GREEN SOLUTIONS PROVIDER

Indian Green Building Council
Accredited Professional

MEDA Regn. No. : MEDA/ECN/CR-01/2014-15/EA-29

GREEN WATER SOLUTIONS PROVIDER PVT. LTD.

Energy & Water Conservation - Consulting, Studies & Audit,
Digital Intelligent Monitoring Systems & Solutions
Renewable Energy, Training & Awareness

CIN No. – 4999PN2009PTC134874

REPORT ON

ENERGY AUDIT

AT

HuzurpagaMahilaVanijya Mahavidyalaya, Pune

BY

GREEN WATER SOLUTIONS PROVIDER PVT.LTD.

PUNE

March– 2018

Contents

List of Figures

List of Tables

ABBREVIATIONS

APFC	: Automatic Power Factor Control
BD	: Billing Demand
CD	: Contract Demand
CFL	: Compact Fluorescent Lamp
FTL	: Fluorescent Tube Lamp
HT	: High Tension
kVA	: kilo Volt Ampere
kVAr	: kilo Volt Ampere reactive
kW	: kilo Watt
kWp	:kilo Watt peak
kWh	: kilo Watt hour (Unit of Electricity)
LED	: Light Emitting Diode
LT	: Low Tension
PF	: Power Factor
MEDA	: Maharashtra Energy Development Agency
MSEDCL	: Maharashtra State Electricity Distribution Company
Solar PV	: Solar Photo Voltaic

ACKNOWLEDGEMENT

We thank Principal Dr.K.P . Bairagi for assigning Energy Audit opportunity of the institution to us.

And sincerely acknowledges the co-operation extended by staff members of the institution for extending their help throughout the study.

Team: Prashant Shinde Energy Auditor.

Farooque Shaikh. Team Member.

EXECUTIVE SUMMARY

Huzurpaga Mahila Vanijya Mahavidyalaya (HMVM), Pune is having an HT supply. From the analysis of past electricity bills of the college, consumption is around 81,065 kWh and □ 14.95 lakh per year.

Following suggestions and observations are made for improving energy efficiency and reducing energy bill:

S. No.	Recommendations	Savings		Investment	Simple Payback
		kWh/year	Rs./year	Rs.	Year
1	Reducing the Maximum Demand from 278 kVA to 60 kVA		324000		
2	Improving average monthly power factor from average of 0.837 to above 0.95 by installing fixed capacitor bank of 10 kVAr		42000	5000	0.2
3	Replacement of FTLs with electronic ballast by LED tube lights – 367 No.	11561	142279	183500	1.3
4	Replacement of conventional fan regulators by electronic regulators – 162 No.	2673	32898	48600	1.5
5	Installation of Solar PV power plant of 10 kWp	14500	178457	700000	3.9
	Total	**28734**	**719634**	**937100**	**1.3**

In addition, following suggestions are made for energy conservation:

- All computers have to be set for power save mode for switching off screen if not used for 15 minutes and hibernate if not used for more than 60 minute.

- Students may be educated towards saving of electricity by displaying messages in the classroom and common public area for switching off lights, fans and computers when not required.

- Fans should not be rewound more than once and has to be replaced by 5 STAR rated energy efficient fans to reduce consumption.

- **With implementation of all the measures, it is possible to reduce the electricity bill be 48%.**So, it is strongly recommended to implement the short term and long term measures of simple payback period less than 2 years immediately.

- The long term plant of Solar PV system may also be taken up in ESCO mode, where in the investor will install and maintain the system and college can get the electricity at a reduced cost of around ₹ 5 / kWh to ₹6 / kWh, which is a reduction of more than 50% in the electricity cost. So, college need not invest any amount upfront.

1 INTRODUCTION

HMMV, Pune is affiliated to the Savitribai Phule Pune University and is recognized by Government of Maharashtra.

1.1 Methodology Adopted

The Audit is conducted as per the guidelines given by MEDA:

1. Relevant Data Collection like inventory list of lighting fixtures, pumps, etc.
2. Measurement of main supply Voltage, Current, p.f., kW, kVAr and kVA are done and the trend is recorded.
3. Analysis of the past data for understanding the consumption patterns.
4. Recommendation of energy efficiency improvement projects and methods to reduce the energy cost.
5. Analysis of Techno-economic feasibility of the projects with Simple payback.

1.2 Instruments Used

Following instruments are used for the study:

a. Single Phase Power Analyser

b. Three phase Power Analyser

2 PAST ELECTRICITY BILL ANALYSIS

2.1 Monthly electricity consumption analysis

- The college receives HT power supply from MSEDCL at 11 kV. The monthly electricity bills are collected and the details are as below:

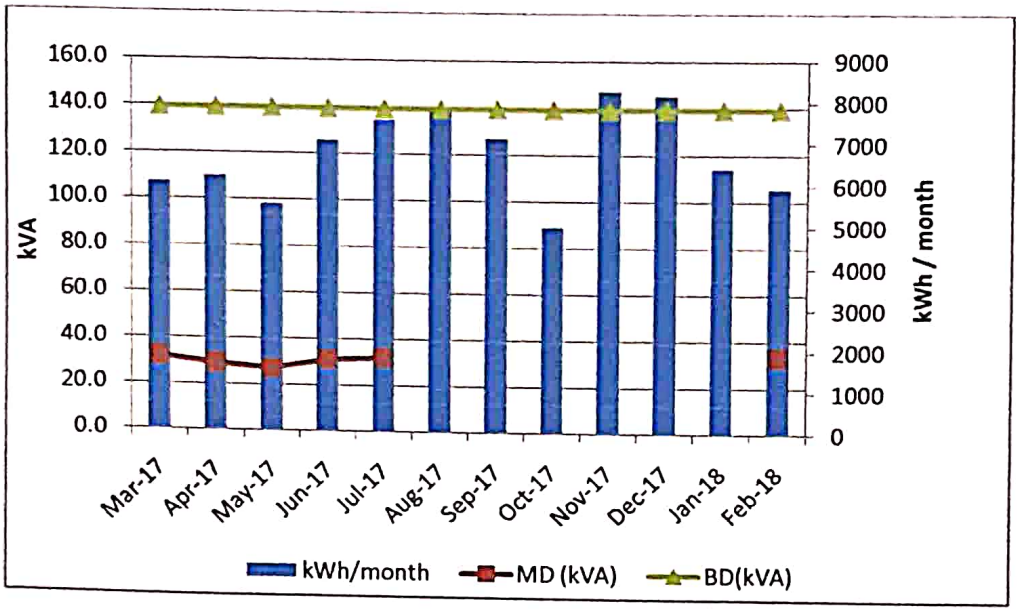
Table 2-1: Electricity Consumption Analysis for HMMV

Month	MD	BD	pf	Consumption	Amount	Cost
	kVA	kVA		kWh	Rs.	Rs./kWh
Feb-18	33.0	139	0.899	5920	114909	19.41
Jan-18		139		6405	122712	19.16
Dec-17		139		8170	146011	17.87
Nov-17		139		8270	142783	17.27
Oct-17		139		5000	101483	20.30
Sep-17		139		7130	124022	17.39
Aug-17		139		7855	138624	17.65
Jul-17	32.0	139	0.894	7560	128416	16.99
Jun-17	31.0	139	0.877	7060	134161	19.00
May-17	27.0	139	0.837	5505	119709	21.75
Apr-17	29.0	139	0.884	6165	112183	18.20
Mar-17	32.0	139	0.826	6025	110282	18.30
Average	**80.7**	**139**	**0.870**	**6755**	**124608**	**18.45**
Minimum	**27.0**	**139**	**0.826**	**5000**	**101483**	
Maximum	**33.0**	**139**	**0.899**	**8270**	**146011**	
Total				**81065**	**1495295**	**18.45**

- The **average yearly electricity cost works out to be □ 18.45 / kWh.**However, for all **savings calculations, cost of □ 12.31/kWh** isconsidered after discounting fixed charges.
- Highest consumption was recorded in the month of November.
- The monthly average consumption is 6,755 kWh amounting to □ 1,24,608.
- The yearly average electricity bill is 81,065 kWh amounting to □ 14.95lakh per year.

- The total consumption pattern is as below:

Figure 2-1: Total Electricity consumption pattern of the premises



- The college is having 277 kVA Contract Demand (CD). Since, the applicable tariff is HT IX B, the minimum Billing Demand (BD) is 50% of 277 kVA, i.e, 139 kVA.
- From the past 12 electricity bills, it is evident that, Maximum Demand (MD) recorded was 33 kVA in February and average MD was 30.7 kVA with minimum of 27 kVA. So, the Demand charges were always 139 kVA. This can be optimised to reduce the electricity bill.
- The monthly power factor varied from 0.826 to 0.899 with average of 0.870. This is on very lower side and penalty of ₹ 2000/- to ₹6500/- per month is levied in the bill. Whenever power factor is below 0.90, a penalty of 1% is levied for decrease of every 0.01 below 0.90. Similarly 1% incentive is given for every 0.01 increase in power factor above 0.95 and maximum of 7% incentive can be achieved if unity power factor is achieved.

3 ELECTRICAL LOADING PROFILE

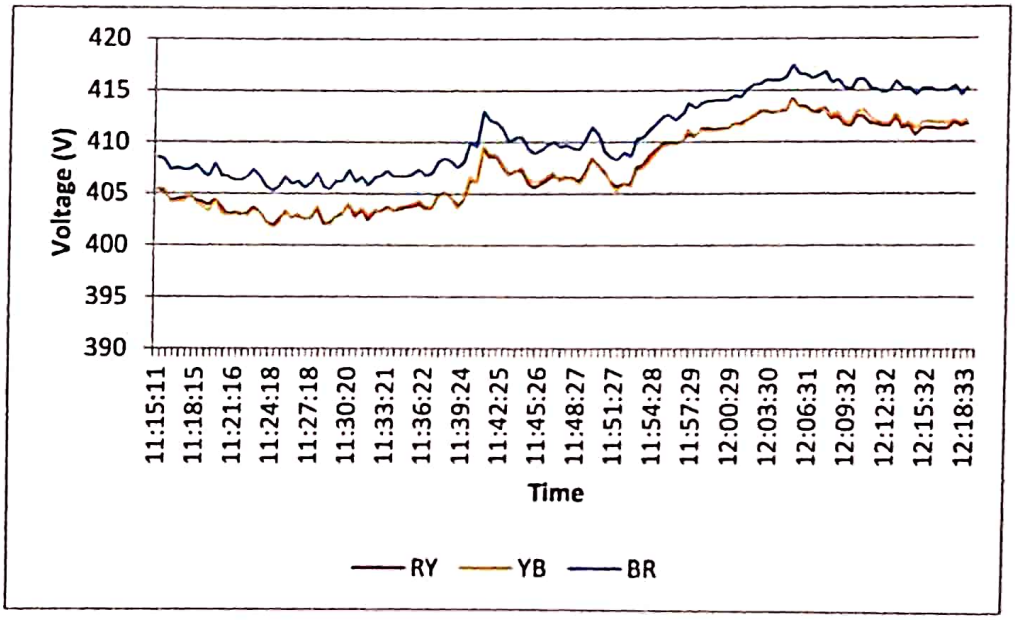
Three phase power analyser was logged on to the main incomer. The recorded parameters were as below:

3.1 Main Supply from MSEDCL

3.1.1 Voltage level

- Phase to Neutral voltage levels were observed as below:

Figure 3-1: Phase to Phase and Phase to Neutral Voltage

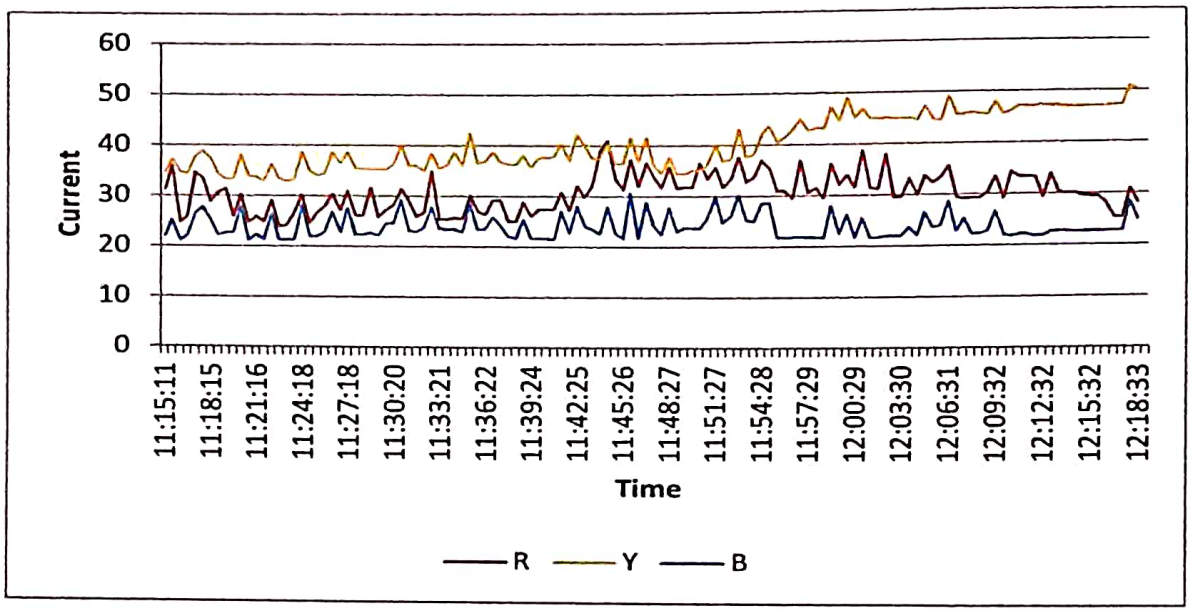


V	Average	Minimum	Maximum
RY	407.5	402.0	414.2
YB	407.6	401.7	414.2
BR	410.7	401.7	417.5

- Average voltages are in the range of 401 V to 417V, which is Normal.
- The maximum voltage of 417V was observed in B-Phase. Y phase voltage lower than the other two phases.
- Voltage unbalance is around 0.51%, which is within limits. Less than 2% is considered to be good.

3.1.2 Current profile

Figure 3-2: Line Current Pattern

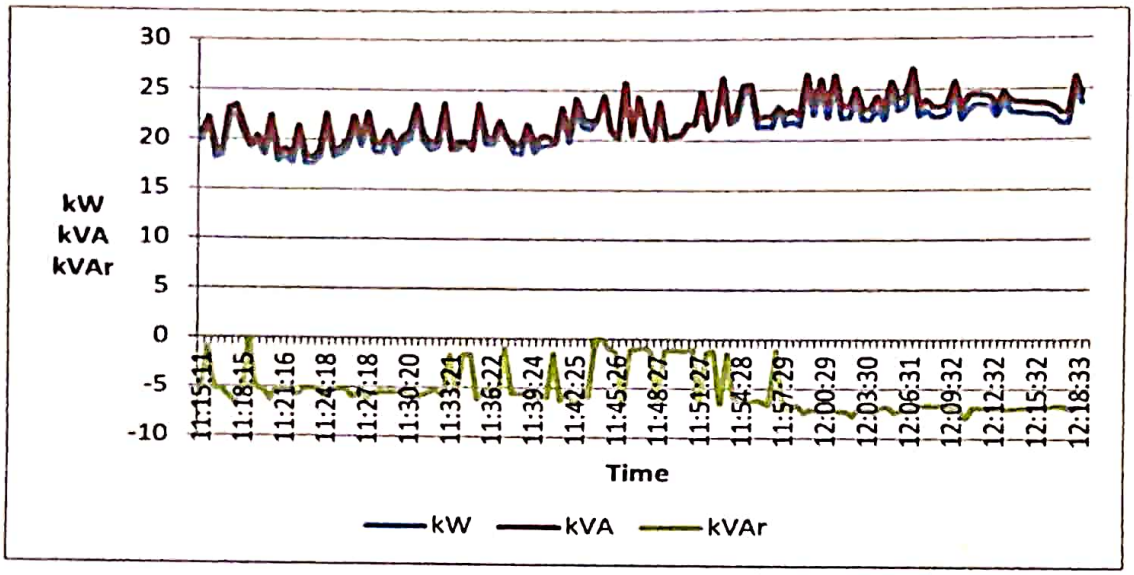


A	Average	Minimum	Maximum
R	30.5	23.9	40.9
Y	40.2	32.9	50.8
B	23.9	21.1	30.7

- The average currents in R, Y and B phases were 30.5A, 40.2A and 23.9A respectively. Considering the single phase loads, the unbalance is not an issue.

3.1.3 Load profile

Figure 3-3:Load Profile of the College

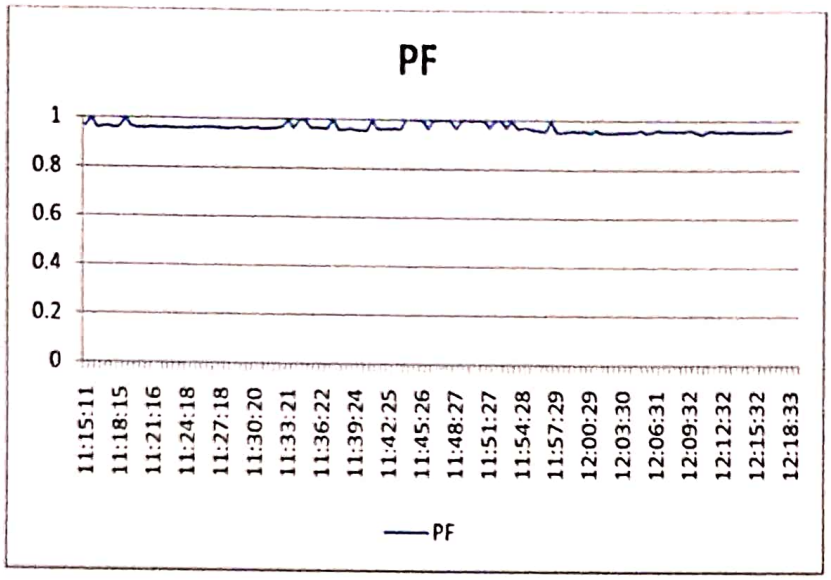


Power	Average	Minimum	Maximum
kW	21.4	17.5	26.1
kVA	22.1	18.3	27.0
kVAr	-5.3	-8.0	0.0

- The average load observed was 21.4 kW / 22.1 kVA.
- The reactive power was 5.3kVAr capacitive.
- Maximum load of 26.1 kW / 27.0 kVA was observed.

3.1.4 Power Factor

Figure 3-4: Power Factor



	Average	Minimum	Maximum
PF	0.97	0.95	1.0

- The average power factor was maintained at 0.95.

3.1.5 Total Harmonic Distortion (THD%)

- The average Voltage Total Harmonic Distortion (THDv%) was around 1.2%, which is well within the limits of 5%.
- The average Current Total Harmonic Distortion (THDi%) was in the range of 21% to 32% under maximum load conditions. This is because of maximum percentage of load is of electronic in nature, like electronic ballasts of tube lights, LED drivers and computers.

3.2 Load measurement

- The load measurements were done in individual feeders. The readings were as below:

Table 3-1: Load measurements

Area / MCB no.		Voltage	Current	Power	PF
		V	A	kW	
Breaker no. 1	R	236	1.45	0.26	0.76
	Y	233	2.1	0.48	0.97
	B	236	5.6	1.2	0.97
	Total			1.84	
2F2 second Floor	R	235	9.5	2.16	0.95
	Y	233	5.2	1.2	0.97
	B	234	0.6	0.11	0.96
	Total			3.47	
2F3 third Floor	R	236	9.6	1.7	0.73
	Y	232	7.2	1.6	0.97
	B	234	5	1.05	0.89
	Total			4.35	
2F4	R	236	0.5	0.1	0.97
	Y	232	3.2	0.7	0.95
	B	234	4	0.8	0.92
	Total			1.6	

4 OBSERVATIONS

4.1 Light& Fan

- The indoor lighting is mainly by FTLand LED. FTLs are fitted with electronic ballast.**The percentage of LED in total lighting fixtures is 2.6%.**
- Fans are having conventional type regulators.
- The no. of light fitting and fans are as below:

Table 4-1: Lighting fixtures and fans

Fitting	Tube (36W)	LED 20W	FAN
Total	367	10	162

4.2 Electricity Tariff

- Present contract demand is very high compared to actual consumption and may be reduced to save on demand charges.
- Presently, the applicable tariff is HT-IX-B.

4.3 Others

- There is a
- The Campus is having enough shade free roof top area to install Solar PV power plant of 10 kWp. This has got the potential to generate electricity up to 18% of the yearly consumption of the college.

5 RECOMMENDATIONS

From the measurements, data analysis, observations and discussions following opportunities are identified for energy saving.

1. Contract Demand optimization

Presently, Contract Demand is 277 kVA, which is very high. The actual recorded MD were in the range of 27 kVA to 33 kVA, with average of 30.7 kVA. The Billing Demand has been 50% of 277 kVA, i.e, 139 kVA, throughout the year, as MD has not crossed 139 kVA anytime. Hence, there is a potential to reduce the Demand Charges by reducing the Contract Demand to 50 kVA. The expected savings are as below:

Present Contract Demand	kVA	277
Minimum Billing Demand @ 40%	kVA	139
Average recorded MD in past 12 months	kVA	31
Additional demand for which payment is done	kVA	108
Demand charges	□/kVA	250
Average Additional demand charges being paid	**□/month**	**27000**
Yearly savings by reduction of Contract Demand	**□/year**	**324000**
Suggested Contract Demand	**kVA**	**50**

2. Improving power factor

From the monthly bill analysis, it is observed that, average monthly of pf is 0.870 and average penalty of □ 3500/month is levied. This can be easily avoided by installing a fixed capacitor bank of 10 kVAr, which is especially required during nonworking hours of the college. The pf is very well maintained above 0.95 during college hours, but it goes very low during nonworking hours and hence penalty is levied.

To be more specific, the nonoperational APFC panel can be modified with 10 kVAr fixed capacitor bank and additional capacitor banks of lower capacitor banks of 2.5 kVAr and 5 kVAr on auto mode, as the college loads are very less. Higher capacity capacitor banks will not work. This can ensure power factor close to unity.

The average yearly savings = □ 3500/month x 12 month = **□42000/year.**

Cost of fixing 440V, heavy duty fixed capacitor bank of 10 kVAr = □5000

Simple payback period **= 2 month**

3. Replacement of FTLs with electronic ballast by LED tube lights

There are around 137 No. FTLs with electronic ballast in the college premises.They can be replaced by LED tube lights of 20W. On an average 7 h / day of usage is considered for payback calculation. The savings calculated are as below for replacement of 367 No. of tubes:

Existing tube light wattage with electronic ballast	W	38
Proposed LED tube light consumption	W	20
Net savings	W	18
Daily operating hours	h/day	7
Yearly operating days	days/year	250
Yearly electricity saved per fitting	kWh/year	31.5
Cost of electricity	Rs./kWh	12.31
Yearly monetary savings per fitting	Rs./year	388
Total number of tube lights to be replaced	No.	367
Total electricity saved	**kWh/year**	**11561**
Total monetary savings	**Rs./year**	**142279**
Total Cost of replacement	**Rs.**	**183500**
Simple payback period	**Year**	**1.3**

Note:

- Each tube light with fittings are available in the range of Rs. 400 to Rs. 600 per piece depending upon the brand and quality. We have considered a cost of Rs. 500 per tube with removal of old fixture and fixing of new fixture for savings calculations. This cost may come down with bulk purchase.
- Tube lights in offices, staff rooms, library, computer labs and class rooms having maximum operating hours may be taken initially for replacement. So, tube lights having maximum operating hours will have lesser simple payback period.
- LED tube lights should not be fitted at places, where it is in the range of eye level and should be sufficiently higher from the eye level.
- **The THDi% of the LED tube lights should be below 15%.** LEDs with higher THDi% will lead to cable heating and frequent failure of capacitor banks.

4. Replacing of conventional fan regulators with electronic regulators

There are around 162 no. of fans with conventional regulators.This can be replaced by electronic regulators. On an average 6 h / day of usage is considered for payback calculation. The estimated savings are as below:

Power consumption by existing fan regulators	W	15
Power consumption by electronic regulators	W	4
Net savings	W	11
Daily operating hours	h/day	6
Yearly operating days	days/year	250
Yearly electricity saved per fitting	kWh/year	16.5
Cost of electricity	Rs./kWh	12.31
Yearly monetary savings per fitting	Rs./year	203
Total number of CFLs to be replaced	No.	162
Total electricity saved	**kWh/year**	**2673**
Total monetary savings	**Rs./year**	**32896**
Total Cost of replacement	**Rs.**	**48600**
Simple payback period	**Year**	**1.5**

5. Installing Solar PV power plant

The college is having very good open terrace area for a roof top Solar PV power plant. College can install a 10 kW grid tied solar pv power plant. This will generate electricity equivalent to 18% of the present consumption. The savings are calculated as below:

Proposed Solar PV plant capacity	kWp	10
Yearly estimated generation	kWh/kWp.year	1450
Total yearly generation	kWh/year	14500
Cost of electricity	Rs./kWh	12.31
Savings due to avoidance of import from MSEDCL	**□/year**	**1,78,457**
Cost of Installation of solar PV plant	**□**	**7,00,000**
Simple payback period	**Year**	**3.9**

With government subsidy and bidding this price will come down and simple payback would be reduced

Annexure-1: List of vendors for reference

S. No.	Name & Address	Product/Service
1	**Wipro Enterprises Ltd** Sarang Gokhale, Bhosale Heights, 1195/5, Fergusson College Road,Pune-411005, Mobile: 9765410521	Lighting product (LED & Conventional lighting)
2	**Philips India Limited** Technopolis Knowledge Park, Mahakali Caves Road, Chakala, Andheri (E), Mumbai - 400093, India. Tel : +91 - 22 - 66912000	Lighting product (LED & Conventional lighting)

Green Water Solutions Provider Pvt.Ltd.