AUTOMOTIVE INDUSTRY DEVELOPMENT CENTRE, AUTOMOTIVE SUPPLIER PARK, ROSSLYN

SOLAR PV TECHNICAL ANALYSIS

Rev 0 – 17 APRIL 2024

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1. ABBREVIATIONS

Abbreviation	Description
A	Amperes
AC	Alternating Current
AIDC	Automotive Industry Development Centre
BESS	Battery Energy Storage System
DB	Distribution Board
DC	Direct Current
ECSA	Engineering Council of South Africa
HV	High Voltage
JB	Junction Box
kA	Kilo Amps
kVA	Kilo Volt-Ampere
kW	Kilowatt
LV	Low Voltage
MV	Medium Voltage
MW	Megawatt
MWp	Megawatt Peak
NMD	Notified Maximum Demand
PV	Photovoltaic
PVGIS	Photovoltaic Geographical Information System
SSEG	Small Scale Embedded Generator
UPS	Uninterruptable Power Supply
VA	Volt-Ampere
V	Volts
W	Watts

2. EXECUTIVE SUMMARY

Durapi was appointed by GIFA to conduct a technical study of the Solar PV capability of AIDC Rosslyn. This includes a PV Solar study as well as Structural Assessments of the identified buildings and carports.

A total of **16 buildings, 3 carports and a taxi rank** were considered in the assessment. The Structural Assessment findings can be found in the Structural Assessment report. This report focuses on the Solar PV Energy analysis and findings.

Annual Energy consumption data was provided by AIDC, which was the basis for the consumption analysis provided in this report. The AIDC Rosslyn receives power from City of Tshwane, through **4 x 11 kV** incomers.

PVGIS was used for the Solar PV Simulations. The results show the following:

- A total of **17 MWp** can be installed on the identified buildings (assuming new structures for the carports)
- **73,239 kWh** solar energy can be harvested from the identified buildings and carports on an **average day**, during the **sunny hours of the day**.
- This available harvested energy from the simulated PV system is more than double the daytime consumption, even during the highest demand month (August).
- This excess renewable solar energy can be sold back to City of Tshwane, or the excess can be stored in Battery Energy Storage Systems (BESS) for consumption at night.
- If only pure grid tied solar systems are considered (i.e., no backup power), then the available roof space far exceeds the demand.
- If BESS are considered, the available roof space allows for excess day-time energy to be stored for night-time use. The possible maximum daily harvest of 73,239kWh is less than the 24-Hr consumption of high demand months, but more than the lowest demand month. This means that all the harvested energy will be used

during all months, except December, which is the lowest demand month.

- A Grid-tied system is preferable due to the high costs associated with BESS; however further studies can be conducted to determine the feasibility of integrating BESS with the Grid-tied Solar PV system.

3. PROJECT BACKGROUND

The Energy Crisis in South Africa has propelled the nation into a critical juncture, necessitating a profound shift in the approach to power generation. This imperative is underpinned by the stark realization that the prevailing reliance on Eskom's traditional Coal Fired Power Stations is unsustainable, both environmentally and economically. To address this pressing challenge, there is an acute need to diversify the energy portfolio and embrace sustainable alternatives especially with the challenges of load shedding that has been a challenge in the country for many years.

GIFA has therefore partnered with AIDC to obtain the necessary funding to look at alternative power generation at the Automotive Supplier Park, Rosslyn in Gauteng. The alternative solar power energy generation is seen as one of the most viable energy alternatives.

Durapi Consulting has been appointed by GIFA to provide professional services for the solar energy for the AIDC, including generation of a technical report detailing the maximum solar PV potential of AIDC Rosslyn, as well as the Structural Assessment of the identified buildings and carports for solar PV.

4. SITE LOCALITY

The Automotive Industry Development Centre site is situated at 30 Helium Road, Automotive Supplier Park in Rosslyn in Tshwane in the Gauteng Province. The site comprises various facilities operated by various service providers. The figure below shows

the site locality together with the buildings considered for PV:

Figure 1 - AIDC Rosslyn Layout

5. PROJECT ASSESSMENT TEAM

Name	Designation	Entity
Thando Mankune	Electrical Technician	Durapi (Consultant)
Willem Van Schalkwyk	PV Designer	Durapi (Consultant)
Raj Chetty	Electrical Engineer	Durapi (Consultant)
Prenevan Moodley	Electrical Engineer	Durapi (Consultant)
Levashni Naidoo	Project Manager	Durapi (Consultant)
Ezekiel Tlomatsana	Structural Technologist	Durapi (Consultant)
Sadam Lehutjo	Junior Structural Engineer	Durapi (Consultant)

6. SOLAR PV ANALYSIS

This section of the technical report focuses on the following:

- Assessment of the total electrical energy consumption of the AIDC in Rosslyn.
- Assessment of the maximum potential energy harvest that can be achieved with the available space(rooftop and open space).
- Testing the sensibility of such a renewable energy project, comparing consumption and potential solar harvest.

6.1 OVERVIEW

AIDC Total Electrical Consumption:

Table 1 - AIDC Consumption Average Day

Consumption, Average Day (kWh)			
Period	**Night-Time Consumption**	**Day-Time Consumption**	**24-Hr Consumption**
Lowest Month	35 139	20 190	55 328
Highest Month	57 511	32 046	89 557

AIDC Total Solar Harvest:

The outcome of the study is that the average daily Solar energy harvest from the collective of all the AIDC PV Generators is **73 239 kWh**,

The 73,239kWh solar energy can be harvested on an average day, during the **sunny hours** of the day.

From Table 1 above, it can be concluded that this available harvested energy is more than double the daytime consumption, even during the highest demand month (August).

This excess renewable solar energy can be used to be sold back to City of Tshwane, or the excess can be stored in Battery Energy Storage Systems (BESS) for consumption at night.

Pure Grid-Tied SSEG's:

If only pure grid tied solar systems are considered (i.e., no backup power), then the available roof space far exceeds the demand.

Grid-Tied SSEG's with BESS

The available roof space allows for excess day-time energy to be stored for night-time use. The possible maximum daily harvest of 73,239kWh is less than the 24-Hr consumption of high demand months, but more than the lowest demand month. This means that all the harvested energy will be used during all months, except December, the lowest demand month.

NB.: A large capital investment will be required for a BESS to accommodate all the excess daily harvested energy, however further studies can be conducted to determine the feasibility of integrating BESS with the Grid-tied Solar PV system.

6.2 ENERGY DEMAND ANALYSIS

Power demand data from a metering system, indicating 4 Main Incomers, for a period of 12 months was studied. This data was assumed to be the 4 primary substations powering the entire AIDC Rosslyn park.

The data presents 2 measurements per hour, and indicates Active, Reactive and Apparent Power. The Apparent Power of the **4 incomers** over the period was used to calculate energy requirements.

6.2.1 DAILY LOAD PROFILE – 12 MONTHS

The figure below shows the daily load profile of the AIDC Rosslyn Park:

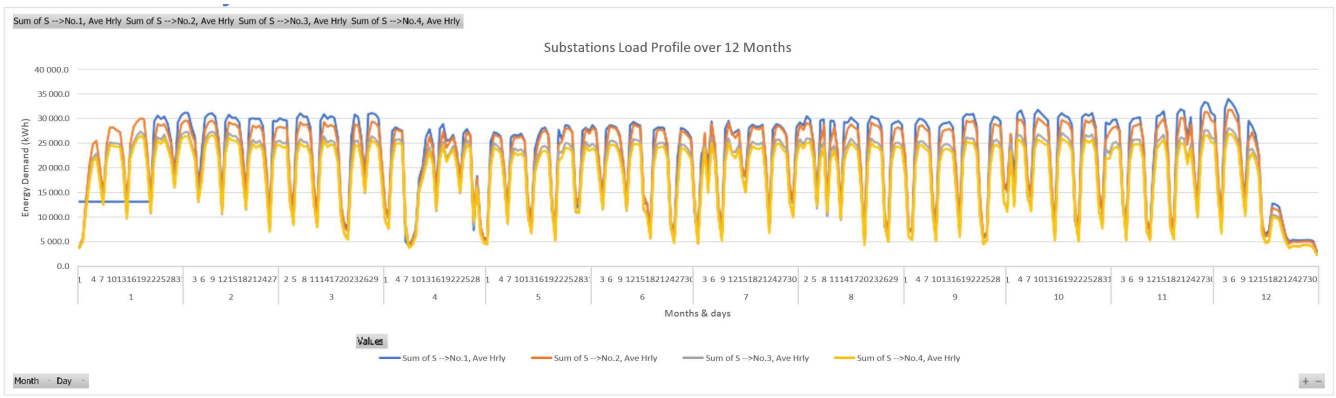


Figure 2 –Daily Load Profile over 12 months

- The horizontal X-Axis sub-divisions indicates days of the month, January to December.
- The vertical Y-Axis indicates energy demand per day, of the 4 incomers.
- The cyclical pattern that can be seen, is the days of the week.

6.2.2 WEEKLY LOAD PROFILE – DAYS OF THE WEEK

The figure below shows the Days of the Week load profile of the AIDC Rosslyn Park,

where Day 1 is Monday, and Day 7 is Sunday:

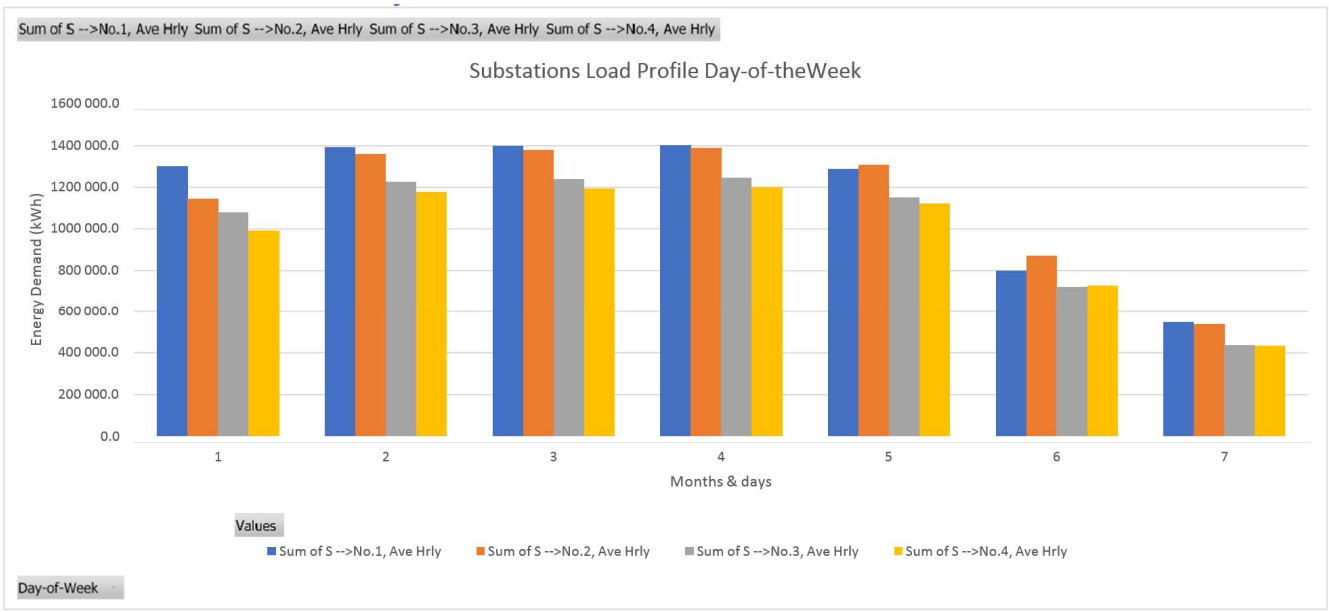


Figure 3 – Weekly Load Profile (Days of the week)

6.2.3 MONTHLY LOAD PROFILE

The Table below shows the monthly load profile of the AIDC Rosslyn Park:

Table 2 - Monthly Load Profile over 12 Months

Row Labels	Sum of S -->No.1, Ave Hrly	Sum of S -->No.2, Ave Hrly	Sum of S -->No.3, Ave Hrly	Sum of S -->No.4, Ave Hrly	
1	541 301.6	714 123.5	641 371.1	620 692.7	kWh
2	737 162.8	698 065.4	628 726.6	608 082.7	kWh
3	771 665.7	727 532.9	637 464.5	616 661.4	kWh
4	580 873.5	564 576.9	513 948.6	498 723.5	kWh
5	689 758.0	674 518.2	605 082.5	582 069.6	kWh
6	690 051.4	675 211.4	604 025.3	583 503.9	kWh
7	698 320.3	686 031.9	609 757.0	587 849.7	kWh
8	766 701.3	732 276.8	649 985.6	627 298.4	kWh
9	680 917.8	650 616.3	566 456.6	546 122.1	kWh
10	762 913.9	722 622.0	637 827.6	611 280.0	kWh
11	736 343.9	698 206.8	614 572.3	590 319.1	kWh
12	477 531.0	451 392.7	390 907.7	376 226.6	kWh
Grand Total	**8 133 541.2**	**7 995 174.7**	**7 100 125.4**	**6 848 829.6**	kWh

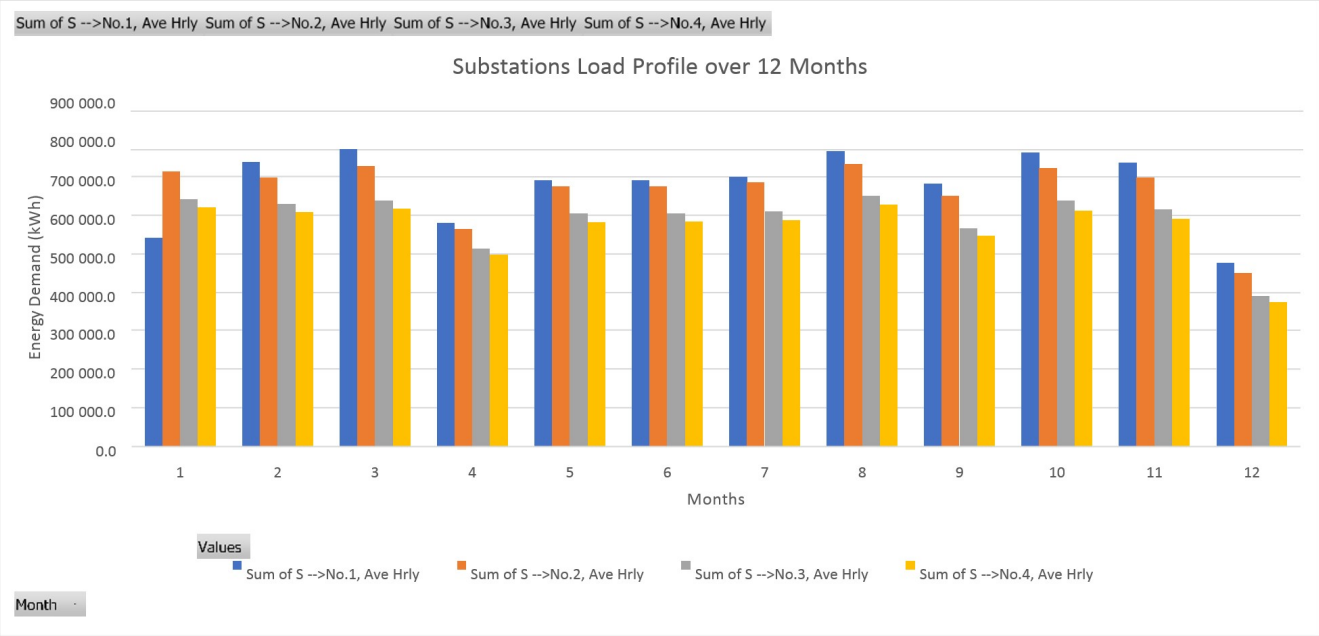


Figure 4 – Monthly Load Profile over 12 Months

The Table below shows the demand for the highest consumption month, i.e., August, for all 4 incomers:

Table 3 –Highest Monthly Demand (Days - August)

Row Labels	Sum of S -->No.1, Ave Hrly	Sum of S -->No.2, Ave Hrly	Sum of S -->No.3, Ave Hrly	Sum of S -->No.4, Ave Hrly	
1	29 215.5	28 677.2	25 820.1	24 868.5	kWh
2	28 561.3	27 638.3	24 688.1	23 890.5	kWh
3	30 480.2	29 064.0	25 966.7	24 976.8	kWh
4	29 720.9	28 758.2	25 889.9	25 183.4	kWh
5	25 019.0	24 554.9	22 072.3	21 656.0	kWh
6	12 386.0	13 798.9	11 690.8	12 294.9	kWh
7	29 595.4	25 027.3	23 848.8	21 678.2	kWh
8	29 821.5	28 629.2	25 132.3	24 270.9	kWh
9	10 252.4	12 686.1	10 390.5	11 053.3	kWh
10	29 587.7	25 075.1	23 212.1	21 294.5	kWh
11	29 420.4	28 128.4	24 511.4	23 594.1	kWh
12	23 521.4	23 811.0	20 596.8	20 391.0	kWh
13	9 934.2	11 051.5	9 355.8	9 631.7	kWh
14	29 243.6	24 732.9	23 203.4	21 253.1	kWh
15	29 124.2	27 836.5	24 601.6	23 688.5	kWh
16	30 216.7	28 811.0	25 876.5	24 918.7	kWh
17	29 542.6	28 221.9	25 086.1	24 270.2	kWh
18	28 948.1	27 625.5	24 365.1	23 464.2	kWh
19	16 978.0	19 481.7	15 372.1	16 026.4	kWh
20	6 324.2	5 578.0	4 379.5	4 271.8	kWh
21	28 934.0	24 429.3	22 914.4	20 783.9	kWh
22	30 445.6	29 205.6	25 934.6	25 089.2	kWh
23	30 065.1	28 612.8	25 196.1	24 220.4	kWh
24	29 922.7	28 480.3	25 039.5	24 191.1	kWh
25	28 295.5	27 397.4	24 025.4	23 236.1	kWh
26	8 096.6	10 748.5	7 972.0	8 891.0	kWh
27	6 863.7	6 255.5	5 061.8	4 912.8	kWh
28	28 806.3	24 348.1	23 153.3	21 082.9	kWh
29	29 185.9	27 872.8	24 986.0	24 127.5	kWh
30	29 456.8	28 227.1	25 116.0	24 282.6	kWh
31	28 735.8	27 511.8	24 526.7	23 804.2	kWh
Grand Total	**766 701.3**	**732 276.8**	**649 985.6**	**627 298.4**	kWh

The Figure below illustrates the demand for the highest consumption month, i.e., August, for all 4 incomers:

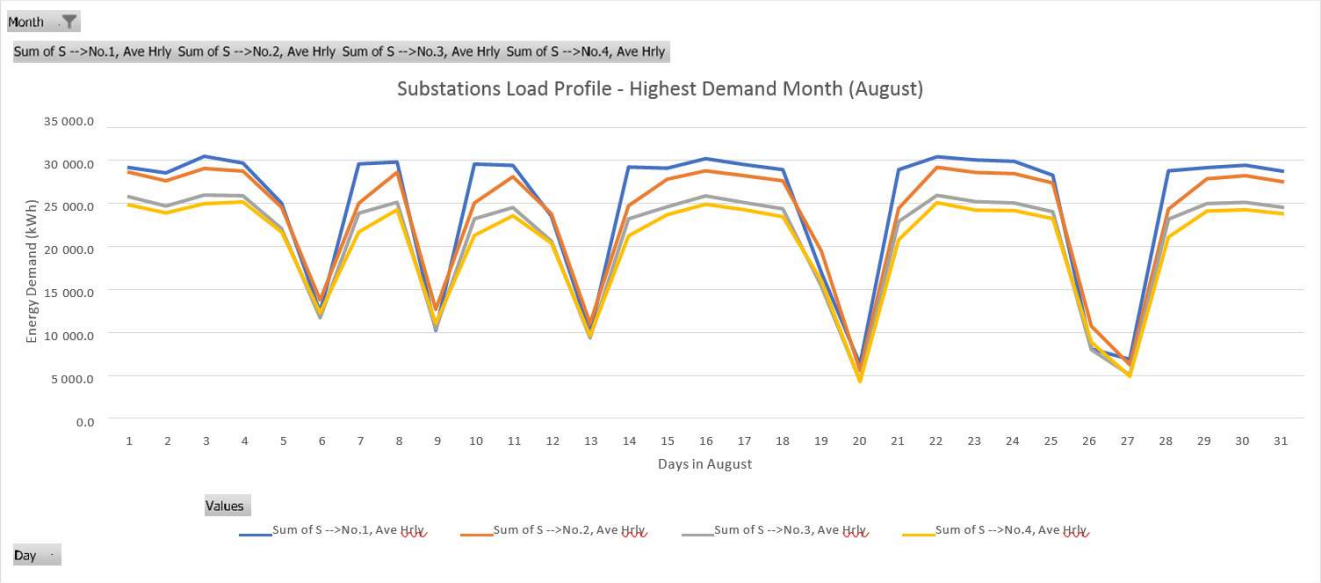


Figure 5 - Highest Demand Month (August)

The Figures below illustrates the demand for the lowest consumption month, i.e., December, for all 4 incomers:

Table 4 - Lowest Demand Month (December)

Row Labels	Sum of S -->No.1, Ave Hrly	Sum of S -->No.2, Ave Hrly	Sum of S -->No.3, Ave Hrly	Sum of S -->No.4, Ave Hrly
1	30 637.5	29 185.2	25 716.6	24 799.3
2	16 173.8	18 410.4	14 194.0	14 750.6
3	10 162.1	8 426.8	7 216.3	6 640.1
4	32 015.3	27 368.2	25 162.4	23 135.3
5	33 931.0	31 748.8	28 030.5	26 767.5
6	33 183.7	31 714.6	27 724.4	26 782.7
7	32 130.4	30 389.8	26 885.4	25 833.6
8	30 461.6	28 847.1	25 030.8	24 002.8
9	18 098.2	20 217.4	16 381.0	16 801.7
10	14 438.9	12 441.5	10 918.8	10 180.2
11	29 547.6	25 459.4	23 427.3	21 329.1
12	28 447.1	27 212.0	23 874.7	23 014.3
13	26 824.5	25 168.6	22 554.3	21 519.4
14	22 712.4	22 312.0	18 993.2	18 544.9
15	7 324.2	8 791.6	6 433.6	6 901.5
16	6 471.7	6 030.9	4 863.9	4 682.2
17	7 280.6	6 467.6	5 202.8	4 956.8
18	12 769.8	11 873.7	10 390.5	9 938.4
19	12 545.2	11 577.1	10 335.8	9 848.2
20	12 047.4	11 202.2	9 869.4	9 452.5
21	8 935.2	8 529.9	6 976.8	6 764.5
22	6 109.3	5 753.1	4 980.9	4 842.1
23	5 018.6	4 633.3	3 810.6	3 690.5
24	5 402.7	5 008.6	4 219.4	4 092.6
25	5 319.5	4 914.4	4 136.6	4 019.7
26	5 270.2	4 905.9	4 103.5	3 986.8
27	5 313.1	5 022.3	4 382.7	4 275.7
28	5 356.8	5 064.4	4 416.0	4 281.1
29	5 345.9	5 018.9	4 316.2	4 222.4
30	5 121.5	4 740.3	3 930.1	3 801.4
31	3 135.2	2 956.6	2 429.2	2 368.6
Grand Total	**477 531.0**	**451 392.7**	**390 907.7**	**376 226.6**

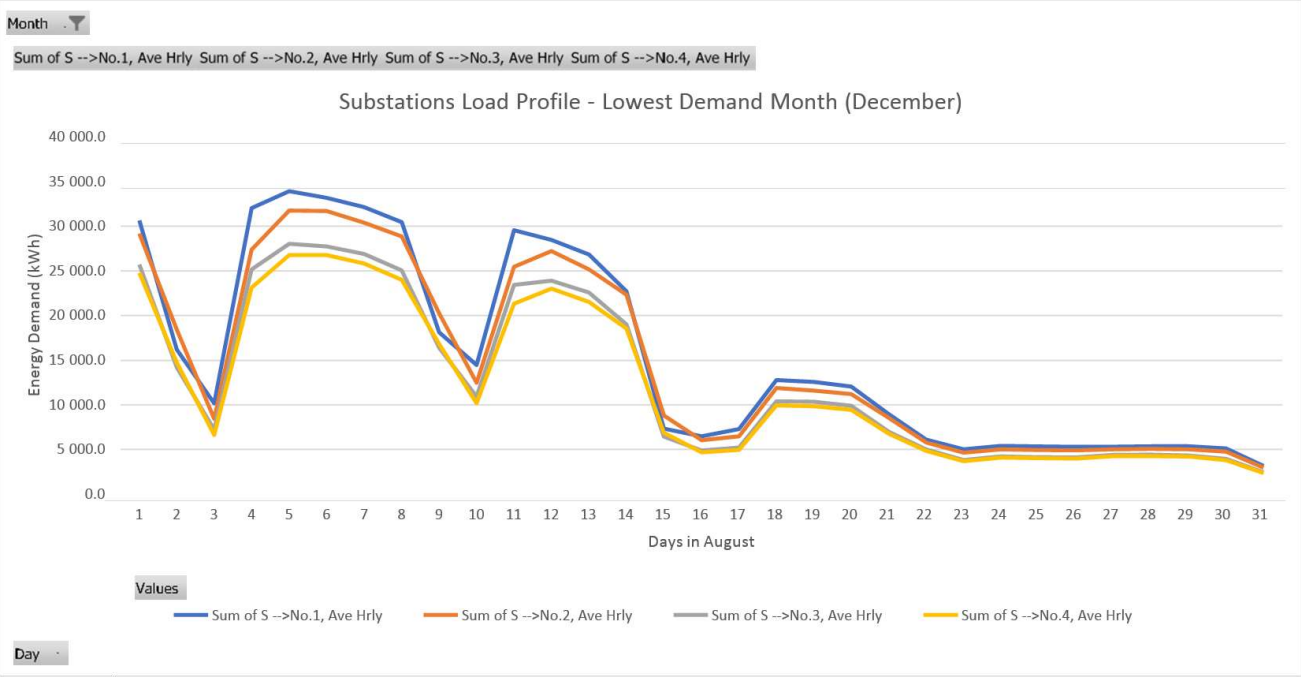


Figure 6 - Lowest Demand Month (December)

6.2.4 DAILY LOAD PROFILE – HIGHEST DEMAND MONTH

The figures below show the load profiles during the highest demand Month (August):

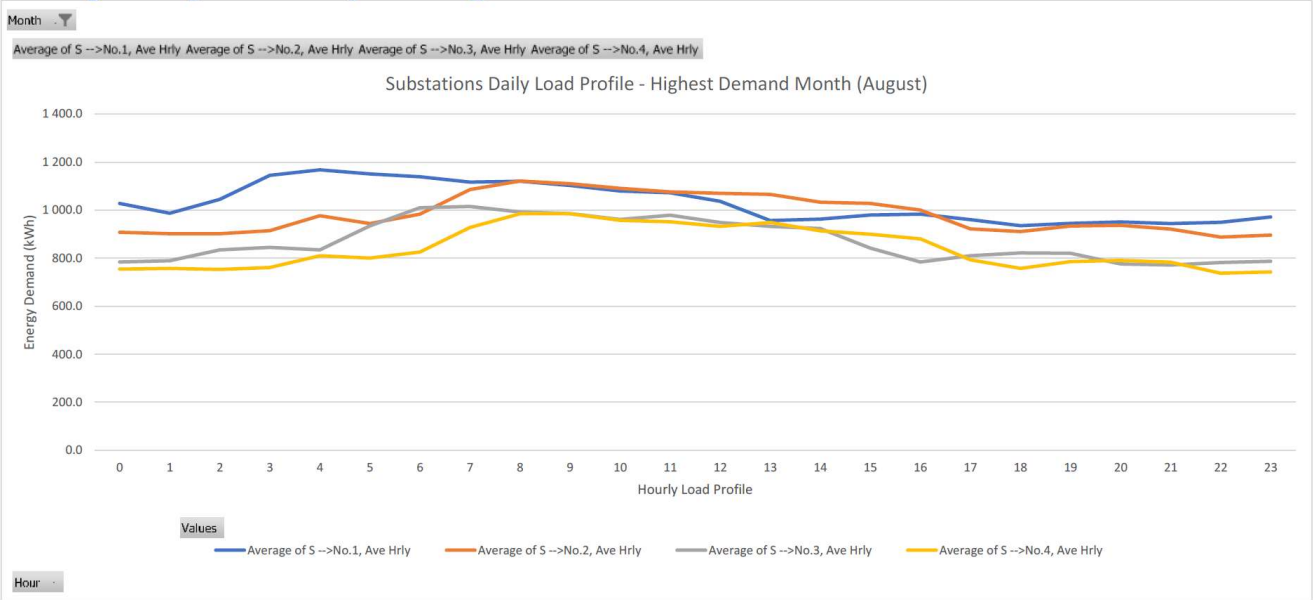


Figure 7 – Average Daily Load Profile Highest Demand Month (August)

Table 5 - Average Energy Demand Per Hour (August)

Row Labels	Average of S -->No.1, Ave Hrly	Average of S -->No.2, Ave Hrly	Average of S -->No.3, Ave Hrly	Average of S -->No.4, Ave Hrly
0	1 028.2	907.7	784.4	754.9 kWh
1	987.1	901.9	789.1	757.3 kWh
2	1 045.3	902.2	834.5	752.9 kWh
3	1 145.0	914.5	845.3	761.1 kWh
4	1 167.9	977.1	834.4	810.3 kWh
5	1 151.1	944.5	934.4	800.7 kWh
6	1 139.0	983.3	1 010.2	826.0 kWh
7	1 116.6	1 085.9	1 015.5	928.0 kWh
8	1 120.7	1 121.5	992.6	984.9 kWh
9	1 102.6	1 110.2	985.8	984.6 kWh
10	1 079.8	1 091.2	961.3	957.8 kWh
11	1 072.3	1 075.9	979.2	951.3 kWh
12	1 036.5	1 069.9	948.8	932.0 kWh
13	956.9	1 065.6	932.2	948.7 kWh
14	962.5	1 033.3	923.5	913.8 kWh
15	980.2	1 028.2	842.1	899.5 kWh
16	983.5	1 000.7	784.4	880.4 kWh
17	960.4	922.2	810.4	792.8 kWh
18	935.7	910.7	821.8	757.7 kWh
19	945.0	933.9	820.3	785.3 kWh
20	950.8	936.5	776.3	791.0 kWh
21	944.4	921.3	771.8	783.6 kWh
22	949.2	887.7	781.7	737.9 kWh
23	971.3	896.1	787.2	742.9 kWh
Grand Total	**1 030.5**	**984.2**	**873.6**	**843.1** kWh

Table 6 - Average Energy Demand per Day/Night (August)

	SS1	SS2	SS3	SS4	Total	
Pre-Dawn (00h00 to 08h00)	8 780.3	7 617.1	7 047.7	6 391.3	***29 836.4***	kWh
Post Dusk (16h00 to 24h00)	7 640.4	7 409.0	6 354.0	6 271.5	***27 674.9***	kWh
Night-Time	**16 420.7**	**15 026.0**	**13 401.7**	**12 662.8**	***57 511.2***	kWh
Day-Time (08h00 to 16h00)	**8 311.6**	**8 595.8**	**7 565.6**	**7 572.7**	***32 045.6***	kWh
24-Hrs	**24 732.3**	**23 621.8**	**20 967.3**	**20 235.4**	***89 556.8***	kWh

6.2.5 DAILY LOAD PROFILE – LOWEST DEMAND MONTH

The figures below show the load profiles during the lowest demand Month (December):

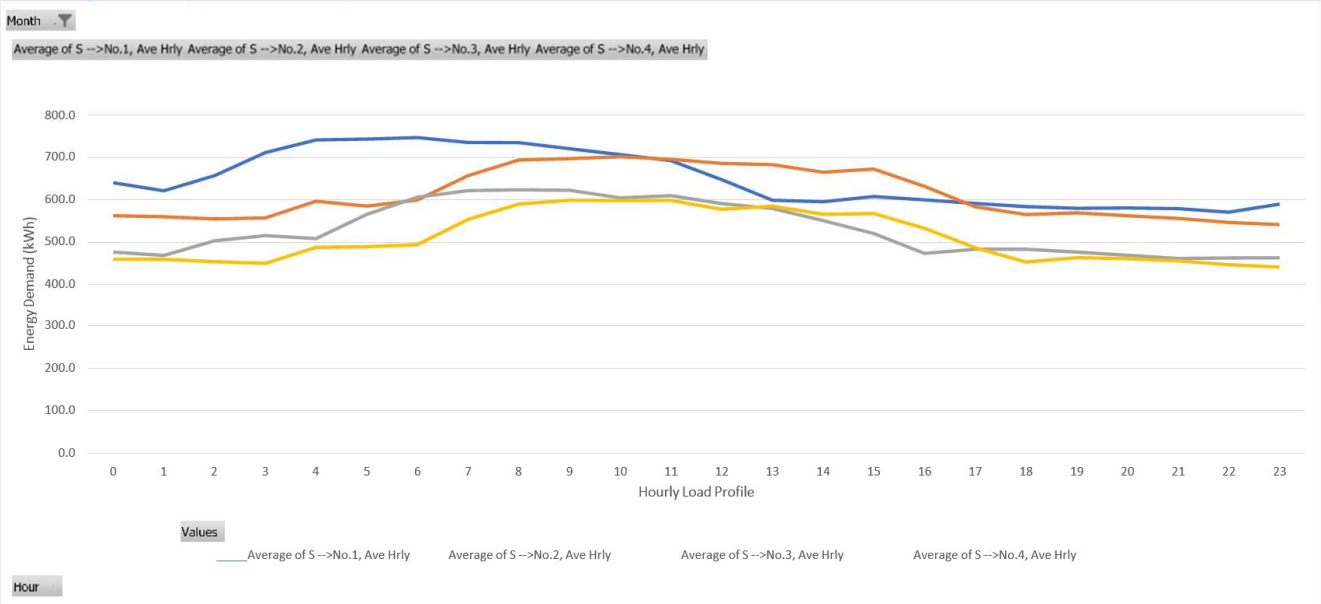


Figure 8 - Average Daily Load Profile Lowest Month (December)

Table 7 - Average Energy Demand per hour - December

Row Labels	Average of S -->No.1, Ave Hrly	Average of S -->No.2, Ave Hrly	Average of S -->No.3, Ave Hrly	Average of S -->No.4, Ave Hrly	
0	640.1	562.8	477.0	459.8	kWh
1	621.2	560.2	468.8	459.4	kWh
2	656.9	555.1	503.7	454.2	kWh
3	711.5	557.4	516.1	450.3	kWh
4	741.1	596.8	508.7	488.0	kWh
5	743.2	585.2	565.8	489.5	kWh
6	747.1	599.9	606.4	494.2	kWh
7	735.1	657.3	622.3	553.9	kWh
8	734.9	694.3	623.8	590.0	kWh
9	720.7	697.7	622.7	599.4	kWh
10	706.9	701.9	604.9	598.6	kWh
11	692.2	695.9	610.0	598.9	kWh
12	647.5	686.5	591.2	577.7	kWh
13	598.9	682.9	579.8	585.1	kWh
14	595.4	665.1	551.1	566.2	kWh
15	607.8	673.0	520.6	568.1	kWh
16	599.8	631.7	473.7	532.6	kWh
17	591.3	583.4	483.8	487.2	kWh
18	583.6	565.3	483.5	453.2	kWh
19	579.9	569.7	477.1	463.7	kWh
20	580.6	562.6	469.5	461.3	kWh
21	579.0	556.6	461.8	456.1	kWh
22	570.4	546.8	463.1	446.8	kWh
23	589.3	541.8	463.2	441.2	kWh
Grand Total	**649.7**	**614.1**	**531.8**	**511.9**	kWh

Table 8 - Average Energy Demand per Day/Night Lowest Month (December)

	SS1	SS2	SS3	SS4	Total	
Pre-Dawn (00h00 to 08h00)	5 596.2	4 674.6	4 268.8	3 849.2	***18 388.8***	kWh
Post Dusk (16h00 to 24h00)	4 674.0	4 558.0	3 775.7	3 742.1	***16 749.8***	kWh
Night-Time	**10 270.2**	**9 232.6**	**8 044.5**	**7 591.4**	***35 138.6***	kWh
Day-Time (08h00 to 16h00)	**5 304.4**	**5 497.2**	**4 704.0**	**4 684.0**	***20 189.7***	kWh
24-Hrs	**15 574.6**	**14 729.8**	**12 748.5**	**12 275.4**	***55 328.3***	kWh

6.3 SOLAR PV HARVEST ANALYSIS

6.3.1 SOLAR PV MODULE INSTALLATION CONSIDERATIONS

BUILDING STRUCTURAL CONSIDERATIONS:

During the simulations, all available areas (unobstructed) of the roofs were considered. It is common for large and extra-large roof spans to require some bracing or additional support to carry the additional weight of densely packed solar PV panels, however this will be detailed in the Structural Assessment section of the study.

For all Carports, it was assumed that new structures will be built to accommodate solar panels.

PANEL SLOPE AND AZIMUTH:

The objective with mounting solar modules to large commercial roofs, is to achieve:

- Maximize the annual solar energy yield.
- Minimize the annual maintenance of PV Modules.
- Minimize structural demand on roof and support structures.
- Minimize roof surface penetration/disruption maintaining integrity to prevent water leaks.
- Minimize dynamic wind load impact on individual panels.
- Minimize dynamic wind load impact on the roof as a unit.

To respect all the above, the target compromise installation targets are:

- 10° PV Module slope as the best compromise to minimize dynamic wind loads, maximize PV Generator capacity, roof exploitation, and rain-washing of solar PV Modules.
- Rail-less mounting, using short-rails to minimise weight and roof surface penetration. This necessitates the modules to be installed in landscape orientation perpendicular to roof seams.

6.3.2 PVGIS P50 ENERGY HARVEST PROBABILITY

PROBABILITY LAW

This approach assumes that over several years of operation, the distribution of the annual yields will follow a statistical law, which is assumed to be the Gaussian (or "normal") distribution.

P50/P90 represent different yield levels, for which the probability that the production of a particular year is 50%, or 90% respectively. Considering the many factors and annual variations, to be 90%certain that a particular harvest will be guaranteed, a lower Specific Yield as to be assumed.

The challenge is then to establish the 2 parameters of this Gaussian distribution, i.e., the Mean value and the Standard deviation.

The main contribution to those parameters will be the uncertainty and variability of the meteor data.

P50 DETERMINATION

The PVGIS data used in this report are representative of an average over several years ("Monthly averages" or "TMY, multi-year"), the simulation results should be considered as an average, and generally corresponds to P50 (mean value of the Gaussian).

6.3.3 PV RESULTS PER ROOF

Table 9 - Roof PV Results

Roof	Type	Number Modules (550W)	PV Gen Size (MWp)	Inter row Distances used mm	Slope	Azimuth	Annual SY (kWh/kWp/a)	Daily SY (kWh/kWp/d)	Daily Energy (kWh)	Annual Energy (kWh)
	Warehouse Rooftop	990	0.5445	450	10	-112	1517	4.2	2 263.03	826 006.50
C1		204	0.1122	350	10	-112	1517	4.2	466.32	170 207.40
C2	Warehouse Rooftop	551	0.30305	450	10	-132	1548	4.2	1 285.26	469 121.40
	Warehouse Rooftop	5803	3.19165	350	10	146	1570	4.3	13 728.47	5 010 890.50
C3		1578	0.8679	450	10	146	1570	4.3	3 733.16	1 362 603.00
	Commercial/Workshops	56	0.0308	350	10	171	1584	4.3	133.66	48 787.20
		120	0.066	350	10	171	1584	4.3	286.42	104 544.00
		142	0.0781	350	10	171	1584	4.3	338.93	123 710.40
F1		136	0.0748	350	10	171	1584	4.3	324.61	118 483.20
	Commercial/Workshops	52	0.0286	450	10	-112	1516	4.2	118.79	43 357.60
		24	0.0132	350	15	-112	1519	4.2	54.93	20 050.80
		121	0.06655	350	15	158	1608	4.4	293.18	107 012.40
		120	0.066	350	15	-112	1519	4.2	274.67	100 254.00
F3		50	0.0275	350	15	-112	1519	4.2	114.45	41 772.50
F4		1399	0.76945	450	10	-123	1534	4.2	3 233.80	1 180 336.30
F5	Warehouse Rooftop	1297	0.71335	350	10	-154	1572	4.3	3 072.29	1 121 386.20
P1	Carports	733	0.40315	350	10	158	1650	4.5	1 822.46	665 197.50
P2	Carports	313	0.17215	350	10	160	1651	4.5	778.68	284 219.65
P3	Carports	5470	3.0085	350	10	-134	1620	4.4	13 352.79	4 873 770.00
Taxi-Rank	Carports	547	0.30085	350	10	-137	1623	4.4	1 337.75	488 279.55
	Warehouse Rooftop	1213	0.66715	350	15	-136	1570	4.3	2 869.66	1 047 425.50
		1131	0.62205	450	10	-136	1552	4.3	2 644.99	965 421.60
E4		132	0.0726	350	10	-136	1552	4.3	308.70	112 675.20
	Warehouse Rooftop									
		475	0.26125	450	10	136	1559	4.3	1 115.86	407 288.75
		641	0.35255	350	15	136	1579	4.3	1 525.14	556 676.45
		602	0.3311	450	10	136	1559	4.3	1 414.21	516 184.90
		556	0.3058	350	15	136	1579	4.3	1 322.90	482 858.20
Yanfeng		584	0.3212	450	10	136	1559	4.3	1 371.92	500 750.80
A5	Warehouse Rooftop	562	0.3091	350	15	-125	1549	4.2	1 311.77	478 795.90
A6	Warehouse Rooftop	650	0.3575	450	10	-125	1538	4.2	1 506.40	549 835.00
A7	Warehouse Rooftop	1346	0.7403	350	15	-125	1549	4.2	3 141.71	1 146 724.70
A8	Warehouse Rooftop	758	0.4169	450	10	-125	1538	4.2	1 756.69	641 192.20
	Warehouse Rooftop	600	0.33	450	10	-125	1538	4.2	1 390.52	507 540.00
		144	0.0792	450	10	-125	1538	4.2	333.72	121 809.60
A9		231	0.12705	20	10	-125	1538	4.2	535.35	195 402.90
A10	Commercial/Workshops	722	0.3971	610	10	-125	1538	4.2	1 673.26	610 739.80
A11	Commercial/Workshops	864	0.4752	20	10	-125	1538	4.2	2 002.35	730 857.60
		30 917	**17.0**						**73 238.82**	**26 732 169.20**

The Table above summarizes the PV Generator Capacity, P50 Yield data and likely daily/annual energy harvest.

Amongst the most important information is the data in the column ***"Daily Energy"***, and the aggregate of all the roofs at the bottom of the table.

The total of **73,238.82kWh** is the sum of the energy that the collective of all the roofs can harvest on an average annual day.

A total of **17MWp** can be achieved by installing Solar PV Panels on the 16 buildings, 3 carports, and the taxi rank.

Reference must be made to the detail below of the individual roof PV Module Layout, and the PVGIS data in the attached files.

European Commission

Performance of grid-connected PV

PVGIS-5 estimates of solar electricity generation:

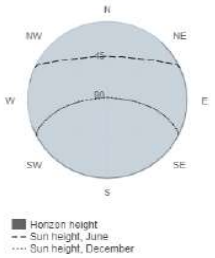
Provided inputs:

Latitude/Longitude:	-25.615,28.076
Horizon:	Calculated
Database used:	PVGIS-SARAH2
PV technology:	Crystalline silicon
PV installed:	1 kWp
System loss:	14 %

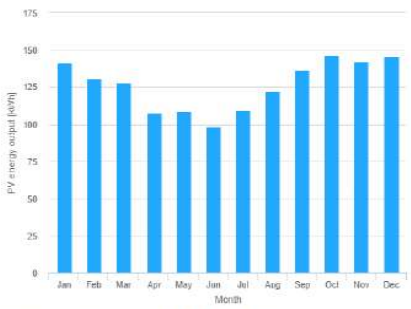
Simulation outputs

Slope angle:	10 °
Azimuth angle:	-112 °
Yearly PV energy production:	1516.89 kWh
Yearly in-plane irradiation:	2088.38 kWh/m²
Year-to-year variability:	38.89 kWh
Changes in output due to:	
Angle of incidence:	-2.95 %
Spectral effects:	0.22 %
Temperature and low irradiance:	-13.17 %
Total loss:	-27.37 %

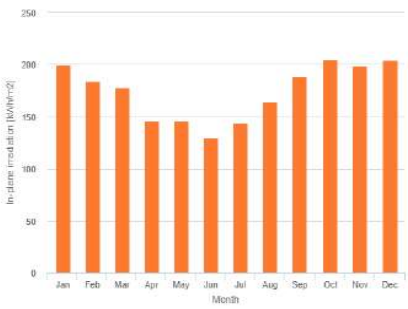
Outline of horizon at chosen location:



Monthly energy output from fix-angle PV system:



Monthly in-plane irradiation for fixed-angle:



Monthly PV energy and solar irradiation

Month	E_m	H(i)_m	SD_m
January	141.2	199.3	16.1
February	130.1	184.0	10.2
March	127.6	177.4	10.9
April	107.7	146.2	10.9
May	109.1	146.3	7.4
June	98.5	130.0	4.3
July	109.4	144.1	3.5
August	122.9	165.3	4.6
September	136.4	188.2	5.7
October	146.4	205.0	8.7
November	141.8	198.6	11.7
December	145.8	204.0	9.0

E_m: Average monthly electricity production from the defined system [kWh].

H(i)_m: Average monthly sum of global irradiation per square meter received by the modules of the given system [kWh/m²].

SD_m: Standard deviation of the monthly electricity production due to year-to-year variation [kWh].

Report generated on 2024/04/06

Figure 9 - Building C1 PVGIS based on 1kWp yield

Figure 10 - Roof C1 – 657.7 kWp

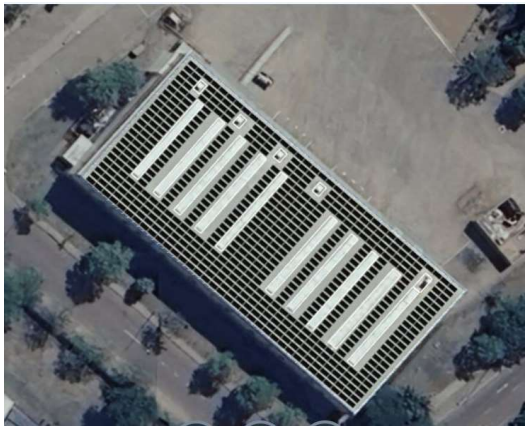


Figure 11 - Roof C2 - 303.05 kWp

Figure 12 - Roof C3 - 4059.6 kWp

Figure 13 - Roof A5 - 309.1 kWp

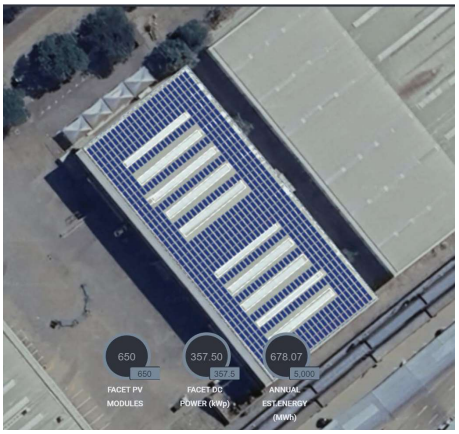


Figure 14 - Roof A6 – 357.5 kWp

Figure 15 - Roof A7 – 750.3 kWp

Figure 16 - Roof A8 – 397.65 kWp

Figure 17 - Roof A9 - 536.25 kWp

Figure 18 - Roof A10 – 501.6 kWp

Figure 19 - Roof A11 – 475.2 kWp

Figure 20 - Roof Yanfeng - 1571.9 kWp

Figure 21 - Roof E4 - 1351 kWp

Figure 22 - Roof F1 – 249.7 kWp

Figure 23 - Roof F3 – 201.85 kWp

Figure 24 - Roof F4 – 769.4 kWp

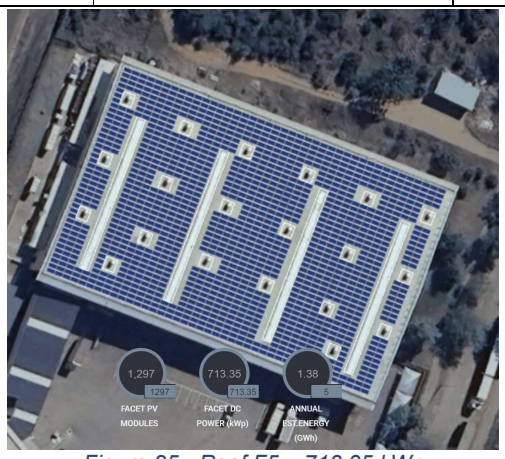


Figure 25 - Roof F5 – 713.35 kWp

Figure 26 - Carport P1 - 403.15 kWp (Assumes New Structure)

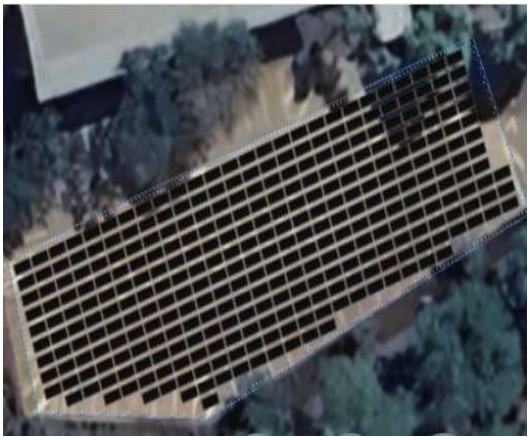


Figure 27 - Carport P2 - 172.15 kWp (Assumes New Structure)

Figure 28 - Carport P3 – 3008.5 kWp (Assumes New Structure)

Figure 29 - Taxi Rank - 300.8 kWp

7. CONCLUSION

Alternative energy solutions are widely supported as they supplement grid energy and provide for the continuity of supply, whilst addressing climate change and sustainability objectives. It is public knowledge that Eskom is seeking support from the private and public sectors to assist in alleviating the current grid constraints in the country.

The PV Study conducted and detailed in this report shows that there is opportunity to benefit from the abundant Solar resources in the country, contributing positively to climate change and supporting the grid during the current Energy crisis.

The AIDC Rosslyn study shows that a total of 17 MWp can be installed on the identified buildings; and that 73,239 kWh of solar energy can be harvested on an average day, during the sunny hours of the day. This available harvested energy from the simulated PV system is more than double the day-time consumption, even during the highest demand month (August). This excess renewable solar energy can be sold back to City of Tshwane, or the excess can be stored in Battery Energy Storage Systems (BESS) for consumption at night.

If only pure grid tied solar systems are considered (i.e., no backup power), then the available roof space far exceeds the demand. If BESS are considered, the available roof space allows for excess day-time energy to be stored for night-time use. The possible maximum daily harvest of 73,239kWh is less than the 24-Hr consumption of high demand months, but more than the lowest demand month. This means that all the harvested energy will be used during all months, except December, which is the lowest demand month.

A Grid-tied system is preferable due to the high costs associated with BESS; however further studies can be conducted to determine the feasibility of integrating BESS with the Grid-tied Solar PV system.