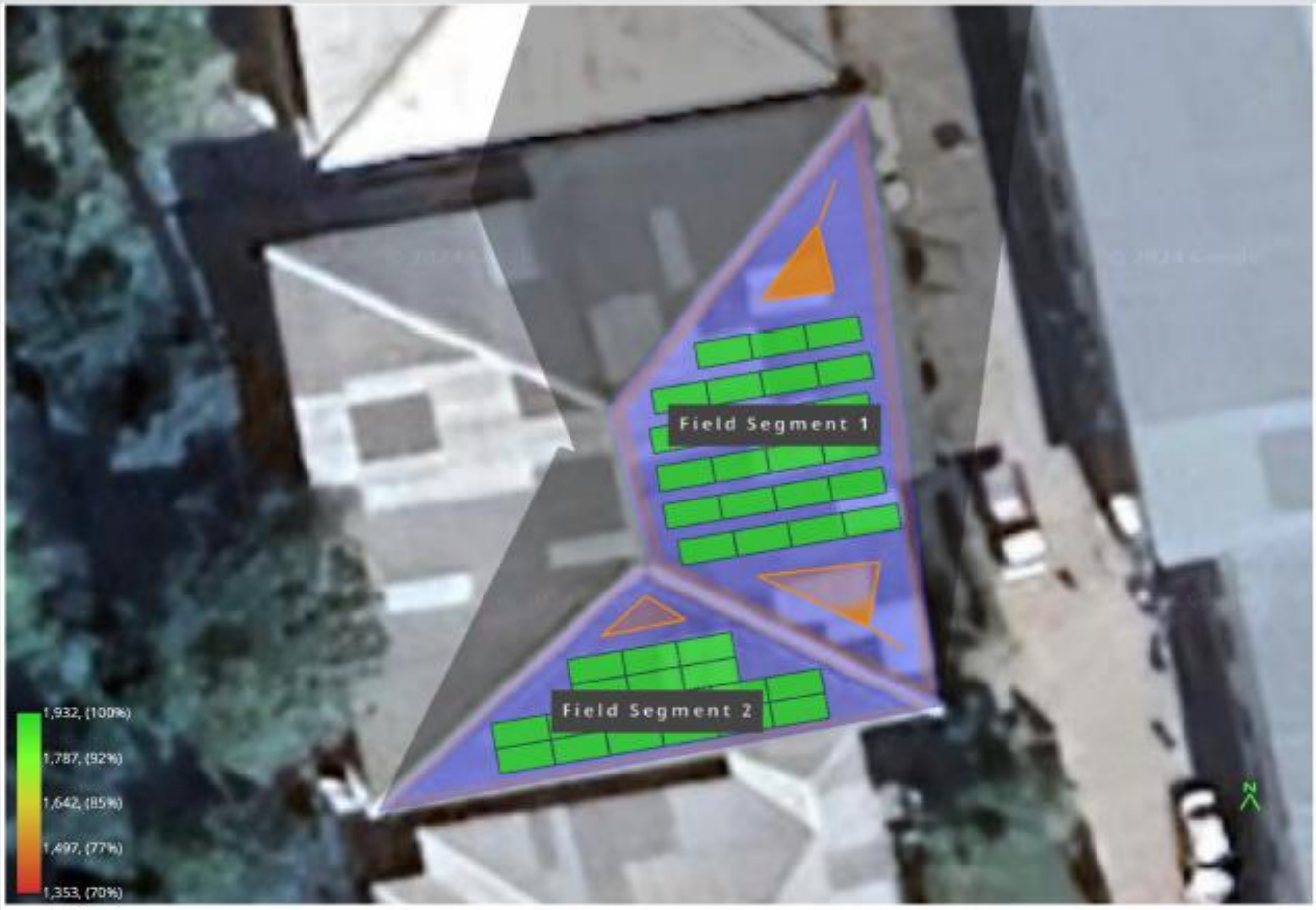


Detailed Layout2



Gynae DHQ Shangla, 34.920254500072, 72.63255444722893

Shading Heatmap



Shading by Field Segment

Description	Tilt	Azimuth	Modules	Nameplate	Shaded Irradiance	AC Energy	TOF[2]	Solar Access	Avg TSRF[2]
Field Segment 1	18.0°	170.0°	23	13.3 kWp	1,885.9kWh/m²	20.0 MWh[1]	97.6%	100.0%	97.6%
Field Segment 2	18.0°	170.0°	18	10.4 kWp	1,885.9kWh/m²	15.7 MWh[1]	97.6%	100.0%	97.6%
Totals, weighted by kWp			**41**	**23.8 kWp**	**1,885.9kWh/m²**	**35.7 MWh**	**97.6%**	**100.0%**	**97.6%**

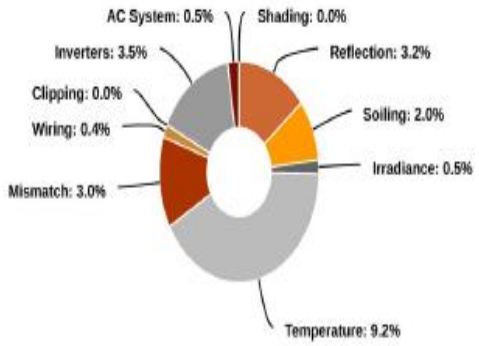
[1] approximate, varies based on inverter performance
[2] based on location Optimal POA Irradiance of 1,932.2kWh/m² at 31.2° tilt and 180.7° azimuth

Solar Access by Month

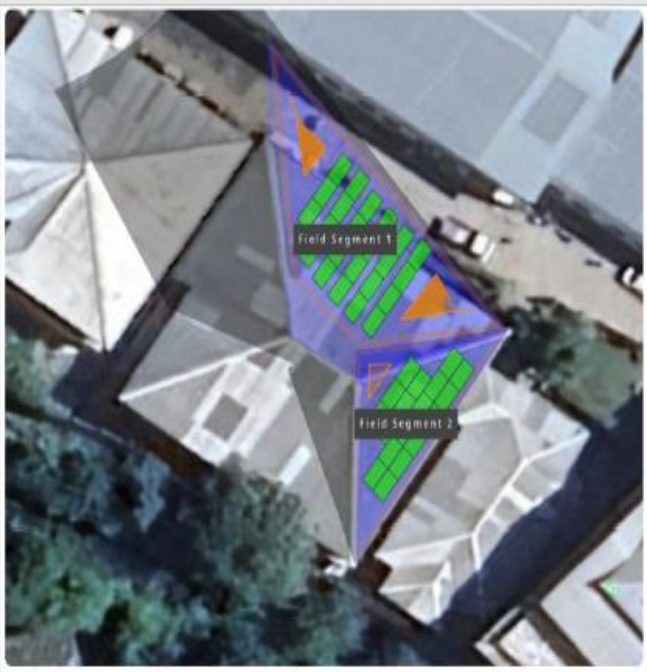
Description	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
Field Segment 1	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Field Segment 2	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Solar Access, weighted by kWp	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
AC Power (kWh)	**2,038.4**	**2,151.4**	**2,808.1**	**3,412.0**	**3,733.0**	**3,683.8**	**3,588.7**	**3,482.0**	**3,405.5**	**2,951.5**	**2,174.8**	**2,243.1**

Monthly Production

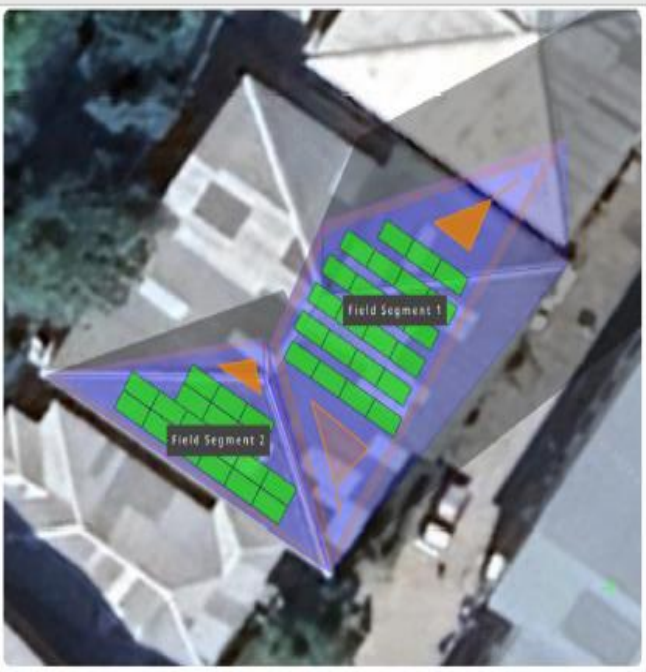
Sources of System Loss



Southwestern Angle



Southeastern Angle



8. X-Ray Building:

8.1 Segregated Load Details of X-Ray Building:

Load at at X-Ray Building						
S.No	**Appliances Name**	**Grid Connected Load**			**Non-Critical/ Solar Connected Load**	**Critical/ Battery Connected Load**
		Watt per App	**Quantity**	**Total Load**		
1	No. of Fans	80	25	2,000	2,000	2,000
2	No. of LED Lights	15	70	1,050	1,050	1,050
3	PCs	500	2	1,000	1,000	1,000
4	Small Printer	500	2	1,000	1,000	
5	X-Ray Machine	75000	1	75,000		
6	Cassete Reader	1000	1	1,000	1,000	1,000
7	Ultra Sound Printer	700	1	700	700	
8	Chest X-Ray TV	4500	1	4,500	4,500	500
	Total Load in Watts			86,250	11,250	5,050
	Total Load in Kilo Watts			**86.250**	**11.25**	**5.05**

8.3 Installation location of major equipment: PV, Inverter, and Battery

Solar PV (Shutter Rooftop at X-Ray Building)

Inverter and Battery (Hall Corridor near DB of X-Ray Building)

8.5 Software Simulation Report of X-Ray Building:

HelioScope

Annual Production Report produced by Project Engineer

X Ray Department DHQ Shangla, 34.920254500072, 72.63255444722893

Report

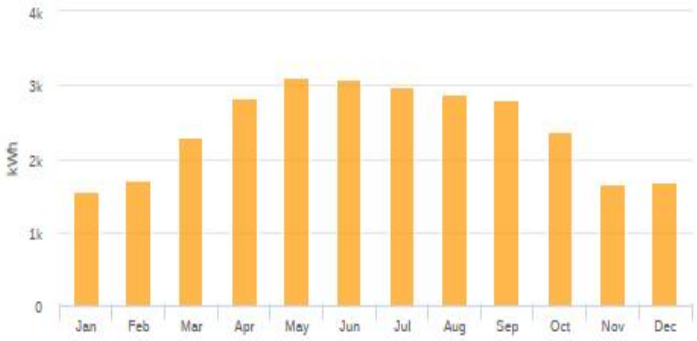
Project Name	DHQ Shangla
Project Address	34.920254500072, 72.63255444722893
Prepared By	Project Engineer rkrizwan892@gmail.com

System Metrics

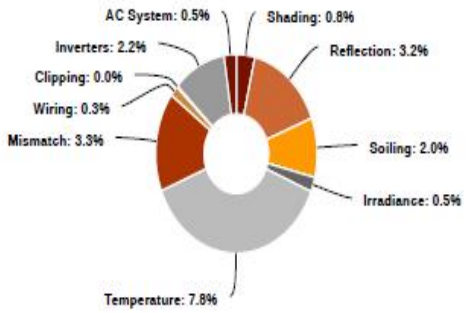
Design	X Ray Department
Module DC Nameplate	19.1 kW
Inverter AC Nameplate	25.0 kW Load Ratio: 0.77
Annual Production	28.98 MWh
Performance Ratio	81.0%
kWh/kWp	1,513.9
Weather Dataset	TMY, 10km Grid, Meteonorm 8 (meteonorm_v8)
Simulator Version	3097d51578-e23caf56b1-8d54507a91-e6f1079e7f

Project Location

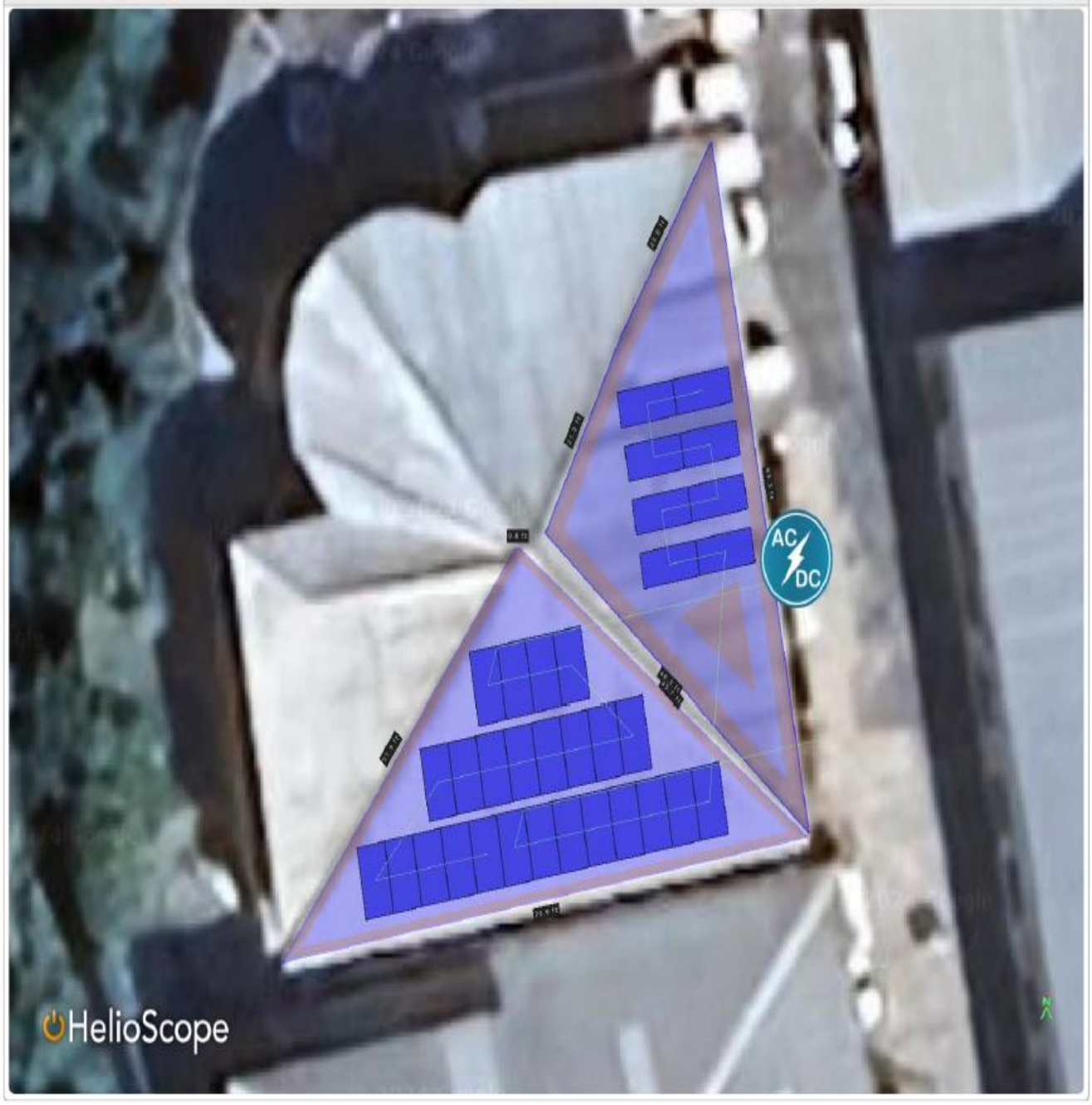
Monthly Production



Sources of System Loss

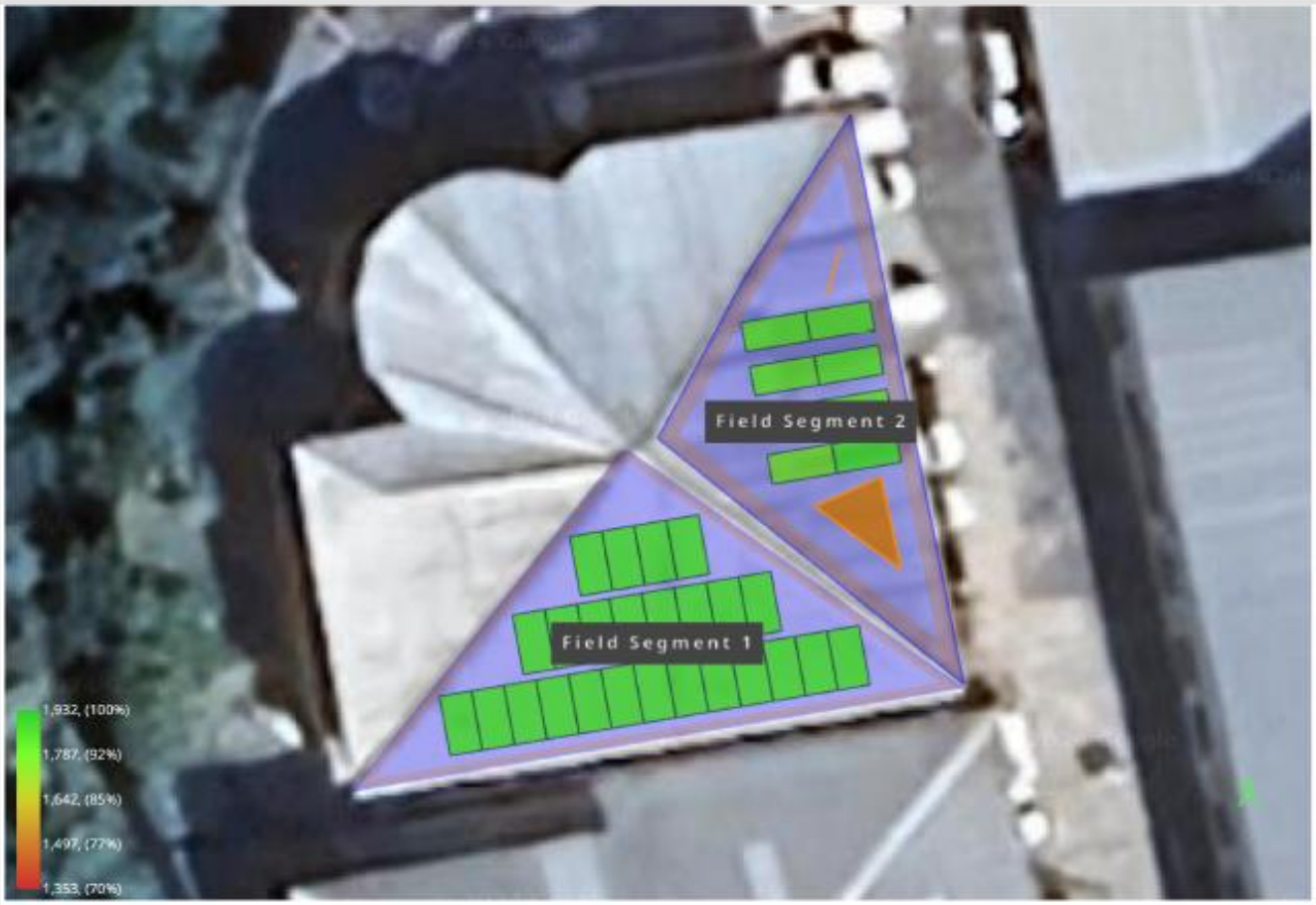


Detailed Layout2



X Ray Department DHQ Shangla, 34.920254500072, 72.63255444722893

Shading Heatmap



Shading by Field Segment

Description	Tilt	Azimuth	Modules	Nameplate	Shaded Irradiance	AC Energy	TOF[2]	Solar Access	Avg TSRF[2]
Field Segment 1	15.0°	170.0°	25	14.5 kWp	1,864.9kWh/m²	21.8 MWh[1]	96.5%	100.0%	96.5%
Field Segment 2	Module: 18.0°	Module: 170.0°	8	4.64 kWp	1,827.1kWh/m²	7.18 MWh[1]	97.6%	96.9%	94.6%
Totals, weighted by kWp			33	19.1 kWp	1,855.7kWh/m²	29.0 MWh	96.8%	99.2%	96.0%

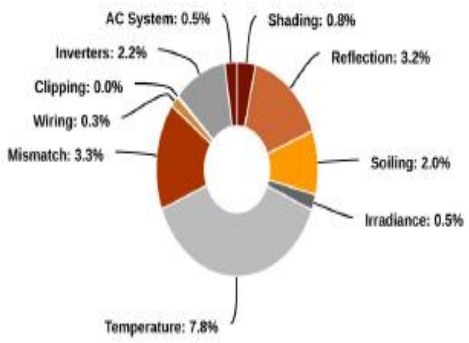
[1] approximate, varies based on inverter performance
[2] based on location Optimal POA Irradiance of 1,932.2kWh/m² at 31.2° tilt and 180.7° azimuth

Solar Access by Month

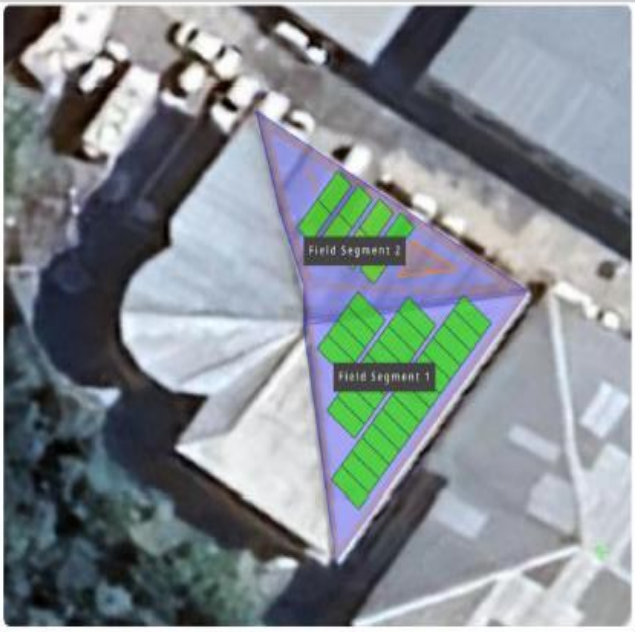
Description	jan	feb	mar	apr	may	jun	jul	aug	sep	oct	nov	dec
Field Segment 1	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Field Segment 2	91%	96%	98%	99%	99%	99%	98%	99%	99%	97%	93%	88%
Solar Access, weighted by kWp	**97.7%**	**98.9%**	**99.5%**	**99.7%**	**99.7%**	**99.7%**	**99.6%**	**99.6%**	**99.7%**	**99.4%**	**98.2%**	**97.1%**
AC Power (kWh)	1,551.5	1,706.1	2,286.4	2,820.3	3,113.0	3,085.3	2,993.9	2,890.0	2,802.4	2,379.8	1,662.1	1,685.7

Monthly Production

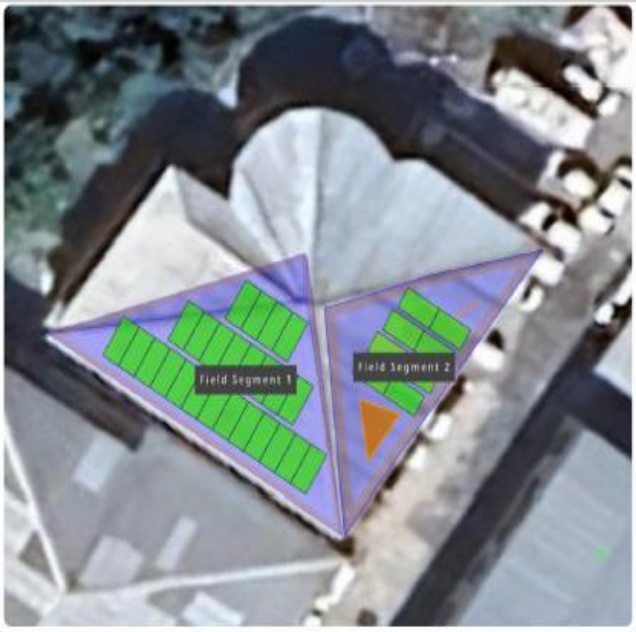
Sources of System Loss



Southwestern Angle



Southeastern Angle



9. Site Layout:

Facility Layout / Sketch