GREEN AUDIT REPORT

NOBLE WOMEN'S COLLEGE
MANJERI

Executed by

OTTO TRACTIONS

2023

OTTO TRACTIONS

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OTTOTRACTIONS
Energy-Engineering-Environment

Green Audit Report
Noble Women's College, Manjeri
Report No: EA 999
2023

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. Ottotractions is an ISO 9001-2015, ISO 17020-2012 and ISO 14001-2015 Certified organization, which ensures the quality of its services.

Acknowledgment

We were privileged to work together with the administration and staff of Noble Women's College, Manjeri 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
Government of India

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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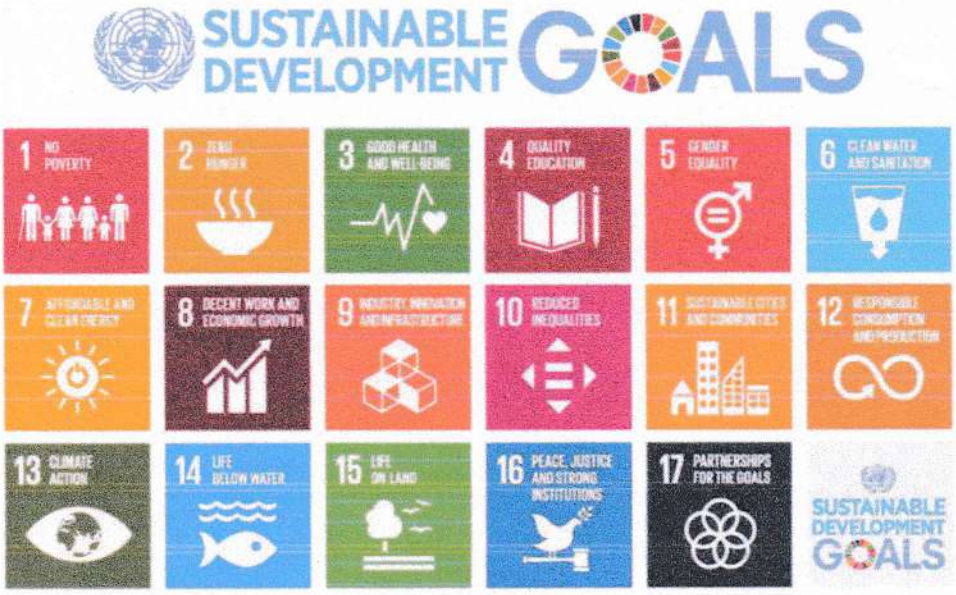
Introduction

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 college 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.

NOBLE WOMEN'S COLLEGE, MANJERI

To mould many young minds towards excellence through education, the management of Islahi Educational Society (I E S) Manjeri a registered charitable Society under societies Registration Act of 1860 (No 396/96) consisting of religious reformers, educationalists and social activists started NOBLE WOMEN'S COLEEGE in 2011 with an aim to uplift the Muslim Community in particular and the society in general by providing quality and moral based education under a conducive cultural environment.

The college has all physical amenities and very efficient faculties. The college is a major hub for young women folk to undergo their higher education in a 'safe' Campus. The upliftment of the half section of the society by facilitating good quality education with cultural ethics and social values as such will lead to empowerment of women

which the society and nation aspire and achieve our motto-Best Education Better Generation

Occupancy Details			
Particulars	2020-21	2021-22	2022-23
Total Students	734	845	859
Staffs	35	43	54
Total Occupancy of the college	769	888	913

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

Form-A							
BASELINE DATA SHEET FOR GREEN AUDIT							
1	Name of the Organisation	NOBLE WOMEN'S COLLEGE, MANJERI					
2	Address (include telephone, fax & e-mail)	NOBLE CAMPUS, VETTEKODE, PULLANCHERI P.O., MANJERI MALAPPURAM DIST, PIN:676121 0483- 2766 364, principal@naasmanjeri.org					
2	Year of Establishment	2011					
3	Name of building and Total No. of Electrical Connections/building	NOBLE WOMEN'S COLLEGE					
4	Total Number of Students	Boys		Girls	859	Total	859
5	Total Number of Staff	54					
6	Total Occupancy	913					
7	Total area of green cover	50%					
8	Type of Electrical Connection	HT	0	LT	1		
9	Total Connected Load (kW)	23					
10	Average Maximum Demand (KVA)	-					
11	Total built up area of the building (M^2)	3500					
12	Number of Buildings	1					
13	Average system Power Factor	0.98					
14	Details of capacitors connected	NA					
15	Transformer Details (Nos., kVA, Voltage ratio)	TR 1					
		NA					
15	DG Set Details (kVA,)	DG1	DG2	DG3	DG4	DG5	Remarks
		3					
16	Details of motors	Rating		Nos.		Remarks	
		5 to 10					
		10 to 50					
		Above 50					
17	Brief write-up about the firm and the energy/environmental conservation activities already undertaken.	Installed LED Lights, 10kWp Solar power plant etc.					
18	Contact Person & Telephone number	Jisna N T					
		9539989978					

2
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 913 occupants of this campuses will reach same number of households. This message will spread to at least 3652 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.

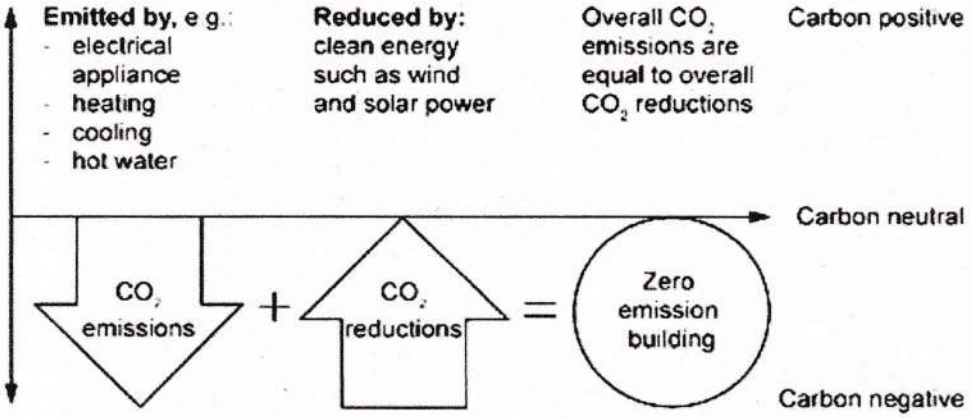
Global Warming Potential (GWP) is a measure of how much heat a greenhouse gas traps in the atmosphere up to a specific time horizon, relative to carbon dioxide. The Global Warming Potential (GWP) was developed to allow comparisons of the global warming impacts of different gases. Specifically, it is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

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)

Only vehicles operate from the campus will take in to the account of transportation. The private vehicles are not considered for accounting carbon foot print. As private vehicle footprint will be in the account for personal footprint.

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 below.

Step 1: Determine the total green weight of the tree

The green weight is the weight of the tree when it is alive. First, you have to calculate the green weight of the above-ground weight as follows:

W above-ground= 0.25 D2 H (for trees with D<11)

W above-ground= 0.15 D2 H (for trees with D>11)

W above-ground= Above-ground weight in pounds

D = Diameter of the trunk in inches

H = Height of the tree in feet

The root system weight is about 20% of the above-ground weight. Therefore, to determine the total green weight of the tree, multiply the above-ground weight by 1.2:

$W_{\text{total green weight}} = 1.2 * W_{\text{above-ground}}$

Step 2: Determine the dry weight of the tree

The average tree is 72.5% dry matter and 27.5% moisture. Therefore, to determine the dry weight of the tree, multiply the total green weight of the tree by 72.5%.

$W_{\text{dry weight}} = 0.725 * W_{\text{total green weight}}$

Step 3: Determine the weight of carbon in the tree

The average carbon content is generally 50% of the tree's dry weight total volume. Therefore, in determining the weight of carbon in the tree, multiply the dry weight of the tree by 50%.

$W_{\text{carbon}} = 0.5 * W_{\text{dry weight}}$

Step 4: Determine the weight of carbon dioxide sequestered in the tree

CO_2 has one molecule of Carbon and 2 molecules of Oxygen. The atomic weight of Carbon is 12 (u) and the atomic weight of Oxygen is 16 (u). The weight of CO_2 in trees is determined by the ratio of CO_2 to C is 44/12 = 3.67. Therefore, to determine the weight of carbon dioxide sequestered in the tree, multiply the weight of carbon in the tree by 3.67. $W_{\text{carbon-dioxide}} = 3.67 * W_{\text{carbon}}$

3

RESULTS AND DISCUSSIONS

3.1 CARBON FOOTPRINT ESTIMATION

3.1.1 ENERGY

a. Electricity

Electricity is purchased from KSEB under 1 LT-6A Ndom Connection, the details are given below.

Electricity Connection Details		
NOBLE WOMEN'S COLLEGE, MANJERI		
1	Name of the Consumer	NOBLE WOMEN'S COLLEGE, MANJERI
2	Tariff	LT-6A 3Ph
3	Consumer Numbers	1165474048654
5	Connected Load Total (kW)	23
6	Annual Electricity Consumption (kWh)	6490

Electricity Bill Analysis

Name of the Consumer		NOBLE WOMEN'S COLLEGE, MANJERI			
Connected load	**23**	Consumer no	**1165474048654**		
Tariff	LT-6A 3Ph	Section	**Manjeri North**		
Month	**kWh Import**	**kWh Export**		**Rs (Total)**	**Rs/kwh**
Apr-22	2222	476		19107	**8.60**
May-22	1251	347		9584	**7.66**
Jun-22	1497	297		11465	**7.66**
Jul-22	1718	343		15635	**9.10**
Aug-22	757	432		5799	**7.66**
Sep-22	519	644		3976	**7.66**
Oct-22	503	556		3964	**7.88**
Nov-22	964	471		7899	**8.19**
Dec-22	771	308		8107	**10.51**
Jan-23	533	695		3968	**7.44**
Feb-23	542	605		3968	**7.32**
Mar-23	794	407		5207	**6.56**

b. Diesel

Diesel Consumption Details				
	Transportation	Generator	Total	cost
	in L	in L	in L	in Rs
20-21	2760	0	2760	262200
21-22	6420	0	6420	609900
22-23	7667	0	7667	728388

c. LPG

LPG Consumption Details			
	200-21	2021-22	2022-23
No Cylinders	8	16	20
Total in kg	120	240	300

Base Line Energy Data				
NOBLE WOMEN'S COLLEGE, MANJERI				
		2020-21	2021-22	2022-23
1	Electricity KSEB (kWh)	4543	6165	6490
2	Electricity Solar, Off grid (kWh)	0.00	0.00	0.00
3	Electricity (KSEB + Off grid) kWh	4543	6165	6490
4	Electricity Grid Tied (kWh)	5581	5581	5581
5	Diesel (L)	2760	6420	7667
6	LPG (kg)	120	240	300.00
7	Biogas (m3)	330.00	330.00	330.00

Energy Consumption Profile				
Sl No	Fuel	2020-21	2021-22	2022-23
		(kCal)	(kCal)	(kCal)
1	Electricity	3906882	5302197	5581260
2	Diesel	28980000	67410000	80506042
3	LPG	1440000	2880000	3600000
4	Biogas	1155000	1155000	1155000
Total		35481882	76747197	90842302

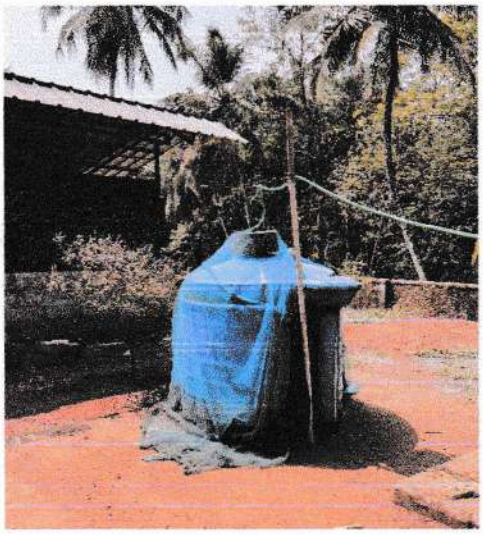
Thermal Fuel Consumption			
NOBLE WOMEN'S COLLEGE, MANJERI			
	2020-21	2021-22	2022-23
Annual LPG consumption in kg	120	240	300
Annual Diesel consumption in L	2760	6420	7667
Annual petrol consumption in L	0	0	0
Annual Biogas consumption in m3	330	330	330

Specific Energy Consumption

OTTOTRACTIONS- ENERGY AUDIT				
NOBLE WOMEN'S COLLEGE, MANJERI				
Energy Performance Index (EPI)				
Sl No	Particulars	2020-21	2021-22	2022-23
1	Total building area (m^2)	3500	3500	3500
2	Annual Energy Consumption (kCal)	35481882	76747197	90842302
3	Annual Energy Consumption (kWh)	41258	89241	105631
4	Total Energy in Toe	3.55	7.67	9.08
5	Specific Energy Consumption kWh/m^2	11.79	25.50	30.18

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			
NOBLE WOMEN'S COLLEGE, MANJERI			
Particulers	2020-21	2021-22	2022-23
Total Occupancy	769	888	913
Waste generated in kg /day	7.69	17.76	18.26
Waste generated in kg /Yr	1691.8	3907.2	4017.2

Non-Degradable waste

Solid non degradable Waste Generation			
NOBLE WOMEN'S COLLEGE, MANJERI			
Particulers	2020-21	2021-22	2022-23
Total Occupancy	769	888	913
Waste paper generated in kg /day	0.1538	0.1776	0.1826
Waste plastic generated in kg /day	0.2307	0.2664	0.2739
Waste paper generated in kg /Yr	33.84	39.07	40.17
Waste plastic generated in kg /Yr	50.75	58.61	60.26

3.4. Transportation

Bus is used for the transportation from the college.

Carbon Emission Profile (2022-23)

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	0.00082	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 2020-23

Carbon Foot Print							
Sl. No.		2020-21	tCO2e	2021-22	tCO2e	2022-23	tCO2e
1	Electricity (kWh)	4543	3.73	6165	5.06	6490	5.32
2	Diesel (L)	2760	8.83	6420	20.54	7667	24.54
3	LPG (kg)	120	0.18	240	0.36	300	0.45
4	Biogas (m3)	330	0.46	330	0.46	330	0.46
5	Degradable Waste in kg/yr.	1692	1.07	3907	2.46	4017	2.53
6	Paper Waste in kg/yr	33.84	0.02	39.07	0.02	40.17	0.02
Total Carbon Foot Print tCO2e/yr			14.28		28.905		33.32

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	2020-21	2021-22	2022-23
Total No of Trees	36	36	36
Carbon sequestrated by trees in the campus (tCO2e)	3.4	3.5	3.73

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 technical supplement.

CARBON FOOTPRINT OF THE CAMPUS (2020-23)

Various carbon emitting activities such as consumption of energy, transportation and waste generation leads to the total emission of **33.32 tCO_2e** per year by the campus. The total carbon sequestration by trees in the campus compound is **3.73 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 2022-23.

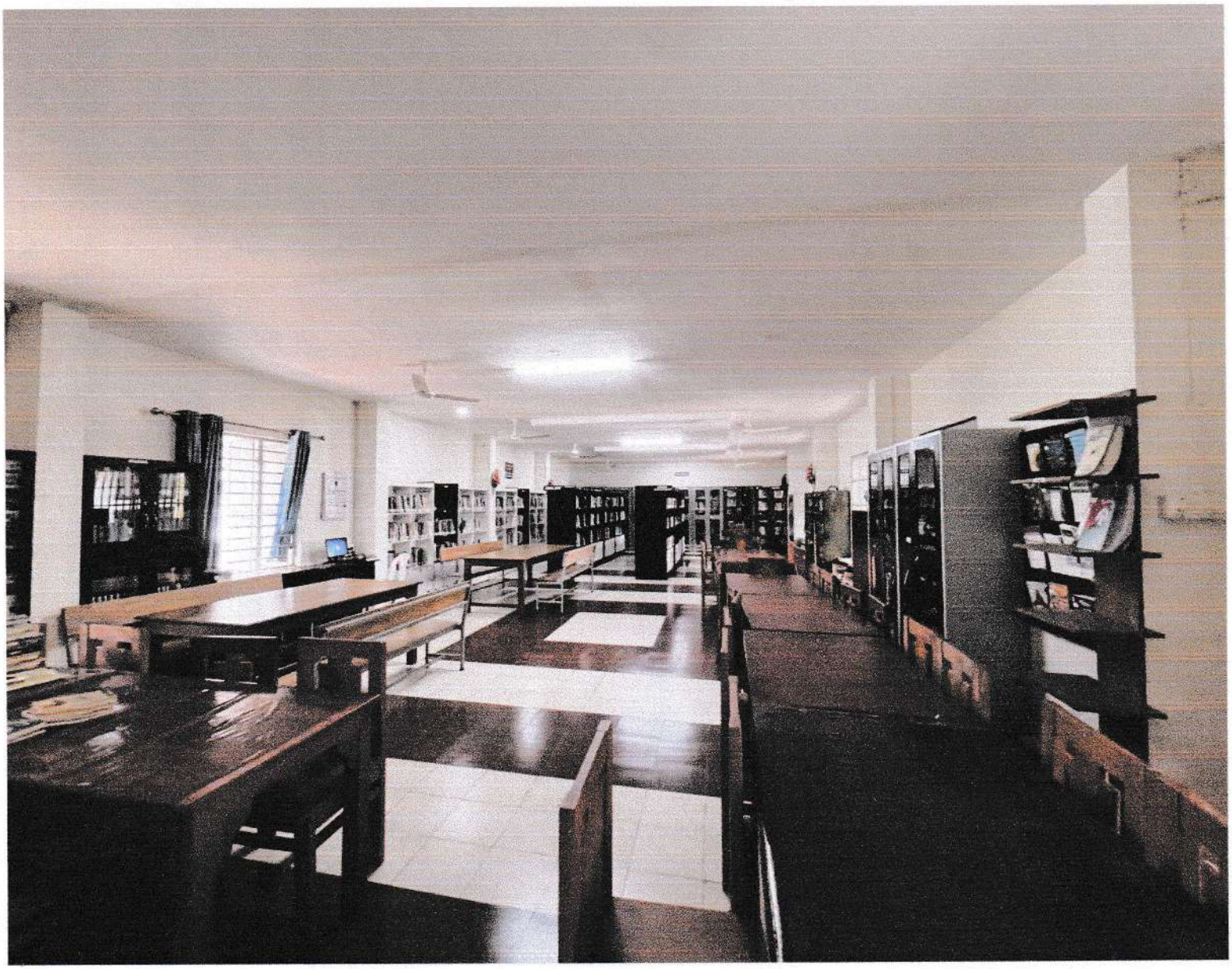
Specific CO2 Footprint

Amount of Carbon to be mitigated for Low Carbon Campus				
Sl No	Particulars	2020-21	2021-22	2022-23
1	Total carbon emission tCO_2e	14.28	28.90	33.32
2	Total carbon sequestration tCO_2e	3.4	3.5	3.73
3	Amount of carbon mitigated through renewable energy tCO_2e	5.04	5.04	5.04
4	To be mitigated tCO_2e	5.89	20.32	24.55
5	Total No of Students	734	845	859
6	Specific Carbon Footprint kg CO_2e/Student/Yr	8.02	24.05	28.58

The total specific carbon emission is estimated as **28.58** kg of CO_2e per student for the year 2022-23.

4

Carbon Mitigation Plans



The total emission of the carbon dioxide per student is **28.58** kg per year (2022-2023). 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 and biogas for its cooking purpose. The biogas plant to treat food waste and the biogas thus generated can be 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						
NOBLE WOMEN'S COLLEGE, MANJERI						
Greenhouse Gas Mitigation through Major Energy Efficiency Projects						
Sl No	Projects	Energy saved(Yearly)		Sustainability (Years)	First year ton of CO2 mitigated	Expected Tons of CO2 mitigated through out life cycle
		(kWh)	MWh	Years		
1	Energy Saving in Lighting by replacing existing 7 No's T8 (40W) Lamps to 18W LED Tube	111	0.11	10	0.08	0.81
2	Energy Saving in Lighting by replacing existing 3 No's T12 (55W) Lamps to 18W LED Tube	80	0.08	10	0.06	0.58
3	Energy Saving by replacing existing 141 No's in-efficient ceiling fans with Energy Efficient Five-star fans	3980	3.98	10	2.91	29.05
Total		**4170**	**4**	**10**	**3.04**	**30.44**

NOBLE WOMEN'S COLLEGE, MANJERI						
Greenhouse Gas Mitigation through Renewable Energy Projects						
Sl No	Projects	Energy saved (Yearly)		Sustainability (Years)	First year ton of CO2 mitigated	Expected Tons of CO2 mitigated through out life cycle
		(kWh)	MWh	Years		
1	Installation of 25kWp Solar Power Plant	34219	34.22	25	24.98	624.49
	Total	34219	34	25	24.98	624

OTTOTRACTIONS- ENERGY AUDIT	
Energy Saving Proposal Code 1	
Energy Saving in Lighting by replacing existing 7 No's T8 (40W) Lamps to 18W LED Tube	
Existing Scenario	
7 numbers of T8(40 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 T8 may be replaced to LED Tube of 18W in phased manner and the savings will be of 55% (inclusive of improved light output and reduced energy consumption)	
Financial Analysis	
Annual working hours (hr)	2400
No of fittings	7
Total load (kW)	0.28
Annual Energy Consumption (kWh)	202
Expected Annual Energy saving for replacing all fittings (kWh)	111
Cost of Power	7.10
Annual saving in Lakhs Rs (1st year)	0.01
Investment required for complete replacements [@Rs 300 per fittings](Lakhs Rs)	0.02
Simple Pay Back (in Months)	32.01

OTTOTRACTIONS- ENERGY AUDIT	
Energy Saving Proposal Code	
Energy Saving in Lighting by replacing existing 3 No's T12 (55W) Lamps to 18W LED Tube	
Existing Scenario	
257 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 18W 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)	2400
No of fittings	3
Total load (kW)	0.17
Annual Energy Consumption (kWh)	119
Expected Annual Energy saving for replacing all fittings (kWh)	80
Cost of Power	13.39
Annual saving in Lakhs Rs (1st year)	0.01
Investment required for complete replacements [@Rs 300 per fittings](Lakhs Rs)	0.01
Simple Pay Back (in Months)	10.13

OTTOTRACTIONS- ENERGY AUDIT	
Energy Saving Proposal	
Energy Saving by replacing existing 141 No's in-efficent ceiling fans with Energy Efficient Five star fans	
Existing Scenario	
There are 141 numbers of ceiling fans installed in the facilty 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 30% with higher service value (air delivery/watt).	
Financial Analysis	
Annual working hours (hrs)	2400
Total numbers of ordinary fans	141
Total load (kW)	9.87
Annual Energy Consumption (kWh)	14213
Expected Annual Energy saving, for total replacement(kWh)	3980
Cost of Power (Rs)	7.10
Annual saving in Lakhs Rs (1st year)	0.28
Investment required for a total replacement (Lakhs Rs)[@3000 Rs per Fan with 50W at full speed]	4.23
Simple Pay Back (in Months)	179.65

Energy Saving Proposal	
Installation of 25kWp 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 10kW 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)	25
Total average kWh per day expected (3.5kWh/day average)	93.75
Total annual Generating Capacity (kWh)	34219
Cost of energy generated annually Lakhs Rs	4.55
Investment required (INR lakh)(Approx)	13.75
Simple Pay Back (in Months)	36.26
Life cycle in Yrs	25
Total Saving in Life Cycle (Approx) RS lakh	113.78

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	33.32
2	Carbon Sequestrated tCO2e/yr	3.73
3	Carbon mitigated by Renewable Energy tCO2e/yr (Installed)	4.58
4	Carbon mitigated by Renewable Energy tCO2e/yr (Proposed)	24.98
5	Carbon mitigated by Energy Efficiency (Proposed) tCO2e/yr	3.04
6	Effective Carbon footprint tCO2e/yr	-3.01
7	Total No of Students	859
8	Specific Carbon Footprint kg CO2e/Student/Yr	-3.51

From this study it was found that carbon footprint of the campus to be **–3.51** kgCO_2e/ Student/ Year in place of current footprint i.e., **28.58** kgCO_2e/ student/ Year. This will be achieved after implementing energy efficiency projects and implementation of 25kWp solar power plant. To achieve this an investment of **18.01 lakhs Rs** is required through energy efficiency and renewable energy projects proposed. It will be around **496 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	4.26
2	Cost of implementation in Renewable Energy Lakhs Rs	13.75
3	Total Lakhs Rs	18.01
4	Total number of students	859
5	Cost per student to make the campus carbon negative Rs/ Student	2097

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Reports and Books

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- Home Energy Audit Manual (2017), Ottotractions & EMC Kerala, No.ES 26, Pp.114
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OTTOTRACTIONS
Energy-Engineering-Environment

6

TECHNICAL SUPPLEMENT

NOBLE WOMEN'S COLLEGE, MANJERI												
Sl.No	Location	Lights				Fans		IT			Others	
		LED-T	LED-B	T8	T12	CF	WF	Printer	Projector	PC	TV	AC (1TR)
1	II MA English				1	1						
2	Alumini Room				1	1						
3	III BA English			2	1	3						
4	II BBA	2				2						
5	I BBA	2		1		3						
6	IQAC		1			1						
7	English Department	2				2		1		1		
8	Physical Education						1					
9	Library	2	16			11		3		6		
10	Computer Lab	4				7			1	53		
11	Classroom	1				1						
12	II BCA	1				2			1			
13	Ground Floor		10									
14	Computer Science Department		1			2			1	1		
15	I MSc Computer Science	1				1		1				
16	I M Com	1				1						
17	II MSc Computer Science	1				1						
18	III B Com	1				4			1			
19	II MA English	1				1						
20	Corridor		1									
21	I Bsc Psychology	1				2		1				
22	Sociology department	2					1	1		1		
23	Commerce and Management Studies	1				2		1		1		
24	III BSc Psychology	1				2						
25	II BSc Psychology	1				2						
26	Seminar Hall	3				4			1			

27	Psychology Lab	2				4		1		1		
28	Counciling Room					1						
29	Psychology Department	1				2		1		1		
30	I MA Sociology		1			1						
31	II MA Sociology		1			1						
32	II MSc Psychology	1				1						
33	Studio	3	2							1		
34	I BA Sociology		1			4			1			
35	II BA Sociology		1			4						
36	Bcom		2			6						
37	Auditorium	5				16						
38	I BCA	1				2						
39	Corridor		7									
40	III BCA			2		2					1	
41	II BCA			1		2			1			
42	III BA Sociology	1				1						
43	III BA English	1		1		3					1	
44	II Mcom	1				1						
45	Office	4				4	1	2		3		
46	Store	1	1			1		1				
47	Hall	4				4						
48	Principal		10			3		1		1	1	
49	Management Room	3	4			2						1
50	Hostel 5 Rooms	10				20						
	Total	**66**	**59**	**7**	**3**	**141**	**3**	**14**	**7**	**70**	**3**	**1**
	Wattage	**20**	**10**	**40**	**55**	**80**	**60**	**100**	**120**	**200**	**100**	**1200**
	Power	**1320**	**590**	**280**	**165**	**11280**	**180**	**1400**	**840**	**14000**	**300**	**1200**

KERALA STATE EECTRICITY BOARD LIMITED

ELECTRICAL SECTION, MANJERI NORTH, VYDYURHI BHAVANAM, MANJERI-676121.

Phone : 0483-2766848, email : ksebmjn@gmail.com.

Bill & Payment history in respect of Consumer No.1165474048654
(Moideen Madani, President, Islahi Educational Society, Pullancheri, Manjeri)
For the period from 01-04-2020 to 28-02-2023.

BILL HISTORY				
Date	Bill No.	Bill Amt	Paid/ Adjusted	Type
01-02-2023	6547230200644	3968	3968	RgCC
05-01-2023	6547230105427	3968	3968	RgCC
01-12-2022	6547221200060	8102	8102	RgCC
01-11-2022	6547221106153	8	8	Surcharge
01-11-2022	6547221100046	7896	7896	RgCC
01-10-2022	6547221004289	13	13	Surcharge
01-10-2022	6547221000059	3951	3951	RgCC
01-09-2022	6547220909307	25	25	Surcharge
01-09-2022	6547220900062	3951	3951	RgCC
01-08-2022	6547220800060	5799	5799	RgCC
21-07-2022	6547220734778	15635	15635	RgCC
01-06-2022	6547220600058	11465	11465	RgCC
26-05-2022	6547220527236	9286	9286	AnulACD
03-05-2022	6547220507141	13	13	Surcharge
03-05-2022	6547220500047	9584	9584	RgCC
12-04-2022	6547220413753	900	900	CGST-Div
12-04-2022	6547220413752	900	900	SGST-Div
12-04-2022	6547220413751	10000	10000	SG-RF
01-04-2022	6547220400197	19107	19107	RgCC
02-04-2022	6547220403231	90	90	CGST-Div
02-04-2022	6547220403230	90	90	SGST-Div
02-04-2022	6547220403229	1000	1000	SG-AF
02-03-2022	6547220300051	16454	16454	RgCC
01-02-2022	6547220200045	14593	14593	RgCC
01-01-2022	6547220105395	5	5	Surcharge
01-01-2022	6547220100042	16137	16137	RgCC
01-12-2021	6547211208787	18	18	Surcharge
01-12-2021	6547211200047	15167	15167	RgCC
01-11-2021	6547211100052	8910	8910	RgCC
01-10-2021	6547211000048	6876	6876	RgCC

PAYMENT HISTORY				
Date	Receipt No.	Amount	Mop	Type
22-02-2023	65470230222701145	3968	ADJ	OnLine
10-01-2023	65470230110701184	3968	ADJ	OnLine
07-12-2022	65470221207701067	8102	ADJ	OnLine
09-11-2022	65470221109701106	7904	ADJ	OnLine
17-10-2022	65470221017701031	3964	ADJ	OnLine
22-09-2022	65470220922701208	3976	ADJ	OnLine
24-08-2022	65470220824701017	5799	ADJ	OnLine
25-07-2022	65470220725701107	15635	ADJ	OnLine
06-06-2022	65470220606701143	19858	ADJ	OnLine
25-05-2022	65470220525403050	893	ADJ	SDInterest
13-05-2022	65470220513701125	9597	ADJ	OnLine
13-04-2022	65470220413701210	19107	ADJ	OnLine
12-04-2022	65470220412101207	11800	CSH	OnCounter
02-04-2022	65470220402101144	1180	CSH	OnCounter
08-03-2022	65470220308701154	16454	ADJ	OnLine
08-02-2022	65470220208701190	14593	ADJ	OnLine
07-01-2022	65470220107701079	16142	ADJ	OnLine
14-12-2021	65470211214701178	15185	ADJ	OnLine
17-11-2021	65470211117701023	8910	ADJ	OnLine
07-10-2021	65470211007701079	6876	ADJ	OnLine
09-09-2021	65470210909701051	5400	ADJ	OnLine
09-08-2021	65470210809701014	5525	ADJ	OnLine
29-07-2021	65470210729401006	596	ADJ	ExcessSD
08-07-2021	65470210708701067	5479	ADJ	OnLine
08-06-2021	65470210608701130	2520	ADJ	OnLine
05-05-2021	65470210505701051	5575	ADJ	OnLine
29-04-2021	65470210429403022	1038	ADJ	SDInterest
29-04-2021	65470210429701033	16898	ADJ	OnLine
16-03-2021	65470210316701102	24968	ADJ	OnLine
21-01-2021	65470210121102148	16245	CHQ	OnCounter

01-09-2021	6547210900044	5400	5400	RgCC	17-11-2020	65470201117102069	15990	CHQ	OnCounter
02-08-2021	6547210800051	6121	6121	RgCC	27-10-2020	65470201027402010	1594	ADJ	ExcessSD
01-07-2021	6547210700047	5479	5479	RgCC	08-09-2020	65470200908701079	8656	ADJ	OnLine
01-06-2021	6547210603716	84	84	Surcharge	18-08-2020	65470200818701038	5125	ADJ	OnLine
01-06-2021	6547210600047	3474	3474	RgCC	16-07-2020	65470200716701044	5529	ADJ	OnLine
03-05-2021	6547210500049	5575	5575	RgCC	20-06-2020	65470200620701034	3055	ADJ	OnLine
03-04-2021	6547210405056	376	376	Surcharge	26-05-2020	65470200526403022	1495	ADJ	SDInterest
03-04-2021	6547210405055	612	612	Surcharge	16-05-2020	65470200516701085	11184	ADJ	OnLine
03-04-2021	6547210400045	15910	15910	RgCC					
01-03-2021	6547210300045	12178	0	RgCC-Dispute					
01-02-2021	6547210205249	27	0	Surcharge-Dispute					
01-02-2021	6547210205248	506	26	Surcharge-Dispute					
01-02-2021	6547210200510	12257	0	RgCC-Dispute					
01-01-2021	6547210100042	11891	11891	RgCC					
01-12-2020	6547201204506	3	3	Surcharge					
01-12-2020	6547201204505	256	256	Surcharge					
01-12-2020	6547201200037	14386	14386	RgCC					
02-11-2020	6547201106224	8	8	Surcharge					
02-11-2020	6547201100045	16237	16237	RgCC					
01-10-2020	6547201000047	15990	15990	RgCC					
03-09-2020	6547200906775	12	12	Surcharge					
03-09-2020	6547200900944	8644	8644	RgCC					
01-08-2020	6547200804358	10	10	Surcharge					
01-08-2020	6547200800040	5115	5115	RgCC					
01-07-2020	6547200706078	10	10	Surcharge					
01-07-2020	6547200700086	5519	5519	RgCC					
01-06-2020	6547200600035	4550	4550	RgCC					
01-05-2020	6547200500015	5588	5588	RgCC					
01-04-2020	6547200400039	5596	5596	RgCC-Rev					

Manjeri,
17-03-2023.

OFFICE OF THE ASSISTANT ENGINEER
KSEB
K.S.E. BOARD LTD.
MANJERI NORTH
Dt:.....
ELECTRICAL SECTION

സീനിയർ സൂപ്രണ്ട് &
പബ്ലിക് ഇൻഫർമേഷൻ ഓഫീസർ
ഇലക്ട്രിക്കൽ സെക്ഷൻ
മഞ്ചേരി നോർത്ത്

OTTOTRACTIONS
Energy Engineering Environment

Noble Women's College MANJERI 676122

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