Criteria 7 – INSTITUTIONAL VALUES AND BEST PRACTICES

SUPPORTING DOCUMENT FOR 7.1.3

Green audit/environmental audit report from recognized bodies

INDEX

GREEN AUDIT REPORT

for

Baba Farid Vidyak Society

(Muktsar Road Campus, Bathinda, Punjab, India)

- Baba Farid College of Engineering and Technology
- Baba Farid College of Management and Technology
- Baba Farid College
- Baba Farid College of Education

Prepared & Submitted By

ECO LABORATORIES & CONSULTANTS PVT. LTD.

An ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018 certified Company

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TC-7477

(April 2021)

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Executive Summary

A Nation's growth starts from its educational institutions, where the ecology is thought as a prime factor of development associated with environment. A clean and healthy environment aids effective learning and provides a conducive learning environment. Educational institutions now a day are becoming more sensitive to environmental factors and more concepts are being introduced to make them eco-friendly.

To preserve the environment within the campus, various viewpoints are applied by the several educational institutes to solve their environmental problems such as promotion of the energy savings, recycle of waste, water reduction, water harvesting etc. The activities pursued by institutes can also create a variety of adverse environmental impacts. To protect such situation Energy Audit, Green Audit and Environment Audit are required to be conducted in these institutions. Energy Audit pave the way to save energy consequently reducing Carbon Emissions. Environmental auditing is a process whereby an organization's environmental performance is tested against its environmental policies and objectives. Green audit is defined as an official examination of the effects an institute has on the environment. It must also be under stood that Energy Audit, Green Audit and Environment Audit are inter related to each other. If you save Energy, it will save Environment. If you save trees or plant trees, it will save Environment and energy. If you clean Environment, it will save human life and save energy.

Eco campus is a concept implemented in many educational institutions, all over the world to make them sustainable because of their mass resource utilization and waste discharge in to the environment. Waste minimization plans for the educational institute are now mandatory to maintain the cleanliness of the campus. To find out the environmental performance of the educational institutions and to analyze the possible solutions for converting the educational campus as eco-campus the conduction of Green Auditing of institution is essential.

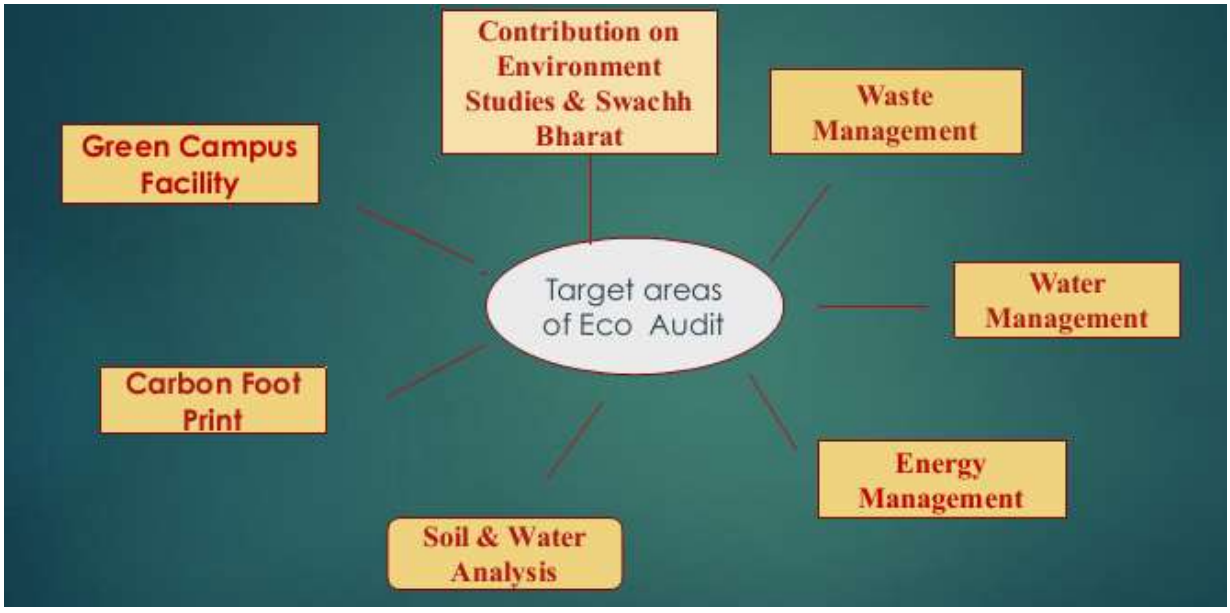
The green auditing of Baba Farid Vidyak Society enables to assess the life style, action and its impact on the environment. This is the first attempt to conduct Environment, Energy and green auditing of this campus. This audit was mainly focused on greening indicators like consumption of energy in terms of electricity and fossil fuel, quality of soil and water, vegetation, waste management practices and carbon foot print of the campus etc. Initially a questionnaire survey was conducted to know about the existing resources of the campus and resource consumption pattern of the students and staffs in the campus. In order to assess the environmental quality, the samples were collected from different locations of the institute and analyzed for applicable

parameters. Finally, a report pertaining environmental management plan with strength, weakness and suggestion on the environmental issue of campus are documented.

Green Audit can be defined as systematic identification, quantification, recording, reporting and analysis of components of environmental diversity. The 'Green Audit' aims to analyze the environmental practices within and outside the institutional campus, which will have an impact on the eco-friendly ambience. It was initiated with the motive of inspecting the work conducted within the organizations whose exercises can cause risk to the health of inhabitants and the environment. Through Green Audit, one gets a direction as how to improve the condition of environment and there are various factors that have determined the growth of carrying out Green Audit. Green audit has been assigned for the assessment of the institute for internal and self-monitoring purpose.

Thus it is imperative that the Baba Farid Vidyak Society evaluates its own contributions toward a sustainable future. As environmental sustainability is becoming an increasingly important issue for the nation, the role of higher educational institutions in relation to environmental sustainability is more prevalent.

Component of Audit



About Baba Farid Vidyak Society

About Baba Farid Vidyak Society

Baba Farid Vidyak Society is a registered society under Societies Registration Act (XXI of 1860 and as amended by Punjab Amendment Act 1957) at Muktsar Road, Bathinda with a mission of "Academic Excellence for Empowerment." Baba Farid Vidyak Society has been running the following Higher Educational Institutions under the ambit of Baba Farid Group of Institutions:

1. Baba Farid College of Engineering and Technology
2. Baba Farid College of Management and Technology
3. Baba Farid College
4. Baba Farid College of Education

All the colleges are approved by respective statuary bodies of Government of India and Government of Punjab such as National Council for Teacher Education (NCTE) and All India Council for Technical Education (AICTE) and the Punjab State Council for Agricultural Education. These colleges are affiliated with state run Punjabi University, Patiala and Maharaja Ranjit Singh Punjab Technical University, Bathinda.

About Green Audit

About Green Audit

Climate change and its impact, has brought into focus the need for environmental protection as a global agenda. It has emerged as the pillar for sustainable development of the world. The UN Sustainable Development Goals (SDG's) are an important step in ensuring nation's responsiveness towards environmental protection. The Legal and the policy framework of the country have incorporated many environmental measures, involving all stakeholders in the mission. In this context, the Educational Institution has been responsible and responsive in implementing green practices, such as green plantation, rain water harvesting structures, solid waste management, liquid waste management, e-waste management, solar powered campus, energy conservation etc.

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Through Green Audit, one gets a direction as how to improve the environment quality with sustainable development and growth. Thus it is imperative that the Baba Farid Vidyak Society evaluates its own contributions toward a sustainable future. As environmental sustainability is becoming an increasingly important issue for the nation, the role of higher educational institutions in relation to environmental sustainability is more prevalent.

Scope and Goals of Green Audit

A clean and healthy environment aids effective learning and provides a conducive learning environment. There are various efforts around the world to address environmental education issues. Green Audit is the most efficient and ecological way to manage environmental problems. It is a kind of professional care which is the responsibility of each individual who are the part of economic, financial, social, environmental factor. It is necessary to conduct green audit in institute campus because students become aware of the green audit, its advantages to save the planet and they become good citizen of our country. Thus Green audit becomes necessary at the institute level. Green audit can be a useful tool for a college to determine how and where they are using the most energy or water or resources; the college can then consider how to implement changes and make savings. It can also be used to determine the type and volume of waste, which can be used for a recycling project or to improve waste minimization plan. Green auditing and

the implementation of mitigation measures is a win-win situation for all the college, the learners and the planet. It can also create health consciousness and promote environmental awareness, values and ethics. It provides staff and students better understanding of Green impact on campus. Green auditing promotes financial savings through reduction of resource use. It gives an opportunity for the development of ownership, personal and social responsibility for the students and teachers.

Objectives of Green Audit

The main aim objectives of this green audit is to assess the environmental quality and the management strategies being implemented in the institute. The specific objectives are:

- To assess the quality of the water and soil in the institute
- To monitor the energy consumption pattern of the institute
- To quantify the liquid and solid waste generation and management plans in the campus.
- To assess the carbon foot print of the campus
- To assess whether the measures implemented by the institute have helped to reduce the Carbon Footprint.
- To impart environment management plans of the institute
- Providing a database for corrective actions and future plans.
- To assess whether extracurricular activities of the Institution support the collection, recovery, reuse and recycling of solid wastes.
- To identify the gap areas and suggest recommendations to improve the Green Campus of the institute.

Benefits of Green Auditing

- More efficient resource management
- To provide basis for improved sustainability
- To create a green campus
- To enable waste management through reduction of waste generation, solid-waste and water recycling
- To create plastic free campus and evolve health consciousness among the stakeholders
- Recognize the cost saving methods through waste minimizing and managing
- Authenticate conformity with the implemented laws
- Empower the organizations to frame a better environmental performance
- Enhance the alertness for environmental guidelines and duties

- Impart environmental education through systematic environmental management approach and Improving environmental standards
- Benchmarking for environmental protection initiatives
- Financial savings through a reduction in resource use
- Development of ownership, personal and social responsibility for the Institute and its environment
- Green audit is important criteria for self-monitoring and assessment of ongoing activities and further improvements in the institute.

Target Areas of Green Audit

Green audit forms part of a resource management process. Although they are individual events, the real value of green audit is the fact that they are carried out, at defined intervals, and their results can illustrate improvement or change over time. Eco-campus concept mainly focuses on the efficient use of energy and water; minimize waste generation or pollution and also economic efficiency.

All these indicators are assessed in the process of "Green Auditing of this educational institute". Eco-campus focuses on the reduction of contribution to emissions, procure a cost effective and secure supply of energy, encourage and enhance energy use conservation, promotes personal action, reduce the institute's energy and water consumption, reduce wastes to landfill, and integrate environmental considerations into all contracts and services considered to have significant environmental impacts. Target areas included in this green auditing are

- Water Resource management,
- Waste management,
- Green campus management
- Environment management
- Health and Safety management
- Carbon footprint management

Auditing for Water Management

Water is a natural resource; all living organisms depend on water. While freely available in many natural environments, in human settlements potable (drinkable) water is less readily available. Groundwater depletion and water contamination are taking place at an alarming rate. Hence it is essential to examine the quality and usage of water in the institute.

Water auditing is conducted for the evaluation of facilities of raw water intake and determining the facilities for water treatment and reuse. The concerned auditor investigates the relevant method that can be adopted and implemented to balance the demand and supply of water.

Water audit has following advantages as

- Water audits provide decision making tools to utility managers, directors, and operators. i.e., knowing where water is being used in your system allows you to make informed decisions about investing resources such as time, labour and money.
- Water audits allow managers to efficiently reduce water losses in the system.
- Reducing water used at the source may even result in delaying or avoiding capital investments such as a new well, more treatment technology or additional water rights.
- Water audits also identify which water uses are earning revenue for the utility and which water uses are not. Thus, System personnel can increase revenue by institute ensuring all appropriate uses are being accurately measured and billed. This leads to more financial capacity in the water system, reduced cost per customer and better management of the water resource.
- Creating awareness among water users i.e., customers can see and understand that the utility is taking proactive steps to manage wasted water and save for the future.
- It is an effective educational and public relations tool for the water system.

Auditing for Waste Management

Human activities create waste, and it is the way these wastes are handled, stored, collected and disposed of, which can pose risks to the environment and to public health. Pollution from waste is aesthetically unpleasing and results in large amounts of litter in our communities which can cause health problems. Solid waste can be divided into three categories as bio-degradable, non-biodegradable and hazardous waste. Bio-degradable wastes include food wastes, canteen waste, wastes from toilets etc. Non-biodegradable wastes include what is usually thrown away in homes and schools such as plastic, tins and glass bottles etc. Hazardous waste is waste that is likely to be a threat to health or the environment like cleaning chemicals, acids and petrol. Unscientific management of these wastes such as dumping in pits or burning them may cause harmful discharge of contaminants into soil and water supplies, and produce greenhouse gases contributing to global climate change respectively. Special attention should be given to the handling and management of hazardous waste generated in the institute. Bio-degradable waste can be effectively utilized for energy generation purposes through anaerobic digestion or can be

converted to fertilizer by composting technology. Non-biodegradable waste can be utilized through recycling and reuse. Thus the minimization of solid waste is essential to a sustainable institute. The auditor diagnoses the prevailing waste disposal policies and suggests the best way to combat the problems.

Auditing for Green Campus Management

Trees play an important ecological role within the urban environment, as well as support improved public health and provide aesthetic benefits to cities. In one year, a single mature tree will absorb up to 48 pounds of carbon dioxide from the atmosphere, and release it as oxygen. The amount of oxygen released by the trees of the campus is good for the people in the campus. So while you are busy studying and working on earning those good grades, all the trees in campus are also working hard to make the air cleaner for you.

Auditing for Carbon Footprint

Burning of fossil fuels (such as petrol) has an impact on the environment through the emission of greenhouse gases into the atmosphere. The most common greenhouse gases are carbon dioxide, water vapours, methane, nitrous oxide and ozone. Of all the greenhouse gases, carbon dioxide is the most prominent greenhouse gas, comprising 402 ppm of the Earth's atmosphere. The release of carbon dioxide gas into the Earth's atmosphere through human activities is commonly known as carbon emissions. Vehicular emission is the main source of carbon emission in the campus, hence to assess the method of transportation that is practiced in the institute is important.

Methodology for Green Audit

Methodology Adopted for Green Audit

The methodology adopted for this audit is comprising of following process steps as

Data Collection

In preliminary data collection phase, exhaustive data collection was performed using different tools such as observation, survey communicating with responsible persons and measurements.

Following steps are taken for data collection:

- The team approaches to each department, library, hostel and canteen etc.
- Data about the general information is collected by observation and interview.
- The power consumption of appliances is recorded by taking an average value in some cases.

Data Analysis

Detailed analysis of data collected include calculation of energy consumption, analysis of latest electricity bill of the campus, understanding the tariff plans provided by state Electricity Board. Data related to water usages are also analyzed using appropriate methodology.

Recommendation

On the basis of results of data analysis and observations, some steps for reducing power and water consumption were recommended. Proper treatments for waste were also suggested. Use of fossil fuels has to be reduced for the sake of community health.

The above target areas particular to the institute was evaluated through questionnaire circulated among the students for data collection. Five categories of questionnaires were distributed.

Onsite Visit

Two-days site visit was conducted by the Experts of Green Audit Team of Eco Laboratories and Consultants Pvt. Ltd. on 14th and 15th April 2021. The key focus of the visit was on assessing the status of the green cover of the Institution, their waste management practices and energy conservation strategies etc. The sample collection was carried out during the visits to assess the quality of environment. The samples air, noise, drinking water and indoor environment were taken from institute. The sample collection, preservation, and analysis were done in the scientific manner as prescribed by the standard procedures.

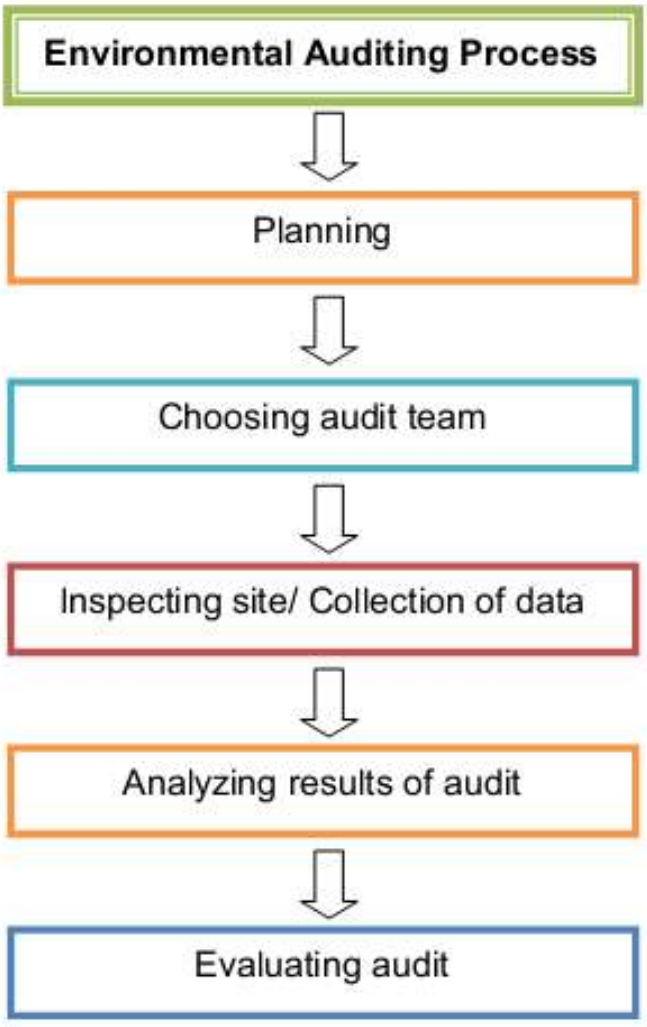
Focus Group Discussion

The Focus Group discussions were held with the Club members, staff members and the management focusing various aspects of Green Audit. The discussion was focused on identifying the attitudes and awareness towards environmental issues at the institutional and local level.

Energy, waste management and Carbon foot print analysis Survey

With the help of teachers and students, the audit team has assessed the energy consumption pattern and waste generation, disposal and treatment facilities of the institute. The monitoring was conducted with a detailed questionnaire survey method.

Process for Environmental Audit



Process adopted for Environmental Audit

Auditing for Water Resource Management

Auditing for Water Resource Management

Process adopted for Auditing of Water Resource Management

Source of Water

The institute is getting total water requirement of 261 KLD from two sources of water as

- Ground water source (Tube wells – 3 Nos.) and
- Rain water collection pond after suitable RO treatment.

The institute has valid permission from Punjab Water Regulation and Development Authority (PWRDA) for the extraction of ground water up to 182 KLD (182m^3/day) from three tube wells.

Baseline of Water Consumption

In India, the design of water supply systems has been done using certain standards. Currently the standard being used is NBC, 2016. This specifies a consideration of use of the following:

- For communities with a population of between 20,000 to 100,000 @ 100 to 135 liters per head per day (Max. 135 lpcd has been considered).
- Persons working in normal working hours i.e. Staff @ 45 liters per head per day
- Visitors in the institute @ 15 liters per head per day

Population in Baba Farid Vidyak Society campus

The details of the population (per head counts) in the institute is presented in below Table

Total student & staff population in the Institute

S. No	Particulars	Total Nos.	Residing	Non-residing
1	No. of Students enrolled in Baba Farid Vidyak Society	4268	280	3988
2	No. of Staff (teaching & non-teaching) in Baba Farid Vidyak Society	520	10	510
Total population in Baba Farid Vidyak Society		**4788**	**290**	**4498**

Total population of daily visitors in the Institute

S. No	Particulars	Total Nos.
1	Daily visitors in Baba Farid Vidyak Society (avg.)	15

Thus, the total maximum permissible water consumption as per Standards laid as per NBC, 2016 is given in below Table.

Total permissible water Consumption as per Standards laid as per NBC, 2016

S. No.	Particulars	Nos.	Water consumption per Person per day (Liters)	Total water consumption Liters per Day
1	No. of student & staff - Non-residing (Day time) Population in Baba Farid Vidyak Society	4498	45	2,02,410
2	No. of student & staff - Residing Population in Baba Farid Vidyak Society	290	100	29,000
3	Daily visitors in Baba Farid Vidyak Society (avg.)	15	15	225
			Grand Total	**2,31,635**

An attempt was made as per NBC, 2016 to understand the demand of water supply and waste water generated.

- Actual Water Demand = 2,31,635 liters per day
- Waste Water Generation = 80% of total water consumption = 1,85,308 liters per day

The source of water requirement is ground water (tube well) and rain water collection and the wastewater generation in campus is 1,85,308 liters per day. The institute has sewage treatment plant of 250 KLD based on MBBR technology and zero liquid discharge technique for an efficient water resource management.

Sewage Treatment Plant at Baba Farid Vidyak Society

The domestic treated water is being used in

- Treated water is used for watering the plantation and green area development.
- Treated water is also used for irrigation purpose.
- Karnal technology has been adopted.

Rainwater Harvesting

Rainwater harvesting is the accumulation and deposition of rainwater for reuse on-site, rather than allowing it to run off. Rainwater can be collected from roofs, and in many places the water collected is redirected to a deep pit (well, shaft, or borehole), a reservoir with percolation. It's uses include water for gardens, livestock, irrigation, domestic use with proper treatment etc. The harvested water can also be used as drinking water, longer-term storage and for other purposes such as groundwater recharge.

Rainwater harvesting provides an independent water supply during regional water restrictions and in developed countries is often used to supplement the main supply. It provides water when there is a drought, can help mitigate flooding of low-lying areas, and reduces demand on wells which may enable groundwater levels to be sustained. It also helps in the availability of potable water as rainwater is substantially free of salinity and other salts. Application of rainwater harvesting in urban water system provides a substantial benefit for both water supply and wastewater subsystems by reducing the need for clean water in water distribution system, less generated storm water in sewer system, as well as a reduction in storm water runoff polluting freshwater bodies. Supplying rainwater that has gone through preliminary filtration measures for non-potable water uses, such as toilet flushing, irrigation, and laundry, may be a significant part of a sustainable water management strategy.

The institute is managing eight ground water recharge pits and one rainwater harvesting pond/ tank in campus to collect rain water from institutional building blocks.

Rain Water Harvesting at Baba Farid Vidyak Society

The rain water collected is being used as various purposes as

- Ground water recharge
- Domestic purpose after RO treatment and
- Irrigation for plantation and green belt development.

Recommendations

- The institute has eight ground water recharge pits and one rainwater harvesting pond/ tank in campus to collect rain water from few institutional building blocks to overcome the gap between huge water demand and water conservation. More Rain Water Harvesting System to tap all Buildings/ Blocks is needed for effective water resource conservation.
- STP based on Zero liquid discharge need to upgraded
- Display boards for water conservation and don't misuse of water should be adopted.
- Automatic switching system/sensors to be adopted on taps for water use and pump sets used for overhead tank filling.

Auditing for Waste Management

Auditing for Waste Management

Pollution from waste is aesthetically unpleasing and results in large amounts of litter in our communities which can cause health problems. Plastic bags and discarded ropes and strings can be very dangerous to birds and other animals. This indicator addresses waste production and disposal, plastic waste, paper waste, food waste, and recycling. Solid waste can be divided into two categories: general waste and hazardous waste. General wastes include what is usually thrown away in homes and schools such as garbage, paper, tins and glass bottles. Hazardous waste is waste that is likely to be a threat to health or the environment like cleaning chemicals and petrol. Unscientific landfills may contain harmful contaminants that leach into soil and water supplies, and produce greenhouse gases contributing to global climate change. Furthermore, solid waste often includes wasted material resources that could otherwise be channeled into better service through recycling, repair, and reuse. Thus the minimization of solid waste is essential to a sustainable institute. The auditor diagnoses the prevailing waste disposal policies and suggests the best way to combat the problems. It is therefore essential that any environmentally responsible institution examine its waste processing practices.

Quantity of Waste Generated

Solid Waste

Generation of Solid Waste

S. No.	Particulars	Nos.	Rate of solid waste generation (kg/person/day)	Total solid waste generation (kg/day)
1	No. of student & staff - Non-residing (Day time) Population in Baba Farid Vidyak Society	4498	0.2	899.6
2	No. of student & staff - Residing Population in Baba Farid Vidyak Society	290	0.4	116
3	Daily visitors in Baba Farid Vidyak Society (avg.)	15	0.2	3
			Grand Total	1,018.6

The total solid waste generation in Baba Farid Vidyak Society is estimated as 1,018.6kg per day.

Management of Solid Wastes

An effective disposal of solid wastes lies on the collection and segregation of wastes in following category wise as

(a) Biodegradable wastes

Canteen waste generated in the institute is being handed over to local cattle keepers and pig farmers to feed their animals. Biodegradable waste as plant leaves, biomass and other wastes are collected about 50-100 kg per day. The collected waste is disposed in manure pits for the preparation organic manures in the range of 20-30 kg per day which is being utilized in garden and plantation and agro farming practices in campus area.

Biodegradable waste management through composting at Baba Farid Vidyak Society

Non-biodegradable

The garbage including non-biodegradable items as metals, bottles, plastics, cans and tins, broken glass wares etc. collected from Baba Farid Vidyak Society in the range of 40-50 kg per day.

Non-biodegradable waste is handed over/ soled to authorized venders with proper accounting on time to time to effective management. Though the institute has tie up M/s SMS Contractors and Suppliers, Bathinda for collection, disposal and management of solid wastes generated in the institute (Agreement letter is enclosed).

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AGREEMENT

It is an agreement made, approved and signed on 20.09.2019 at Baba Farid Group of Institutions, Muktsar Road, Bathinda (a multi-college campus of Baba Farid Vidyak Society, Bathinda) by and between;

Baba Farid Vidyak Society (Registered), Ajit Road, Street No. 13, Bathinda through its authorized representative Sh. Harpal Singh S/o Sh. Bahadur Singh, aged 66 years, Deputy Director (Facility Management) of Baba Farid Group of Institutions, Muktsar Road, Bathinda(a Campus of Society),[hereinafter called the Society which expression shall include its representatives, successors and assigns where the context so admits] of the One Part

And

M/s SMS Contractors and Suppliers, 24461, Street No. A/2, Guru Ki Nagri, Bathinda - 151001, Contact No. 9814090590 / 99140 90590 Email: sukhmandersinghbti@gmail.com and Corporate office at SCF No. 67, Model Town, Phase – I, Bathinda (a partnership firm duly registered with Registrar of Firms and Societies, Punjab, Chandigarh vide Registration No. 1498/2013-14 dated 12.08.2013 through its Partner, Shri Sukhmander Singh son of Shri Baldev Singh, (Aadhar No. 761012347970) aged 42 years, resident of 24461, Street No. A/2, Guru Ki Nagri, Bathinda -151001, Contact No. 9814090590 / 99140 90590 Email: sukhmandersinghbti@gmail.com [hereinafter called the Firm / Service Provider /

Whereas;

(a) The Society has its multi college Campus under the name and style of Baba Farid Group of Institutions at Muktsar Road, Village Deon, Bathinda (hereinafter called the Campus).

(b) The Firm is engaged in the business of various contract works and general supplies including and movement of Solid Waste.

(c) Sh. Harpal Singh, aforesaid, representative of the Society, is authorized to enter into, sign and execute agreements/ contracts/MOU/deeds for and on behalf of the society with various parties/concerns/persons for necessary provisions of facilities for the above campus of the Society vide Resolution Dated 22.04.2017 of the society.

(d) Mr. Sukhmander Singh, Partner of the firm, is authorized to do all the deeds and things related to the affairs of the Firm for and on behalf of the Firm including any kind of business dealings and its agreements through its representations and signatures vide authorization of dated 08.08.2013 of the Firm.

(e) The Firm has been providing its services to the Society for collection, removal, transportation and disposal of all the solid waste from the campus of the society since 01.05.2018 as per terms and conditions mutually settled and agreed upon between the parties to this agreement.

Now, in consideration of mutual promises, the parties hereby conclude from verbal declarations, agreements in writing as under, for reference, legitimacy, recognition etc to avoid any future misunderstanding, conflict, litigation etc.:-

I.Term/Validity of agreement

That this agreement is in force from since 1 st day of May, 2018 and shall remain in force until terminated by either party in accordance with the provisions of this agreement.

II. Scope of work, duties, rights, responsibilities and liabilities of the Firm:

1. Scope of work - To collect, remove, transport, and dispose of all the solid waste from the designated dumping point of the campus premises of the Society at the scheduled time on daily basis i.e. from 1.00 PM to 3.00 PM.
2. Management of tools-tackles and machinery - To manage, arrange and provide trained manpower, vehicles, tools, equipment, storage containers and all the facilities required for provision of services to the entire satisfaction of the Society.
3. Holiday - If a holiday occurs or falls on collection days, the collection ordinarily made on the next succeeding day. Society shall provide to the Firm the list of holidays to be observed at its campus.
4. Hazardous waste - No hazardous waste shall be collected, removed, transported and disposed of by the Firm.
5. Solid waste - The solid waste covered in the scope of work of Firm shall also include the waste, other than routine waste, accumulating from any event/function/program etc. of campus premises of the society.
6. Penalty - The Firm shall pay to the society Rs.1000/- (Rupees one thousand only) per day as penalty in case of non-lifting of waste by the Firm as per agreement.
7. Ownership - The Firm shall be the sole owner of the solid waste material as and when it removes by the Firm from the premises of the Society.

Management of Bio-chemicals/Hazardous wastes

The institute is operating chemical testing laboratories, health centre, DG sets and other electrical appliances which generate biochemical hazardous wastes.

- Autoclaving is used to sterilize biological waste. Autoclave uses high-pressure steam to sterilize equipment and biological waste. The high pressure steam will reach temperatures up to 120-125°C, which is sufficient to kill most microorganisms including bacteria, viruses and spores.
- In chemistry lab, acid waste is neutralized with a base, while basic waste is neutralized with acid. The neutralized water then goes to distillation process to prepare distilled water for laboratory use.
- The used and waste oils from DG sets, machinery and other electronic appliances is sold to service vendors during maintenance and servicing work.

Management of E-Waste

Baba Farid Vidyak Society has opted "By back purchase policy" to reduce and minimize the e-waste. The new electronic instruments/ equipment, computers and peripherals are purchased under by the institute under by back scheme only so that no accumulation of e-waste generates in the campus.

However, other broken and outdated electronic items which can't be replaced are handed over to authorized vendor for proper disposal.

Management of Liquid Wastes

a) Domestic and Sewage

Domestic wastewater including sewage generation in the campus is about 1,85,308 liters per day (185 KLD). The institute has sewage treatment plant of 250 KLD based on MBBR technology for an efficient water resource management.

The domestic treated water is being used in

- Treated water is used for watering the plantation and green area development.
- Treated water is also used for irrigation purpose.
- Karnal technology has been adopted.

b) Laboratory Effluents

The institute has chemical testing laboratories generating effluent water as very less. So the adoption of treatment facility is not feasible.

In chemistry lab, acid waste is neutralized with a base, while basic waste is neutralized with acid. The neutralized water then goes to distillation process to prepare distilled water for laboratory use. Hence, the laboratory waste is being neutralized first and reused/ recycled then by distillation process for lab water requirements.

Excess effluent need to disposed of through a govt. approved and registered vendor.

Recommendations

- The recycle and reuse practices for solid waste management to be adopted to manage the natural resources and prevent environmental degradation.
- STP with ZLD technique is recommended to effective conservation of water resource.
- The hazardous wastes and e-wastes need to be regularly monitored with records and to ensure the hand over to the authorized vendors for the proper disposal to manage the natural resources and prevent environmental degradation.

Auditing for Environmental Management

Auditing of Environmental Management

As part of green audit of campus, we carried out the environmental monitoring of campus including illumination and ventilation in the class room. It was observed that illumination and ventilation is adequate considering natural light and fresh air circulations.

Natural ventilation and lighting system at BABA FARID VIDYAK SOCIETY

a) Outdoor Environment

Air Quality Index (AQI)

Air Quality Index (AQI) transforms complex air quality data of criteria pollutants into a single number (index value), with nomenclature and colour. AQI was launched on 17 October 2014 in India to disseminate information on air quality in an easily understandable form for the general public. AQI has six categories of air quality which are defined as Good, Satisfactory, Moderately Polluted, Poor, Very Poor and Severe. AQI is considered as 'One Number- One Colour-One Description' for the common man to judge the air quality within his vicinity. The formulation of the index was an initiative under ***Swachh Bharat Mission (cleanliness Mission)***, based on the recommendations of IIT Kanpur and the Expert Group formed in this regard. The earlier measuring index in this regard was limited to three indicators, while the current measurement index had been expanded with five additional parameters. The measurement of AQI is based on following pollutants, namely

- Particulate Matter (size less than 10 µm) or (PM_{10}),
- Particulate Matter (size less than 2.5 µm) or ($PM_{2.5}$),
- Nitrogen Dioxide (NO_2),
- Sulphur Dioxide (SO_2),
- Carbon Monoxide (CO),
- Ozone (O_3) and
- Ammonia (NH_3),

AQI Index values and their associated health impacts

AQI	Associated Health Impacts
Good (0–50)	Minimal Impact
Satisfactory (51–100)	May cause minor breathing discomfort to sensitive people.
Moderately polluted (101–200)	May cause breathing discomfort to people with lung disease such as asthma, and discomfort to people with heart disease, children and older adults.
Poor (201–300)	May cause breathing discomfort to people on prolonged exposure, and discomfort to people with heart disease
Very Poor (301–400)	May cause respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart diseases.
Severe (401-500)	May cause respiratory impact even on healthy people, and serious health impacts on people with lung/heart disease. The health impacts may be experienced even during light physical activity.

Methodology of AQI

The ambient air quality has been assessed through scientifically designed ambient air quality monitoring network. The monitoring network was designed based on the following considerations:

- Meteorological conditions
- Geographical conditions
- Topography of the area
- Likely impacts and sensitive receptors

Ambient air quality monitoring network was established as per CPCB guidelines in triangular method @120-degree orientation of three sampling locations. Ambient air quality monitoring was done on 24 hourly basis at each identified locations simultaneously.

Parameters & Methods of Air Quality Monitoring

Test methods for determining Various Air Quality Parameters are described in below **Table** as

Test methods for determination of Air Quality Parameters

S. No.	Test Parameter	Test Method
1.	Particulate Matter (PM_{10})	IS:5182 (P-23) 2006 RA 2017
2.	Particulate Matter ($PM_{2.5}$)	Lab SOP EL/SOP/AAQ/01
3.	Sulphur Dioxide (SO_2)	IS:5182 (P-2) 2001 RA 2017
4.	Nitrogen Dioxide (NO_2)	IS:5182 (P-6) 2006 RA 2017
5.	Ammonia (NH_3)	Lab SOP EL/SOP/AAQ/02
6.	Ozone (O_3)	IS:5182 (P-9):2006 RA 2014
7.	Carbon Monoxide (CO)	IS 5182 Part-10:1999, RA 2014

Sampling Procedure

Particulate samples for PM_{10} were collected on Whatman glass fiber filters using respirable dust sampler (AAS 217NL, Ecotech) whereas samples for $PM_{2.5}$ were collected on Whatman Quartz filter papers (47 mm diameter) using fine particulate sampler (AAS 127Mini, Ecotech). During sampling a laminar flow was maintained as 16.7 liters per min (1.0 m^3 per hr) for $PM_{2.5}$ and 1.13 m^3 per minute for PM_{10}. The air sampling was done on 24 hourly basis at a nominal sampling height of 3 meter at each location. Gaseous sampling was done using Thermoelectrically cooled Gas sampler (AAS 109TE, Ecotech) whereas CO was collected in tedlar bag for the analysis by NDIR CO Analyzer (APMA-370, Horiba) and Benzene was collected in activated carbon absorber tubes for GC analysis.

Construction of Air Quality Index (AQI)

- Based on the measured ambient air concentrations, corresponding standards and likely health impact (known as health breakpoints), a sub-index is calculated for each of the pollutants.
- A sub-index is a linear function of concentration e.g. the sub-index for $PM_{2.5}$ will be
  - 51 at concentration 31 µg/m^3,
  - 100 at concentration 60 µg/m^3, and
  - 75 at concentration of 45 µg/m^3

The formula for calculating a sub-index is as follows:

Sub Index for a pollutant = Upper limit of the previous AQI category to which the pollutant's current reading would have fallen **+**[(current reading **–** upper limit of the previous reading category of the pollutant)***** (width or interval of the AQI category for the current level of reading **/** width or interval of the current reading category of the pollutant)]

Eg. Sub-index for $PM_{2.5}$

If concentration is 150 µg/m3, the sub index would be = 300+[(150-120)*100/130] = 323

If concentration is 45 µg/m3, the sub index would be = 30+[(45-30)*50/30] = 75

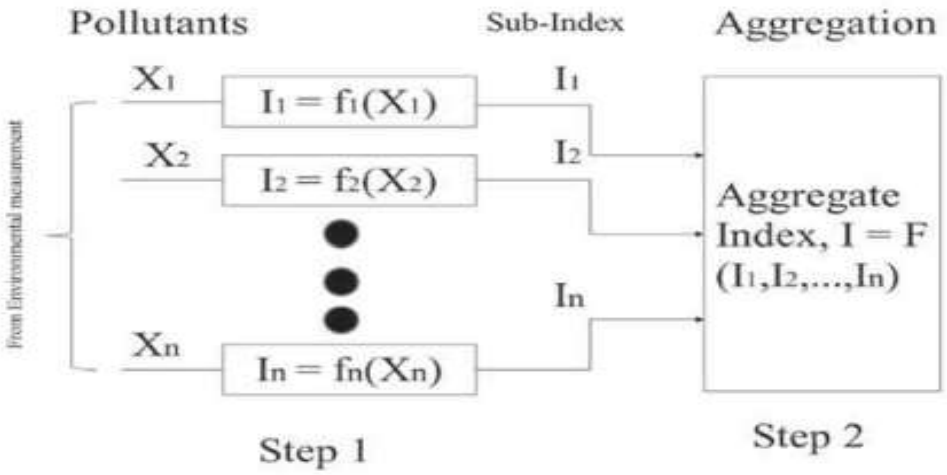


Fig. 7: Index and Sub-index of Pollutants

- Primarily two steps are involved in formulating an AQI: (i) formation of sub-indices (for each pollutant) and (ii) aggregation of sub-indices to get an overall AQI.
- Formation of sub-indices (I1, I2,...., In) for n pollutant variables (X1, X2...., Xn) is carried out using sub-index functions that are based on air quality standards and health effects. Mathematically;

$I = f(Xi), i=1, 2,...,n$ [Eq. 1]

- Each sub-index represents a relationship between pollutant concentrations and health effect as the functional relationship between sub-index value (Ii) and pollutant concentrations (Xi).
- Aggregation of sub-indices, Ii is carried out with some mathematical function (described below) to obtain the overall index (I), referred to as AQI.

$I = F(I1, I2, ...,In)$ [Eq. 2]

- The aggregation function usually is a summation or multiplication operation or simply a maximum operator.

Sub-indices (Step 1)

Sub-index function represents the relationship between pollutant concentration Xi and corresponding sub index Ii. It is an attempt to reflect environmental consequences as the concentration of specific pollutant changes. It may take a variety of forms such as linear, non-linear and segmented linear. Typically, the I-X relationship is represented as follows:

$I = aX + ß$ [Eq. 3]

Where, a =slope of the line, ß = intercept at X=0

The general equation for the sub-index (Ii) for a given pollutant concentration (Cp); as based on 'linear segmented principle' is calculated as:

$Ii = [\{(IHI-ILO)/(BHI-BLO)\}*(Cp-BLO)]+ILO$ [Eq. 4]

Where,

BHI = Breakpoint concentration greater or equal to given concentration.

BLO = Breakpoint concentration smaller or equal to given concentration.

IHI =AQI value corresponding to BHI

ILO = AQI value corresponding to BLO

Ip = Pollutant concentration

Aggregation of Sub-indices (Step 2)

Once the sub-indices are formed, they are combined or aggregated in a simple additive form or weighted additive form:

Weighted Additive Form

$I = \text{Aggregated Index} = \sum WiIi \quad (\text{For } i= 1, \ldots..,n)$ [Eq. 5]

where,

$\sum Wi = 1$

Ii = sub-index for pollutant i

n = number of pollutant variables

Wi = weightage of the pollutant

Root-Sum-Power Form (non-linear aggregation form)

I = Aggregated Index = [∑Iip](1/p) [Eq. 6]

where,

p is the positive real number >1

Root-Mean-Square Form

I = Aggregated Index = {1/k (I12+I22+…… + Ik2)}0.5 [Eq. 7]

Finally; AQI = Max (Ip) (where; p= 1,2,…..,n; denotes n pollutants)

The AQI values and corresponding ambient concentrations (health breakpoints) for the identified eight pollutants are as follows:

AQI Category, Pollutants and Health Breakpoints

AQI Category (Range)	Categories for various readings of pollutant based on health breakpoints/health impacts						
	PM_{10}	$PM_{2.5}$	NO_2	O_3	CO	SO_2	NH_3
	24-hr	24-hr	24-hr	8-hr	8-hr	24-hr	24-hr
Good (0-50)	0-50	0-30	0-40	0-50	0-1.0	0-40	0-200
Satisfactory (51-100)	51-100	31-60	41-80	51-100	1.1-2.0	41-80	201-400
Moderately polluted (101-200)	101-250	61-90	81-180	101-168	2.1- 10	81-380	401-800
Poor (201-300)	251-350	91-120	181-280	169-208	10-17	381-800	801-1200
Very poor (301-400)	351-430	121-250	281-400	209-748*	17-34	801-1600	1200-1800
Severe (401-500)	430 +	250+	400+	748+*	34+	1600+	1800+

***One hourly monitoring (for mathematical calculations only)**

Calculator for Air Quality Index (AQI)

- For manual monitoring stations, an AQI calculator is developed by CPCB wherein data can be fed manually to get AQI value.
- The excel sheet for calculating AQI, as uploaded by CPCB

Interpretation of Air Quality Index (AQI)

- The worst sub-index reflects overall AQI

For instance, if the sub index of $PM_{2.5}$ =75, SO_2 = 63, NO_2 =38 then the AQI will be 75 which is the same as the value of the sub index of $PM_{2.5}$.

- The Sub-indices for individual pollutants at a monitoring location are calculated using
  - ✓ 24-hourly average concentration value (8-hourly in case of CO and O_3)
  - ✓ Health breakpoint concentration range (e.g. AQI at 6 am on a day will incorporate data from 6am on previous day to the current day).
  - ✓ AQI is calculated by eight pollutants however, overall AQI can be calculated with available data for minimum three pollutants out of which one should necessarily be either $PM_{2.5}$ or PM_{10}.
  - ✓ Minimum of 16 hours' data is considered necessary for calculating sub index
  - ✓ AQI index values can vary depending on the time of the day.
  - ✓ AQI reflects the status of the worst pollutant in that city. i.e. higher reading in one city can be due to high concentration of PM whereas in some other city it may be due to SO_2.
  - ✓ If one pollutant out of eight is in the "poor" category, then AQI will be in "poor" category.

For manual monitoring stations, data were fed manually in AQI calculator developed by CPCB to get AQI value. The AQI calculation has been depicted as

Air Quality Index (AQI) Calculator

Air Quality Index (AQI) Calculator					
Date	**DD-MM-YYYY**	**INPUT**	**Station**	**NSIT**	
Pollutants	**Duration**	**Conc. in µg/m3 (CO in mg/m3)**	**Sub-Index**	**Check**	**AQI**
PM_{10}	24-hr avg	86	93	1	**86**
$PM_{2.5}$	24-hr avg	54	96	1	
SO_2	24-hr avg	11	13	1	
NO_2	24-hr avg	20	24	1	
CO	max 8-hr	0.11	6	1	

O_3	max 8-hr	22	19	1	
NH_3	24-hr avg	20	7	1	
Concentrations of minimum three pollutants are required; one of them should be PM10 or $PM_{2.5}$. The check displays "1" when a non-zero value is entered					

Interpretation of Air Quality Index (AQI)

Air Quality Index

Indicators & Categories of Air Quality Index

Good (0–50)
Satisfactory (51–100)
Moderately polluted (101–200)
Poor (201–300)
Very Poor (301–400)
Severe (401-500)

AQI Result

Test Results of Air Quality Index

Air Quality Index	Air Quality Status
86	**Satisfactory (51–100)**

The Air Quality Index (AQI) is observed as 81 that indicates the ambient air quality is Satisfactory at institute and safe for human health.

b) Indoor Environment

Indoor environment was monitored for visual comfort, thermal comfort, ventilation and noise levels in each institute blocks.

Visual and Thermal Comfort

Visual comfort was monitored using Lux monitor and thermal comfort was monitored by Heat stress analyzer for temperature and humidity levels.

a) Indoor Lux (Illumination) Monitoring

Photographic view of visual comfort and Lux Level Monitoring

b) Indoor Particulate Dust Level Monitoring

Photographic view of Indoor Dust Level Monitoring

c) Indoor Noise Level Monitoring

Photographic view of Indoor Noise Level Monitoring

Indoor environment in respect to visual comfort, thermal comfort, noise levels and ventilation was found to be satisfactory in each block of the institute.

Auditing for Health and Safety

Auditing for Health and Safety

a) Fire Safety

Fire Safety Measures at Baba Farid Vidyak Society

Fire safety appliances are in place and appropriate in each department/sections. All fire safety system in each department of Baba Farid Vidyak Society are certified and approved from Punjab Fire Services (Bathinda MC).

b) Health Safety

Health community center/dispensary is operational in campus for primary health checkups and treatments in case of any medical emergency or medical requirements.

Health safety measures were reported in place as per requirements in respect to safe and potable drinking water supply with RO systems. Drinking water sample was tested for the purpose of portability and suitability of water quality. The available water quality was found to be safe for domestic and human consumption.

Photographic view of Indoor Noise Level Monitoring

c) Traffic & Parking Area

The campus has designated parking area in place that is sufficient to manage daily traffic fleet in the campus due. Good traffic management practices reduce the accidental risks to students, staff and visitors coming to the campus.

Auditing for Green Campus Management

Auditing for Green Campus Management

Unfortunately, the biodiversity is facing serious threats from habitat loss, pollution, over consumption and invasive species. Species are disappearing at an alarming rate and each loss affects nature's delicate balance and our quality of life. Without this variability in the living world, ecological systems and functions would break down, with detrimental consequences for all forms of life, including human beings. Newly planted and existing trees decrease the amount of carbon dioxide in the atmosphere. Trees play an important ecological role within the urban environment, as well as support improved public health and provide aesthetic benefits to cities. In one year, a single mature tree will absorb up to 48 pounds of carbon dioxide from the atmosphere, and release it as oxygen. The amount of oxygen that a single tree produces is enough to provide one day's supply of oxygen for people. So while you are busy studying and working on earning those good grades, all the trees on campus are also working hard to make the air cleaner for us. Trees on our campus impact our mental health as well; studies have shown that trees greatly reduce stress, which a huge deal is considering many students are under some amount of stress. The institute is nestled amidst tall trees and lush green plants as

- Trees - 71 species & 1969 Nos.
- Herbs & Shrubs - 12 species & 685 Nos.
- Medicinal Plants - 11 species & 25 Nos.
- Ornamental Plants - 14 species.

Tree Plantation at Baba Farid Vidyak Society

List of Trees in Baba Farid Vidyak Society campus

Sr. No.	Name of Tree/ Plant	Nos.
1	Ficus Benjamina	200
2	Ficus Panda	100
3	Golden Ficus	15
4	R-Kuli Farm	3
5	Kadam	6
6	Kachnar	17
7	Pilkan	41
8	Malsari	69
9	Sukhchain	120
10	Putran Jiwa	24
11	Gulmohar	90
12	Termilia	20
13	Alstonia	70
14	Mohangani	15
15	Ashoka	48
16	Pagoda	44
17	Morpankhi	70
18	Fishtail Palm	30
19	Silver Rouk	41
20	Arjun	10
21	Chil	5
22	Goldern Bottle Brush	5
23	Pahadi Pipl	2
24	Zed Drofa	5
25	Cher	23
26	Fonus Palm	6
27	Chandani	8
28	Silver Okas	14
29	Kangi Palm	2
30	Heavy Cus	18
31	Amal tash	100
32	Neem	110

33	Thune	3
34	Sukhchain	100
35	Barkain	30
36	Haar Shingar	5
37	Toot	10
38	Bagan Belia	20
39	Crezuana	12
40	Amelia	35
41	Tikoma	5
42	Ficus	120
43	Bottle Palm	70
44	Rose	95
45	Jamun	120
46	Amaltash	10

List of Herbs & Shrubs in Baba Farid Vidyak Society campus

Sr. No.	Name of Tree/ Plant	Nos.
1	Marigold	60
2	Sweet william	50
3	Dianthus	25
4	Hollyhock	50
5	Rose	10
6	Calendual	120
7	Canaly tuff	50
8	Panzy	40
9	Ice Flower	60
10	Petunia	20
11	Poppy	100
12	Baby Sunflower	100

List of Medicinal Plants in Baba Farid Vidyak Society campus

Sr. No.	Name of Tree/ Plant	QTY
1	Rose	10
2	Lemon Grass	25
3	Tulsi	10
4	Insulin	10
5	Aloe Vera	7
6	Arjun	5
7	Carelamon	5
8	Sohanjuana	8
9	Kadhi Patta	4
10	Neem	4
11	Pathar Chatt	5

List of Ornamental Plants in Baba Farid Vidyak Society campus

Sr. No.	Name of Tree/ Plant
1	Gulmohar
2	Fish Tail Palm
3	Fox Tail Palm
4	Bottle Palm
5	Bougain Villea
6	Pagoda Tree
7	Thuja Tree
8	Bottle Brush
9	Silver Oak
10	Ashoka
11	Bamboo Palm
12	Amaltas
13	Ficus Durenta
14	Ficus Panda

List of Hydrophytes in Baba Farid Vidyak Society campus

S. No.	Plants	Common Names	Family
1.	Azolla pinnata	Azolla	Azollaceae
2.	Ceratophyllum submersum	Coon's tail	Ceratophyllaceae
3.	Eichhornia crassipes	Water hyacinth	Pontederiaceae
4.	Hydrilla verticillata	Water thyme	Hydrocharitaceae
5.	Marsilea quadrifolia	Water clover	Marsileaceae
6.	Nelumbo nucifera	Lotus	Nelumbonaceae
7.	Typha latifolia	Cat tail	Typhaceae

List of Palm in Baba Farid Vidyak Society campus

S. No.	Plants	Common Names	Family
1.	Calamus rotang	Rattan	Arecaceae
2.	Caryota urens	Fish palm	Arecaceae
3.	Cycas circinalis	Queen sago	Cycadaceae
4.	Cycas revoluta	Sago palm	Cycadaceae
5.	*Dypsis lutescens*	Golden cane bamboo	Arecaceae
6.	*Livistona chinensis*	China Palm	Arecaceae
7.	*Phoenix dactylifera*	Date palm	Arecaceae
8.	*Roystonia regia*	Royal Palm	Arecaceae

Green belt development with sufficient tree cover/ plantation is managed by the campus over 9.7 acres. Method of Irrigation adopted by the campus to manage green area has been depicted as

Sr. No.	Method	Plantation Type
1.	Flood Irrigations	For Mad/ Field Crops
2.	Basin System of Irrigation	For Ornamental Crops
3.	Check Basin/ Flooding	For Fruits

House Keeping

Baba Farid Vidyak Society ensures neat and clean environment in the educational campus. Consequently, buildings are kept clean and sanitized on regular basis on all working days. A good housekeeping practices were observed during audit.

Recommendations

- All trees in the campus should be with a track record
- Create automatic drip irrigation system during summer holidays
- Encouraging students and conducting competitions among departments for making the campus green.

Auditing for Carbon Footprint

Auditing for Carbon Footprint

Commutation of stakeholders has an impact on the environment through the emission of greenhouse gases into the atmosphere consequent to burning of fossil fuels (such as petrol and diesel vehicles). The most common greenhouse gases are carbon dioxide, water vapour, methane, nitrous oxide and ozone. Among the greenhouse gases, carbon dioxide is the most prominent greenhouse gas, comprising 402 ppm of the Earth's atmosphere. The release of carbon dioxide gas into the Earth's atmosphere through human activities is commonly known as carbon emissions.

An important aspect of doing an audit is to be able to measure your impact so that we can determine better ways to manage the impact. In addition to the water, waste, energy and biodiversity audits we can also determine what our carbon footprint is, based on the amount of carbon emissions created. One aspect is to consider the distance and method traveled between home and college every day. It undertakes the measure of bulk of carbon dioxide equivalents exhaled by the organization through which the carbon accounting is done. It is necessary to know how much the organization is contributing towards sustainable development. It is therefore essential that any environmentally responsible institution examine its carbon footprint.

Transportation

Distance should not be a constraint in reaching out for quality education. Keeping this in mind, Baba Farid Group of Institutions has provided a well-connected transport service to fetch the students as well as the faculty members from their locations to the college.

- A fleet of more than 125 buses ferry around 6000 students from nearby areas and distant locations.
- The facility covers more than 80+ kms of radius.
- The buses cover at least 120 different bus routes.
- Areas of six districts namely Bathinda, Barnala, Faridkot, Muktsar, Mansa and Sirsa are covered by bus routes.

The institute is operating common transportation facility for students and staff as buses for outdoor transport and E-Rickshaws for in door transport. Mostly students & staff is encouraged to use public transport.

Green Energy

Reducing the Carbon Footprints

- Installation of more solar panels or solar energy generation devices should be enhanced to reduce the electricity footprint of the campus. Terrace of each building can be utilized to produce electricity from tilt-able solar modules.
- The food waste generated from the institute hostel mess, guest house, canteens and staff quarters should be converted into the biogas which can be further utilized for hostel kitchens.
- Adoption of E-vehicle for common transportation facility and solar battery operated vehicles in campus to reduce carbon footprints and save environment.
- The Green computing or E-work is helping the organization to reduce footprint very effectively.
- The use of solar energy based lamps in streets and corridors in campus will reduce carbon footprint.
- The awareness should be made among the faculty, students and other employees regarding Clean Development Mechanism (CDM) to reduce the consumption of electricity and natural resources.
- Establish a system of carpooling among the staff to reduce the number of four wheelers coming to the institute.
- Encourage students and staff to use cycles and follow No Vehicle Day on one day in a week to save fuel consumption.
- As an outcome effort can be made to reduce carbon foot prints by using electrical vehicles in the campus and green computing in the administration and examination.

Evaluation of Audit Findings

Evaluation of Audit Findings

- Management of solid wastes by authorized vendors is found satisfactory.
- Management of chemical hazardous wastes as laboratory effluents need to be stablished.
- Management of biodegradable wastes by converting into manures using composting/ manure pits is appreciable.
- More rain water harvesing systems/ rechare pits need to be establish covering all buildings with seprate and dedicated drainange system to avoid surface runoff contaminations.
- Efforts of energy conservation by adopting solar pannels as water heater and street lights need to be established.
- Gardens with sufficient green belt in Baba Farid Vidyak Society premises are found well maintained.
- Green policy/Environmental policy statement indicating the commitment of the institute towards its environmental performance should be followed.
- Use of notice boards and signs to reduce over exploitation of natural resources need to be displayed.
- Environmental education programs have to be strengthened.
- Establish a purchase policy for environmental friendly materials
- Bio degradable waste may be used for non-conventional energy generation or steam generation for cooking food/washing cloths etc.
- Bio gas plant should be installed to manage biodegradable wastes
- Strengthen the environmental awareness programs with huge plantation and environment friendly techniques to protect the environment and natural resources.
- Initiative for carbon accounting such as adequate common transportation facilities for all students and staff is appreciable.
- Encourage students to use bicycles.
- A model solid waste management system based on 3R's (reduce, reuse and recycle) to be established to reduce undue pressure on municipal system and to convert solid wastes into valuable resources.
- Establish a plastic free campus and use of paper plates and cups in place of plastics for all functions in the institute.

Recommendations

Recommendations

Following are some of the key recommendation for improving campus environment:

- A model solid waste management system based on 3R's (reduce, reuse and recycle) to be established to reduce undue pressure on municipal system and to convert solid wastes into valuable resources.
- Management of Hazardous wastes as laboratory effluents need to be stablished. Chemical effluent water from laboratories and waste oils from DG sets, electrical appliances and other machinery need to handed over to govt. authorized and registered vendors only for effective management of hazardous wastes.
- Adoption of more rain water harvesting system need to be installed on remaining Building/ Blocks and automatic drip irrigation system to conserve the valuable water resources.
- Sewage treatment with zero liquid discharge is recommended to effective management of water resources.
- Automatic drip irrigation system need be adopted in plantation and green belt development areas and irrigation areas.
- Adoption of sufficient e-vehicle for common transportation facility and solar battery operated vehicles in campus to reduce carbon footprints and save environment.
- Adoption of more solar energy options to reduce the stress on natural resources, to prevent environmental degradation and economic viability.

Basic and Fundamental Components of environmental sustainability

Preparation of Action Plan for Audit

Preparation of Action Plan for Audit

There should be Committee formation for energy audit, green audit and environmental audit involving faculties and students. Policies referring to management and approach towards the use of resources need to be considered. The institute should have a green policy and environmental policy for its sustainable development. The environmental policy formulated by the management should be implemented meticulously. The institute should have a policy on awareness raising or training programs (for ground staff or kitchen staff for example) and an environment friendly procurement policy (the Institute's policy for purchasing ecofriendly materials). Green Audits are exercises which generate considerable quantities of valuable management information. The time and effort and cost involved in this exercise is often considerable and in order to be able to justify this expenditure, it is important to ensure that the findings and recommendations of the audit are considered at the correct level within the organization and that action plans and implementation programs result from the findings. Audit follow up is part of the wider process of continuous improvement. Without follow-up, the audit becomes an isolated event which soon becomes forgotten in the pressures of organizational priorities and the passing of time.

Exit Meeting

The exit meeting was conducted jointly by the experts of Eco Laboratories and Consultants Pvt. Ltd. and the team members of the institute. It was a mechanism to provide the management and staff a broad feedback on the preliminary findings of the audit team before completing the audited report. The exit meeting was held in the campus of institute on 15th April 2021. Clarification on certain information gathered was sought by the audit team from the management and staff of the institute.

Draft Audit Report

The information gathered by the audit team was consolidated as a draft audit report. This draft report was then circulated to the audit team and those directly concerned with the audit to check the report for accuracy. The draft green audit report was also discussed in the exit meeting.

Final Audit Report

The final audit report is the corrected final document which contains the findings and recommendations of the audit. It will also form one of the bases of future audits because the information it contains informs some of the tests and analyses that need to be performed in the future. Final Audit Report was submitted to the Principal / Director of the institute.

Follow Up and Action Plans

Green audits form a part of an on-going process. Innovative green initiatives have to be designed and implemented every year to make the institute environmentally sustainable. Follow up programs of green auditing recommendations should be done meticulously before next audit.

Next Audit

In order to promote continuous improvement, it is recommended to conduct the next green auditing during the year 2023.

Transparency of Green Audit Report

Green audit report is one of the useful means of demonstrating an organization's commitment to openness and transparency. If an organization believes it has nothing to hide from its stakeholders, then it should feel confident enough to make its green audit reports freely available to those who request them. As a basic rule, green audit reports should be made available to all stakeholders.

About Eco Group (Consultant)

ABOUT ECO GROUP

Eco Group is North India's reputed environmental organization Headquartered in Mohali (Chandigarh) that offers consultancy and environmental-related turnkey solutions for overall pollution abatement and sustainable development. We are a professional engineering firm with National level consultancy approved by QCI/ NABET and Environmental and Mechanical testing laboratory approved by MoEF&CC, NABL (ISO/IEC 17025:2017) and state boards.

Eco Group, established in 1998 has designed, engineered and executed more than 1,000 installations of Water, Domestic Sewage and Industrial Effluent Treatment Plants. With the help of our state-of-the-art technologies and apt infrastructure, we are proud to maintain an impeccable quality record, owing to our customer satisfaction levels. These treatment plants operate with the help of trained staff, including Sewage Treatment Plants (STPs), Effluent Treatment Plants (ETPs), Reverse Osmosis Plants (ROs), etc. In the last 20 years, we have undertaken several projects successfully and have created sustainable solutions to environmental issues.

Eco Group has two major business divisions as Eco Paryavaran Engineers & Consultants Pvt. Ltd. and Eco Laboratories & Consultants Pvt. Ltd. The former caters to consultancy and providing engineering solutions for environmental pollution whereas the latter pertains to the analytical and consultancy services in the field of lab testing and environmental studies. Eco Paryavaran is North India's leading supplier of pollution control equipment with world-class infrastructure.

Eco Laboratories is NABL (National Accreditation Board for Testing and Calibration Laboratories) accredited for ISO/IEC 17025:2017, approved by Ministry of Environment, Forest and Climate Change (MoEF&CC) & State Pollution Control Board (SPCBs) in the field of air, noise, wastes, water/wastewater and microbiological testing. Eco Laboratories & Consultants Pvt. Ltd. is also Government approved (ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018) and National Accreditation Board for Education and Training (NABET).

Team of Experts for the Study

S. No.	Name of Expert	Role of Expert	ID of Expert
1.	**Dr. Sandeep Garg** (Ph. D. & ME in Env. Sc., BE in Civil)	**Managing Director** ▪ NABL approved authorized signatory ▪ MoEF&CC approved govt. analyst ▪ NABET approved EIA Coordinator & Functional Area Expert ▪ Chairman IWE & Ex-Advisor, GMADA	
2.	**Dr. Rai Singh** (Ph. D. & M. Sc. Env. Sc. P.G. Diploma in Industrial Safety, Health & Env.)	**Dy. General Manager (Technical & Environment)** ▪ MoEF&CC approved Govt. Analyst; ▪ NABL approved authorized signatory ▪ NABET approved Environmental Expert ▪ Worked in CPCB (2001-12) as Research Scientist	
4.	**Dr. Simranjit Kaur** (M.Sc. & M.Phill.; Ph.D. in Solid Waste Management)	**Deputy General Manager – EMS & Biological Lab** **Quality Manager – Analytical Division** ▪ NABL Technical Assessor, ▪ NABL approved authorized signatory ▪ MoEF&CC approved govt. analyst ▪ NABET approved EIA Coordinator & Functional Area Expert	
5.	**Mr. Maninder Preet Singh** (Diploma in Electrical & Electronics)	**Manager (Projects)**	
6.	**Mr. Umesh Kumar** (M. Tech – Nanotech)	**Technical Manager &** **Sr. Laboratory Analyst** (Environment & Chemical) NABL approved authorized signatory	

Approvals of Eco Laboratory

Approvals of Eco Laboratory

MOEF&CC ACCREDITATION CERTIFICATE

रजिस्ट्री सं० डी० एल०-33004/99 REGD. NO. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

असाधारण
EXTRAORDINARY
भाग II—खण्ड 3—उप-खण्ड (ii)
PART II—Section 3—Sub-section (ii)
प्राधिकार से प्रकाशित
PUBLISHED BY AUTHORITY

सं. 758] नई दिल्ली, बुधवार, फरवरी 28, 2018/फाल्गुन 9, 1939
No. 758] NEW DELHI, WEDNESDAY, FEBRUARY 28, 2018/PHALGUNA 9, 1939

पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय

अधिसूचना

नई दिल्ली, 26 फरवरी, 2018

NOTIFICATION

New Delhi, the 26th February, 2018

S.O. 857(E).—In exercise of the powers conferred by clause (b) of sub-section (1) of section 12 and section 13 of the Environment (Protection) Act, 1986 (29 of 1986), read with rule 10 of the Environment (Protection) Rules, 1986, the Central Government hereby makes the following further amendments in the notification of the Government of India in the erstwhile Ministry of Environment and Forests, number S.O. 1174(E), dated the 18th July, 2007, namely: -

In the Table appended to the said notification, -

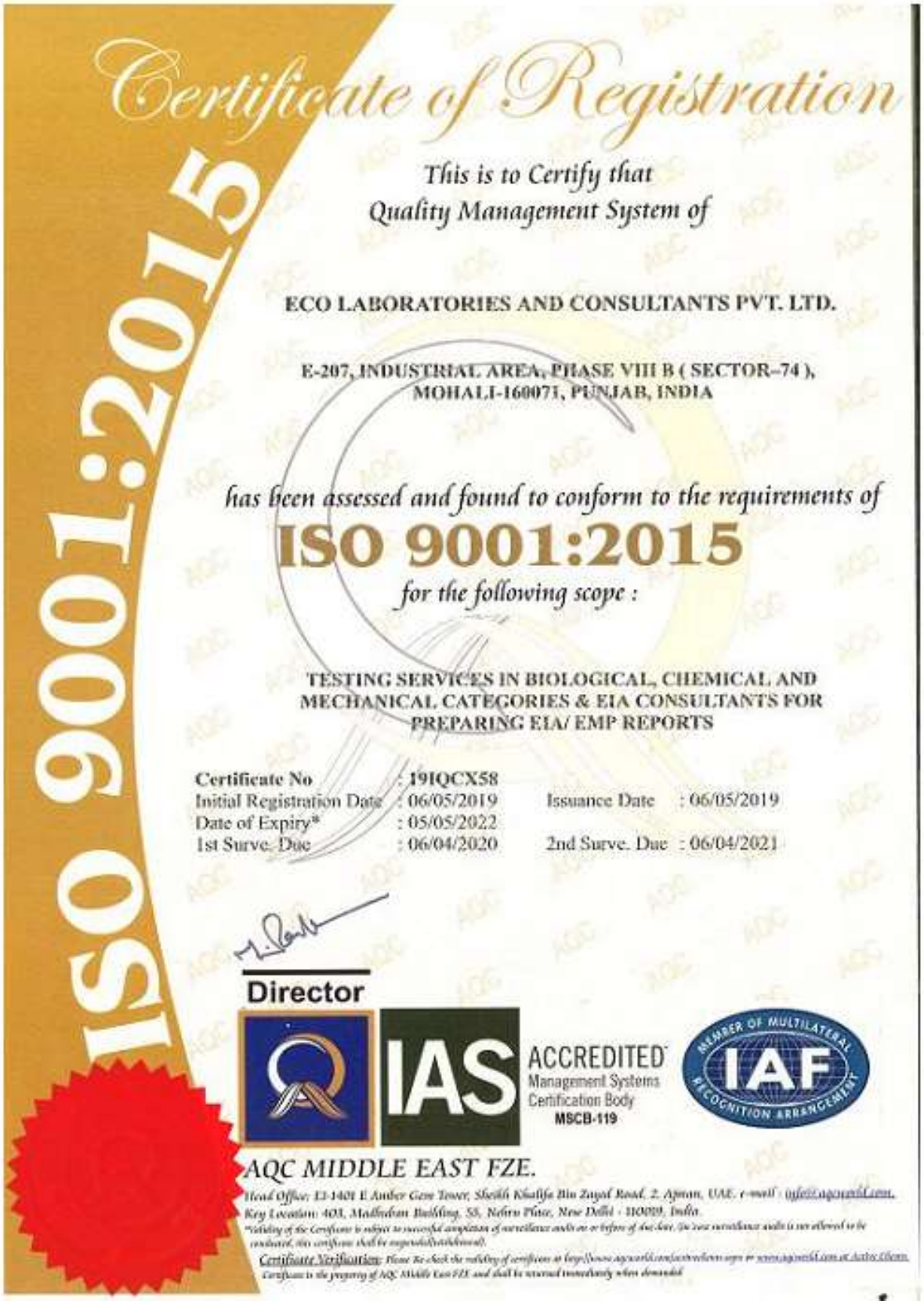
(i) for serial numbers 1,17,24,26,30,39,41,45,81,86,87,93,94,95,96 and 100 the entries relating thereto, the following serial numbers and entries shall be substituted, namely: -

S.No.	Name of the Laboratory	Name of the Govt. Analyst	Recognition with effect from and valid up to
(1)	(2)	(3)	(4)
"1	M/s Mantec Consultants Pvt. Ltd. D-36, Sector-VI, Noida-201301, Uttar Pradesh	(i) Mr. Gaja Nand Mallick (ii) Dr. Vivek Dwivedi (iii) Mr. Sumit Verma	26.02.2018 to 25.02.2023
17	M/s Idma Laboratories Limited	(i) Mr. Ankush Aggarwal	26.02.2018

	391, Industrial Area, Phase-I, Panchkula-160019,Haryana	(ii)Mr. Niranjan Dev Behl (iii) Dr. Rajendra Kumar Jain	to 25.02.2023
24	M/s Newcon Consultants & Laboratories Pvt. Ltd. 8th K.M. Stone, Delhi Meerut Road, Morta (Opp. Manan Dham Mandir), Ghaziabad-201003, Uttar Pradesh	(i) Mr. Pankaj Gupta (ii) Mr. Amit Kumar Singh (iii) Mr. Intekhab Khan	26.02.2018 to 25.02.2023
26	M/s Klean Laboratories & Research Pvt. Ltd. 402, Purushottam Plaza, Opp. Baner Telephone Exchange,Baner Road, Pune-411045, Maharashtra	(i) Mr. Vishwas Waman Kale (ii) Mr. Sanjay Kamalakar Mardikar (iii) Ms. Manjusha Gaikwad	26.02.2018 to 25.02.2023
30	M/s Lawn Enviro Associates, "Lawn House" #184-C, Vengalrao Nagar, Hyderabad-500038, Telangana	(i) Mr. Devireddy Nagarujuna Reddy (ii) Ms. Chevula Anuradha (iii) Ms.Vangani Pallavi	26.02.2018 to 25.02.2023
39	M/s Team Test House. (A Unit of Team Institute of Science & Technology Pvt. Ltd.) G-1-584, RIICO Industrial Area, Sitapura, Jaipur-302022, Rajasthan	(i) Mrs. Kavita Mathur (ii) Mr. Kedar Nath Mukhopadhyay (iii) Mr.Rajesh Maheshwari	26.02.2018 to 25.02.2023
41	M/s Envirochem Research & Test Labs Pvt. Ltd. HIG-79, Sector-E, Aliganj, Lucknow-226024, Uttar Pradesh	(i) Dr. Madan Mohan Agarwal (ii) Sh. Vivek Kumar Gupta (iii) Mrs. Saroj Singh	26.02.2018 to 25.02.2023
45	M/s Mineral Engineering Services 25/XXV, Club Road, Bellary-583103, Karnataka	(i) Mr. M. Sachin Raju (ii) Mr. M.R. Durga Prasad (iii) Mr. A.D. Yashwanth Arun Murthy	26.02.2018 to 25.02.2023
81	M/s Advanced Environmental Testing and Research Lab Pvt. Ltd. 63/1, Kailash Vihar, Near ITO, City Center-II, Gwalior-474011, Madhya Pradesh	(i)Mr. Rajesh Jain (ii)Dr. Dinesh Kumar Uchchariya (iii) Mr. Arvind Kumar Sharma	26.02.2018 to 25.02.2023
86	M/s Care Labs Plot No. 1, 3rd Floor, Sai Sadan Complex, Shiva Ganga Colony, L.B. Nagar, Hyderabad-500074, Telangana	(i) Mr.K. Srinivasa Rao (ii) Ms. Gouthami Gangula (iii) Ms. P. Mamatha	26.02.2018 to 25.02.2023
87	M/s Green Circle Inc. Green Empire, Anupushpam Habitat Centre, Nr. Yash Complex, Above Asix Bank Ltd., Gotri Main Road, Vadodara-390021, Gujarat	(i) Mr. Pradeep Joshi (ii) Mr. Ram Raghav (iii) Ms. Shital Jashvantsinh Parmar	26.02.2018 to 25.02.2023
93	M/s Eco Laboratories & Consultants Pvt. Ltd. E-207, Industrial Area, Phase- VIII B, Sector-74, Mohali-160071, Punjab	(i) Mr. Sandeep Garg (ii) Ms. Simranjit Kaur (iii) Dr. Deepika Thakur	26.02.2018 to 25.02.2023
94	M/s Hubert Enviro Care Systems Pvt. Ltd. No. 18, 92nd Street, Ashok Nagar, Chennai-600083, Tamil Nadu	(i)Dr. J.R. Moses (ii)Dr. Rajkumar Samuel (iii) Mr. A.K. Natarajan	26.02.2018 to 25.02.2023
95	M/s Nawal Analytical Laboratories Plot No. 100, New SIDCO Industrial Estate, Sri Nagar, Hosur-635109, Tamil Nadu	(i) Mr. D.Balakrishnan (ii) Ms. S. Elamathi (iii) Mr. K.B.Krishnamoorthy	26.02.2018 to 25.02.2023

Approved

ISO 9001: 2015 CERTIFICATE



ISO 9001:2015

Certificate of Registration

This is to Certify that
Quality Management System of

ECO LABORATORIES AND CONSULTANTS PVT. LTD.

E-207, INDUSTRIAL AREA, PHASE VIII B (SECTOR–74),
MOHALI-160071, PUNJAB, INDIA

has been assessed and found to conform to the requirements of

ISO 9001:2015

for the following scope :

TESTING SERVICES IN BIOLOGICAL, CHEMICAL AND MECHANICAL CATEGORIES & EIA CONSULTANTS FOR PREPARING EIA/ EMP REPORTS

Certificate No	: **19IQCX58**		
Initial Registration Date	: 06/05/2019	Issuance Date	: 06/05/2019
Date of Expiry*	: 05/05/2022		
1st Surve. Due	: 06/04/2020	2nd Surve. Due	: 06/04/2021

Director

IAS ACCREDITED Management Systems Certification Body MSCB-119

MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT IAF

AQC MIDDLE EAST FZE.

Head Office: E3-1401 E Amber Gem Tower, Sheikh Khalifa Bin Zayed Road, 2, Ajman, UAE. e-mail : info@aqcworld.com,
Key Location: 403, Madhukan Building, 55, Nehru Place, New Delhi - 110019, India.
**Validity of the Certificate is subject to successful completion of surveillance audits on or before of due date. In case surveillance audits is not allowed to be conducted, this certificate shall be suspended/withdrawn).*
Certificate Verification: Please Re-check the validity of certificate at http://www.aqcworld.com/certificates.aspx or www.aqcworld.com or Authorities.
Certificate is the property of AQC Middle East FZE and shall be returned immediately when demanded

ISO 14001: 2015 CERTIFICATE

ISO 14001:2015

Certificate of Registration

This is to Certify that
Environmental Management System of

ECO LABORATORIES AND CONSULTANTS PVT. LTD.

E-207, INDUSTRIAL AREA, PHASE VIII B (SECTOR–74),
MOHALI-160071, PUNJAB, INDIA

has been assessed and found to conform to the requirements of

ISO 14001:2015

for the following scope :

TESTING SERVICES IN BIOLOGICAL, CHEMICAL AND MECHANICAL CATEGORIES & EIA CONSULTANTS FOR PREPARING EIA/ EMP REPORTS

Certificate No	: 191ECS58		
Initial Registration Date	: 06/05/2019	Issuance Date	: 06/05/2019
Date of Expiry*	: 05/05/2022		
1st Surve. Due	: 06/04/2020	2nd Surve. Due	: 06/04/2021

Director

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MOHALI-160071, PUNJAB, INDIA

has been assessed and found to conform to the requirements of

ISO 45001:2018

for the following scope :

TESTING SERVICES IN BIOLOGICAL, CHEMICAL AND MECHANICAL CATEGORIES & EIA CONSULTANTS FOR PREPARING EIA/ EMP REPORTS

Certificate No	: 19IOCN74		
Initial Registration Date	: 06/05/2019	Issuance Date	: 06/05/2019
Date of Expiry*	: 05/05/2022		
1st Surve. Due	: 06/04/2020	2nd Surve. Due	: 06/04/2021

Director

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Acknowledgement

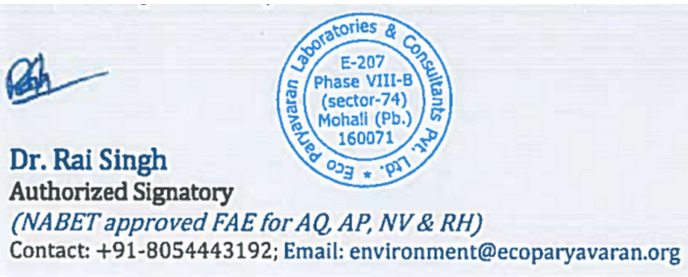
Acknowledgement

Eco Laboratories and Consultants Pvt. Ltd. is thankful to the Management and the Principal/Director of Baba Farid Vidyak Society for entrusting processes of Green auditing with us.

We thank all the participants of the auditing team especially students, faculty and non-teaching staff who took pain along with us to gather the data through survey.

We also thank the office staff who helped us during the document verification.

For Eco Laboratories and Consultants Pvt. Ltd.



Dr. Rai Singh
Authorized Signatory
(NABET approved FAE for AQ, AP, NV & RH)
Contact: +91-8054443192; Email: environment@ecoparyavaran.org

***** *End of Report* *****

Energy audit

APRIL 2023

For

Baba Farid Vidyak Society

Muktsar Road (Campus), Bathinda, Punjab (India)

- Baba Farid College of Engineering and Technology
- Baba Farid College of Management and Technology
- Baba Farid College
- Baba Farid College of Education

Prepared & Submitted By

ECO PARYAVARAN LABORATORIES & CONSULTANTS PVT. LTD.

An ISO 9001:2015, ISO 14001:2015 & ISO 45001:2018 certified Company

QCI-NABET, MOEF&CC, NABL and PPCB approved Laboratory

ECO Bhawan, E-207, Industrial Area, Phase VIIIB, Sector-74, Mohali-160071, (Punjab)

Tel: 8872043185, Website: www.ecoparyavaran.org

TC-7477

ENERGY MANAGEMENT

The fundamental goal of energy management is to produce good & provide service with the least cost & least environmental effects. Energy is one of the major inputs for the economic development of any country. The fundamental goal of energy management is to produce goods & provide service with the least cost & least environmental effects.

"The strategy of adjusting & optimizing energy, using systems & procedures so as to reduce energy requirements per unit of output while holding constant or reducing total cost of producing the output from these systems"

The objective of energy management is to achieve & maintain optimum energy procurement & utilization, throughout the organization and:

To minimize energy cost / waste without affecting production & quality.

To minimize environmental effects.

ELECTRICAL ENERGY

Energy resources utilized by all the departments, support services & the administrative buildings of *"Baba Farid College"* including electricity, solar energy & liquid fuels as Diesel. Major use of energy is at office, canteen, hostel & laboratories, for lighting, cooking & workshop instruments. Electricity is supplies to the college by Punjab Electricity Board & the tariff rate is 6.63 / kwh. The communication process for awareness in relation to energy conservation is found inadequate.

- Regular monitoring of equipment's and immediate rectification of any problems.
- Conduct more save energy awareness programs for students & staff.
- Observe a power saving day every year.
- Automatic power switch off system should be introduced.
- Use of APFC panel.

ABOUT THE LOCATION

	FACILITY INFORMATION
FACALITY TYPE	*COMMERCIAL / INSTITUTIONAL*
TYPE	*EDUCATION*
PREPARED FOR	*Baba Farid College Bathinda*
PREPARED BY	*ECO PARYAVARAN*
FACILITY NAME	*Baba Farid College*
CITY	*Bathinda*
STATE	*PUNJAB*

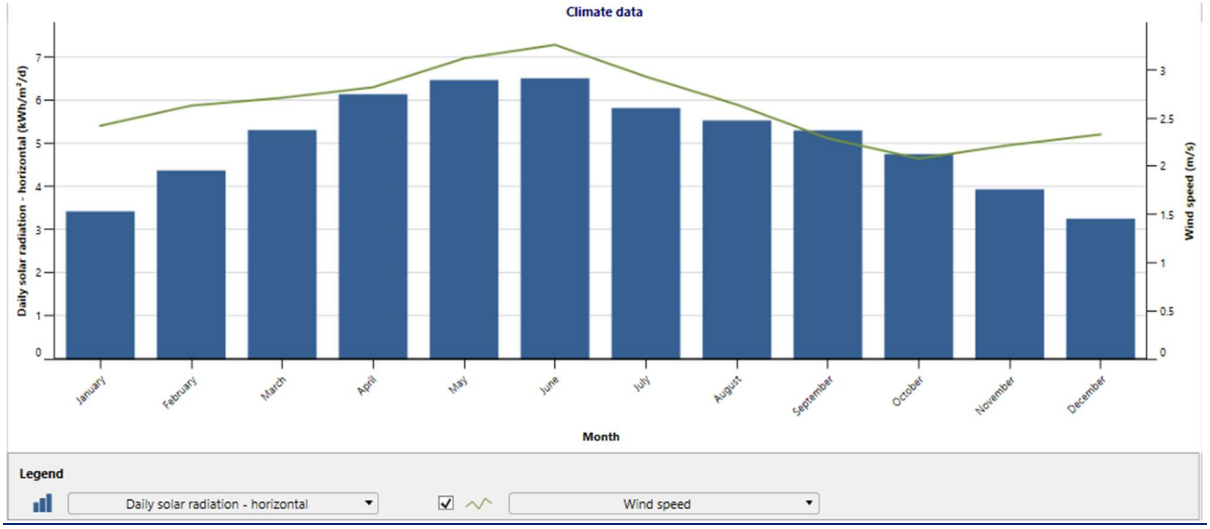
CLIMATE DATA ACCORDING TO LOCTION

Site reference conditions

Climate data location: India - Punjab - Bathinda | Facility location: India

	Unit	Climate data location	Facility location	Source
Latitude		30.2	30.3	
Longitude		75.0	74.8	
Climate zone		1B - Very hot - Dry		NASA
Elevation	m	201	208	NASA – Map
Heating design temperature	°C	4.7		NASA
Cooling design temperature	°C	37.7		NASA
Earth temperature amplitude	°C	25.5		NASA

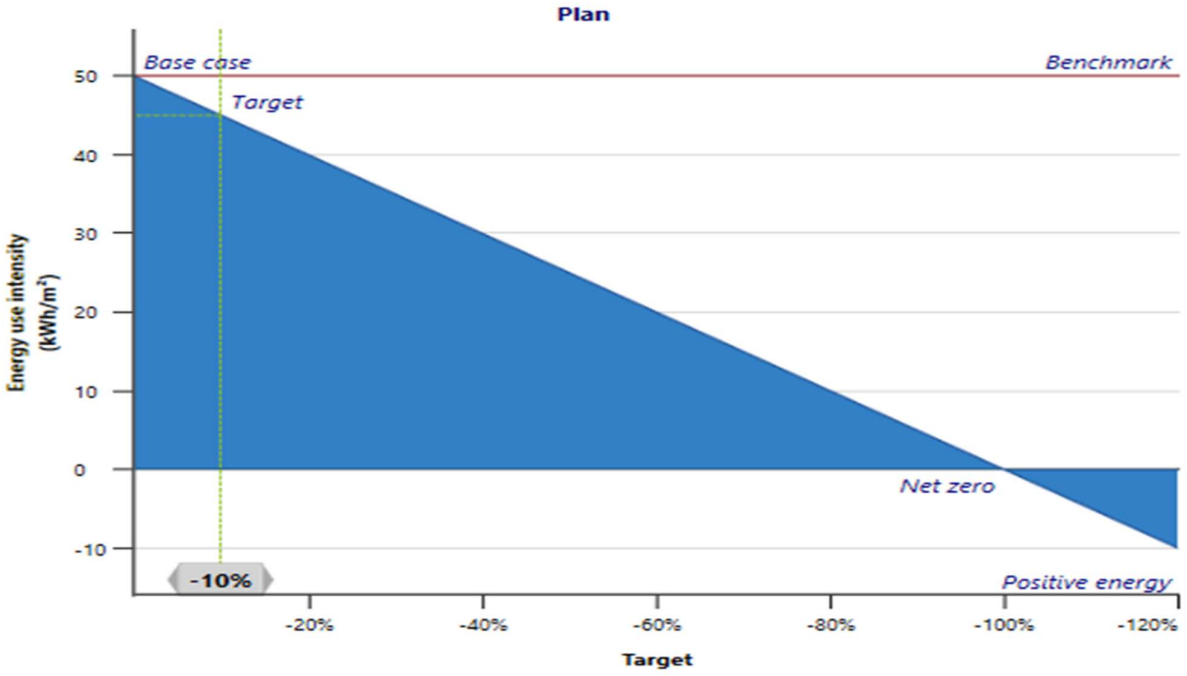
Month	Air temperature	Relative humidity	Precipitation	Daily solar radiation - horizontal	Atmospheric pressure	Wind speed	Earth temperature	Heating degree-days 18 °C	Cooling degree-days 10 °C
	°C	%	mm	kWh/m²/d	kPa	m/s	°C	°C-d	°C-d
January	13.3	37.5%	12.09	3.43	99.3	2.4	12.2	146	102
February	16.4	36.5%	21.00	4.38	99.1	2.6	15.7	45	179
March	22.8	29.0%	14.57	5.32	98.8	2.7	22.8	0	397
April	29.4	20.9%	10.50	6.15	98.3	2.8	30.3	0	582
May	35.1	17.9%	15.50	6.48	97.8	3.1	37.0	0	778
June	37.0	28.0%	50.70	6.52	97.4	3.3	39.4	0	810
July	35.0	46.0%	97.34	5.83	97.4	2.9	36.8	0	775
August	33.0	53.5%	98.58	5.54	97.7	2.6	34.2	0	713
September	30.8	47.5%	61.20	5.31	98.1	2.3	31.5	0	624
October	26.4	31.0%	8.06	4.76	98.7	2.1	26.0	0	508
November	20.8	25.5%	2.40	3.94	99.1	2.2	19.7	0	324
December	15.6	30.5%	6.82	3.26	99.3	2.3	14.2	74	174
Annual	**26.3**	**33.7%**	**398.76**	**5.08**	**98.4**	**2.6**	**26.7**	**265**	**5,966**
Source	NASA	NASA	NASA	NASA	NASA	NASA	NASA	NASA	NASA
Measured at					m	10	0		



Graphical Representation of Solar Radiation & Wind Speed Month Wise

BENCHMARK- COMMERCIAL / INSTITUTIONAL- EDUCATION

Benchmark - Commercial/Institutional - Education	Step 1 - Analysis type	
Facility size	2,10,437	m²
Fuel consumption		
Energy use intensity		
Energy unit	kWh	
Reference unit	m²	
Benchmark	50	kWh/m²
Minimum (Typical)	40	kWh/m²
Maximum (Typical)	55	kWh/m²
Base case	50	kWh/m²
Reference year	2022	
Set target	Target	
Year		
Target	-10%	
Proposed case	45	kWh/m²
Facility - Plan	**Annual**	
Fuel consumption	kWh	
Base case	1,05,21,850	
Proposed case	94,69,665	
Fuel saved	10,52,185	

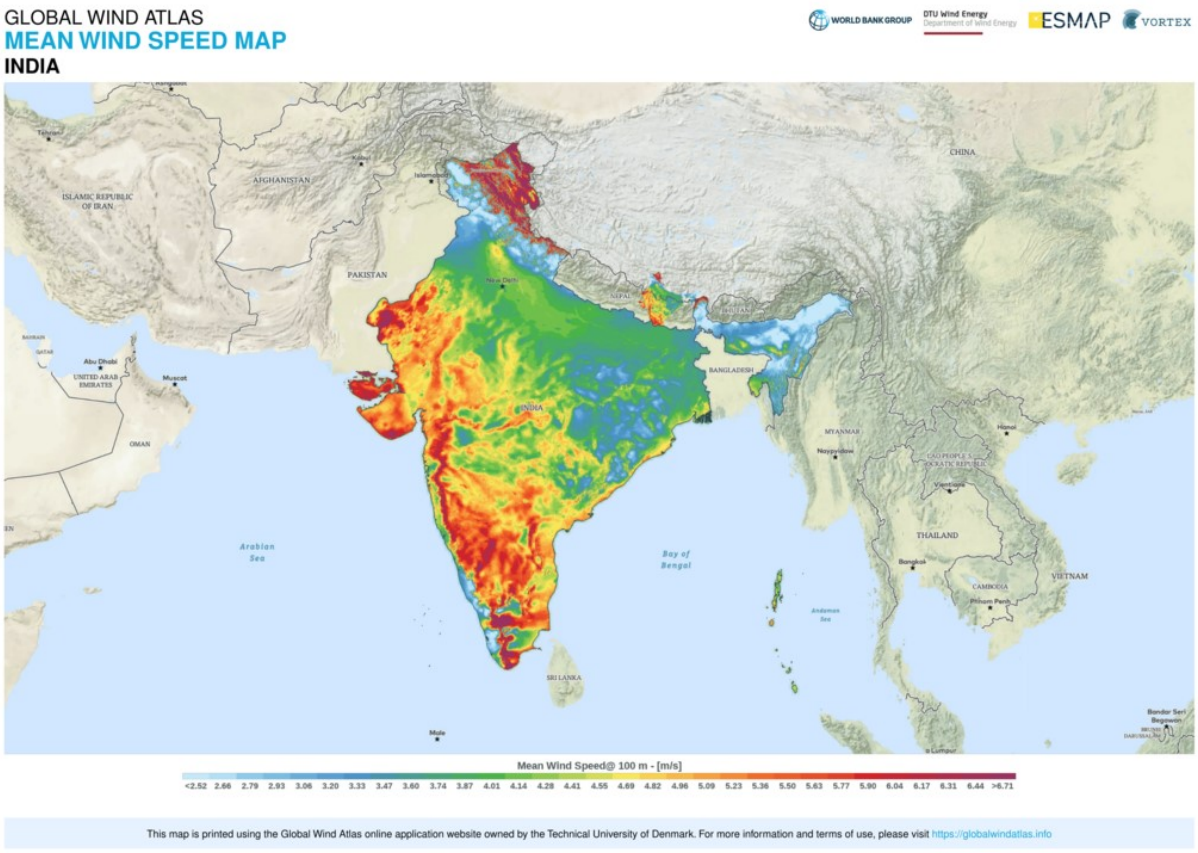


GRAPHICAL REPRESENTATION OF ENERGY USE INTENSITY WITH -10% TARGET

WIND ENERGY

Operating a wind power plant is more complex than simply erecting wind turbines in a windy area. Wind power plant owners must carefully plan where to position wind turbines and must consider how fast and how often the wind blows at the site.

Good places for wind turbines are where the annual average wind speed is at least 9 miles per hour (mph)—or 4 meters per second (m/s)—for small wind turbines and 13 mph (5.8 m/s) for utility-scale turbines. Favourable sites include the tops of smooth, rounded hills; open plains and water; and mountain gaps that funnel and intensify wind. Wind speeds generally increase with increasing elevation above the earth's surface. Large wind turbines are placed on towers that range from about 500 feet to as high as 900 feet tall. **From the climatic data the campus is not suitable for generation of wind energy.**



PIC SHOWING THE WIND SPEED DATA IN VARIOUS STATES OF INDIA

SOLAR WATER HEATING SYSTEM

Solar water heaters -- sometimes called solar domestic hot water systems -- can be a cost-effective way to generate hot water. They can be used in any climate, and the fuel they use -- sunshine -- is free. There are solar water boilers in the facility. Following is the comparison of solar heater with electricity.

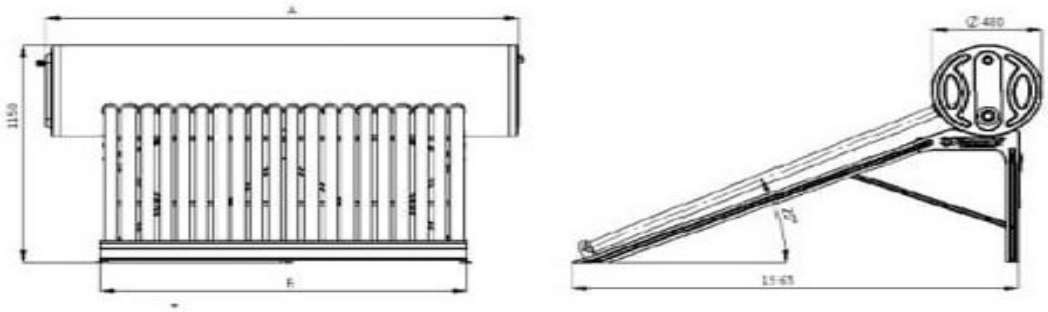
Calculations for solar water heating system

From the data given by the college we absorb that the facility have installed solar water boiler of capacity 12800L which is sufficient & there are no further recommendation on it. Solar boiler details are as follows

SOLAR WATER HEATING IN CAMPUS

Technical specification of 300L solar water boiler for example

TECHNICAL SPECIFICATION OF ALPHA PRO						
Parameter		**VTC 100 L**	**VTC 150 L**	**VTC 200 L**	**VTC 250 L**	**VTC 300 L**
Angle of Stand	°	25				
Heating Element		Optional				
Anode provision (Ø21.3x 165mm)	No	1	1	1	1	1
Corrosion Protection		Mg Anode, Dia.21 x 165mm				
Inlet with 3/4"	nos	1	1	1	1	1
Vent Pipe (Bottom)	nos	1	1	1	1	1
Outlet (Bottom Opening D47)	nos	3/4"	3/4"	3/4"	3/4"	3/4"
Base Length (L)	mm	1965	1965	1965	1965	1965
Base Width (B)	mm	812	1212	1612	2012	2412
Height (H)	mm	1150	1150	1150	1150	1150
Tank Length (A)	mm	1197	1597	2097	2647	3047



STREET LIGHTS & FLOOD LIGHTS

Streets lights are the important part of in energy management. It is absorbed the institution have not adopted the solar street lights or solar flood lights, which can be seen in below pic.

PIC SHOWING THE STREET LIGHT USED BY THE COLLEGE IN THE CAMPUS

CALCULATIONS FOR STRTEET LIGHTS

Total street lights used in the campus	=	18.
Wattage of individual light	=	15w
so total wattage	=	270w
Total flood lights used in the campus	=	18
Wattage of individual light	=	250w
so total wattage	=	4500w
Total wattage of all the lights	=	4770w or 5kw Approx.
One unit of electricity	=	1000 W/h
Operating hours	=	12hr
Units consumed in one day	=	60
Unit consumed in one month	=	1800

Electrical charges of one month	=	Rs.11934 (@6.63/unit)
Cost of installing 18 solar street lights 18w	=	Rs. 36000
Cost of installing 22 flood lights 200w	=	Rs. 97000
Total cost of replacement	=	Rs. 133000

So, capital cost recovery time = (133000/11934) = 1 years Approx

BENEFITS OF USING SOLAR FLOOD LIGHTS:

- Solar led flood light hanging solar spotlights outdoor powered by sunlight, turns on at dusk and off at dawn automatically, built-in 12000mAh LifePO4 battery, which lights up for continuously 15 hours. Once fully charged at night, landscape lighting in your garden.
- 200W solar flood light comes with 918SMD 5730 chipset LEDs, which provides Up to 15 hours of continuous and highly bright lighting (depends on mode). The automatic sensor switch on the solar lantern switches on at night and goes off in the morning. This feature makes it the most economical and innovative solar light outdoor.
- Using energy-saving solar flood lights outdoor, is a smart eco-choice. This led flood light can convert up to 19% of sunlight into electricity and also sustain an ample amount of battery life even under rainy weather.
- Solar flood light auto ON/OFF solar flood light for home outdoor pathway and garden use, is wireless and can be self-installed. The outdoor solar led lamp can easily be mounted on to the wall or Pole with the included screws.
- Solar rechargeable flood light for outdoor garden are incredibly durable and will survive for years due to their ABS construction and IP65 waterproof designs. The solar-led lights for outdoor use are extremely long-lasting suitable for any weather conditions and suitable for patios, lawns, garden, deck, yard, drive, fence, works well even in extreme weather conditions

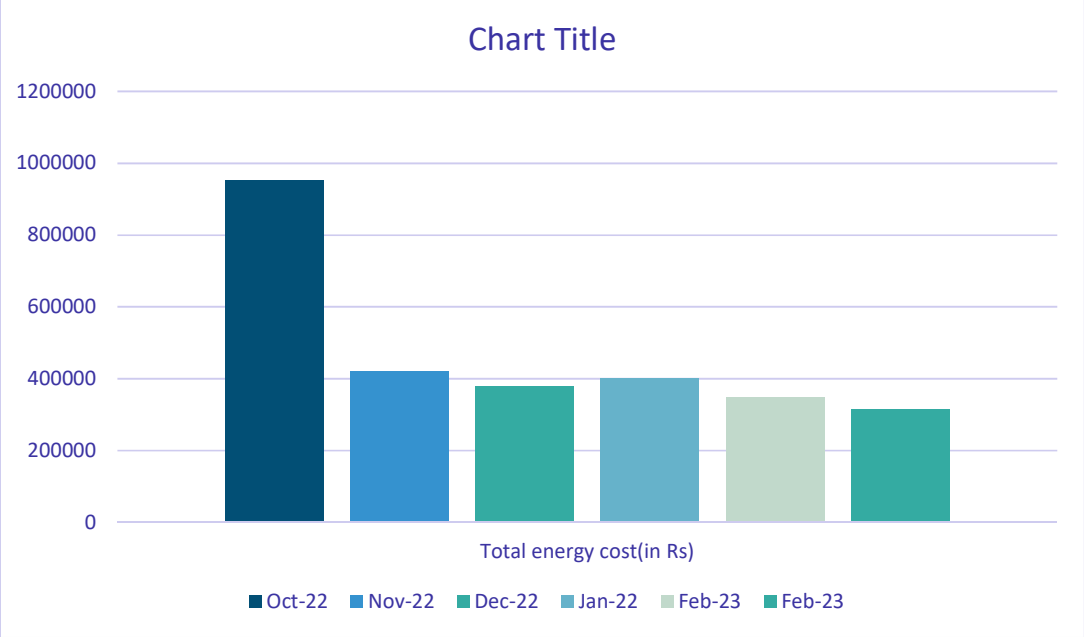
ENERGY CONSUMPTION IN COLLEGE

There are two sources of electricity source in the facility

1. Main electricity with tariff rate of Rs. 6.63 Kw/h
2. Electricity from Solar
3. Electricity from Generators

The six-month Energy consumption of the college is shown in below table

S. No	Bill month	Rate/kwh	Total energy cost(in Rs)	Bill no
1	Oct-22	6.63	953910	1004924629
2	Nov-22	6.63	421530	1005037134
3	Dec-22	6.63	378250	1005137429
4	Jan-22	6.63	399740	1005229552
5	Feb-23	6.63	347870	1005333133
6	Feb-23	6.63	314550	1005420249



GRAPHICAL REPRESENTATION

The sample bill is shown below:

4/5/23, 11:53 AM PSPCL Bill 3007650580 due on 2023-APR-06

PUNJAB STATE POWER CORPORATION LIMITED
(Regd. Office P.S.E.B. Head Office, The Mall Patiala-147001,Ph: 1912), CIN: U40109PB2010SGC033813
E-mail: 1912@pspcl.in, Website: www.pspcl.in, GSTIN NO: 03AAFCP5120Q1ZC
Original for Recipient Duplicate for Supplier, Taxable Invoice, Invoice-cum-Bill of Supply

Billing Category: **BS HT BULK SUPPLY DPC**

Sub Division	Division	Circle	Bill Cycle	Bill Date	Bill No.
GONIANA SUB DIVISION	CITY DIVISION BHATIN	BHATINDA	03-2023	22-MAR-2023	1005420249

A/C No.: 3007650580
Consumer Name: M/S BABA FARID VIDYAK
Address: DEON GONIANA-151201-INDIA
GST No:
Connection Date: 19-12-2021
Mobile No.: 95XXXXX043

Load	Contract Demand	Tariff Type	Bill Status	Due Date Cash/Online	Due Date OD/Cheque	Bill Amount
1425.00		BS HT BULK SUPPLY DPC	O	06-Apr-2023	03-Apr-2023	Rs.314550/-

Voltage Supply	Details of Meter: Meter Number	Make	Capacity	Digit	Meter Status	CT Make	CT No.
11.00	PBB49619	SECURE	5-6	6	O	19176	

Feeder Code	Date of New Reading	Date of Old Reading	Bill Period	Meter Security	Securit Cons.	Security cons/Meter Security Interest
	21-MAR-2023	16-FEB-2023	33	35000	1350000	

Meter Reading

Details	Old Reading	New Reading	Current Units	Meter Multiplier	Line CT Ratio	Meter CT Ratio	Overall Multiplier	MMTS Correction	Old Meter Cons.	Unit Consumed
KWH				1.00	50/5	5/5	10.00			
KVAH				1.00	50/5	5/5	10.00			
MDI	10.98	12.2		1.00	50/5	5/5	10.00			122.00

(A) Fixed Charges

Contract Demand (L) KVA	Actual Demand KVA (A)	80% of (L) KVA (B)	A or B whichever greater KVA (C)	Rate per KVA per month (R)	Billing Days (D)	A: Fixed Charges Amount =CxRxDx12/365
	122.00	800.00	800.00	300.00	33	260384.00

(B) Energy Charges

	Units	Rate/kWh	Amount	B: Total Energy Charges
0-100	0		0.00	0
100-300	0		0.00	
300-500	0		0.00	
500 & ABOVE	0		0.00	

(C) Fuel Cost Adjustment Charges — ***Additional Surcharges**

Total Energy Charges	KVAH Consumption	Rate of FCS/KVAH	C: Amount	Unit	Rate	Amount	C: FCA + Addl Surcharges
0			0.00			0.00	0

(D) Rental Charges — **GST**

Meter Rent for PSPCL Meter	MCB, CT/PT Unit Rental	Rent for any other equipment	Total Rent	HSN Code	SGST	CGST	Total GST	D: Total Rent with Tax
1585	0		1585		142.65	142.65	285.3	1870.3

(E) Surcharges

Voltage Surcharge: Supply Voltage	Catered Voltage	Surcharge Rate	Voltage Surcharge Amount	Demand Surcharge: Demand in excess	Rate of Demand Surcharge	Amount of Demand Surcharge	ToD Surcharge: Peak Hours KVAH	Rate	Amount	E: Total Surcharge (Rs.)
11.00	11.00			0.00	0.00	0.00	0.00		0.00	0.00

(F) Rebates

Voltage Rebates: Units	HT/EHT Rebate	Amount	ToD Rebates: Non-Peak Hours KVAH	Rate	Amount	F: Total Rebates (Rs.)
0.00	0.00	0.00	0.00	1.25	0.00	0.00

(G) Previous Adjustment Amount Notice No.: and Date:

Units	Fixed Charges	Energy Charges	FCA	Rentals	Surcharges(+)	Rebates(-)	Taxes	Subsidy	Total	G: Net Previous Adjustment (Rs.)
		/		/			/0		0/-100	0/-100

(H) Sundry Charges/Allowances Notice No.: - and Date: -

Late Payment Interest	Units	Fixed Charges	Energy Charges	FCA	Rentals	Surcharges(+)	Rebates(-)	Taxes	Subsidy	Total	H: Net Sundry Charges/Allowances (Rs.)
	/	/	/ 0	/ 0	/ 0	/	/ 0	/ 0	/	0	0

(I) Subsidy

Subsidised KVAH	Rate for Subsidy	Amount	I: Net Subsidy (Rs.)
	0.00	0.00	0.00

(J) Taxation

Electricity Duty	Municipal Tax	IDF	Cow Cess	Total Tax	Net Energy Charges	TCS/TDS	Curr/Prev Rounding Amount	NET BILL AMOUNT
								Rs.314550/-

SOLAR ENERGY IN COLLEGE

The campus has installed solar plant of capacity nearly about 500 Kw of their own. Which can be seen in the below pic.

The total solar panels used by different departments

S.NO.	DEPARTMENT	INDIVIDUAL RATING(IN KW)	TOTAL RATING (IN KW)
1	BLOCK-A	25	75

	INNOVATION CENTER	25	
	GIRLS HOSTEL	25	
	BLOCK-B	50	150
	BLOCK-C	50	
	BLOCK-NEW C	50	
	BLOCK-F	150	150
	BLOCK-G		
	BLOCK-H	125	125
TOTAL			500

The above tables show the graphical representation of consumption of electrical energy and solar energy of six months & twelve months respectively. It is observed that the college have installed the solar panels and the capacities are shown below:

Image shows the Solar Energy used in Campus

From the above data it is concluded that:

Total Kw of solar energy = 500 KW

Average cost/month from

In an ideal condition, a 1kw system will generate around 3unit/day. That means a 500kw system can generate at least 500 x3 = 1500units in a day or 45000 units of energy is saved by the college per month.

It is recommended to increase the solar energy capacity by 100kw, by which the institution can be benefited as follows:

Total installation cost 100kw of solar panel = Rs. 45,00,000

Units of energy generated per day = Rs. 300

Units generated per month	=	9000
Monthly saving in INR @ Rs.6.63	=	Rs. 60,000 Approx.

So, capital cost recovery time = (45,00,000/60,000) = 75 Months

CONCLUSION

From the above data we conclude that the college have installed the solar panels of capacity 500KW. By our recommendation the college should at least increase their solar capacity by 20% which is 100KW which causes the saving of Rs. 60000 per month. The tentative cost of 100 Kw of solar plant would cost Rs. 45,00,000. This amount can be pay back in less than 75 months.

ENERGY SOURCE FROM FUEL (GENERATOR)

GENERATOR OF 500KVA CAPACITY

GENERATOR OF 250KVA CAPACITY

A diesel generator is used for emergency power supply in case of electricity shutdown or places where their power supply demand. Diesel generator generates electric energy by using a diesel engine along with an electric generator.

Nowadays, diesel generator usage is essential for industries backup, emergency, and electric systems in case of power failure. Hiring diesel generators for monitor electric current continuously and automatically start the generator when there is a power cut or power shutdown period and generator supply the power until the power comes back.

The diesel generator is the most important equipment for industries and helps to run the industries' productions continuously. The favourable growth of industries such as oil & gas industries, telecom, mining, constructions, hospitals, and retail shops.

There are mainly 2 Generator in the facility of 500KVA & 250KVA. The technical data sheet is given below:

TECHNICAL DATA SHEET

Prime Rating at rated rpm (as per ISO8528)		**kVA**	**320 HD**	**380 HD**	**400 HD**	**500 HD**	**600 HD**	**625 HD**	**750 HD**	**900 HD**	**1010 HD**
		kW	**256**	**304**	**320**	**400**	**480**	**500**	**600**	**720**	**808**
Genset Model			KG1-320 WS	KG1-380 WS	KG1-400 WS	KG1-500 WS	KG1-600 WS	KG1-625 WS	KG1-750WS	KG1-900WS	KG1-1010 WS
Frequency		Hz	50	50	50	50	50	50	50	50	50
Power factor		lagging	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Voltage (with Three Phase Supply)		V	415 3Ø	415 3Ø	415 3Ø	415 3Ø	415 3Ø	415 3Ø	415 3Ø	415 3Ø	415 3Ø
Governing class (As per ISO 8528 Part-V)			G3	G3	G3	G3	G3	G3	G3	G3	G3
Noise level		dBA	< 75	< 75	< 75	< 75	< 75	< 75	< 75	< 75	NA
Fuel Consumption*	At 100 % Load	Ltrs/hr	69	83.3	86.9	107.5	125.9	130.5	154	197	199
	At 75 % Load		52.5	61.2	65.09	81.9	94.2	98.6	126.4	163	155
	At 50 % Load		37.6	44.1	46	57.1	63.8	66.2	89.7	120	112
Fuel tank capacity		Ltrs	850	850	850	990	990	990	990	990	990
Weight of genset with	Dry	Kg	5910	6000	6050	7200	7700	7800	8300	13600	13200
canopy (approx.)^											
Overall dimensions of genset	Length	mm	5180	5446	5650	5650	6560	6560	6800	8000	7800
	Width	mm	2000	2000	2000	2000	2000	2000	2300	2300	2300
	Height	mm	2408	2408	2408	2558	2710	2710	2713	2713	2713

Electrical Battery starting voltage		Volts-DC	24	24	24	24	24	24	24	24	24
ENGINE											
Engine Model			DV8TA G1	DV8TA G2	DV8TA G3	DV10TA G1	DV12TA G1	DV12TA G2	DV12ETA G11	DV16ETA G2	DV16ETA G1
Rated output (Prime Continuous rating as per ISO 3046)		kW	294	346	360	447	532	552	663	799	889
No. of cylinder		Number	8	8	8	10	12	12	12	16	16
Cubic capacity 2		Ltrs	15.92	15.92	15.92	19.89	23.88	23.88	23.88	31.86	31.86
Bore x Stroke		mm	130x150	130x150	130x150	130x150	130x150	130x150	130x150	130x150	130x150
Rated Speed		RPM	1500	1500	1500	1500	1500	1500	1500	1500	1500
Aspiration		NA/TC/TA	TA	TA	TA	TA	TA	TA	TA	TA	TA
Lube Oil change period		hrs	500	500	500	500	500	500	500	500	500
Lube Oil Sump Capacity		Ltrs	105	115	115	120	145	145	145	205	205
ALTERNATOR											
Insulation Class			Class H	Class H	Class H	Class H	Class H	Class H	Class H	Class H	Class H
Ingression Protection			IP 23	IP 23	IP 23	IP 23	IP 23	IP 23	IP 23	IP 23	IP 23
Alternator Efficiency (at 100% load) 0.8 pf**			94.3	93.3	93.4	94.6	95	95	94.6	95.3	95.1

Alternator Efficiency (at 75% load) 0.8 pf**			93.8	93.8	94	94.9	95.2	95.2	94.9	95.5	95.4
Permissible Voltage Dip at Full Load 0.8 pf Lag			< 20 %	< 20 %	< 20 %	< 20 %	< 20 %	< 20 %	< 20 %	< 20 %	< 20 %
Time Permitted to build up rated voltage at rated RPM			< 5 sec provided engine reach the rated speed								
Short Circuit Withstand Time		sec	3 Times Rated Current for "3 sec"	3 Times rated current for "10 sec "							
Overload Withstand Capacity		%	10% overload for one hour once in 12 hours								

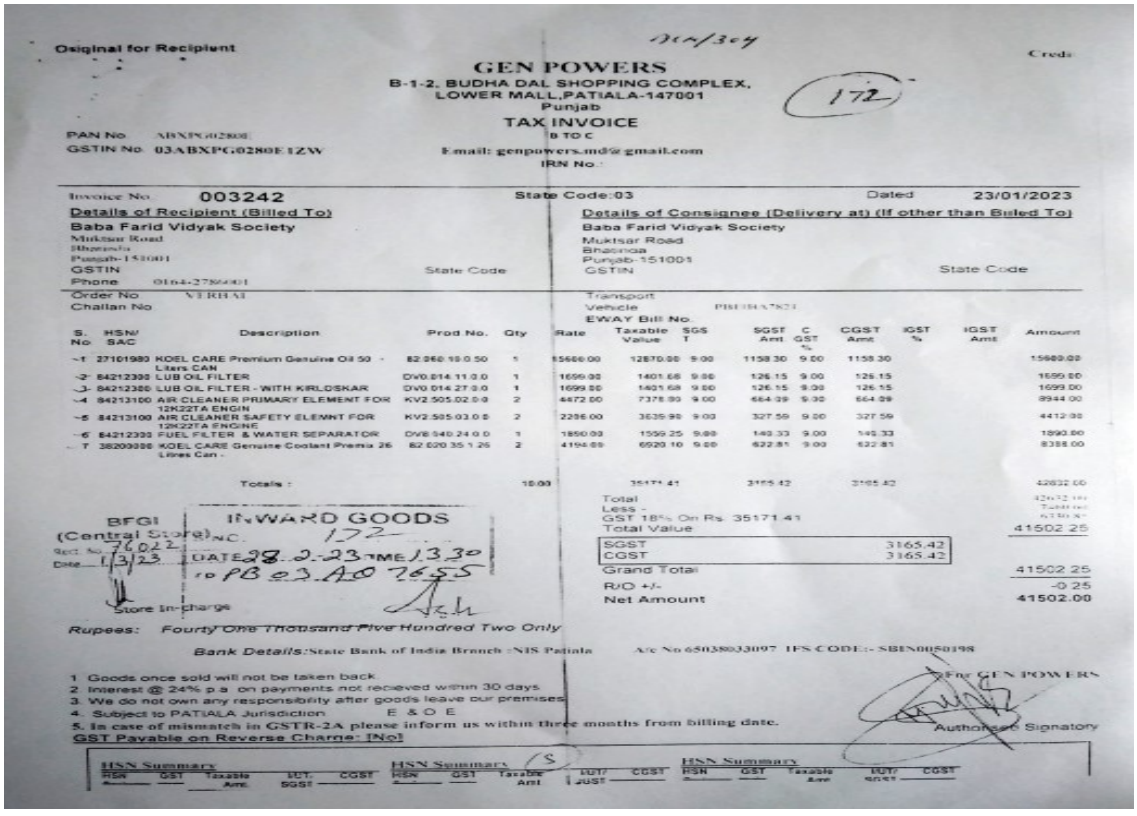
Prime Rating at rated rpm (as per ISO8528)1	**kVA**	**180**	**200**	**250**
	kW	**144**	**160**	**200**
Genset Model		KG1-180WS	KG1-200WS	KG1-1-250WS
Frequency	Hz	50	50	50
Power factor	lagging	0.8	0.8	0.8
Voltage	V	415 3Ø	415 3Ø	415 3Ø

Governing class (As per ISO 8528 Part-V)			G3	G3	G3
Noise level		dBA	< 75	< 75	< 75
Fuel Consumption*	At 100 % Load	Ltrs/hr	41.3	45.9	56.9
	At 75 % Load		30.9	34.4	42.6
	At 50 % Load		22.7	25.5	22.9
Fuel tank capacity		Ltrs	460	460	460
Weight of genset with canopy (approx.) ^	Dry	Kg	3900	3900	4010
	Wet	Kg	4300	4340	4320
Overall dimensions of genset^	Length	mm	4300	4340	4340
	Width	mm	1740	1740	1740
	Height	mm	1970	1970	1975
Electrical Battery starting voltage		Volts-DC	24	24	24
ENGINE					

Engine Model		**GSL1500TA G2**	**GSL1500TA G2**	**GSL1500TA G3**
Rated output (Prime Continuous rating as per ISO 8528-1)	KW	183	183	228
	HP	248	248	310
No. of cylinder	Number	6	6	6
Cubic capacity	Ltrs	8.86	8.86	8.86
Bore x Stroke	mm	118 x 135	118 x 135	118 x 135
Rated Speed	RPM	1500	1500	1500
Aspiration	NA/TC/TA	TA	TA	TA
Lube Oil change period	Hrs	500	500	500
Lube Oil Sump Capacity	Ltrs	27	27	27
Coolant Capacity	Ltrs	32	29.2	31.8
ALTERNATOR				
Insulation Class		Class H		
Ingression Protection		IP 23		
Alternator Efficiency (at 100% load) 0.8 pf**		93	93.5	93.6
Alternator Efficiency (at 75% load) 0.8 pf**		93.6	93.8	93.9

Permissible Voltage Dip at Full Load 0.8 pf		< 20%	< 20%	< 19%
Time Permitted to build up rated voltage at Rated RPM		< 1 sec provided engine reach the rated speed		
Short Circuit Ratio		0.53	0.545	0.45
Short Circuit Withstand Time	sec	3 times rated current for < 3sec		
Overload Withstand Capacity	%	10% overload for one hour once in 12 hours & for 150% for 30 sec		
For Intermediate ratings, Kindly contact nearest KOEL office				

SERVICE RECORD



Original for Recipient

GEN POWERS
B-1-2, BUDHA DAL SHOPPING COMPLEX,
LOWER MALL,PATIALA-147001
Punjab
TAX INVOICE
B TO C

PAN No. ABNPG0280E
GSTIN No. 03ABXPG0280E1ZW
E-mail: genpowers.md@gmail.com
IRN No.:

Invoice No. 003242 State Code:03 Dated 23/01/2023

Details of Recipient (Billed To)
Baba Farid Vidyak Society
Muktsar Road
Bhatinda
Punjab-151001
GSTIN
Phone 0164-2786001
State Code

Details of Consignee (Delivery at) (If other than Billed To)
Baba Farid Vidyak Society
Muktsar Road
Bhatinda
Punjab-151001
GSTIN
State Code

Order No. NTRHAI
Challan No.
Transport
Vehicle PB03AA7621
EWAY Bill No.

S. No	HSN/ SAC	Description	Prod No.	Qty	Rate	Taxable Value	SGS T	SGST Amt	C GST %	CGST Amt	IGST %	IGST Amt	Amount
1	27101980	KOEL CARE Premium Genuine Oil 50 Liters CAN	82 960 10 0 50	1	15600.00	12870.00	9.00	1158.30	9.00	1158.30			15600.00
2	84212300	LUB OIL FILTER	DV0 014 11 0 0	1	1699.00	1401.68	9.00	126.15	9.00	126.15			1699.00
3	84212300	LUB OIL FILTER - WITH KIRLOSKAR	DV0 014 27 0 0	1	1699.00	1401.68	9.00	126.15	9.00	126.15			1699.00
4	84213100	AIR CLEANER PRIMARY ELEMENT FOR 12K22TA ENGIN	KV2 505 02 0 0	2	4472.00	7378.80	9.00	664.09	9.00	664.09			8944.00
5	84213100	AIR CLEANER SAFETY ELEMNT FOR 12K22TA ENGINE	KV2 505 03 0 0	2	2295.00	3635.98	9.00	327.59	9.00	327.59			4412.00
6	84212300	FUEL FILTER & WATER SEPARATOR	DW8 540 24 0 0	1	1850.00	1559.25	9.00	140.33	9.00	140.33			1890.00
7	38200000	KOEL CARE Genuine Coolant Premix 26 Litres Can	82 020 35 1 26	2	4194.00	6920.10	9.00	622.81	9.00	622.81			8388.00
		Totals :		10.00		35171.41		3165.42		3165.42			42832.00

BFGI (Central Store) INWARD GOODS
REC. No. 172
Ref. No. 76022
Date 1/3/23 DATE 28-2-23 TIME 13.30
ID PB 03 AO 7655
Store In-charge

Total	
Less :	
GST 18% On Rs. 35171.41	
Total Value	41502.25
SGST	3165.42
CGST	3165.42
Grand Total	41502.25
R/O +/-	-0.25
Net Amount	41502.00

Rupees: Fourty One Thousand Five Hundred Two Only

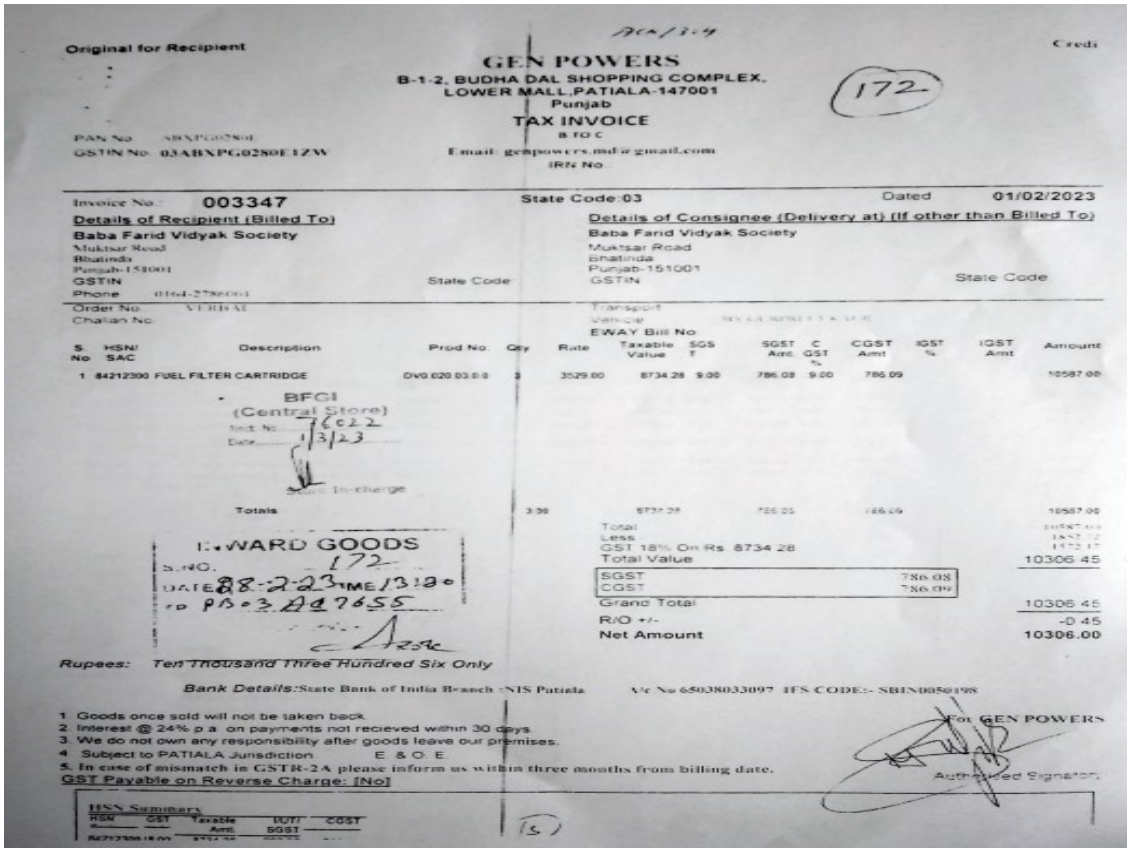
Bank Details: State Bank of India Branch :NIS Patiala A/c No 65038033097 IFS CODE:- SBIN0050198

1. Goods once sold will not be taken back
2. Interest @ 24% p.a. on payments not received within 30 days
3. We do not own any responsibility after goods leave our premises
4. Subject to PATIALA Jurisdiction E & O E
5. In case of mismatch in GSTR-2A please inform us within three months from billing date.

GST Payable on Reverse Charge: [No]

For GEN POWERS
Authorised Signatory

HSN Summary | HSN | GST | Taxable Amt | SGST | CGST



Original for Recipient

GEN POWERS
B-1-2, BUDHA DAL SHOPPING COMPLEX,
LOWER MALL,PATIALA-147001
Punjab
TAX INVOICE

GSTIN No: 03ABXPG0280E1ZW

Invoice No.: 003347 State Code:03 Dated 01/02/2023

Details of Recipient (Billed To)
Baba Farid Vidyak Society
Muktsar Road
Bhatinda
Punjab-151001
GSTIN
Phone
State Code

Details of Consignee (Delivery at) (If other than Billed To)
Baba Farid Vidyak Society
Muktsar Road
Bhatinda
Punjab-151001
GSTIN
State Code

Order No.
Challan No.
Transport
Vehicle
EWAY Bill No.

S. No	HSN/ SAC	Description	Prod No.	Qty	Rate	Taxable Value	SGST	SGST Amt	C GST %	CGST Amt	IGST %	IGST Amt	Amount
1	84212300	FUEL FILTER CARTRIDGE	DV0.020.03.0.0	3	3529.00	8734.28	9.00	786.08	9.00	786.09			10587.00

BFCI
(Central Store)
Ind. No. 7622
Date 1/3/23
Store In-charge

Totals 3.00 8734.28 786.08 786.09 10587.00

INWARD GOODS
S.NO. 172
DATE 28-2-23 TIME 13:20
PO PB-3 AA 7655

Total
Less
CGST 18% On Rs 8734.28
Total Value 10306.45

SGST 786.08
CGST 786.09

Grand Total 10306.45
R/O +/- -0.45
Net Amount 10306.00

Rupees: Ten Thousand Three Hundred Six Only

Bank Details: State Bank of India Branch :NIS Patiala A/c No 65038033097 IFS CODE:- SBIN0050198

1. Goods once sold will not be taken back.
2. Interest @ 24% p.a. on payments not recieved within 30 days.
3. We do not own any responsibility after goods leave our premises.
4. Subject to PATIALA Jurisdiction E & O.E.
5. In case of mismatch in GSTR-2A please inform us within three months from billing date.

GST Payable on Reverse Charge: [No]

For GEN POWERS
Authorised Signatory

HSN Summary

HSN	GST	Taxable Amt	IGST	CGST
84212300	18.00	8734.28		786.08

(5)

As per the data provided by the college the total working hours of the generators in 1 month 10 days is 30 Hrs. Approx.

From technical data sheet fuel consumed by 250kva & 500kva generators

Fuel consumed by 250kva genset @ 30 % load = 19L/hr

Fuel consumed by 500kva genset @ 30% load = 34L/hr

Cost of Diesel in Punjab = Rs. 88

Fuel consumed by 250kva genset in given time = 30 x 19 = 570 L

So, total cost of 250kva genset on given time = Rs. 50,160

Fuel consumed by 500kva genset in given time = 30 x 34 = 1020 L

So, total cost of 500kva genset on given time = Rs. 89760

Total costing of all the generator = Rs. 139920

But use of generator causes the carbon emission. The typical emission calculation is given as below:

RETScreen - Emission Analysis **Subscriber: Viewer**

Base case electricity system (Baseline)

Fuel type	Fuel mix %	CO_2 emission factor kg/GJ	CH_4 emission factor kg/GJ	N_2O emission factor kg/GJ	Electricity generation efficiency %	T&D losses %	GHG emission factor $kgCO_2/kWh$
Solar	40.0%	0.0	0.0000	0.0000	20.0%	7.0%	0.000
Diesel (#2 oil)	4.0%	70.0	0.0020	0.0006	80.0%	7.0%	0.340
Electricity mix	44	3.8	0.0001	0.0000		3.1%	0.014

Baseline changes during project life

Base case system GHG summary (Baseline)

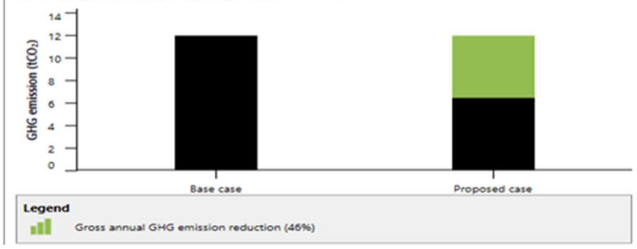
Fuel type	Fuel mix %	CO_2 emission factor kg/GJ	CH_4 emission factor kg/GJ	N_2O emission factor kg/GJ	Fuel consumption kWh	GHG emission factor $kgCO_2/kWh$	GHG emission tCO_2
Electricity	75.9%	3.8	0.0001	0.0000	1,28,107	0.014	1.7
Diesel (#2 oil)	24.1%	70.0	0.0020	0.0006	40,571	0.253	10.3
Total	100.0%	19.7	0.0006	0.0002	1,68,678	0.071	12.0

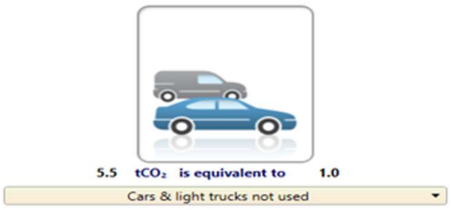
Proposed case system GHG summary

Fuel type	Fuel mix %	CO_2 emission factor kg/GJ	CH_4 emission factor kg/GJ	N_2O emission factor kg/GJ	Fuel consumption kWh	GHG emission factor $kgCO_2/kWh$	GHG emission tCO_2
Electricity	79.9%	3.8	0.0001	0.0000	83,535	0.014	1.1
Diesel (#2 oil)	20.1%	70.0	0.0020	0.0006	21,024	0.253	5.3
Total	100.0%	17.1	0.0005	0.0001	1,04,559	0.062	6.4

GHG emission reduction summary

GHG emission		
Base case	tCO_2	12.0
Proposed case	tCO_2	6.4
Gross annual GHG emission reduction	tCO_2	5.5





From the above data we absorb that the GHG emission of generator is nearly about 10.3. And with the slight increase of the use of solar inverters the GHG emission is reduced to 5.3. And the monthly cost of fuel used is also reduced.

The calculations of solar inverter costing, capacity and the payback time is shown below:

- Capacity of solar inverter = 20kw
- Cost of 5kw solar inverter = Rs. 50000
- So, cost of 20kw solar inverter = Rs. 2,00,000
- Reduction 20kw from generator costs = Rs. 2100

Payback time	=	**Less than 6 years**

LOAD LIST DEPARTMENT WISE

Block Wise Load Detail							
Sr. No.	**Block**	**Equipment Name**	**Type**	**Load (inW)**	**QTY**	**Total Load (W)**	**Total Load (KW)**
1	**A Block**	Ac(s)	Centralized 51 Ton		6		67.83
			Centralized 33 Ton		6		43.89
			Centralized 3.5 Ton		1		4.655
			Split		1		1.995
			Split		1		1.064
		Wall Fan	Khitan/ Havell	40	30	1200	1.2
		Tube Lights	fluorescent/LED	40	120	4800	4.8
		Exaust Fans	Khitan	50	6	300	0.3
		Oven		200	1	200	0.2
		Water Cooler	Usha	1500	1	1500	1.5
		Fridge	LG	250	1	250	0.25
2	**B Block**	Ac(s)	Window 1.5 Ton		68		135.66
			Split 1.5 Ton		1		1.995
			Centralized 14 Ton		2		18.62
		Fan	Havell	80	80	6400	6.4
		Wall Fan	Khitan/ Havell	40	10	400	0.4
		Tube Lights	fluorescent/LED	40	40	1600	1.6
		Exaust Fans	Khitan	50	50	2500	2.5
		Oven		200	2	400	0.4
		Water Cooler	Usha	1500	3	4500	4.5
		Fridge	LG	250	1	250	0.25

3	**C Block**	Ac(s)	Window 1.5 Ton		70		139.65
			Split 1.5 Ton		1		1.995
			Split 2 Ton		2		5.32
		Fan	Havell	80	177	14160	14.16
		Wall Fan	Khitan/ Havell	40	8	320	0.32
		Tube Lights	fluorescent/LED	40	115	4600	4.6
		Exaust Fans	Khitan	50	10	500	0.5
		Oven		200	3	600	0.6
		Water Cooler	Usha	1500	2	3000	3
4	**New-C Block**	Ac(s)	Window 1.5 Ton		71		141.645
			Split 1.5 Ton		4		7.98
		Fan	Havell	80	205	16400	16.4
		Wall Fan	Khitan/ Havell	40	10	400	0.4
		Tube Lights	fluorescent/LED	40	220	8800	8.8
		Exaust Fans	Khitan	50	23	1150	1.15
		Oven		200	1	200	0.2
		Water Cooler	Usha	1500	5	7500	7.5
5	**Innovation Center**	Ac(s)	Centralized 8.5		7		79.135
			Centralized 5.5		4		29.26
			Split 1.5 Ton		3		5.985
			Window 1.5 Ton		2		3.99
			Window 1 Ton		1		1.33
		Fan	Havell	80	30	2400	2.4
		Wall Fan	Khitan/ Havell	40	30	1200	1.2
		Tube Lights	fluorescent/LED	40	150	6000	6
		Exaust Fans	Khitan	50	2	100	0.1
		Oven		200	1	200	0.2

		Water Cooler	Usha	1500	1	1500	1.5
6	D Block	Ac(s)	Window 1.5 Ton		32		63.84
			Split 1.5 Ton		1		1.995
		Fan	Havell	80	167	13360	13.36
		Wall Fan	Khitan/ Havell	40	15	600	0.6
		Tube Lights	fluorescent/LED	40	114	4560	4.56
		Exaust Fans	Khitan	50	8	400	0.4
		Oven		200	1	200	0.2
		Water Cooler	Usha	1500	2	3000	3
7	E Block	Ac(s)	Window 1.5 Ton		55		109.725
		Fan	Havell	80	202	16160	16.16
		Wall Fan	Khitan/ Havell	40	35	1400	1.4
		Tube Lights	fluorescent/LED	40	158	6320	6.32
		Exaust Fans	Khitan	50	10	500	0.5
		Oven		200	4	800	0.8
		Water Cooler	Usha	1500	4	6000	6
8	F Block	Ac(s)	Window 1.5 Ton		96		191.52
			Split 1.5 Ton		1		1.995
		Fan	Havell	80	213	17040	17.04
		Wall Fan	Khitan/ Havell	40	10	400	0.4
		Tube Lights	fluorescent/LED	40	136	5440	5.44
		Exaust Fans	Khitan	50	14	700	0.7
		Oven		200	3	600	0.6
		Water Cooler	Usha	1500	4	6000	6
9	G Block	Ac(s)	Window 1.5 Ton		70		139.65
			Split 1.5 Ton		2		3.99
		Fan	Havell	80	230	18400	18.4

		Wall Fan	Khitan/ Havell	40	12	480	0.48
		Tube Lights	fluorescent/LED	40	285	11400	11.4
		Exaust Fans	Khitan	50	6	300	0.3
		Oven		200	4	800	0.8
		Water Cooler	Usha	1500	3	4500	4.5
10	**H Block**	Ac(s)		1.995	112	223.44	0.22344
		Fan	Havell	80	340	27200	27.2
		Wall Fan	Khitan/ Havell	40	15	600	0.6
		Tube Lights	fluorescent/LED	40	233	9320	9.32
		Exaust Fans	Khitan	50	17	850	0.85
		Oven		200	3	600	0.6
		Water Cooler	Usha	1500	7	10500	10.5
11	**Main Gate**	Ac(s)	Window 1.5 Ton		2		3.99
		Fan	Havell	80	5	400	0.4
		Wall Fan	Khitan/ Havell	40	2	80	0.08
		Tube Lights	fluorescent/LED	40	7	280	0.28
		Exaust Fans	Khitan	50	3	150	0.15
		Oven		200	1	200	0.2
		Water Cooler	Usha	1500	1	1500	1.5
12	**Workshop**	Ac(s)		0	0	0	0
		Fan	Havell	80	41	3280	3.28
		Wall Fan	Khitan/ Havell	40	0	0	0
		Tube Lights	fluorescent/LED	40	25	1000	1
		Exaust Fans	Khitan	50	9	450	0.45
		Oven		200	1	200	0.2
		Water Cooler	Usha	1500	1	1500	1.5
13		Ac(s)	Window 1 Ton		77		102.41

	Boys Hostel		Split 1.5 Ton		1		1.995
		Fan	Havell	80	100	8000	8
		Wall Fan	Khitan/ Havell	40	2	80	0.08
		Tube Lights	fluorescent/LED	40	350	14000	14
		Exaust Fans	Khitan	50	5	250	0.25
		Oven		200	0	0	0
		Water Cooler	Usha	1500	3	4500	4.5
		Solar Gysar	2000 ltr		3		
			500 ltr		3		72
14	**Girls Hostel**	Ac(s)	Window 1 Ton		68		90.44
			Split 0.8 Ton		1		0.8
		Fan	Havell	80	150	12000	12
		Wall Fan	Khitan/ Havell	40	2	80	0.08
		Tube Lights	fluorescent/LED	40	320	12800	12.8
		Exaust Fans	Khitan	50	8	400	0.4
		Oven		200	0	0	0
		Water Cooler	Usha	1500	3	4500	4.5
		Soalr Gysar	2000 ltr		1		
			200 ltr		9		
			500 ltr		3	72 KW	72
		Fridge	LG	250	1	250	0.25
15	**Main Seminar Hall**	Ac(s)	Castable 8.5 Ton		2		22.61
			Centralized 5.5 Ton		1		7.315
			Centralized 2 Ton		2		5.32
			Window 1.5 Ton		4		7.98
		Fan		0	0	0	0
		Wall Fan	Khitan/ Havell	40	6	240	0.24

		Tube Lights	fluorescent/LED	40	25	1000	1
		Exaust Fans	Khitan	50	2	100	0.1
		Water Cooler	Usha	1500	1	1500	1.5
16	STP	Motors	3 HP	2358	3	7074	7.074
			5 HP	3930	2	7860	7.86
			1.5 HP	1179	2	2358	2.358
		Tube Lights		40	3	120	0.12
		Fan		80	1	80	0.08
17	RO	Pump	5.5 HP	4323	2	8646	8.646
		Motors	1.5 HP	1179	2	2358	2.358
			2 HP	1572	1	1572	1.572
		FAN		80	2	160	0.16
		Tube Lights		40	3	120	0.12
18	Dhobhi Ghat	Motors - 3 PHASE	Monoblack 10HP	7860	1	7860	7.86
			Monoblack 7.5 HP	5895	1	5895	5.895
			Samercible 7.5 HP	5895	3	17685	17.685
			Samercible 2 HP	1572	2	3144	3.144
		Motors - Single Phase	Samercible 2 HP	1572	2	3144	3.144
			Monoblack 1.5 HP	1179	1	1179	1.179
19	Center Store	Ac(s)	Window 1 Ton		1		1.33
		Fan		80	4	320	0.32
		Wall Fan		50	2	100	0.1
		Tube Lights		40	10	400	0.4
		Exaust Fans		100	1	100	0.1
		Oven		200	1	200	0.2
Total Load in KW							**1994.002**

PHOTOS OF LAB EQUIPMENTS

From above load list, the observation is given below

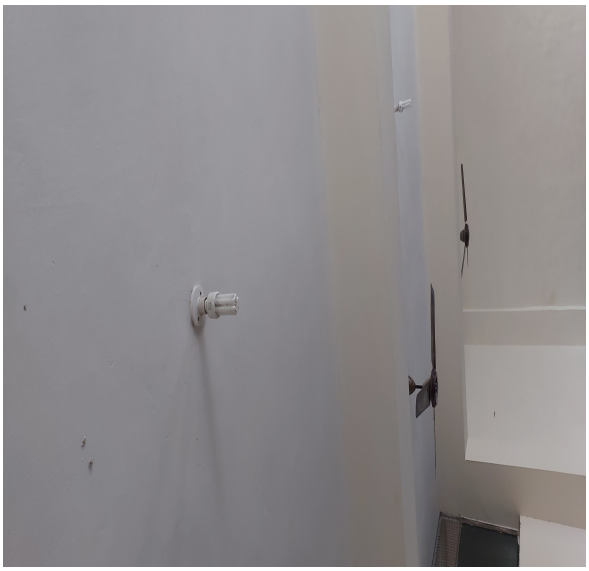
Total no of CFL used in campus

SI.no	Wattage	Qty.
1	20	340
2		

And total no of florescent tube used

SI.no	Wattage	Qty.
1	40	1500

PHOTOS OF LIGHTS USED IN CAMPUS



Efficiency

If we talk about efficiency CFLs & LEDs are both significantly energy efficient. As for comparison the CFLS are 25% more efficient than incandescent light bulb & LEDs are roughly 75% more efficient.

LIFESPAN

The lifespan of LEDs is much longer than CFLs. As the

Average lifespan of CFLs is 10,000 Hrs.

Average lifespan of LEDs is 25,000 Hrs.

Hence from above we can calculate that the LEDs are almost 40% more efficient than CFLs.

LUMENS

The luminance of CFLs is 60 Lu/w. While the luminance of LEDs 80 Lu/w.

This means that around 10w of power, an LED will be just bright as a 14w of CFLs

CONCLUSION

From the above data we conclude that if we replace the CFL with the LED lights much electricity would be saved and the calculation is given below:

Total no. 20 watt CFLs used = 340

Lumen per watt of CFL = 60 Lu/w

So, Total Lumen of 20w CFL is = 1200 Lu

This luminance can be achieved by 14w of LED

- So, 340 number of 20w CFL will consume almost 6800w & same amount of 14w LED will consume 4760w. Which is about 2040w less

Now talking about the Fluorescent tube lights.

Luminance of Fluorescent tube light = 70 Lu/w

Luminance of LED tube light = 140Lu/w

Total no. 40 w Fluorescent tube light used = 1500

Lumen per watt of Fluorescent tube light = 70 Lu/w

So, Total Lumen of 40w Fluorescent tube light = 2800 Lu

This luminance can be achieved by 18w of LED tube light

- So, 1500 number of 40w Fluorescent tube light will consume almost 60000w & same amount of 18w LED tube light will consume 27000w. Which is about 33000w less

Hence, we can save up to 35040 watts OR 35KW of energy.

COSTING AND PAYBACK TIME FOR REPLACING CFL WITH LED

Cost of 14w LED light = Rs. 200/p

Cost of 340 14w LED light =Rs. 43225

Total cost of replacing all the CFLs = Rs.68000

Average use of lights per year = 270 x 7 h = 1890hr

From above value approx. 2kw of energy is saved

Hence, total energy saved per year = 2 x 1890 = 3780kwh

Saving in Rupees/year 3780 x 6.63 = Rs.25061

So, capital cost recovery time = (43225/25061) = 1.8 YEARS Approx.

COSTING AND PAYBACK TIME FOR REPLACING FLUORESCENT TUBE LIGHT WITH LED TUBE LIGHT

Cost of 18w LED tube light = Rs.530/p

Cost of 1500 18w LED tube light =Rs.795000

Average use of lights per year = 270 x 7 h = 1890hr

From above value approx. 33kw of energy is saved

Hence, total energy saved per year = 33 x 1890 = 62370kwh

Saving in Rupees/year = 62370 x 6.63 = Rs.413513

So, capital cost recovery time = (795000/413513) = 1.7 YEASRS Months Approx. by replacing the fluorescent tube light with LED tube light

Use of master switch outside each room

Installation of a master switch outside a room can make it easy for a person to switch off all the appliances of a room in case someone forgets to switch off while leaving the room. This can help improving energy efficiency.

Use of motion sensors in toilets

Toilets have large potential of saving energy by use of automation tools. Motion sensors can be used there to automatically switch on the light when there is any movement and switch off the light Then there is no movement. This can greatly reduce the total load in toilets, each toilet has 4 tube light in average. There will be 2sensors required in a toilet.

Cost analysis of Installing Motion Sensors in a Typical Toilets:

- Approximate total no of toilets in campus =30
- Approximate total no of light in toilets = 112
- Average power of the tube light =18 w
- Average no of motion sensor required =28
- Average reduction of usage per day by motion sensor =4hr

Total energy saved in toilets per year:

- Total energy consumes by toilets =18X112=2kwh
- Energy consumed in normal condition per day =2X7=14Kwh
- Energy saved by motion sensor per day =2X4=8kwh
- Hence, energy saved by motion sensor per year =8X270=2160kwh
- Total amount saved per year = Rs 14000 approx.
- Cost of installation per motion sensor = Rs 500
- Total cost of installing motion sensor in toilets = 500x30=Rs15000
- Capital cost recovery time = 15000/14000 = 1 Yr

Hence the capital cost recovery time for installing motion sensor in toilets is 1 years. Hence, this is a highly recommended step to largely reduce the consumption in toilets.

High investment/Long Term Replacement

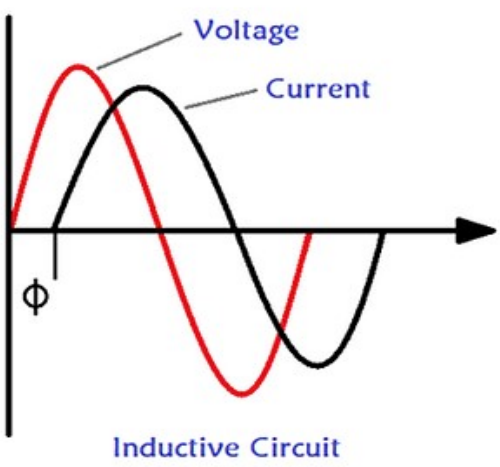
Energy substitution (electrical energy to solar energy)

As we know in campus there is a huge consumption of electrical energy which is not economical so instead of using electrical energy, we switch to alternate energy source which is solar energy.

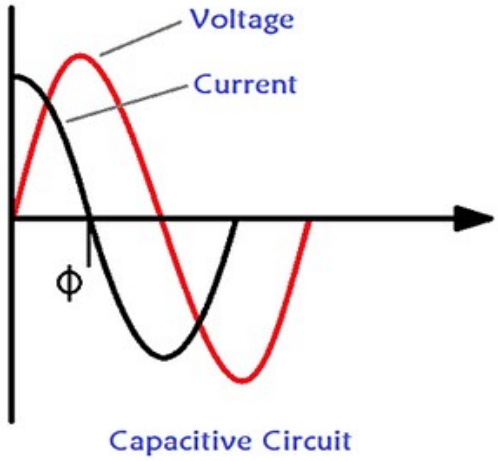
Understanding Power Factor and How It Affects Electricity Bills

Aside from safety and reliability, several other goals including efficiency should be pursued in the design and implementation of electrical systems. One of the measures of efficiency in an electrical system is the efficiency with which the system transforms the energy it receives into useful work.

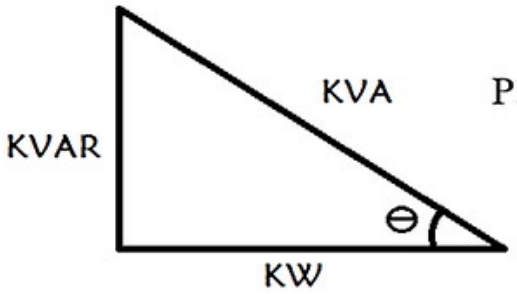
This efficiency is indicated by a component of electrical systems known as the Power Factor. The **power factor indicates how much power is actually being used to perform useful work** by a load and how much power it is "wasting". As trivial as its name sounds, it is one of the major factors behind high electricity bills, power failures and sometimes the imbalance in electrical networks.



Inductive Circuit



Capacitive Circuit



$$P.F. = \frac{\text{Actual Power}}{\textit{Apparent Power}} \quad \text{or} \quad P.F. = \text{Cos}\Theta$$

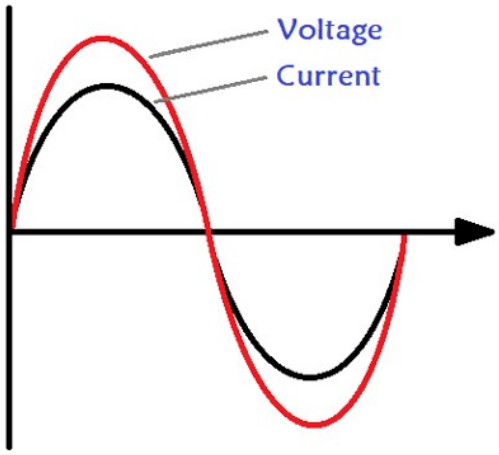
To be able to properly describe power factor and its practical significance, it is important to refresh your memory about the different types of electrical loads and components of Power that exist.

From basic electricity classes, electrical loads are basically of two types;

1. **Resistive Loads**
2. **Reactive Loads**

Resistive Loads

Resistive loads, as the name implies, are loads are made up of **purely resistive elements**. For this kind of loads (considering ideal conditions), all the power supplied to it are dissipated for useful work due to the fact that the **current is usually in phase with the voltage**. A good example of resistive loads includes incandescent light bulbs and batteries.



Resistive Circuit

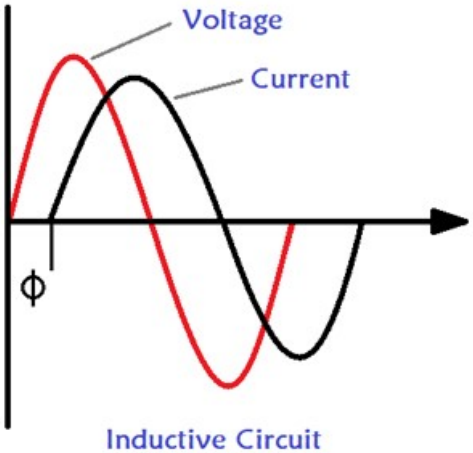
Relationship between current and voltage for a Resistive Load

For this kind of loads, a power component known as Real/Active/working Power is associated. We will take a closer look at it in a bit.

Reactive loads

Reactive loads, on the other hand, are a little bit more complex. While they cause a drop in voltage and draw current from the source like resistive loads, they dissipate no useful power (no work was done).

Reactive loads can either be capacitive or Inductive. In inductive loads, the power drawn is used up in setting up magnetic flux without any direct work performed, while for capacitive loads, the power is used in charging the capacitor and not directly producing work. The power thus dissipated in reactive loads is referred to as **Reactive power**. Reactive loads are characterized by **the current leading (Capacitive loads) or lagging (Inductive loads) behind the voltage**, as such, a phase difference usually exists between the current and the voltage.



Inductive Circuit

Relationship between Voltage and Current for an Inductive Load

The **variations in these two types of load brought about the existence of three power components in electrical systems**, namely;

1. Actual Power
2. Reactive Power
3. Apparent Power

To pick them one after the other;

Actual Power

This is the power associated with resistive loads. It is the power component dissipated to the performance of actual work in electrical systems. From heating to lighting, etc., It is expressed in **Watts (W)** (along with its multipliers, kilo, Mega, etc.) and symbolically represented by the letter P.

Reactive Power

This is the power associated with reactive loads. As a result of the delay between voltage and current in reactive loads (either capacitive or inductive), the energy dissipated, produces no work. It is referred to as reactive power and its unit is **Volt-Ampere Reactive (VAR)**.

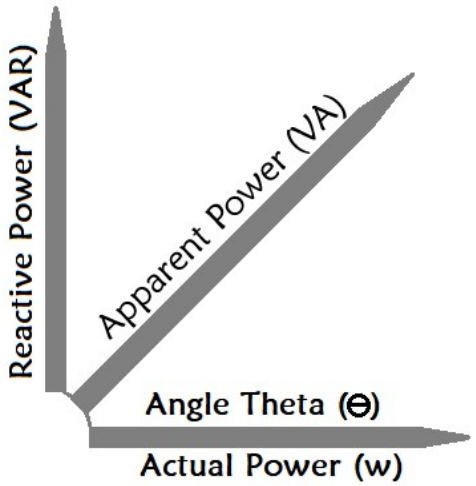
Apparent Power

Typical electrical systems comprise of both resistive and inductive loads, think about your light bulbs and heaters for resistive loads, and equipment with motors, compressors, etc. as inductive loads. Thus in an electrical system, **Total Power is a combination of the actual and reactive power components**, this total power is called the Apparent Power as given by the sum of the Actual power and reactive power. Its unit is **volt-amps (VA)** and represented mathematically by the equation;

$$\text{Apparent Power} = \text{Actual Power} + \text{Reactive power}$$

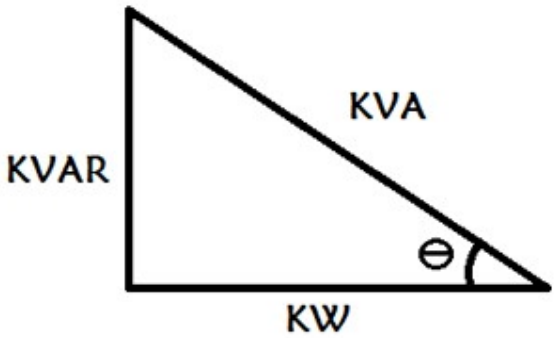
This combination leading to the apparent power is what brings about the **power factor**.

In Ideal situations, the actual power dissipated in an electrical system is usually greater than the reactive power. The image below shows the **vector diagram** drawn using the three Power components.



Vector Diagram

Transforming the vector diagram, we get the triangle below; none as the power triangle.



Power Triangle

By obtaining the cosine of the angle theta, we are able to decipher the efficiency of the system in using the power it receives for work. This efficiency evaluated as the ratio of the actual power to the apparent power is referred to as the **power factor** with values between 0 and 1. From the power triangle, according to the cosine rule (Adjacent over hypotenuse), the power factor can also be estimated as the ratio of actual power to the apparent power. mathematically;

P.F. = Actual Power / Apparent Power or P.F. =CosΘ

Putting this side by side with the equation for determining apparent power, it's easy to see that an increase in reactive power (presence of a high number of reactive loads), leads to an increase in apparent power and a larger value for angle theta, which ultimately results in a low power factor when its cosine (cos) is obtained. On the flip side, a reduction in reactive loads (reactive power) leads to an increased power factor, indicating high efficiency in systems with less reactive loads.

Importance of Power Factor

At very low power factor values, a large quantity of energy from the mains is wasted as a chunk of it will not be used for meaningful work due to the presence of more reactive loads indicated by the low power factor. This place a strain on the supply system as both the real power required by the load and the reactive power used to satisfy reactive loads will be drawn from the system to meet the requirements of the load.

This strain and "wastage" typically leads to huge electricity bills for consumers (especially industrial consumers) as utility companies calculate consumption in terms of apparent power, as such, they end up paying for power which was not used to achieve any "meaningful" work.

Even in situations where the power is being provided by the company's generators, money is wasted on bigger generators, larger sized cables, etc., required to provide power when a good number of it is just going to waste.

Power factor surcharge according to "*Punjab State Electricity Regulatory Commission (P.S.E.R.C)"*

According to para SXI.6 Power Factor Surcharge/Incentive

Consumers shall be required to maintain a monthly average power factor of 0.90. The monthly average power factor shall mean the ratio of total kWh to total kVAh supplied during the month. The ratio shall be rounded up to two decimal points.

According to para SXI. 6.1 Low Power Factor Surcharge

If the monthly average power factor falls below 0.90, the consumer shall pay on the energy charges a surcharge of 1% for each 0.01 decrease in the monthly average power factor below 0.90. The surcharge shall be 2% for each 0.01 decrease of monthly average power factor below 0.80.

According to para SXI. 6.2 Power Factor Incentive

If the monthly average power factor exceeds 0.90, incentive @ 0.25%, for each increase of 0.01 above 0.90 shall be allowed on the energy charges.

HOW TO SOLVE THIS PROBLEM?

To solve the above problem, we have to improve the power factor by installing the APFC panel which can maintain the power factor above 0.9 and helps in generating the power factor incentive, which causes the reduction in bill.

THE COLLEGE HAVE ALREADY INSTALLED **APFC Panels Capacity – 550 KVR**

THE APFC PANEL PICS ARE SHOWN BELOW

Let us take an example

Let the bill amount	=	Rs. 20000
From load list avg. PF	=	0.75
Desired power factor	=	0.9
For 0.9 to 0.8 % cap. Charge	=	10 x 1% = 10%
For 0.8 to 0.75 % cap. Charge	=	5 x 2% = 10%
So, total cap. Charge would be	=	10+10% = 20%

If power factor is 0.9 then reduction in bill would be

20% of total bill amount	=	16000
So reduced bill amount	=	331980-265584= Rs. 4000

After using the APFC panel the average power factor will be 0.97.

So, total hike in power factor = 7%

According to para SXI. 6.2 Power Factor Incentive will be 0.25% for increase of 0.01

So, 7% of Rs. 16000 rebate will be = Rs. 1400

Total bill amount =Rs. 14600

Total saving after installing APFC panel = Rs. 6000

Cost of installing APFC panel = Rs. 32000 approx.

So, the payback time will approximately 6 months by using the APFC panel.

CONCLUSION AND RECOMMENDATIONS

- As per the climatic data of the location it is seen that the annual solar radiation of the area is 4.68 kw/m^2/d, which is very good reading for solar power harvesting and by following this we can see that the energy benchmarks of the campus is 50kwh/m^2 and if only 10% of total kwh/m^2 is reduced i.e. 45kwh/m^2 the 1052185 KWh of energy is saved in one year.
- There are mainly 2 generators in the campus of different ratings which is shown in table-A above and also the carbon emission due to generator calculations are given above. According to our recommendations only by reducing the 20kw of power produced by generator with Solar inverters the GHG emission is reduced from 10.3 to 5.3. and the replacement of solar inverters would cost Rs. 2,00,000, which would be recovered back in 6 years.
- The department vise electrical load list of is given above and from the load list most of the lights source used by the campus is CFL's & fluorescent tube lights. According to our suggestion these lights should be replaced with LED & LED tube lights which can plays the major role in saving the electricity which can be seen in above calculations. And it is observed that the replacement cost is Rs. 838225, which can be recovered in 2 years.
- The final suggestion is the use of motion sensors in toilets which can save up to 2160kw of energy per year i.e. Rs. 14000 per year. Cost of installation of sensors is Rs. 15000 which can be recovered in 1 year

About Eco Group (Consultant)

ABOUT ECO GROUP

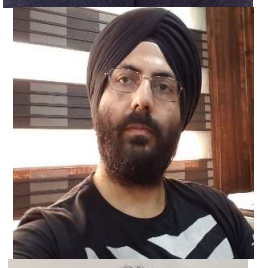
Eco Group is North India's reputed environmental organization Headquartered in Mohali (Chandigarh) that offers consultancy and environmental-related turnkey solutions for overall pollution abatement and sustainable development. We are a professional engineering firm with National level consultancy approved by QCI/ NABET and Environmental and Mechanical testing laboratory approved by MoEF&CC, NABL (ISO/IEC 17025:2017) and state boards.

Eco Group, established in 1998 has designed, engineered and executed more than 1,000 installations of Water, Domestic Sewage and Industrial Effluent Treatment Plants. With the help of our state-of-the-art technologies and apt infrastructure, we are proud to maintain an impeccable quality record, owing to our customer satisfaction levels. These treatment plants operate with the help of trained staff, including Sewage Treatment Plants (STPs), Effluent Treatment Plants (ETPs), Reverse Osmosis Plants (ROs), etc. In the last 20 years, we have undertaken several projects successfully and have created sustainable solutions to environmental issues.

Eco Group has two major business divisions as Eco Paryavaran Engineers & Consultants Pvt. Ltd. and Eco Paryavaran Laboratories & Consultants Pvt. Ltd. The former caters to consultancy and providing engineering solutions for environmental pollution whereas the latter pertains to the analytical and consultancy services in the field of lab testing and environmental studies. Eco Paryavaran is North India's leading supplier of pollution control equipment with world-class infrastructure.

Eco Paryavaran Laboratories is NABL (National Accreditation Board for Testing and Calibration Laboratories) accredited for ISO/IEC 17025:2017, approved by Ministry of Environment, Forest and Climate Change (MoEF&CC) & State Pollution Control Board (SPCBs) in the field of air, noise, wastes, water/wastewater and microbiological testing. Eco Paryavaran Laboratories & Consultants Pvt. Ltd. is also Government approved (ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018) and National Accreditation Board for Education and Training (NABET).

Team of Experts for the Study

S. No.	Name of Expert	Role of Expert	ID of Expert
1.	**Dr. Sandeep Garg** (Ph. D. & ME in Env. Sc., BE in Civil)	Managing Director ▪ NABL approved authorized signatory ▪ MoEF&CC approved govt. analyst ▪ NABET approved EIA Coordinator & Functional Area Expert ▪ Chairman IWE & Ex-Advisor, GMADA	
2.	**Dr. Rai Singh** (Ph. D. & M. Sc. Env. Sc. P.G. Diploma in Industrial Safety, Health & Env.)	Dy. General Manager (Technical & Environment) ▪ MoEF&CC approved Govt. Analyst; ▪ NABL approved authorized signatory ▪ NABET approved Environmental Expert ▪ Worked in CPCB (2001-12) as Research Scientist	
4.	**Dr. Simranjit Kaur** (M.Sc. & M.Phill.; Ph.D. in Solid Waste Management)	Deputy General Manager – EMS & Biological Lab Quality Manager – Analytical Division ▪ NABL Technical Assessor, ▪ NABL approved authorized signatory ▪ MoEF&CC approved govt. analyst ▪ NABET approved EIA Coordinator & Functional Area Expert	
5.	**Dr. Ajay Kumar**	Chief Technical Officer Quality Manager ▪ NABL approved authorized signatory	
6.	**Mr. Navjyot Singh** (BE Electrical & specialization in MEP)	Manager (Projects)	
7.	**Mr. Umesh Kumar** (M. Tech – Nanotech)	Technical Manager & Sr. Laboratory Analyst (Environment & Chemical) ▪ NABL approved authorized signatory	

Approvals of Eco Paryavaran Laboratory

Approvals of Eco Laboratory

NABET ACCREDITATION CERTIFICATE

Quality Council of India

National Accreditation Board for Education & Training

Certificate of Accreditation

Eco Laboratories and Consultants Pvt Ltd, Mohali

E 207, Phase VIII B, Sector 74, Industrial Area, SAS Nagar, Mohali

The organization is accredited as ***Category-A*** *under the QCI-NABET Scheme for Accreditation of EIA Consultant Organization, Version 3: for preparing EIA-EMP reports in the following Sectors –*

S. No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Mining of minerals- opencast only	1	1 (b)	A
2	Metallurgical industries	8	3 (a)	B
3	Cement plants	9	3 (b)	A
4	Synthetic organic chemicals industry (dyes & dye intermediates; bulk drugs and intermediates excluding drug formulations; synthetic rubbers; basic organic chemicals, other synthetic organic chemicals and chemical intermediates)	21	5 (f)	A
5	Distilleries	22	5 (g)	A
6	Sugar Industry	25	5 (j)	B
7	Industrial estates/ parks/ complexes/ Areas, export processing zones (EPZs), Special economic zones (SEZs), Biotech parks, Leather complexes	31	7 (c)	A
8	Common Effluent Treatment Plants (CETPs)	36	7 (h)	B
9	Building and construction projects	38	8 (a)	B
10	Townships and Area development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RA AC minutes dated July 02, 2021 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/21/1936 dated Sept 10, 2021. The accreditation needs to be renewed before the expiry date by Eco Laboratories and Consultants Pvt Ltd, Mohali following due process of assessment.

Sr. Director, NABET	Certificate No.	Valid up to
Dated: Sept 10, 2021	NABET/EIA/2023/RA 0211	Dec 17, 2023

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.

NABL ACCREDITATION CERTIFICATE

National Accreditation Board for Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

ECO LABORATORIES AND CONSULTANTS PVT. LTD.

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

ECO GROUP, ECO BHAWAN, E-207, INDUSTRIAL AREA, PHASE VIII-B, (SECTOR 74), MOHALI, PUNJAB, INDIA

in the field of

TESTING

Certificate Number: TC-7477

Issue Date: 01/06/2021 Valid Until: 31/05/2023

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Identity : ECO LABORATORIES AND CONSULTANTS PVT. LTD.

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

MOEF&CC ACCREDITATION CERTIFICATE

रजिस्ट्री सं० डी० एल०-33004/99 REGD. NO. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

असाधारण
EXTRAORDINARY
भाग II—खण्ड 3—उप-खण्ड (ii)
PART II—Section 3—Sub-section (ii)
प्राधिकार से प्रकाशित
PUBLISHED BY AUTHORITY

सं. 758] नई दिल्ली, बुधवार, फरवरी 28, 2018/फाल्गुन 9, 1939
No. 758] NEW DELHI, WEDNESDAY, FEBRUARY 28, 2018/PHALGUNA 9, 1939

पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय

अधिसूचना

नई दिल्ली, 26 फरवरी, 2018

NOTIFICATION

New Delhi, the 26th February, 2018

S.O. 857(E).—In exercise of the powers conferred by clause (b) of sub-section (1) of section 12 and section 13 of the Environment (Protection) Act, 1986 (29 of 1986), read with rule 10 of the Environment (Protection) Rules, 1986, the Central Government hereby makes the following further amendments in the notification of the Government of India in the erstwhile Ministry of Environment and Forests, number S.O. 1174(E), dated the 18th July, 2007, namely: -

In the Table appended to the said notification, -

(i) for serial numbers 1,17,24,26,30,39,41,45,81,86,87,93,94,95,96 and 100 the entries relating thereto, the following serial numbers and entries shall be substituted, namely: -

S.No.	Name of the Laboratory	Name of the Govt. Analyst	Recognition with effect from and valid up to
(1)	(2)	(3)	(4)
"1	M/s Mantec Consultants Pvt. Ltd. D-36, Sector-VI, Noida-201301, Uttar Pradesh	(i) Mr. Gaja Nand Mallick (ii) Dr. Vivek Dwivedi (iii) Mr. Sumit Verma	26.02.2018 to 25.02.2023
17	M/s Idma Laboratories Limited	(i) Mr. Ankush Aggarwal	26.02.2018

	391, Industrial Area, Phase-I, Panchkula-160019,Haryana	(ii)Mr. Niranjan Dev Behl (iii) Dr. Rajendra Kumar Jain	to 25.02.2023
24	M/s Newcon Consultants & Laboratories Pvt. Ltd. 8th K.M. Stone, Delhi Meerut Road, Morta (Opp. Manan Dham Mandir), Ghaziabad-201003, Uttar Pradesh	(i) Mr. Pankaj Gupta (ii) Mr. Amit Kumar Singh (iii) Mr. Intekhab Khan	26.02.2018 to 25.02.2023
26	M/s Klean Laboratories & Research Pvt. Ltd. 402, Purushottam Plaza, Opp. Baner Telephone Exchange,Baner Road, Pune-411045, Maharashtra	(i) Mr. Vishwas Waman Kale (ii) Mr. Sanjay Kamalakar Mardikar (iii) Ms. Manjusha Gaikwad	26.02.2018 to 25.02.2023
30	M/s Lawn Enviro Associates, "Lawn House" #184-C, Vengalrao Nagar, Hyderabad-500038, Telangana	(i) Mr. Devireddy Nagarujuna Reddy (ii) Ms. Chevula Anuradha (iii) Ms.Vangani Pallavi	26.02.2018 to 25.02.2023
39	M/s Team Test House, (A Unit of Team Institute of Science & Technology Pvt. Ltd.) G-1-584, RIICO Industrial Area, Sitapura, Jaipur-302022, Rajasthan	(i) Mrs. Kavita Mathur (ii) Mr. Kedar Nath Mukhopadhyay (iii) Mr.Rajesh Maheshwari	26.02.2018 to 25.02.2023
41	M/s Envirochem Research & Test Labs Pvt. Ltd. HIG-79, Sector-E, Aliganj, Lucknow-226024, Uttar Pradesh	(i) Dr. Madan Mohan Agarwal (ii) Sh. Vivek Kumar Gupta (iii) Mrs. Saroj Singh	26.02.2018 to 25.02.2023
45	M/s Mineral Engineering Services 25/XXV, Club Road, Bellary-583103, Karnataka	(i) Mr. M. Sachin Raju (ii) Mr. M.R. Durga Prasad (iii) Mr. A.D. Yashwanth Arun Murthy	26.02.2018 to 25.02.2023
81	M/s Advanced Environmental Testing and Research Lab Pvt. Ltd. 63/1, Kailash Vihar, Near ITO, City Center-II, Gwalior-474011, Madhya Pradesh	(i)Mr. Rajesh Jain (ii)Dr. Dinesh Kumar Uchchariya (iii) Mr. Arvind Kumar Sharma	26.02.2018 to 25.02.2023
86	M/s Care Labs Plot No. 1, 3rd Floor, Sai Sadan Complex, Shiva Ganga Colony, L.B. Nagar, Hyderabad-500074, Telangana	(i) Mr.K. Srinivasa Rao (ii) Ms. Gouthami Gangula (iii) Ms. P. Mamatha	26.02.2018 to 25.02.2023
87	M/s Green Circle Inc. Green Empire, Anupushpam Habitat Centre, Nr. Yash Complex, Above Asix Bank Ltd., Gotri Main Road, Vadodara-390021, Gujarat	(i) Mr. Pradeep Joshi (ii) Mr. Ram Raghav (iii) Ms. Shital Jashvantsinh Parmar	26.02.2018 to 25.02.2023
93	M/s Eco Laboratories & Consultants Pvt. Ltd. E-207, Industrial Area, Phase- VIII B, Sector-74, Mohali-160071, Punjab	(i) Mr. Sandeep Garg (ii) Ms. Simranjit Kaur (iii) Dr. Deepika Thakur	26.02.2018 to 25.02.2023
94	M/s Hubert Enviro Care Systems Pvt. Ltd. No. 18, 92nd Street, Ashok Nagar, Chennai-600083, Tamil Nadu	(i)Dr. J.R. Moses (ii)Dr. Rajkumar Samuel (iii) Mr. A.K. Natarajan	26.02.2018 to 25.02.2023
95	M/s Nawal Analytical Laboratories Plot No. 100, New SIDCO Industrial Estate, Sri Nagar, Hosur-635109, Tamil Nadu	(i) Mr. D.Balakrishnan (ii) Ms. S. Elamathi (iii) Mr. K.B.Krishnamoorthy	26.02.2018 to 25.02.2023

Approved

ISO 9001: 2015 Certificate

Certificate of Registration

ISO 9001:2015

This is to Certify that
Quality Management System of

ECO PARYAVARAN ENGINEERS & CONSULTANTS PRIVATE LIMITED

E-204 & 205, INDUSTRIAL AREA, PHASE VIII B (SECTOR–74),
MOHALI-160071, PUNJAB, INDIA.

has been assessed and found to conform to the requirements of

ISO 9001:2015

for the following scope :

DESIGNING, MANUFACTURING, SUPPLY AND COMMISSIONING OF POLLUTION CONTROL EQUIPMENTS.

Certificate No	: **22IQJH70**		
Initial Registration Date	: 21/04/2022	Issuance Date	: 21/04/2022
Date of Expiry	: 20/04/2025		
1st Surve. Due	: 21/03/2023	2nd Surve. Due	: 21/03/2024

Director

IAS ACCREDITED Management Systems Certification Body MSCB-119

MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT IAF

AQC MIDDLE EAST LLC

Head Office: Office No. 02, Ground Floor, Sharjah Media City, Sharjah, UAE. e-mail : info@aqcworld.com,
Key Location: A-60, Sector - 2, Noida, Uttar Pradesh, 201301, India.
*Validity of the Certificate is subject to successful completion of surveillance audit on or before of due date. (in case surveillance audit is not allowed to be conducted, this certificate shall be suspended/withdrawn).
Certificate Verification: Please Re-check the validity of certificate at http://www.aqcworld.com/activeclients.aspx or www.aqcworld.com at Active Clients.
Certificate is the property of AQC Middle East LLC and shall be returned immediately when demanded*

ISO 14001: 2015 Certificate

Certificate of Registration

ISO 14001:2015

This is to Certify that
Environmental Management System of

ECO PARYAVARAN LABORATORIES & CONSULTANTS PRIVATE LIMITED

E-207, INDUSTRIAL AREA, PHASE VIII B (SECTOR–74), MOHALI–160071, PUNJAB, INDIA.

has been assessed and found to conform to the requirements of

ISO 14001:2015

for the following scope :

TESTING SERVICES IN BIOLOGICAL, CHEMICAL AND MECHANICAL CATEGORIES & EIA CONSULTANTS FOR PREPARING EIA/EMP REPORTS.

Certificate No	: **22IEJS76**		
Initial Registration Date	: 21/04/2022	Issuance Date	: 21/04/2022
Date of Expiry	: 20/04/2025		
1st Surve. Due	: 21/03/2023	2nd Surve. Due	: 21/03/2024

Director

IAS ACCREDITED Management Systems Certification Body MSCB-119

MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT IAF

AQC MIDDLE EAST LLC

Head Office: Office No. 02, Ground Floor, Sharjah Media City, Sharjah, UAE. e-mail: info@aqcworld.com,
Key Location: A-60, Sector - 2, Noida, Uttar Pradesh, 201301, India.
"Validity of the Certificate is subject to successful completion of surveillance audits on or before of due date. (In case surveillance audit is not allowed to be conducted, this certificate shall be suspended/withdrawn).
Certificate Verification: Please Re-check the validity of certificate at http://www.aqcworld.com/activeclients.aspx or www.aqcworld.com at Active Clients.
Certificate is the property of AQC Middle East LLC and shall be returned immediately when demanded

ISO 45001: 2018 Certificate

Certificate of Registration

ISO 45001:2018

This is to Certify that
Occupational Health & Safety Management System of

ECO PARYAVARAN LABORATORIES & CONSULTANTS PRIVATE LIMITED

E-207, INDUSTRIAL AREA, PHASE VIII B (SECTOR–74), MOHALI–160071, PUNJAB, INDIA.

has been assessed and found to conform to the requirements of

ISO 45001:2018

for the following scope :

TESTING SERVICES IN BIOLOGICAL, CHEMICAL AND MECHANICAL CATEGORIES & EIA CONSULTANTS FOR PREPARING EIA/EMP REPORTS.

Certificate No	: **22IOJA85**		
Initial Registration Date	: 21/04/2022	Issuance Date	: 21/04/2022
Date of Expiry	: 20/04/2025		
1st Surve. Due	: 21/03/2023	2nd Surve. Due	: 21/03/2024

Director

IAS ACCREDITED Management Systems Certification Body MSCB-119

MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT IAF

AQC MIDDLE EAST LLC

Head Office: Office No. 02, Ground Floor, Sharjah Media City, Sharjah, UAE. e-mail: info@aqcworld.com,
Key Location: A-60, Sector - 2, Noida, Uttar Pradesh, 201301, India.
*Validity of the Certificate is subject to successful completion of surveillance audit on or before of due date. (in case surveillance audit is not allowed to be conducted, this certificate shall be suspended/withdrawal).
Certificate Verification: Please Re-check the validity of certificate at http://www.aqcworld.com/activeclients.aspx or www.aqcworld.com in Active Clients.
Certificate is the property of AQC Middle East LLC and shall be returned immediately when demanded.

Approvals of Eco Experts

NATURE SCIENCE FOUNDATION

(A Unique Research and Development Centre for Society Improvement
(ISO 9001:2015, 14001:2015, 45001:2018 & 50001:2018 Certified Organization
& Ministry of MSME Registered Organisation)
Coimbatore - 641 004, Tamil Nadu, India. [www.nsfonline.org.in]

Regd. No. 114 / 2017

Certificate of Lead Auditor Course

This is to certify that Dr. RAI SINGH, Department of Environment, Eco Paryavaran Laboratories and Consultants Pvt. Ltd., Mohali, Punjab has successfully completed a Lead Auditor Course on "Environment Management System, Green Campus Audit, Energy Audit and Hygiene Audit to Educational Institutions and Industrial Sectors" (Fourth Series) organized by the Nature Science Foundation, Coimbatore – 641 046, Tamil Nadu, India from 26th September 2022 to 30th September 2022.

Motto of NSF
'Save the Nature to Save the Future' & 'Go Green to Save the Planet'

Chairman, *Nature Science Foundation* | Certified ISO Auditor, *Environment Management System* | Certified Auditor IGBC AP, *Indian Green Building Council* | Certified BEE Auditor, *Bureau of Energy Efficiency*

Acknowledgement

Acknowledgement

Eco Paryavaran Laboratories and Consultants Pvt. Ltd. is thankful to the Management and the Principal/Director of Baba Farid Vidyak Society for entrusting processes of Energy Audit with us.

We thank all the participants of the auditing team especially students, faculty and non-teaching staff who took pain along with us to gather the data through survey.

We also thank the office staff who helped us during the document verification.

For Eco Paryavaran Laboratories and Consultants Pvt. Ltd.

Dr. Rai Singh
Authorized Signatory
(NABET approved FAE for AQ, AP, NV & RH)
Contact: +91-8054443192; Email: environment@ecoparyavaran.org

***** End of Report *****