GREEN AUDIT REPORT

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PROVIDENCE WOMEN'S COLLEGE

KOZHIKKODE

2021

Executed by

OTTOTRACTIONS
Energy-Engineering-Environment

GREEN AUDIT REPORT

PROVIDENCE WOMEN'S COLLEGE

CALICUT

Green Audit Report

Providence Women's College

Report No: EA 804

2021-September

About OTTOTRACTIONS

OTTOTRACTIONS established in 2005, is an organization with proven track record and knowledge in the field of energy, engineering, and environmental services. They are the first Accredited Energy Auditor from Kerala for conducting Mandatory Energy Audits in Designated Consumers as per Energy Conservation Act-2001. Government of Kerala recognized and appreciated **OTTOTRACTIONS** by presenting its prestigious **"The Kerala State Energy Conservation Award 2009"** for the best performance as an Energy Auditor.

Acknowledgment

We were privileged to work together with the administration and staff of Providence Women's College for their timely help extended to complete the audit and bringing out this report.

With gratitude, we acknowledge the diligent effort and commitments of all those who have helped to bring out this report.

We also take this opportunity to thank the bona-fide efforts of audit team for unstinted support in carrying out this audit.

We thank our consultants, engineers and backup staff for their dedication to bring this report.

Thank you.

B V Suresh Babu
Accredited Energy Auditor
AEA 33, Bureau of Energy Efficiency

Preface

Educational institutions always had an important leadership role in society in demonstrating types of changes that used to occur with respect to the prime issues of the time. All around the world, educational institutions are taking steps to declare themselves the next carbon neutral school as a part of the global trend of becoming sustainable. In 2007, Victoria University School of Architecture and Design declared themselves the first carbon neutral campus in the world through the purchase of carbon credits. This concept is not a sustainable model as it does not guarantee the capture of carbon forever and also it is expensive.

The potential for any academic institution- (may be a school in a remote village or a university in an urban setting) - to become the driver for change is huge. Its role of practicing leadership in its community can be utilized to encourage and influence carbon neutral living.

The biggest factors that contribute towards emission are Energy, Transportation and Waste. Any reduction in the carbon emission by the above sectors, starts with the behavioral changes (Low cost) and/or technological investments (High cost). In order to make these changes, the students are to be educated properly on the concept of carbon neutral campuses and methods to reduce it.

In India, the concept of carbon neutral campuses is gaining momentum. Green Audit in Campuses measures the amount of Green House Gases (GHG) emissions produced as a result of its operations through an accounting like inventory of all the sources of GHGs and carbon sequestration in the school campus. Based on this, the total carbon footprint is estimated. Measures are recommended to bring down the carbon footprint of the campus and to make it a carbon neutral campus.

B Zachariah

Director, OTTOTRACTIONS

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Technical Supplement		

ISO 9001 : 2015 Certified (22DQJE85)
ISO 14001:2015 Certified (22DEJE84)

OTTOTRACTIONS

Energy-Engineering-Environment

Green Audit

Certificate

This is to certify thatThe data collection has been carried out diligently and truthfully;

All data monitoring devices are in good working condition and have been calibrated or certified by approved agencies authorised and no tampering of such devices has occurred;

All reasonable professional skill, care and diligence had been taken in preparing the audit report and the contents thereof are a true representation of the facts;

Adequate training provided to personnel involved in daily operations after implementation of recommendations; and

The Green Audit for the period 2018-21 has been carried out in accordance with the various rules and regulations in India.

This Certificate is issued to Providence Women's College, Kozhikkode on their request. Dated this 12th day of September 2021.

ACCREDITED ENERGY AUDITOR
AEA-33, BUREAUOF ENERGY EFFICIENCY
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OTTOTRACTIONS
Energy Engineering Environment

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Introduction

Background

All across the developed countries, educational institutions are now moving to a sustainable future by becoming carbon neutral and greener spaces. They are taking responsibility for their environmental impact and are working to neutralize those effects. To become carbon neutral, institutions are working to reduce their emissions of greenhouse gases, cut their use of energy, use energy efficient equipment, use more renewable energy, plant and protect green cover and emphasize the importance of sustainable energy sources. Institutions that have committed to becoming carbon neutral have recognized the threat of global warming and are therefore committing to reverse the trend. Studies on this line has not struck roots in most of the developing countries-especially among students.

The Sustainable Development Goals (SDGs), launched by the United Nations in 2015, are an excellent vehicle for driving this change. They represent an action plan for the planet and society to thrive by 2030. The SDGs provide a window of opportunity for creating multidimensional operational approaches for climate change adaptation. They address poverty, hunger and climate change, among other issues central to human progress and sustainable development, such as gender equality, clean water and sanitation, and responsible consumption and production.

The Green Audit of Providence Women's College, Calicut aims to assist campus to reduce their carbon footprint and educate tomorrow's leaders about strategies for carbon mitigation using their campus as a model. Also, this audit covers institutes responses towards SDGs by covering SDG 3,6,7,11,13,15. The green audit also aims to educate students and teachers on the concept of carbon footprint and to enable the students to collect data pertaining to the carbon

emissions and carbon sequestration in their campus and to calculate the specific carbon footprint of the campus.

The project also suggests plans to make the campus carbon neutral or even carbon negative by implementing carbon mitigation strategies in areas such as,

a. Energy
b. Transportation
c. Waste minimisation
d. Carbon Sequestration etc.

The major objectives of the audit are:

- To make aware students and teachers on the concept of carbon footprint.
- To calculate the specific carbon footprint of the campus and classify it as carbon negative, neutral or positive.
- To create carbon mitigation plans to reduce their footprint based on the data generated.

Providence Women's College

Providence Women's College, Calicut, Kerala, founded by the sisters of Apostolic Carmel came into being on 1st July, 1952. It was the sacred mission of Mother Veronica the foundress of the congregation to train young women who had embraced religious life and send them far and wide on vocations of service to the community. Providence Women's College was the result of the efforts of such a committed group, headed by Mother Gabrielle, who became the Founder Principal. This was a dream come true for the young women in the Malabar region who had to otherwise go as far as Mangalore or Madras in search of a women's college. Thus, this college opened a new chapter in the annals of Malabar, as its first women's college. The college is registered under the Apostolic Carmel Education Society, S No.4 of 1957, Calicut. The Managing Governing Body includes the Provincial Superior, Educational Secretary, the Principal, the Local Manager, a representative of the management and a religious staff nominated by the Provincial Superior.

Occupancy Details			
Particulars	2018-19	2019-20	2020-21
Total Students	1793	1778	1848
Staffs	84	83	85
Total Occupancy of the college	1877	1861	1933

For calculating per capita carbon emission estimation, only the student strength is taken into account.

BASELINE DATA SHEET FOR GREEN AUDIT											
1	Name of the Organisation	PROVIDENCE WOMEN'S COLLEGE									
2	Address (include telephone, fax & e-mail)	Providence College Rd, Malaparamba, Kozhikode, Kerala 673009,providencecollegecalicut@gmail.com									
2	Year of Establishment	1952									
3	Name of building and total No. of Electrical Connections/building	HT (1)									
4	Total Number of Students	Boys	-	Girls	-	Total	1848				
5	Total Number of Staff	85									
6	Total Occupancy	1933									
7	Total area of green cover (Acre)	37									
8	Type of Electrical Connection(nos)	HT	1	LT	0						
9	Contract Demand (KVA) /Connection	70									
10	Average Maximum Demand (KVA)	57.75									
11	Total built up area of the building (m^2)	21506									
12	Number of Buildings	7									
13	Average system Power Factor	0.94									
14	Details of capacitors connected	NA									
15	Transformer Details (Nos., kVA, Voltage ratio)	TR 1	TR 2	TR 3	TR 4	TR 5	TR 6				
		NA	NA	NA	NA	NA	NA				
15	DG Set Details (kVA)	DG1	DG2	DG3	DG4	DG5	Remarks				
		10	NA	NA	NA	NA	-				
16	Details of motors	Rating		Nos.		Remarks					
		5 to 10		NA		NA					
		10 to 50		NA		NA					
		Above 50		NA		NA					
17	Brief write-up about the firm and the energy/environmental conservation activities already undertaken.	Installed 37kWp solar power plant, Biogas plants are used for cooking.									
18	Contact Person & Telephone number	Principal									
		0495 -2371696									

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METHODOLOGY

2.1. Sensitisation

Low Carbon campus initiatives are successful when everyone in the campus is engaged including students, teachers and staff. A team of students, teachers and staff were formed to participate in the audit. A sensitisation among students and teachers on the concept of carbon footprint was conducted.

During the audit the students and staffs were sensitised on the project and trained to be a part of the data collection team. This helped in conducting the survey in a participatory mode so that the awareness will penetrate to the grass root level. During the data collection field visit it was stressed that the team will spread these ideas to their homes and friends. This will help in a horizontal and vertical spread of the message to a wider group. It is assumed that through 1861 occupants of this campuses will reach same number of households. This message will spread to at least 7444 individuals approximately.

2.2 Estimation of carbon footprint

A carbon footprint is the amount of greenhouse gases—primarily carbon dioxide—released into the atmosphere by a particular human activity. A carbon footprint can be a broad measure or be applied to the actions of an individual, a family, an event, an organization, or even entire nation. It is usually measured as tons of CO_2 emitted per year, a number that can be supplemented by tons of CO_2-equivalent gases, including methane, nitrous oxide, and other greenhouse gases.

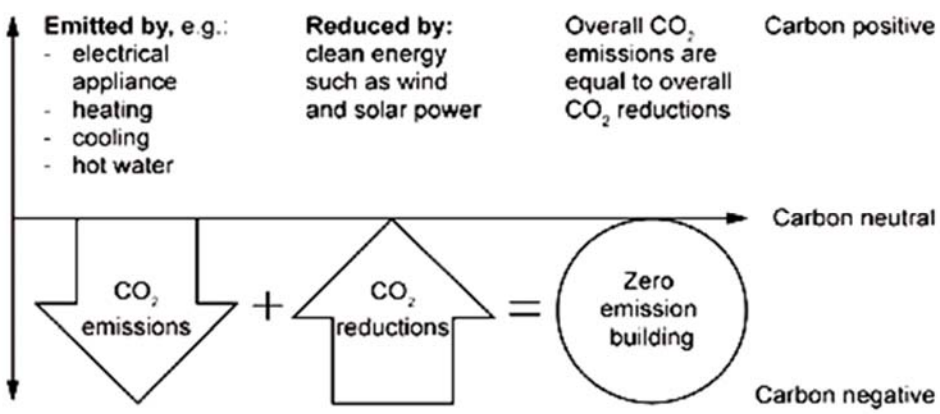
Global Warming Potential (GWP) is a measure of how much heat a greenhouse gas traps in the atmosphere up to a specific time horizon, relative to carbon dioxide. The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases. Specifically, it is a measure of how much energy the emissions of one ton of a gas will absorb over a given period of time, relative to the emissions of one ton of carbon dioxide (CO_2).

Global Warming Potentials (IPCC Second Assessment Report)					
Species	Chemical formula	Lifetime (years)	Global Warming		
			20 years	100 years	500 years
Carbon dioxide	CO2	variable §	1	1	1
Methane *	CH4	12±3	56	21	6.5
Nitrous oxide	N2O	120	280	310	170
HFC-23	CHF3	264	9100	11700	9800
HFC-32	CH2F2	5.6	2100	650	200
HFC-41	CH3F	3.7	490	150	45
HFC-43-10mee	C5H2F10	17.1	3000	1300	400
HFC-125	C2HF5	32.6	4600	2800	920
HFC-134	C2H2F4	10.6	2900	1000	310
HFC-134a	CH2FCF3	14.6	3400	1300	420
HFC-152a	C2H4F2	1.5	460	140	42
HFC-143	C2H3F3	3.8	1000	300	94
HFC-143a	C2H3F3	48.3	5000	3800	1400
HFC-227ea	C3HF7	36.5	4300	2900	950
HFC-236fa	C3H2F6	209	5100	6300	4700
HFC-245ca	C3H3F5	6.6	1800	560	170
Sulphur hexafluoride	SF6	3200	16300	23900	34900
Perfluoromethane	CF4	50000	4400	6500	10000
Perfluoroethane	C2F6	10000	6200	9200	14000
Perfluoropropane	C3F8	2600	4800	7000	10100
Perfluorobutane	C4F10	2600	4800	7000	10100
Perfluorocyclobutane	c-C4F8	3200	6000	8700	12700
Perfluoropentane	C5F12	4100	5100	7500	11000
Perfluorohexane	C6F14	3200	5000	7400	10700

The methodology for carbon footprint calculations are still evolving and it is emerging as an important tool for green house management. In the present study carbon emission data from the campus is estimated under four categories viz.

a. Energy
b. Transportation
c. Waste minimisation
d. Carbon Sequestration

Carbon neutrality refers to achieving net zero GHG emission by balancing the measured amount of carbon released into atmosphere due to human activities, with an equal amount sequestrated in carbon sinks. It is crucial to restrict atmospheric concentrations of GHGs released from various socio-economic, developmental and life style activities using biological or natural processes. It is recognized that addressing climate change is not as simple as switching to renewable energy or offsetting GHG emissions. Rather, providing an opportunity for innovation in new developmental activities for viable and effective approach to address the problem.



Energy

In the campus carbon emission from energy consumption is categorised under two headings viz. energy from Electrical and Thermal. Energy used for transportation is calculated under transportation sector.

A detailed energy audit is conducted to understand the energy consumption of the campus. Information on total connected loads, their duration of usage and documents like electricity

bills are evaluated. Connected loads are calculated by conducting a survey on electrical equipment on each location. Duration of usage was found out by surveying the users. The survey of equipment was conducted in a participatory mode.

The fuel consumption for cooking, like LPG, was studied by analysing the annual fuel bills and usage schedules during the study. Discussions were carried out with the concerned individuals who actually operate the cooking system.

Transportation

There is no vehicles operates from campus for its logistics.

Carbon emission from transportation to be calculated by using the following formula:

Carbon Emission = Number of each type of vehicles × Avg. fuel consumed per year ×

Emission factors (based on the fuel used by the vehicle)

Waste Minimisation

The waste generated from the campus is also responsible for the greenhouse gas emission. So, in order to calculate the total carbon foot print of the campus it is necessary to estimate the greenhouse gas emission from the waste generated in the campus by the activity of the students, teachers and staffs.

The calculation of the waste generated has been conducted by keeping measuring buckets for collecting the waste generated in a day. This waste so generated was calculated by weighing it.

Carbon Sequestration

Carbon sequestration is the process involved in the long-term storage of atmospheric carbon dioxide. Trees remove carbon dioxide from the atmosphere through the natural process of photosynthesis and store the carbon in their leaves, branches, stems, bark, and roots.

Carbon sequestrated by a tree can be found out by using different methods. Since this study is employed the volumetric approach, the calculation consists of five processes.

- Determining the total weight of the tree
- Determining the dry weight of the tree
- Determining the weight of carbon in the tree
- Determining the weight of CO_2 sequestrated in the tree
- Determining the weight of CO_2 sequestrated in the tree per year

Detailed calculations and results are given in the technical supplements of this document.

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RESULTS AND DISCUSSIONS

3.1 CARBON FOOTPRINT ESTIMATION

3.1.1 ENERGY

a. Electricity

Electricity is purchased from KSEB from one HT Connection, the details are given below.

Electricity Connection Details		
PROVIDENCE WOMEN'S COLLEGE		
1	Name of the Consumer	PROVIDENCE WOMEN'S COLLEGE Providence College Rd, Malaparamba, Kozhikode, Kerala 673009,providencecollegecalicut@gmail.com
2	Tariff	HT II(A) GENERAL
3	Consumer Number	1365980025581
5	Connected Load Total	50kVA
6	Annual Electricity Consumption (kWh)	122273

Electricity Bill Analysis (from 2018 to 2021)

Electricity Bill Details (2021-22)												
Month	Name of the Consumer				PROVIDENCE WOMEN'S COLLEGE							
	Contract Demand(kVA)		50		Consumer number & Section			1365980025581				
	Tariff		HT II(A) GENERAL					Karaparamba				
	kWh				kVA			PF	PF Incentive	PF Penalty	Rs (Total)	Rs/kwh
	Z1	Z2	Z3	Total	Z1	Z2	Z3					
Apr	3408	1610	2712	7730	31.93	26.67	28.48	0.9	1099.98		63803.04	**8.25**
May	369	1008	1906	3283	22.06	25.93	15.73	0.91	370.78		35325.19	**10.76**
Jun	0	473	1430	1903	27.44	14.28	15.37	0.89	349.27		25461.33	**13.38**
Jul	411	764	1327	2502	21.73	16.78	15.39	0.89	500.24		30378	**12.14**
Aug	1710	878	1567	4155	31..2	16.61	15.66	0.92	352.99		40437.13	**9.73**
Sep												
Oct												

Electricity Bill Details (2020-21)												
Month	Name of the Consumer				PROVIDENCE WOMEN'S COLLEGE							
	Contract Demand(kVA)		50		Consumer number & Section			1365980025581				
	Tariff		HT II(A) GENERAL					Karaparamba				
	kWh				kVA			PF	PF Incentive	PF Penalty	Rs (Total)	
	Z1	Z2	Z3	Total	Z1	Z2	Z3					
Apr	2398	1513	2535	6446	39.84	26.52	20.57	0.94		183.93	56047.18	**8.7**
May	0	0	813	813	16.63	19.17	8.38	0.90		85.36	18003.05	**22.1**
Jun	0	0	1521	1521	15.39	22.39	14.94	0.91		127.76	21428.91	**14.1**
Jul	835	715	1140	2690	21.19	10.57	10.37	0.89		541.45	31685.7	**11.8**
Aug	766	769	1272	2807	20.05	17.01	11.1	0.88		724.12	32753.06	**11.7**
Sep	152	588	955	1695	19.15	16.4	6.59	0.83		931.13	25815.05	**15.2**
Oct	1735	1227	1934	4896	22.9	20.18	16.61	0.92		422.18	45936.46	**9.4**
Nov	2195	1415	2344	5954	22.95	21.95	22.27	0.91		680.46	52361.35	**8.8**
Dec	2038	1047	1725	4810	25.68	21.27	18.41	0.89		960.84	45217.14	**9.4**
Jan	1483	839	1208	3530	22.42	17.83	14.41	0.85		1531.95	38171.71	**10.8**
Feb	2744	1144	1622	5510	29.74	24.81	14.42	0.87		1748.36	50836.35	**9.2**
Mar	2874	1339	2038	6251	29.76	25.75	19.2	0.89		1256.56	55096.93	**8.8**

Electricity Bill Details (2019-20)												
Month	Name of the Consumer				PROVIDENCE WOMEN'S COLLEGE							
	Contract Demand(kVA)		50		Consumer number & Section			1365980025581				
	Tariff		HT II(A) GENERAL					Karaparamba				
	kWh				kVA			PF	PF Incentive	PF Penalty	Rs (Total)	Rs/kwh
	Z1	Z2	Z3	Total	Z1	Z2	Z3					
Apr	7335	1594	2998	11927	40.62	20.24	24.28	0.95	-1616.56		88128.15	**7.38896202**
May	3596	913	1613	6122	31.23	18.87	16.32	0.91	-166.73		55217.31	**9.01948873**
Jun	2861	550	1049	4460	23.1	13.89	7.98	0.87	724.59		45799.23	**10.2688857**
Jul	5952	1274	2041	9267	43.03	28.83	15.47	0.95	-1268.16		73508.4	**7.93227582**
Aug	7605	1852	3031	12488	42	30	21	0.95	-669.71		96066.16	**7.69267777**
Sep	6624	1690	2742	11056	44.2	25.01	19.78	0.96	-314.03		88393.85	**7.99510221**
Oct	6222	1520	2418	10160	49.76	26.63	24.52	0.97	-577.67		82829.81	**8.15254035**
Nov	8242	1944	3148	13334	48.52	29.61	23.44	0.96	-378.53		102611.9	**7.69550472**
Dec	9349	2085	3532	14966	57.75	23.7	24.11	0.97	-847.03		114160.2	**7.62797007**
Jan	6705	1557	2639	10901	47.93	24.59	23.18	0.96	-308.55		87455.64	**8.02271718**
Feb	5904	1959	3283	11146	47	31	22	0.91	1266.13		88572.04	**7.94653149**
Mar	2398	1513	2535	6446	39.84	26.52	20.57	0.94	183.93		56047.18	**8.69487744**

Electricity Bill Details (2018-19)												
Month	Name of the Consumer			PROVIDENCE WOMEN'S COLLEGE								
	Contract Demand(kVA)		50	Consumer number & Section			1365980025581					
	Tariff		HT II(A) GENERAL				Karaparamba					
	kWh				kVA			PF	PF Incentive	PF Penalty	Rs (Total)	Rs/kwh
	Z1	Z2	Z3	Total	Z1	Z2	Z3					
Apr												
May												
Jun												
Jul												
Aug												
Sep												
Oct												
Nov												
Dec												
Jan	5761	1414	2462	9637	40.56	22.79	20.74	0.94	-1050.68		75527.54	7.83724603
Feb	5657	1346	2312	9315	40.41	20.86	22.63	0.93	-762.21		73916.07	7.93516586
Mar	6767	1599	2719	11085	46.81	21.34	18.5	0.95	-1512.64		83665.71	7.54765088

b. Diesel

Diesel Consumption Details		
Year	in L	Rs
16-17	58.5	3800
17-18	357.1	25000
18-19	145.4	12356
19-20	59.9	5394
20-21	0	0

c. LPG

LPG Consumption in college		
Year	Cost	Consumption (kg)
18-19	9365	177.935
19-20	4224	80.256
20-21	4650	73.625

LPG Consumption in Hostel	
Year	Consumption (kg)
18-19	1368
19-20	1414
20-21	456

Base Line Energy Data				
PROVIDENCE WOMEN'S COLLEGE				
		2018-19	2019-20	2020-21
1	Electricity KSEB (kWh)	102126	103932	39885
2	Electricity Solar - Off grid (kWh)	47268	47268	47268
3	Electricity (KSEB + Off grid) kWh	149393	151200	87152
4	Electricity Grid Tied (kWh)	0.00	0.00	0.00
5	Diesel (L)	145.36	59.93	0.00
6	LPG (kg)	1546	1494	530
7	Biogas(Kg)	20700	14490	18630

Energy Consumption Profile				
Sl No	Fuel	2018-19	2019-20	2020-21
		(kCal)		
1	Electricity	128478238	130031613	74950763
2	Diesel	1526329	629300	0
3	LPG	18551220	17926272	6355500
4	Biogas	63000000	44100000.00	56700000.00
Total (kCal)		211555787	192687185	138006263
Total (kWh)		245995.1	224054.87	160472.399

Thermal Fuel Consumption			
PROVIDENCE WOMEN'S COLLEGE			
	2018-19	2019-20	2020-21
Annual LPG consumption in kg	1545.935	1494	529.625
Annual Diesel consumption in L	145.36	59.93	0.00
Annual petrol consumption in L	0.0	0.0	0
Annual Biogas consumption in m3	18000	12600	16200

Specific Energy Consumption

OTTOTRACTIONS- ENERGY AUDIT				
PROVIDENCE WOMEN'S COLLEGE				
Energy Performance Index (EPI)				
Sl No	Particulars	2018-19	2019-20	2020-21
1	Total building area (m^2)	21506	21506	21506
2	Annual Energy Consumption (kCal)	211555787	211587185	144306263
3	Annual Energy Consumption (kWh)	245995.1	246031.6	167797.98
4	Total Energy in Toe	21.16	21.16	14.43
5	Specific Energy Consumption kWh/m^2	11.44	11.44	7.80

In 2020-21 the energy consumption was less due to lock down based on covid 19 pandemic. So the specific energy consumption in 2019-20 may be taken as benchmark.

3.3. Waste Generation total

The major concern of waste management will be focused on the solid waste produced by the campus. Solid wastes produced in the campus are mainly of three types, food waste, paper waste, and plastic waste. Food wastes produced in the campus are mainly by two means. The vegetable wastes produced in the kitchen during the food preparation. The food waste produced by the students and staffs of the campus after the consumption of meals.

Degradable Waste

Degradable Waste Generation			
PROVIDENCE WOMEN'S COLLEGE			
	2018-19	2019-20	2020-21
Total Occupancy	1877	1861	1933
Waste generated in kg /day	37.54	46.525	15.464
Waste generated in kg /Yr	4955.28	6141.3	2041.25

Non-Degradable waste

Solid non degradable Waste Generation			
PROVIDENCE WOMEN'S COLLEGE			
	2018-19	2019-20	2020-21
Total Occupancy	1877	1861	1933
Waste paper generated in kg /day	0.38	0.41	0.19
Waste plastic generated in kg /day	0.56	0.62	0.29
Waste paper generated in kg /Yr	82.59	90.98	42.53
Waste plastic generated in kg /Yr	123.88	136.47	63.79

3.4. Transportation

There is no bus operating from the college.

Carbon Emission Profile (2020-21)

Carbon emissions in the campus due to the day-to-day activities are calculated and is discussed below. The emission factors considered for estimation and its units are given.

Emission Factors		
Item	Factor	Unit
Electricity	0.00079	tCo_2e/kWh
LPG	0.0015	tCo_2e/kg
Diesel	0.0032	tCo_2e/kg
Petrol	0.0031	tCo_2e/kg
Food Waste	0.00063	tCo_2e/kg
Paper Waste	0.00056	tCo_2e/kg
Plastic Waste	0.00034	tCo_2e/kg

Carbon Foot Print 2020-21

Carbon Foot Print							
Sl. No.	Particulars	2018-19	tCO2e	2019-20	tCO2e	2020-21	tCO2e
1	Electricity (kWh)	102126	80.68	103932	82.11	39885	31.51
2	Diesel (L)	145.36	0.47	59.93	0.19	0.00	0.00
3	LPG (kg)	177.94	0.27	80.26	0.12	73.63	0.11
4	Biogas (Kg)	20700.00	28.98	14490.00	20.29	18630.00	26.08
5	Degradable Waste in kg/yr.	4955.28	3.12	6141.30	3.87	2041.25	1.29
6	Paper Waste in kg/yr	82.59	0.05	90.98	0.05	42.53	0.02
7	Plastic Waste in kg/yr	123.88	0.04	136.47	0.05	63.79	0.02
Total Carbon Foot Print tCO2e/yr			113.60		106.67		59.03

3.5. CARBON SEQUESTRATION

All the activities including energy consumption and waste management have their equivalent carbon emission and they positively contribute to the carbon footprint of the campus. Carbon sequestration is the reverse process, at which the emitted carbon dioxide will get sequestrated according to the type of carbon sequestration employed. Even though there are many natural sequestration processes are involved in a campus, the major type of sequestration among them is the carbon sequestration by trees.

Carbon Sequestration			
Particulars	2018-19	2019-20	2020-21
Total number of trees	400	420	428
Carbon sequestrated by trees in the campus (tCO2e)	2.49	2.65	3.32

Trees sequestrate carbon dioxide through the biochemical process of photosynthesis and it is stored as carbon in their trunk, branches, leaves and roots. The amount of carbon sequestrated by a tree can be calculated by different methods. In this study, the volumetric approach was taken into account, thus the details including CBH (Circumference at Breast Height), height, average age, and total number of the trees, are required. Details of the trees in the campus compound are given in the Table 3.18. Detailed table is included in the technical supplement.

Carbon sequestrated by a tree can be found out by using different methods. Since this study is employed the volumetric approach, the calculation consists of five processes.

- Determining the total weight of the tree
- Determining the dry weight of the tree
- Determining the weight of carbon in the tree
- Determining the weight of CO_2 sequestrated in the tree
- Determining the weight of CO_2 sequestrated in the tree per year

Carbon sequestrated by each species of trees in the campus compound is given in the Table.3.19 Detailed calculation results are listed out in the tables provided in the technical supplements of 'Carbon sequestration'.

Form 5										
Sl. No	Name of tree (Botanical name)	Circumference (cm)	Stem diameter (cm)	Height of trees (m)	Total weight of tree	Weight of carbon	No.of similar trees	Total carbon sequest	Carbon Sequestrated by	Average age (years)
1	Anacardium occidentale	36	11.46	2	10.90	0.00	10	0.045	0.004	6
2	Mangifera indica	32	10.19	3	12.92	0.01	25	0.133	0.005	7
3	Spoudias pinnata	30	9.55	4	15.14	0.01	1	0.006	0.006	8
4	Cananga odorata	26	8.28	5	14.22	0.01	1	0.006	0.006	9
5	Polyalthia longifolia	24	7.64	6	14.54	0.01	15	0.090	0.006	10
6	Alstonia macrophylla	22	7.00	7	14.25	0.01	2	0.012	0.006	11
7	Alstonia scholaris	28	8.91	6	19.79	0.01	1	0.008	0.008	12
8	Areca catechu	32	10.19	3	12.92	0.01	10	0.053	0.005	13
9	Caryota urens	20	6.37	5	8.41	0.00	1	0.003	0.003	14
10	Cocos nucifera	34	10.82	4	19.45	0.01	300	2.407	0.008	15
11	Chrysalidocarpus lutescens	25	7.96	3	7.89	0.00	1	0.003	0.003	16
12	Tecoma stans	31	9.87	2	8.09	0.00	2	0.007	0.003	17
13	Spathodea campanulate	39	12.41	5	31.99	0.01	3	0.040	0.013	18
14	Oroxylon indicum	21	6.68	6	11.13	0.00	1	0.005	0.005	19
15	Casuarina equisetifolia	24	7.64	4	9.69	0.00	4	0.016	0.004	20
16	Terminalia catappa	26	8.28	3	8.53	0.00	4	0.014	0.004	21
17	Muntingia calabura	37	11.78	4	23.04	0.01	3	0.029	0.010	22
18	Bridelia retusa	44	14.01	5	40.72	0.02	2	0.034	0.017	23
19	Mallotus tetracoccus	46	14.64	6	53.41	0.02	2	0.044	0.022	24
20	Phyllanthus acidus	37	11.78	5	28.80	0.01	1	0.012	0.012	25

21	Phyllanthus emblica	35	11.14	4	20.61	0.01	2	0.017	0.009	26
22	Macaranga indica	33	10.50	6	27.49	0.01	10	0.113	0.011	27
23	Abrus pricatorium	36	11.46	5	27.26	0.01	2	0.022	0.011	28
24	Gliricidia sepum	39	12.41	3	19.20	0.01	25	0.198	0.008	29
25	Pongamia pinnata	42	13.37	5	37.10	0.02	2	0.031	0.015	30
26	Adenanthera pavonina	45	14.32	2	17.04	0.01	2	0.014	0.007	31
27	Dalbergia sisso	48	15.28	6	58.16	0.02	1	0.024	0.024	32
28	Butea monosperma	29	9.23	2	7.08	0.00	1	0.003	0.003	33
29	Bauhinia purpurea	31	9.87	4	16.17	0.01	5	0.033	0.007	34
30	Delonix regia	33	10.50	3	13.74	0.01	1	0.006	0.006	35
31	Saraca asoka	26	8.28	5	14.22	0.01	2	0.012	0.006	36
32	Cassia fistula	25	7.96	2	5.26	0.00	3	0.007	0.002	37
33	Cassia siamea	22.5	7.16	5	10.65	0.00	5	0.022	0.004	38
34	Tamarindus indica	20	6.37	4	6.73	0.00	10	0.028	0.003	39
35	Peltophorum pterocarpum	17.5	5.57	3	3.87	0.00	10	0.016	0.002	40
36	Acacia caesia	26	8.28	5	14.22	0.01	1	0.006	0.006	41
37	Acacia auriculiformis	28	8.91	6	19.79	0.01	2	0.016	0.008	42
38	Samania saman	32	10.19	4	17.23	0.01	5	0.036	0.007	43
39	Cinnamomum camphora	30	9.55	6	22.72	0.01	1	0.009	0.009	44
40	Cinnamomum zeylanicum	24	7.64	3	7.27	0.00	4	0.012	0.003	45
41	Strychnos nux-vomica	28	8.91	5	16.49	0.01	4	0.027	0.007	46
42	Magnolia nilgirica	35	11.14	4	20.61	0.01	1	0.009	0.009	47
43	Azadirachta indica	31	9.87	5	20.21	0.01	5	0.042	0.008	48
44	Cipadessa baccifera	31.4	9.99	6	24.89	0.01	1	0.010	0.010	49
45	Artocarpus heterophyllus	31.8	10.12	4	17.02	0.01	50	0.351	0.007	50
46	Artocarpus incises	32.2	10.25	3	13.09	0.01	2	0.011	0.005	51
47	Ficus auriculata	32.6	10.38	5	22.35	0.01	1	0.009	0.009	52
48	Ficus benghalensis	33	10.50	6	27.49	0.01	1	0.011	0.011	53
49	Ficus religiosa	33.4	10.63	4	18.77	0.01	1	0.008	0.008	54
50	Ficus racemosa	33.8	10.76	5	24.03	0.01	2	0.020	0.010	55
51	Myristica fragrans	34.2	10.89	6	29.52	0.01	15	0.183	0.012	56
52	Eucalyptus globulus	34.6	11.01	4	20.15	0.01	1	0.008	0.008	57
53	Eugenia caryophyllata	35	11.14	3	15.46	0.01	1	0.006	0.006	58
54	Syzygium cumini	35.4	11.27	5	26.36	0.01	2	0.022	0.011	59
55	Dendrocalamus strictus	35.8	11.40	6	32.35	0.01	20	0.267	0.013	60
56	Caralia brachiate	36.2	11.52	3	16.54	0.01	2	0.014	0.007	61
57	Aegle marmelos	36.6	11.65	4	22.54	0.01	1	0.009	0.009	62
58	Morinda citrifolia	37	11.78	2	11.52	0.00	1	0.005	0.005	63
59	Anthocephalus kadamba	37.4	11.90	6	35.31	0.01	1	0.015	0.015	64
60	Santalum album	37.8	12.03	5	30.05	0.01	10	0.124	0.012	65
61	Chrysophyllum cainito	38.2	12.16	4	24.56	0.01	2	0.020	0.010	66
62	Achras zapota	38.6	12.29	3	18.80	0.01	4	0.031	0.008	67
63	Mimusops elenji	39	12.41	2	12.80	0.01	4	0.021	0.005	68
64	Pouteria campechiana	39.4	12.54	3	19.59	0.01	1	0.008	0.008	69
65	Ailanthus excelsa	39.8	12.67	2	13.33	0.01	4	0.022	0.005	70
66	Simarouba glauca	40.2	12.80	2	13.60	0.01	2	0.011	0.006	71
67	Kleinhovia hospita	40.6	12.92	4	27.74	0.01	1	0.011	0.011	72
68	Trema orientalis	41	13.05	5	35.36	0.01	2	0.029	0.015	73
69	Citharexylum spinosum	41.4	13.18	5	36.05	0.01	1	0.015	0.015	74
70	Gmelina arborea	41.8	13.31	3	22.05	0.01	1	0.009	0.009	75
71	Tectona grandis	42.2	13.43	2	14.98	0.01	20	0.124	0.006	76
72	Mesua ferra	42.6	13.56	2	15.27	0.01	1	0.006	0.006	77
73	Bombax malabaricum	43	13.69	4	31.11	0.01	2	0.026	0.013	78
74	Lagerstroemia indica	43.4	13.81	3	23.77	0.01	10	0.098	0.010	79
75	Auracaria heterophulla	43.8	13.94	4	32.28	0.01	3	0.040	0.013	80
76	Cycas circinalis	44.2	14.07	2	16.44	0.01	2	0.014	0.007	81
77	Cycas revoluta	36	11.46	3	16.36	0.01	3	0.020	0.007	82
						Total	428	3.317	0.1899	

Details of the trees having diameter more than 15cm and having heights above 150cm from ground level is taken for the study

CARBON FOOTPRINT OF THE CAMPUS (2019-20)

Various carbon emitting activities such as consumption of energy, transportation and waste generation leads to the total emission of **106.67 tCO_2e** per year by the campus. The total carbon sequestration by trees in the campus compound is **2.65 tCO_2e**.

Thus, the current carbon footprint of the campus will be the difference of total carbon emission and total carbon sequestration/mitigation. the following table shows the carbon footprint level of 2020-21.

Specific CO2 Footprint

Amount of Carbon to be mitigated for Low Carbon Campus				
Sl No	Particulars	2018-19	2019-20	2020-21
1	Total carbon emission tCO2e	113.60	106.67	59.03
2	Total carbon sequestration tCO2e	2.49	2.65	3.32
3	Amount of carbon mitigated through renewable energy tCO2e	66.32	57.63	63.42
4	To be mitigated tCO2e	44.79	46.39	-7.71
5	Total No of Students	1793	1778	1848
6	Specific Carbon Footprint kg CO2e/Student/Yr	24.98	26.09	-4.17

The total specific carbon emission is estimated as **26.09** kg of CO_2e per student for the year 2019-20 and **-4.17** kg of CO_2e per student for the year 2020-21. (the reduction in CO2 foot print is due to the impact of pandemic year)

4

Carbon Mitigation Plans

The total emission of the carbon dioxide per student is **26.09** kg per year (2019-2020). Emission reduction plans were prepared to bring the existing per capita carbon footprint to zero or below so as to bring the campus a carbon neutral or carbon negative campus.

This can be achieved in many ways but, every alternate plan must be in such a way that, it must fulfill the actual purpose of each activity that is considered.

Here, three major methods are taken in to account as the plans for reducing the carbon emission of the campus.

- Resource optimisation
- Energy efficiency
- Renewable energy

RESOURCE OPTIMISATION

The effective use of resources can limit its unnecessary wastage. Optimal usage of the resources (such as fuels) can save the fuel and can also reduce the carbon emission due to its consumption. This technique can be effectively implemented in the 'transportation' and 'waste' sectors of the campus.

WASTE MINIMISATION

Optimal utilisation of paper and plastic stationaries can reduce the frequency of purchase of items. This can reduce the unnecessary wastage of money as well as the excess production of waste. In the case of food, proper food habits and housekeeping practices can optimise its usage.

Currently, the campus is taking an appreciable effort to reduce the unnecessary production of wastes. But the campus still has opportunities to reduce the generation of waste and can improve much more. Resource optimisation can be effectively implemented in all type of waste generated in the campus and the campus can expect about 50% reduction the total waste produced.

ENERGY EFFICIENCY

Energy efficiency is the practice of reducing the energy requirements while achieving the required energy output. Energy efficiency can be effectively implemented in all the sectors of the campus.

FUELS FOR COOKING

The campus uses commercial LPG cylinders for its cooking purpose. The campus installed biogas plant to treat food waste and the biogas thus generated used in kitchen. Installation of a solar water heater to rise the water temperature to a much higher level, then it has to consume only very less amount of thermal energy for preparing the same amount of food is another method. This can make a positive benefit to the campus by saving money, energy and can reduce the carbon emission of the campus due to thermal energy consumed for cooking.

TRANSPORTATION

Energy efficiency of the transportation sector is mainly depended on the fuel efficiency of the vehicles used. Here mileage of the vehicle (kmpl - Kilometres per Litre) is calculated to assess the fuel efficiency of the vehicle.

Percentage of closeness is the ratio of actual mileage of the vehicle to its expected mileage. If the percentage of closeness of mileages of each vehicle is greater than that of its average, then the efficiency status of the vehicle is considered as 'Above average' and else, it is considered as 'Below average'

Carbon Mitigation Proposals

After analyzing the historical and measured data the following projects are proposed to make the campus carbon neutral. The projects are from energy efficiency and renewable energy. The further additions in the green cover increase will also give positive impact in the carbon mitigation.

OTTOTRACTIONS- ENERGY AUDIT						
PROVIDENCE WOMEN'S COLLEGE						
Greenhouse Gas Mitigation through Major Energy Efficiency Projects						
Sl No	Projects	Energy saved(Yearly)		Sustainability (Years)	First year ton of CO_2	CO_2 mitigated through out
		(kWh)	MWh	Years		
1	Energy Saving in Lighting by replacing existing 186 No's T8 Lamps to 20W LED Tube	**2976**	2.98	10	2.17	21.72
2	Energy Saving in Lighting by replacing existing 115 No's T12 (55W) Lamps to 18 W LED Tube	**4238**	4.24	10	3.09	30.94
3	Energy Saving in Lighting by replacing existing 8 No's CFL(15W) Lamps to 9W LED	**67**	0.07	10	0.05	0.49
4	Energy Saving by replacing existing 381 No's inefficient ceiling fans with Energy Efficient Five star fans	**11582**	11.58	10	8.46	84.55
Total		**18863**	**19**	**10**	**13.77**	**138**

OTTOTRACTIONS- ENERGY AUDIT						
PROVIDENCE WOMEN'S COLLEGE						
Greenhouse Gas Mitigation through Renewable Energy Projects						
Sl No	Projects	Energy saved(Yearly)		Sustainability (Years)	First year ton of CO_2 mitigated	CO_2 mitigated through out life
		(kWh)	MWh	Years		
1	Energy Generation from 37kWp Solar Power Plant installed	**50644**	50.64	25	36.97	924.25
2	Installation of 40 kWp Solar Power Plant	**51100**	51.10	26	41.90	1089.45

Energy Saving Proposal Code EA 804.01	
Energy Saving in Lighting by replacing existing 186 No's T8 Lamps to 20W LED Tube	
Existing Scenario	
186 numbers of T8 lamps were identified during the energy audit field survey in the facility. During discussion with staffs it is observed that the average utility of these fittings are of 30%.	
Proposed System	
The existing T8 may be replaced to LED tube of 20 W in phased manner and the savings will be of 50 % (inclusive of improved light output and reduced energy consumption)	
Financial Analysis	
Annual working hours (hr)	2000
No of fittings	186
Total load (kW)	7.44
Annual Energy Consumption (kWh)	5952
Expected Annual Energy saving for replacing all fittings (kWh)	2976
Cost of Power	8.00
Annual saving in Lakhs Rs (1st year)	0.24
Investment required for complete replacements [@Rs 300 per fittings](Lakhs Rs)	0.56
Simple Pay Back (in Months)	28.13

OTTOTRACTIONS- ENERGY AUDIT	
Energy Saving Proposal Code EA 776.05	
Energy Saving in Lighting by replacing existing 115 No's T12 (55W) Lamps to 18W LED Tube	
Existing Scenario	
115 numbers of T12(55 W) lamps were identified during the energy audit field survey in the facility. During discussion with officers it is observed that the average utility of these fittings are of 30%.	
Proposed System	
The existing T12 may be replaced to LED Tube of 18 W in phased manner and the savings will be of 67% (inclusive of improved light output and reduced energy consumption)	
Financial Analysis	
Annual working hours (hr)	2000
No of fittings	115
Total load (kW)	6.33
Annual Energy Consumption (kWh)	6325
Expected Annual Energy saving for replacing all fittings (kWh)	4238
Cost of Power	8.00
Annual saving in Lakhs Rs (1st year)	0.34
Investment required for complete replacements [@Rs 300 per fittings](Lakhs Rs)	0.35
Simple Pay Back (in Months)	12.21

OTTOTRACTIONS- ENERGY AUDIT	
Energy Saving Proposal Code EA 804.03	
Energy Saving in Lighting by replacing existing 8 No's CFL(15W) Lamps to 9W LED BULB	
Existing Scenario	
8 numbers of CFL(15 W) lamps were identified during the energy audit field survey in the facility. During discussion with officers it is observed that the average utility of these fittings are of 30%.	
Proposed System	
The existing CFL may be replaced to LED bulb of 9W in phased manner and the savings will be of 40% (inclusive of improved light output and reduced energy consumption)	
Financial Analysis	
Annual working hours (hr)	2000
No of fittings	8
Total load (kW)	0.12
Annual Energy Consumption (kWh)	168
Expected Annual Energy saving for replacing all fittings (kWh)	67
Cost of Power	8.00
Annual saving in Lakhs Rs (1st year)	0.01
Investment required for complete replacements [@Rs 170 per fittings](Lakhs Rs)	0.01
Simple Pay Back (in Months)	30.36

Energy Saving Proposal Code EA 804.04	
Energy Saving by replacing existing 381 No's in-efficient ceiling fans with Energy Efficient Five star fans	
Existing Scenario	
There are 381 numbers of ceiling fans installed in the facility with minimum 8 hrs a day operation. All are conventional type and most of them are very old.	
Proposed System	
There is an energy saving opportunity in replace the existing fans with new five star labelled fans. The five star labelled fans give a savings up to 38% with higher service value (air delivery/watt).	
Financial Analysis	
Annual working hours (hrs)	2000
Total numbers of ordinary fans	381
Total load (kW)	30.48
Annual Energy Consumption (kWh)	30480
Expected Annual Energy saving, for total replacement(kWh)	11582
Cost of Power (Rs)	8.00
Annual saving in Lakhs Rs (1st year)	0.93
Investment required for a total replacement (Lakhs Rs)[@2175 Rs per Fan with 50W at full speed]	8.29
Simple Pay Back (in Months)	107.32

Energy Saving Proposal Code 804.05	
Installation of 40 kWp Solar Power Plant	
Existing Scenario	
There is a good potential of solar power electricity generation. The availability of sunlight is very high. There are some canopies available in the proposed site, but by having proper trimming of trees this may be avoided. If the SPVs are place in the roof top it will help improving RTTV (Roof Thermal Transmit Value) of the building.	
Proposed System	
It is proposed to have a Solar Power Plant of 40kW at the beginning stage. The state and central government is pushing and giving good assistance to the installation. It can be installed as an internal grid connected system which is much cheaper than off grid system. Now days the technology provides trouble free grid interactive and connected system. The installation will provide 25yrs trouble free generation with only 20% efficiency loss at the 25th year.	
Financial Analysis	
Proposed Solar installed Capacity (kW)	40
Total average kWh per day expected (3.5kWh/day average)	140.00
Total annual Generating Capacity (kWh)	51100
Cost of energy generated annually Lakhs Rs	4.09
Investment required (INR lakh)(Approx)	30.00
Simple Pay Back (in Months)	88.06
Life cycle in Yrs	25
Total Saving in Life Cycle (Approx) RS lakh	102.20

Executive Summary					
Consolidated Cost Benefit Analysis of Energy Efficiency Improvement Projects					
PROVIDENCE WOMEN'S COLLEGE					
Sl No	Projects	Investment	Cost saving	SPB	Energy saved
		(Lakhs Rs)	(Rs)/Yr	Months	kWh/Yr
1	**Energy Saving in Lighting by replacing existing 186 No's T8 Lamps to 20W LED Tube**	1.54	0.24	77.81	2976
2	**Energy Saving in Lighting by replacing existing 115 No's T12 (55W) Lamps to 18 W LED Tube in Third Floor**	0.95	0.34	33.79	4238
3	**Energy Saving in Lighting by replacing existing 8 No's CFL(15W) Lamps to 9W LED BULB in GROUND and first Floor**	0.01	0.005	30.36	67
4	**Energy Saving by replacing existing 381 No's in-efficient ceiling fans with Energy Efficient Five star fans**	8.29	0.93	107.32	11582
	Total	10.80	1.51	62.32	18863.35
(The saving are projected as per the assumed operation time observed based in the discussions with the plant officials. The data of saving percentages are taken from BEE guide books and field measurements.)					
Consolidated Cost Benefit Analysis of Renewable Energy Projects					
5	**Installation of 40 kWp Solar Power Plant**	30.00	4.09	88.06	51100

5

CONCLUSION

The carbon emission from different sectors namely, Energy, Transportation and wastes were calculated using standard procedures. Carbon sequestration by the trees present in the campus was also estimated. From these the total carbon footprint of the campus was arrived at.

Net Carbon Emission after implementing Energy Efficiency projects and Renewable Energy Projects Proposed		
1	Total Carbon Foot Print tCO2e/yr	106.67
2	Carbon Sequestrated tCO2e/yr	2.65
3	Carbon mitigated by Renewable Energy tCO2e/yr (installed) (Solar)	36.97
4	Carbon mitigated by Renewable Energy tCO2e/yr (Proposed) (Solar)	41.90
5	Carbon mitigated by Renewable Energy (Installed) (Biogas)	28.98
6	Carbon mitigated by Energy Efficiency (Proposed) tCO2e/yr	13.77
7	Effective Carbon footprint tCO2e/yr	-17.60
8	Total No of Students	1778.00
9	Specific Carbon Footprint kg CO2e/Student/Yr	-9.90

From this study it was found that carbon footprint of the campus to be **26.09** $kgCO_2e$/ Student/ Year in place of current footprint i.e., **-9.90** $kgCO_2e$/ student/ Year. This will be achieved after implementing energy efficiency projects and implementation of 40kWp solar power plant. To achieve this an investment of **39.20 lakhs Rs** is required through energy efficiency and renewable energy projects proposed. It will be around **2204.9 Rs per student** to make the campus the carbon negative.

Cost to make the campus Carbon Negative		
1	Cost of implementation in Energy Efficiency Lakhs Rs	9.20
2	Cost of implementation in Renewable Energy Lakhs Rs	30.00
3	Total Lakhs Rs	39.20
4	Total number of students	1778
5	Cost per student to make the campus carbon negative Rs/ Student	2204.9

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OTTOTRACTIONS
Energy-Engineering-Environment

6

TECHNICAL SUPPLEMENT

PROVIDENCE WOMEN'S COLLEGE												
LOCATION	LIGHT					FAN		IT		AC		
	T8	T12	CFL	LED TUBE	LED BULB	CF	EF	PC	Projector	1.5	2tr	3tr
Hall	4					5			1			
Classroom 1-5	5					10						
Computer room	1					2		5				
Staffroom	1					2						
Principal room	1					2						
Auditorium	10					32						
Science Block												
Physics section	6	3			1	8						
Chemistry section Staffroom		1				3						
Chemistry lab		5		2		9	4					
Classroom 1-2				2		2						
Class 1		1				1						
Class 2	1					1						

Hostel *137	137					137						
canteen						3						
Library Block		39				48						
Office Block	5	4		2		6		1				
Conference room		8		1		3						
Audio visual room	3		8	4		4						
Network admin	1					1						
Principal room	3	1		2		3						
Classroom 1-8	8					16						
Computer lab						10		101		1		1
Class 1-5		10				10						
Assembly block		43				21		4				
PG Block *3					12	42			3	5		
Total	**186**	**115**	**8**	**13**	**13**	**381**	**4**	**111**	**4**	**6**	**0**	**1**

List of trees in the campus

Sl. No	Botanical name	Common name	Family	Number of trees
1	Anacardium occidentale	Parangi mavu	Anacardiaceae	10
2	Mangifera indica	Mavu	"	25
3	Spoudias pinnata	Ambazham	"	1
4	Cananga odorata	Swarna chembakam	Annonaceae	1
5	Polyalthia longifolia	Aranamaram	"	15
6	Alstonia macrophylla	Devils tree	Apocynaceae	2
7	Alstonia scholaris	Yakshippala	"	1
8	Areca catechu	Kavungu	Arecaceae	10
9	Caryota urens	Anappana	"	1
10	Cocos nucifera	Thengu	"	300
11	Chrysalidocarpus lutescens	Palm	"	1
12	Tecoma stans	Manja arali	Bignoniaceae	2
13	Spathodea campanulate		"	3
14	Oroxylon indicum	Palaka payyani	"	1
15	Casuarina equisetifolia	Kattadi	Casuarinaceae	4
16	Terminalia catappa		Combretaceae	4
17	Muntingia calabura	Panchara pazham	Elaeocarpaceae	3
18	Bridelia retusa		Euphorbiaceae	2
19	Mallotus tetracoccus		"	2
20	Phyllanthus acidus		"	1
21	Phyllanthus emblica		"	2
22	Macaranga indica	Vatta/Uppoothi	"	10

23	Abrus pricatorium	Kunnikkuru	Fabaceae- Papilionaceae	2
24	Gliricidia sepum	Seema Konna	"	25
25	Pongamia pinnata		"	2
26	Adenanthera pavonina	Manjadi	"	2
27	Dalbergia sisso	Irool	"	1
28	Butea monosperma	Plasu	"	1
29	Bauhinia purpurea	Mandaram	Caesalpiniaceae	5
30	Delonix regia	Gulmohar	"	1
31	Saraca asoka	Asokam	"	2
32	Cassia fistula	Kanikonna	"	3
33	Cassia siamea		"	5
34	Tamarindus indica	Valan puli	"	10
35	Peltophorum pterocarpum	Copper pod	"	10
36	Acacia caesia	Inja	Mimosaseae	1
37	Acacia auriculiformis		"	2
38	Samania saman	Rain tree	"	5
39	Cinnamomum camphora		Lauraceae	1
40	Cinnamomum zeylanicum	Karuvapatta	"	4
41	Strychnos nux-vomica	Kanjiram	Loganiaceae	4
42	Magnolia nilgirica	Chambakam	Magnoliaceae	1
43	Azadirachta indica	Aryaveppu	Meliaceae	5
44	Cipadessa baccifera		"	1
45	Artocarpus heterophyllus	Plavu	Moraceae	50
46	Artocarpus incises	Breadfruit"	"	2
47	Ficus auriculata	Athi	"	1
48	Ficus benghalensis	Peral	"	1
49	Ficus religiosa	Arayal	"	1
50	Ficus racemosa	Athi	"	2
51	Myristica fragrans	Jathi	Myristicaceae	15

52	Eucalyptus globulus	Eucalyptus	Myrtaceae	1
53	Eugenia caryophyllata	Clove	"	1
54	Syzygium cumini	Njaval	"	2
55	Dendrocalamus strictus		Poaceae	20
56	Caralia brachiate		Rhizophoraceae	2
57	Aegle marmelos	Koovalam	Rutaceae	1
58	Morinda citrifolia	Noni	Rubiaceae	1
59	Anthocephalus kadamba	Kadambu	"	1
60	Santalum album	Chandanam	Santalaceae	10
61	Chrysophyllum cainito	Swarnapathri	Sapotaceae	2
62	Achras zapota	Sapota	"	4
63	Mimusops elenji	elanji	"	4
64	Pouteria campechiana	Egg fruit	"	1
65	Ailanthus excelsa	Matti	Simaroubaceae	4
66	Simarouba glauca	Lakshmitharu	"	2
67	Kleinhovia hospita		Sterculiaceae	1
68	Trema orientalis	amapotti	Ulmaceae	2
69	Citharexylum spinosum	Parijatham	Verbanaceae	1
70	Gmelina arborea	Kumizhu	"	1
71	Tectona grandis	Thekku	"	20
72	Mesua ferra	Nagamaram	Clusiaceae	1
73	Bombax malabaricum	Elavu	Bombacaceae	2
74	Lagerstroemia indica	Manimaruth	Lytharaceae	10
75	Auracaria heterophulla	Christmas tree	Auracariaceae	3
76	Cycas circinalis		Cyacadaceae	2
77	Cycas revoluta		"	3