ANNUAL PROGRESS REPORT FOR SDG 7 – 2024

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17.3.7. University publishes progress against SDG 7

St. Peter's Institute of Higher Education and Research (SPIHER) is committed to SDG 7: Affordable and Clean Energy by promoting sustainable energy practices and awareness among students and staff. The campus integrates energy-efficient technologies, including LED lighting and solar panels, to reduce its carbon footprint and energy costs. SPIHER also incorporates renewable energy concepts into its curriculum and research initiatives, encouraging innovation in green technologies. Through seminars, workshops, and community outreach, the university educates stakeholders on energy conservation and sustainable alternatives. SPIHER's efforts reflect its dedication to fostering a culture of clean, reliable, and affordable energy for all. SPIHER is at the forefront of developing new technologies. SDG 7 promotes affordable, reliable, and sustainable energy access, which requires innovation in renewable energy sources, energy storage, grid systems, and energy efficiency. This focus provides engineering students with real-world challenges that encourage them to innovate and develop clean energy solutions.

SPIHER students will become future leaders and decision-makers in industries that have significant environmental impacts. By emphasizing SDG 7, engineering colleges prepare students to approach these roles with a mindset oriented toward sustainability, responsible energy use, and environmental impact.

SPIHER often engage in research, and SDG 7 encourages research in renewable energy technologies like solar, wind, geothermal, and bioenergy. Institutions that focus on SDG 7 can attract funding for clean energy research, which in turn provides students with hands-on experience in cutting-edge fields.

Role of Hydrogen in Sustainable Transportation

Seminar Topic: 'Role of Hydrogen in Sustainable Transportation'

Date: 19/09/2024

Recourse Person: Dr. AK. Sahu, Principal Scientist, Central Electrochemical Research Institute, Madras Unit, CSIR Madras Complex, Taramani, Chennai.

This seminar on *"Role of Hydrogen in Sustainable Transportation"* was organized to highlight emerging clean-energy solutions and their impact on the future of mobility. In alignment with SDG 7: Affordable and Clean Energy, the session focused on hydrogen as a renewable, carbon-free fuel essential for building an energy-efficient and environmentally responsible transportation sector.

The seminar discussed the production of green hydrogen, its high energy density, and its potential to drastically reduce emissions from heavy vehicles, public transport, and industrial logistics. Participants gained insights into fuel-cell technology, hydrogen storage systems, and global advancements in hydrogen-powered mobility. The resource person emphasized how

hydrogen can complement solar and wind energy to create a resilient and diversified clean-energy ecosystem.

By creating awareness of hydrogen's role in decarbonizing transportation, the seminar encouraged students to explore innovative, sustainable energy solutions and contributed to strengthening institutional commitment to SDG 7: ensuring access to clean, reliable, and modern energy for all.

Programme Brochure

Dr. R. Rani Hemamalini, Director IQAC & Head addressing the gathering

Interaction of the Chief Guest with the team and Vice Chancellor on clean energy

Public Links

https://www.instagram.com/p/DADJFiPPeXY/?igsh=MWZoNXAyYzZpemcwOQ==

https://www.facebook.com/share/p/6dSR6UYqBQbTJSV1/?mibextid=qi2Omg

https://x.com/SpiherIndia/status/1836297508986790332?t=FRWZAbKTIlmK4py4Ry8rRw&s=19

https://x.com/SpiherIndia/status/1836297508986790332?t=FRWZAbKTIlmK4py4Ry8rRw&s=19

Research Articles published under SDG 7

1. **Vengatesan S, Jayakumar A, Sadasivuni KK. FCEV vs. BEV—A short overview on identifying the key contributors to affordable & clean energy (SDG-7). Energy Strategy Reviews. 2024 May 1;53:101380.**

Energy Strategy Reviews 53 (2024) 101380

Contents lists available at ScienceDirect

Energy Strategy Reviews

journal homepage: www.elsevier.com/locate/esr

Review

FCEV vs. BEV — A short overview on identifying the key contributors to affordable & clean energy (SDG-7)

S. Vengatesan [a,b], Arunkumar Jayakumar [c], Kishor Kumar Sadasivuni [d,e,*]

[a] Research Vision Technology and Business Centre India, Tamil Nadu, India
[b] Department of Mechanical Engineering, College of Engineering and Technology, SRM Institute of Science and Technology, KTR Campus, SRM Nagar, Chengalpattu, 603203, Tamil Nadu, India
[c] St. Peter's Institute of Higher Education and Research—AVADI, Avadi, Chennai, 600054, Tamil Nadu, India
[d] Center for Advanced Materials, Building H10, Zone 6, Office E133, Qatar University, Doha, P.O. Box 2713, Qatar
[e] Department of Mechanical and Industrial Engineering, Qatar University, Doha, P.O. Box 2713, Qatar

ARTICLE INFO

Keywords:
Fuel cell electric vehicle
Battery electric vehicle
Socio-economic aspect
Infrastructure
Range

ABSTRACT

Battery electric vehicles (BEVs) are surging worldwide due to technology improvements in lithium-based batteries and rising petroleum prices. India's EV30@30 campaign aggressively penetrate the Electric vehicle and target share by 30% in 2030. Sarcastically, from the Indian context, the availability of Li-source is limited and subsequently, there has been an impetus to find out a promising electric vehicle (EV). Fuel cell-based EVs are one such potential option. The present review critically assesses the scope and perspective of battery electric vehicles (BEVs)with fuel cell electric vehicles (FCEVs) in line with the Indian context. The assessment validates that fuel cell-based EVs can be a likely option for the Indian sub-continent. As a whole, FCEV technology will advance, and over time, smaller and mid-segment commercial vehicles will eventually be more affordable in addition to being sustainable, especially when using green hydrogen as a fuel. The total cost of ownership (TOC) of FCEV is better than BEV for the period of twelve years and also supports the future of FCEV in the Indian context (Sorakkai et al. 2024).

1. Introduction

Energy has become a fundamental component that is very much essentially a part of our life, from charging your mobile to automobiles. The automobile sector in India predominantly relies on petroleum-based fossil resource that emits greenhouse gases (GHGs). Thus, Climate change is largely caused by increasing greenhouse gas emissions [1–6]. Continued emission of GHGs can potentially cause severe, pervasive, and irreversible impacts on the climate which include higher heat waves, rise in sea level, and intensification in the storm surges. The use of petroleum and related hydrocarbon fuels is very much inevitable in the recent context. Ironically, the upsurge in the use of Petroleum-based Internal Combustion Engine (ICE) vehicles is causing prevalent environmental tribulations in our atmosphere due to the emission of noxious greenhouse gases, such as COx, SOx, NOx, and particulate matter. Transport-related emissions contribute to over 30 % of global emissions, with close to 70 % of these emissions coming from on-road cars, according to a report by the International Energy Agency (IEA) [7]. Table 1 provides the detailed outline of emission level and its health issues. In addition, from the economic perspective due to low supply and high demand, the cost of petroleum-based products is significantly causing (3%) negative impact on nations GDP. Although Battery-based EVs are emerging as a potential option, they still lack the range anxiety and again from the Indian context, we have limited Lithium resources. Fuel cell-based energy systems are potential and reliable energy systems, which convert clean hydrogen fuel into power with water and heat as by-products. In this situation, FCEVs will become significantly more ecologically beneficial and achieve a "true" zero emission because of the usage of renewable energy sources for power generation (solar, wind, ocean, etc.). Assessments of FCEV's life cycle, environment, and toxicology are provided in the report [8–11]

1.1. Why proton exchange membrane (PEM) fuel cells for EV application?

Their distinguishing features include:

- High electrical efficiency (at least double that of the most efficient ICE vehicle [12,13])
- Lower temperature/pressure ranges (20 to 120 °C/1 barg) [14, 15]
- Due to this high-power density and energy density [10,16,17], they have potential applications in transportation.

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E-mail addresses: arunkumarjayakumar@gmail.com (A. Jayakumar), kishorkumar@qu.edu.qa (K.K. Sadasivuni).

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Received 1 August 2023; Received in revised form 30 March 2024; Accepted 8 April 2024
Available online 16 April 2024

2. **Priya VS, Brindha S. Optimizing Solar Power Generation and Integration in Automotive Systems Through IoT. Indian Journal of Science and Technology. 2024 Oct 23;17(40):4158-67.**

INDIAN JOURNAL OF SCIENCE AND TECHNOLOGY

RESEARCH ARTICLE

Optimizing Solar Power Generation and Integration in Automotive Systems Through IoT

V Sri Priya[1]* S Brindha[2]

1 Research scholar, Department of Computer Science & Applications, St Peters Institute of Higher Education and Research, Avadi, Chennai, Tamil Nadu, India

2 Associate Professor, Department of Computer Science & Applications, St. Peter's Institute of Higher Education and Research, Avadi, Chennai, Tamil Nadu, India

OPEN ACCESS

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Sripriyarisa@gmail.com

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Abstract

Objective: This study presents an Internet of Things (IoT)- based system with edge intelligence that predicts power production with over 98% accuracy and monitors substations and smart solar installations, ensuring reliable power distribution in industrial IoT environments. This system enhances sustainability, safety, and energy management in smart buildings by reducing power fluctuations by 30% and improving decision-making, leading to a 95% reduction in energy management costs. **Method:** An IoT-enabled power monitoring system was implemented for smart solar panels and substations, incorporating edge intelligence for instantaneous prediction and decision-making. An IoT-enabled solar charging station was deployed for smart homes and Industry 4.0 applications. The cloud was used for analyzing sensor data, with a response time of less than 1 second. **Findings:** The proposed framework increased the efficiency and reliability of power production and distribution by 25% across commercial, residential, and industrial contexts. It significantly mitigated power fluctuations, reducing downtime by 40% and achieving a 95% cost reduction in energy management compared to traditional systems. IoT integration improved safety and sustainability metrics by 20% in smart buildings. **Novelty:** The framework integrates edge intelligence with IoT in smart solar systems and substations, providing a sophisticated control system that enhances power distribution decision-making. It facilitates real-time monitoring and prediction of power production with over 98% accuracy, emphasizing sustainability, safety, and energy management improvements of up to 30% in smart buildings.

Keywords: IoT-based control system; Smart solar systems; Edge intelligence; Power substations; Load management; Energy sustainability

1 Introduction

IoT is currently assuming a significant role in global research, particularly in the field of sophisticated wireless communication, and is serving as the basis for a number of

3. **Subbulakshmi G, Sujatha S, Saraswathi V. Harnessing Blockchain and Deep Learning for Enhanced Energy Analytics in Photovoltaic Systems. In2024 International Conference on System, Computation, Automation and Networking (ICSCAN) 2024 Dec 27 (pp. 1-7). IEEE.**

IEEE Advancing Technology for Humanity

MANAKULA VINAYAGAR INSTITUTE OF TECHNOLOGY

(An Autonomous Institution)
Accredited by NAAC with 'A' Grade and NBA
Kalitheerthalkuppam, Puducherry- 605 107
Ph: 0413 2643007/Website: www.mvit.edu.in

IEEE Madras Section

6th IEEE- International Conference on Systems, Computation, Automation, and Networking

ICSCAN'24

Certificate of Presentation

This is to certify that Rani Hemamalini Ranganathan, HOD/EEE of St. Peter's Institute of Higher Education & Research has presented the paper titled Harnessing Blockchain & Deeplearning for Enhanced Energy Analytics in Photovoltaic Systems in the 6th IEEE- International Conference on Systems, Computation, Automation, and Networking , organized by Manakula Vinayagar Institute of Technology, Puducherry, on 27th and 28th December 2024

Dr. R. VALLI
CONFERENCE CHAIR
MVIT

Dr. S. MALARKKAN
PRINCIPAL
MVIT

Shri. M. DHANASEKARAN
CHAIRMAN AND MANAGING DIRECTOR
SMVE Trust

Certificate of Presentation

4. **Ramar M, Mariappan SM, Gunasekaran S, Navaneethan M, Singhal A, Yang K, Archana KJ, Balagopalan S, Ambikeswari N, Shkir M, Karthikeyan B. Tuning Electron–Phonon Coupling in Se-Doped Fe2O3 for Efficient Photocatalysis: Experimental and First-Principles Calculations. ACS Applied Nano Materials. 2024 Mar 22;7(7):6935-45.**

ACS Applied Nano Materials › Vol 7/Issue 7 › Article

Cite Share Jump to Expand

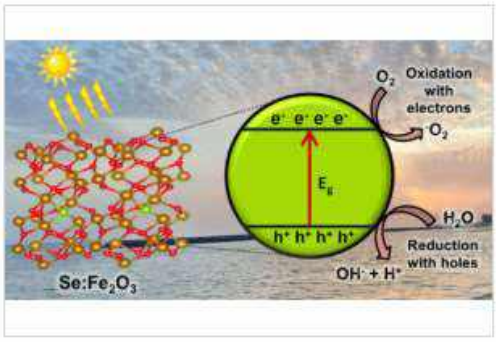
ARTICLE | March 22, 2024

Tuning Electron–Phonon Coupling in Se-Doped Fe_2O_3 for Efficient Photocatalysis: Experimental and First-Principles Calculations

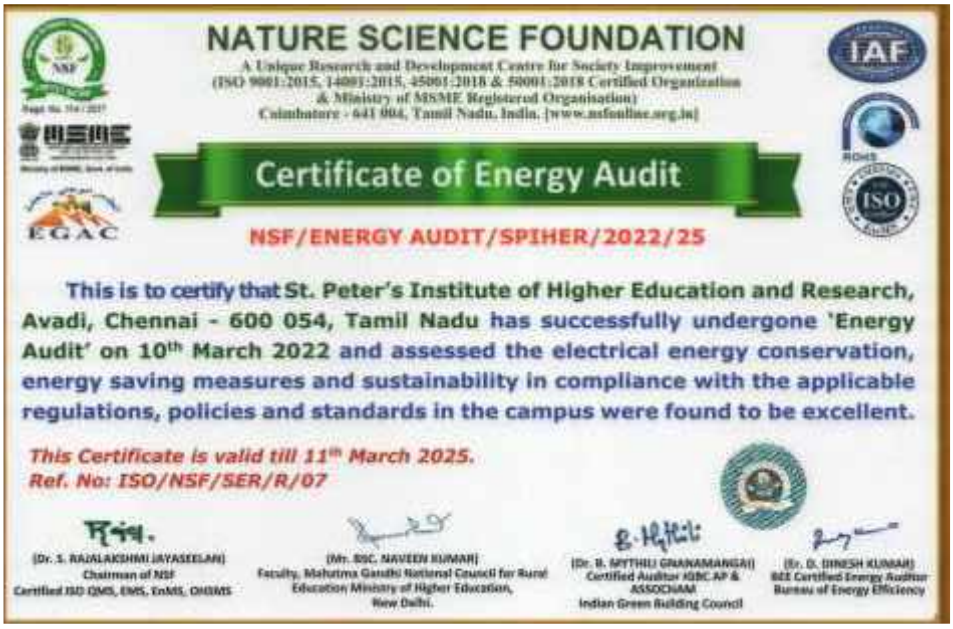
Mahalakshmi Ramar, ,, Sivalingam Muthu Mariappan, ,, S. Gunasekaran*, ,, M. Navaneethan, ,, Ayush Singhal, ,, Kesong Yang*, ,, K. Janani Archana, ,, Susmitha Balagopalan, ,, N. Ambikeswari, ,, Mohd Shkir*, , and , Balasubramanian Karthikeyan*,

Abstract

Reducing the electron−phonon (el−ph) coupling in Fe_2O_3 can significantly boost carrier mobility by overcoming the customary trapping effects caused by polaron formation. Despite various efforts to understand the polaron formation and their transport properties, any direct measurement of el−ph coupling strength is still lacking. Hence, we prepared Fe_2O_3 and Se-doped Fe_2O_3 through a solid-state reaction and measured the el−ph coupling strength through the Fano-resonance approach. The reduced coupling strength in Se-modified Fe_2O_3 indicates that the self-trapped carriers can easily hop the lattice and consequently have a larger lifetime, as confirmed in time-resolved photoluminescence measurements. Further, to determine the Se doping site and to reveal the underlying mechanism for the changes in carrier lifetime, we performed first-principles density functional theory calculations by considering all the possible substitutional doping models. Our calculations show that Se will substitute the O atoms (Se@O) under ambient conditions rather than Fe atoms



Energy Audit Certificate awarded to SPIHER for compliance with sustainable campus practices and Environmental Inspection Certificate recognizing SPIHER's adherence to green standards and eco-friendly initiatives.



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 Organization)
Coimbatore - 641 006, Tamil Nadu, India. [www.nsfonline.org.in]

Certificate of Energy Audit

NSF/ENERGY AUDIT/SPIHER/2022/25

This is to certify that St. Peter's Institute of Higher Education and Research, Avadi, Chennai - 600 054, Tamil Nadu has successfully undergone 'Energy Audit' on 10th March 2022 and assessed the electrical energy conservation, energy saving measures and sustainability in compliance with the applicable regulations, policies and standards in the campus were found to be excellent.

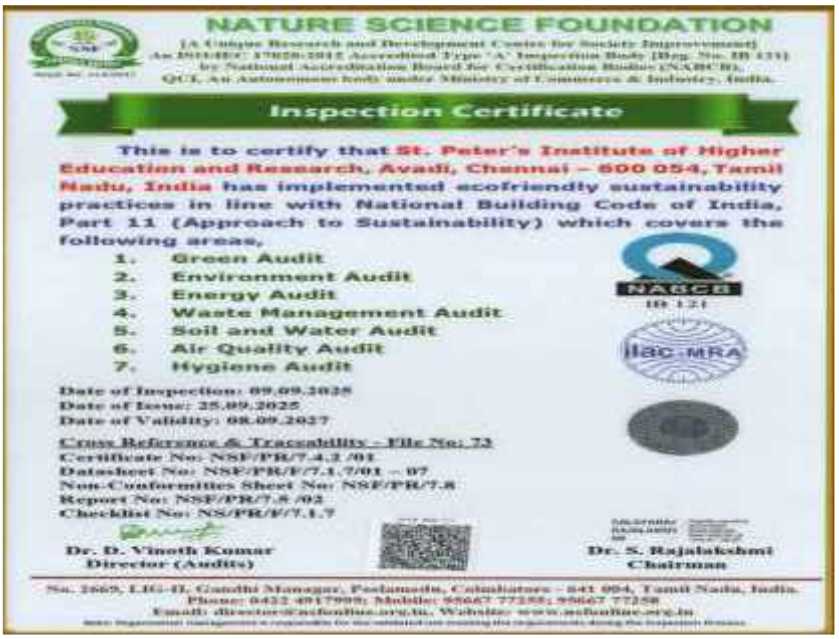
This Certificate is valid till 11th March 2025.
Ref. No: ISO/NSF/SER/R/07

(Dr. S. RAJALAKSHMI JAYASEELAN)
Chairman of NSF
Certified ISO QMS, EMS, EnMS, OHSMS

(Mr. BSC. NAVEEN KUMAR)
Faculty, Mahatma Gandhi National Council for Rural Education Ministry of Higher Education, New Delhi.

(Dr. B. MYTHILI GNANAMANGAI)
Certified Auditor IGBC AP & ASSOCHAM
Indian Green Building Council

(Er. D. DINESH KUMAR)
BEE Certified Energy Auditor
Bureau of Energy Efficiency



NATURE SCIENCE FOUNDATION

Inspection Certificate

This is to certify that St. Peter's Institute of Higher Education and Research, Avadi, Chennai – 600 054, Tamil Nadu, India has implemented ecofriendly sustainability practices in line with National Building Code of India, Part 11 (Approach to Sustainability) which covers the following areas,

1. Green Audit
2. Environment Audit
3. Energy Audit
4. Waste Management Audit
5. Soil and Water Audit
6. Air Quality Audit
7. Hygiene Audit

Date of Inspection: 09.09.2025
Date of Issue: 25.09.2025
Date of Validity: 08.09.2027

Cross Reference & Traceability – File No: 73
Certificate No: NSF/PR/7.4.3 /01
Datasheet No: NSF/PR/F/7.1.7/01 – 07
Non-Conformities Sheet No: NSF/PR/7.8
Report No: NSF/PR/7.8 /02
Checklist No: NS/PR/F/7.1.7

Dr. D. Vinoth Kumar
Director (Audits)

Dr. S. Rajalakshmi
Chairman

No. 2669, LIG-II, Gandhi Manager, Podanoor, Coimbatore - 641 004, Tamil Nadu, India.
Phone: 0422 4917999; Mobile: 95667 77255; 95667 77258
Email: director@nsfonline.org.in, Website: www.nsfonline.org.in

Best Green campus Award Certificate awarded to SPIHER for compliance with sustainable campus practices and Environmental Inspection Certificate recognizing SPIHER's adherence to green standards and eco-friendly initiatives.

NATURE SCIENCE FOUNDATION

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Coimbatore-641 004, Tamil Nadu, India. www.nsfonline.org.in

Certificate of Best Green Campus Award

NSF/BGCA/SPIHER/2022/25

This is to certify that St. Peter's Institute of Higher Education and Research, Avadi, Chennai - 600 054, Tamil Nadu has been honoured with "Best Green Campus Award" for maintaining the campus as per the "Green and Energy Conservation Building Code". The Organization imparts the thrust of innovating new ideas to accomplish eco-friendly environment to the stakeholders. Energy and Environment Management Audits such as 'Green Campus Audit', 'Environment Audit' and 'Energy Audit' were carried out on 10th March 2022.

This Certificate is valid till 11th March 2025.
Ref. No: ISO/NSF/SER/R/07

(Dr. S. RAJALAKSHMI JAYASEELAN) Chairman of NSF Certified ISO QMS, EMS, EnMS, OHSMS

(Mr. BSC. NAVEEN KUMAR) Faculty, Mahatma Gandhi National Council for Rural Education Ministry of Higher Education, New Delhi.

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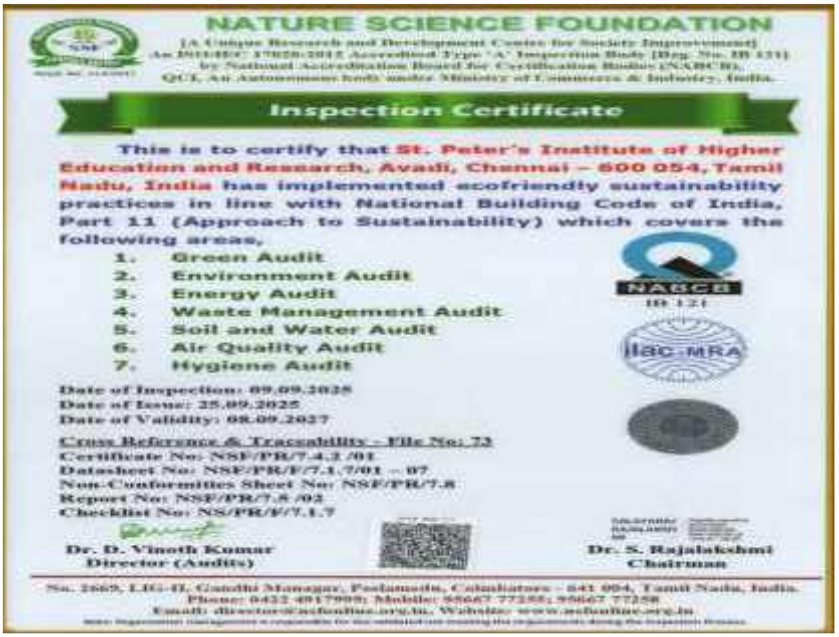

NATURE SCIENCE FOUNDATION

[A Unique Research and Development Centre for Society Improvement]
An ISO/IEC 17020:2012 Accredited Type 'A' Inspection Body [Reg. No. IB 121] by National Accreditation Board for Certification Bodies (NABCB), QCI, An Autonomous body under Ministry of Commerce & Industry, India.

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Chairman

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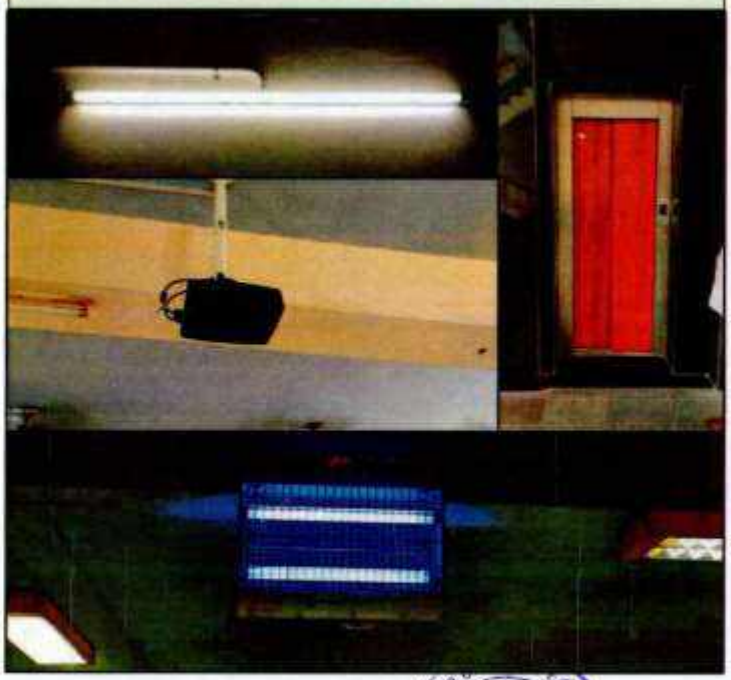
Phone: 0422 4917999; Mobile: 95667 77255; 95667 77258
Email: director@nsfonline.org.in, Website: www.nsfonline.org.in

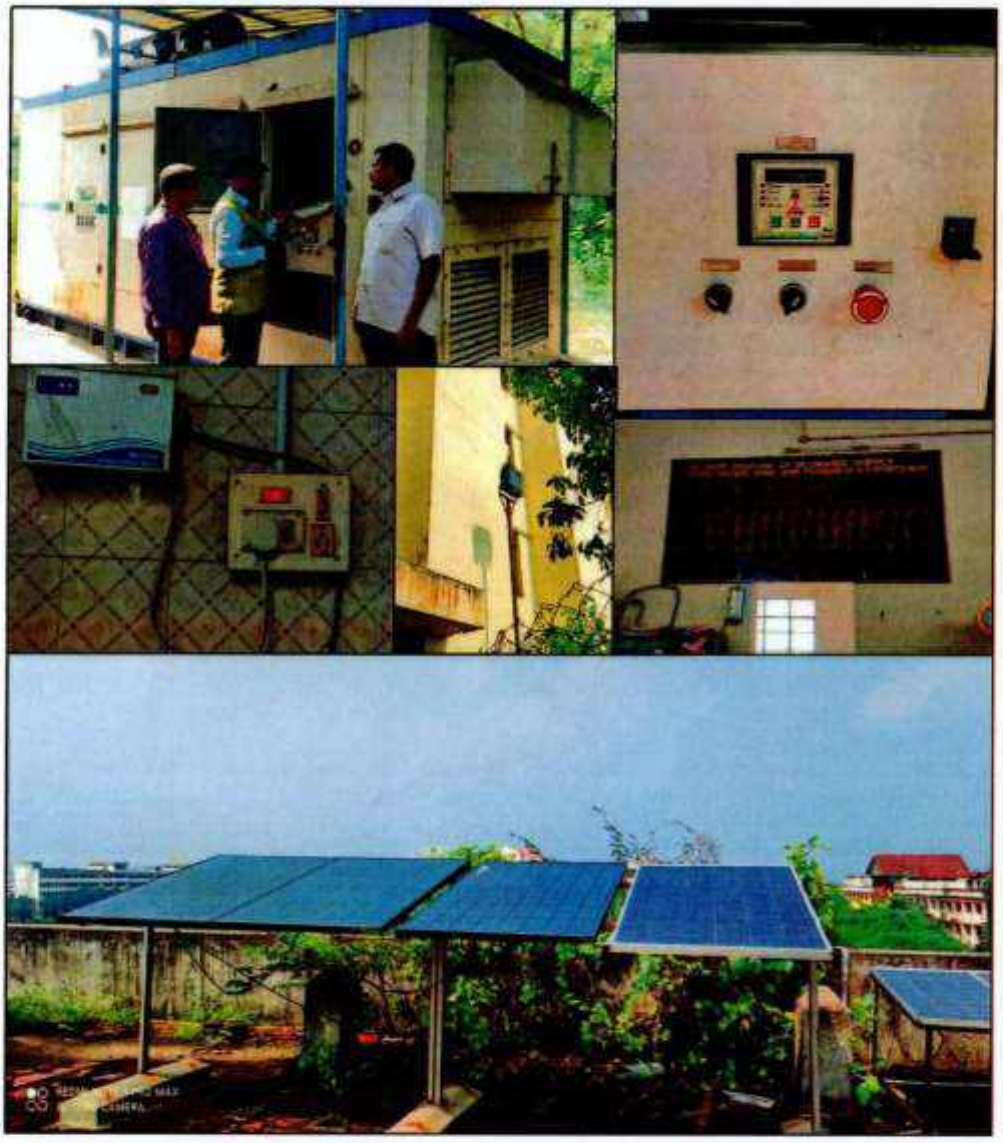
Energy Management and Conservation Activities in
St. Peter's Institute of Higher Education and Research,
Chennai, Tamil Nadu.

Walk through audit at SPIHER college



Deemed to be University Chennai 600 054

Registrar
St. Peter's Institute of Higher Education and Research
(Deemed to be University U/S 3 of the UGC Act, 1956)
Avadi, Chennai-600 054



Best Practices followed by
St. Peter's Institute of Higher Education and Research,
Chennai, Tamil Nadu.

12. Best Practices followed in the Organization

- Transformer, Generators and UPS are protected properly with fencing and kept awareness boards on 'Dangers' and 'Warnings'.
- Most of places, sign board of 'Switch ON' and 'Switch OFF' are kept towards saving energy measures to the stakeholders.
- Electrical wires, switch boxes and stabilizers are properly covered without any damage which will cause any problems to the staff and student members.

Deemed to be University Chennai 600 054

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Avadi, Chennai-600 054

Sensor-Based Energy Conservation

Sensor based Energy Conservation is implemented by utilizing sensor based motion-sensor activated LED bulbs and tube lights in the campus

Sensor-based automation plays a critical role in modern energy conservation strategies, and SPIHER has proactively adopted this technology across its campus infrastructure. The University has significantly invested in **motion-sensor-activated LED bulbs and tube lights**, with over **100 units installed** in key areas including floor corridors, seminar halls, conference rooms, hostels, and restrooms. These smart fixtures automatically deactivate when no movement is detected, eliminating unnecessary electricity consumption. In addition, **sensor-operated hand-wash units** have been introduced to support water-efficiency objectives and minimize wastage. Through these automated systems, SPIHER demonstrates its commitment to adopting intelligent technology that enhances operational sustainability while fostering a culture of conscious resource utilization.

LED-Based Power-Efficient Lighting :

LED lighting represents one of the most effective energy-saving solutions in contemporary facilities management. With rapid advancements in LED performance, increased product availability, and reduced cost due to improved manufacturing efficiencies, LEDs now provide high-quality illumination while consuming a fraction of the power required by conventional 100-watt incandescent bulbs.

SPIHER has implemented extensive **LED-based lighting across the campus** as part of its long-term energy-efficiency drive. By replacing traditional lighting systems with LED alternatives, the Institute significantly reduces electrical load, lowers carbon impact, and aligns its operations with globally recognized clean-energy practices.

LED Bulbs in Conference Hall

LED Bulbs Facilities in Seminar Hall

REPORT ON KNOWLEDGE TRANSFER SESSION ON "NATURAL DISASTERS REBUILDING & RECOVERY"

Date: 02nd September 2024 Venue: Mechanical Block, Seminar Hall

Time: 10.00 am onwards

Event: Knowledge Transfer Session on "Natural Disasters - Rebuilding & Recovery"

Program aligns with two Sustainable Development Goals: Quality Education (Goal 4) and Industry, Innovation and Infrastructure (Goal 9).

Organizers:

- Department of Chemistry - St. Peter's Institute of Higher Education & Research
- Department of Civil Engineering - St. Peter's Institute of Higher Education & Research
- IQAC - St. Peter's Institute of Higher Education & Research

Invited Speakers:

1. Mr. C. Sakthivel, Assistant Professor, Department of Chemistry Topic: Types of disasters
2. Mr. R. Rajeshwaran, Assistant Professor, Department of Civil Engineering Topic: Seismic Design of building

Advisors:

- Maj. Dr. M. Venkatramanan (Dean - FASCMH, SPIHER)
- Dr. S. Selvan (Advisor - Dean (Engg), SPIHER)

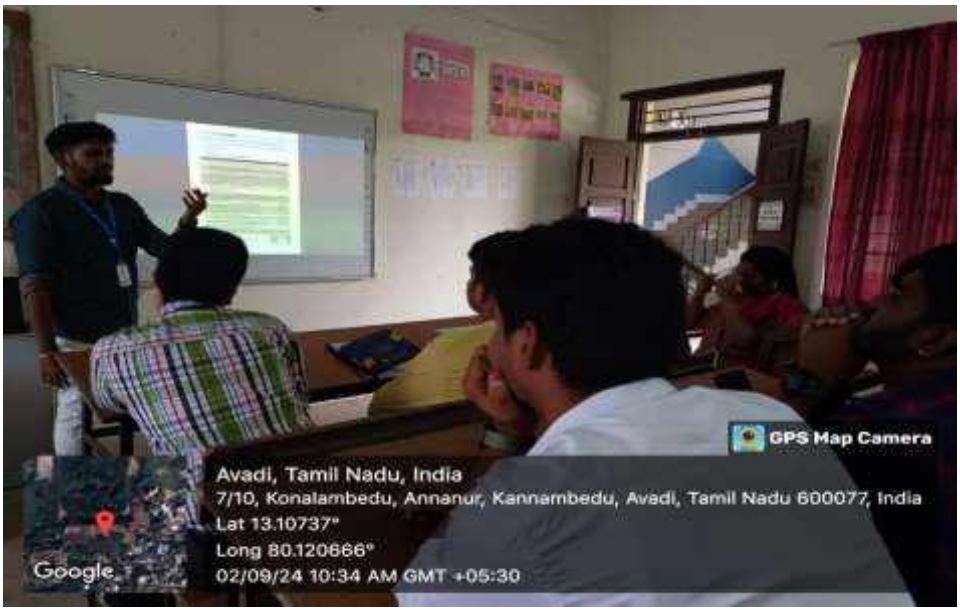
Conveners:

- Dr. Sayeeda Sultana (Professor & Head, Department of Chemistry, SPIHER)
- Dr. B. Hemalatha (Professor, Department of Civil Engineering, SPIHER)

The event aims to provide knowledge on natural disasters, focusing on rebuilding and recovery efforts. The invited speakers' explained about natural disasters such as earthquakes, hurricanes, floods, and wildfires cause significant damage to infrastructure, homes, and communities, requiring coordinated rebuilding and recovery efforts. Post-disaster recovery involves immediate relief such as providing shelter, food, and medical care, followed by long-term rebuilding, which includes restoring infrastructure, homes, and local economies. Successful recovery strategies emphasize community involvement, government support, and resilience-building to mitigate future risks. Sustainable building practices, such as using disaster-resistant materials and designs, are also critical to ensure that rebuilt structures can withstand future events, helping communities recover faster and stronger.

Event organized on 2/9/2024 for ensuring all renovations / new builds are following energy efficiency standards

Rebuilding lives after natural disasters begins with shared knowledge and collective resilience. This knowledge transfer session on "Natural Disasters – Rebuilding & Recovery" empowers communities with practical strategies for safer, stronger futures. This event fits into the context of ensuring all renovations / new builds are following energy efficiency standards.



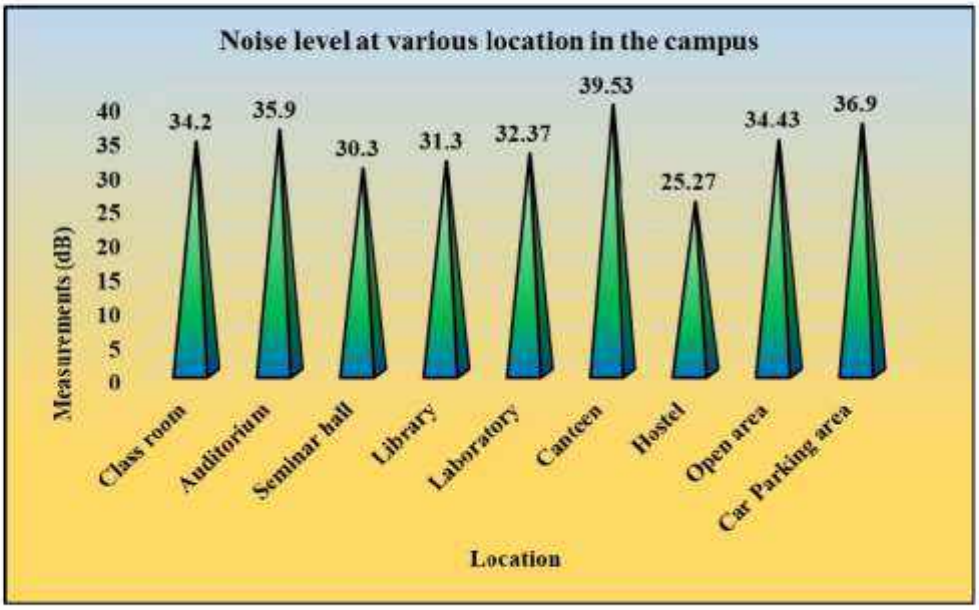
Rebuilding after disaster is not just about structures, but about hope and dignity. This session on "Natural Disasters – Rebuilding & Recovery" lights the path from shock to sustainable renewal ensuring all renovations / new builds are following energy efficiency standards. This event fits into the context of ensuring all renovations / new builds are following energy efficiency standards.

From ruins to resilience: every community can rise stronger after a natural disaster. This session on "Natural Disasters – Rebuilding & Recovery" imparted knowledge on how to plan, rebuild and thrive. This event fits into the context of ensuring all renovations / new builds are following energy efficiency standards.

Table 5. Noise level at various location in the campus

S. No	Locations	Measurements (dB)	Major noise sources	Remarks
1.	Class room	34.20	Students and Staff	No Noise Pollution
2.	Auditorium	35.90	Students	No Noise Pollution
3.	Seminar hall	30.30	Students	No Noise Pollution
4.	Library	31.3	Staff members	No Noise Pollution
5.	Laboratory	32.37	Students	No Noise Pollution
6.	Canteen	39.53	Students and Staff	No Noise Pollution
7.	Hostel	25.27	Students	No Noise Pollution
8.	Open area	34.43	Students and staff	No Noise Pollution
9.	Car Parking area	36.90	Vehicles	No Noise Pollution
	Mean	33.36%		
	SE	0.45		
	CD	0.80		

Figure 3. Noise level at various location in the campus



Noise level measured in various locations at the Campus

= 4.38 metric tons

365 is the number of days per year
0.01 is the coefficient to calculate the emission in metric tons per 100 km for bus

a. Transportation per year (Car)

= (Number of cars entering the campus x 2 x approximate travel distance of a vehicle each day inside campus only (in kilometers) x 365/100) x 0.02
= ((5 x 20 x 1 x 365)/100)) x 0.02
= 7.3 metric tons

365 is the number of days per year
0.02 is the coefficient to calculate the emission in metric tons per 100 km car

b. Transportation per year (Motorcycles)

= (Number of motorcycles entering the campus x 2 x approximate travel distance of avehicle each day inside campus only (in kilometers) x 365/100) x 0.01
= ((110 x 20 x 1 x 365)/100)) x 0.01
= 80.3 metric tons

365 is the number of days per year
0.01 is the coefficient to calculate the emission in metric tons per 100 km for motorcycles.

c. Total Carbon emission per year

= total emission from electricity usage + transportation (bus, car, motorcycle)
= (357.28 + 4.38 + 7.3 + 80.3)
= 449.26 metric tons

4.2.8. Noise level measurements (NBC Checkpoint 12.4.4.)

Noise is all unwanted sound or set of sounds that causes annoyance or can have a health impact and noise level is measured in decibels (dB). The body can also respond to lower noise levels. Level of noise are expected tobe within 55 dB in residential areas, including institutions. Class room noise levels aresupposed to be around 50 db. Sound Level Meter / Noise Thermometer are used to measure the noise level in the surroundings which converts the sound signal to an equivalent electrical signal and the resulting sound pressure level in decibels (dB) referenced to 20 µPa. Noise level prescribed by Central Pollution Control Board was presented in the Table 4.

Table 4. Noise level standard prescribed by Central Pollution Control Board, Government of India

Area Code	Zone	Limits in dB (A) Leq	
		Day Time	Night Time
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence	50	40

Source: IS : 12065 - 1987

Table 3. Annual Energy Consumption of Fuels in the Campus

S. No	Month	Diesel consumption (Liters)	Petrol consumption (Liters)	LPG consumption (kg)
1	September 2024	3368	162	56
2	October 2024	3097	145	56
3	November 2024	2867	152	56
4	December 2024	2463	140	56
5	January 2025	3230	150	51
6	February 2025	2917	156	50
7	March 2025	3298	170	56
8	April 2025	3310	148	56
9	May 2025	3488	145	22
10	June 2025	3023	150	18
11	July 2025	2444	150	56
12	August 2025	2585	151	56

4.2.6. Carbon footprint

The carbon footprint per year is calculated (www.carbonfootprint.com) based on electricity usage per year in which CO_2 emission from electricity and the sum of transportation per year in terms of number of the shuttle buses service operated by the Organization and number of cars, motorcycles and trucks entering in the Organization campus. These factors are multiplied with total number of trips in each day and approximate travel distance of vehicles covered in each day with a coefficient (0.01) to calculate the emission of CO_2 in metric tons per year. Humans contribute to a massive increase of carbon dioxide emissions by burning fossil fuels, deforestation, and other industrial activities.

4.2.7. Calculation of carbon footprint

The carbon footprint analysis can be calculated based on the earlier reports as stated in www.carbonfootprint.com which is the sum of electricity usage per year. According to the data provided by the Management, carbon emission due to electricity consumption and fossil fuels are presented hereunder.

The CO_2 emission from electricity

= (electricity usage per year in kWh/1000) x 0.84, where 0.84 is the coefficient to convert kWh to metric tons

= (425344 kWh/1000) x 0.84

= 357.28 metric tons

According to the above calculations, carbon emission due to electricity usage per year accounts for 357.28 metric tons.

Transportation per year (Shuttle)

= (Number of the shuttle vehicle in the campus x (2) x total trips for shuttle bus service each dayx approximate travel distance of a vehicle each day inside campus only (20 km)x 365/100) x 0.01

= ((6 x 20 x 1 x 365)/100)) x 0.01

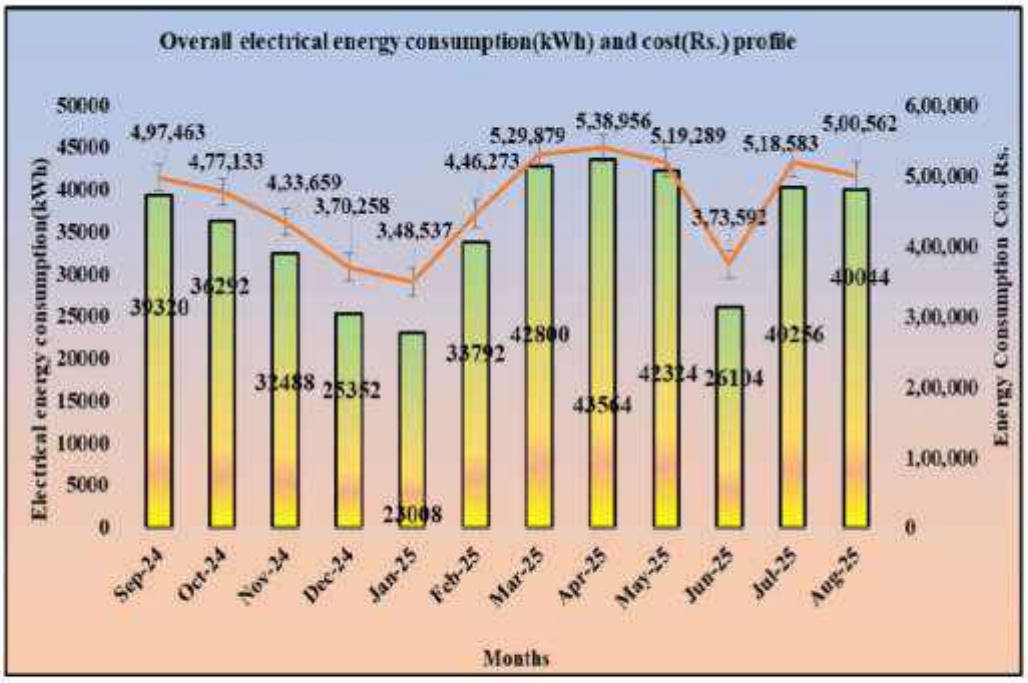


Figure 2. Overall electrical energy consumption and cost profile

Table 2. Electrical energy consumption and cost profile in the Institution

S. No	Months	Rating / Capacity units in kWh	Cost in Rs.
1.	September 2024	39320	4,97,463
2.	October 2024	36292	4,77,133
3.	November 2024	32488	4,33,659
4.	December 2024	25352	3,70258
5.	January 2025	23008	3,48,537
6.	February 2025	33792	4,46,273
7.	March 2025	42800	5,29,879
8.	April 2025	43564	5,38,956
9.	May 2025	42324	5,19,289
10	June 2025	26104	3,73,592
11.	July 2025	40256	5,18,583
12.	August 2025	40044	5,00,562

4.2.5. Power consuming equipment and electrical appliances

Other than electrical energy from grid, energy generated using fossil fuels for the year are presented in the Table 3.

Energy conservation facilities observed in the Campus

4.2.4. Energy consumption and cost profile (NBC Checkpoint 12.3.4.)

The following chart shows the profile of energy consumed and the cost for one year by the auditee (Figures 1 & 2; Table 2).

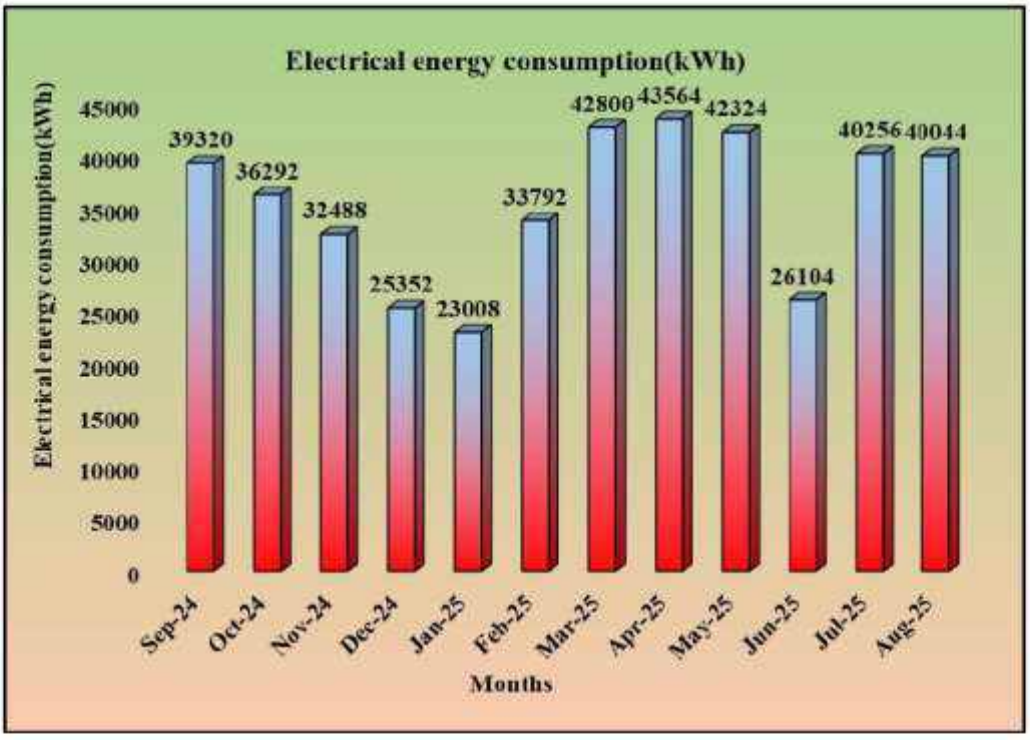


Figure 1. Electrical energy consumption profile

4.2.2. Lighting facilities (NBC Checkpoint 6.2.2 – 6.2.10, 7.1.1.2 and 7.5)

External shading facilities are made based on the sun path to reduce the energy consumption. Day light integration is implemented in the building by placing adequate number of windows. Electrical lighting facilities during day time increases the energy consumption, it is observed that sufficient day lighting facilities are available through windows which in turn reduce the energy consumption bill of the Organization. Artificial lighting facilities are regularly monitored and maintained. In some areas sensor lights are implemented to save energy. External and internal signage lifts are made up of recycled material with maximum light intensity. In the buildings windows head are higher to penetrate day light.

Natural Lighting facilities observed during day time

4.2.3. Building Service Optimization (NBC Checkpoint 11)

To save energy in the buildings there should be a proper plan for HVAC system. In the organization it is observed that adequate natural ventilation is implemented and practices. In some places exhaust fans are used for ventilation especially in the canteen and laboratories. To reduce the heat inside the building shading patterns are maintained by planting trees in and around the campus. Solar panels are implemented at the roof top to reduce the heat and to save energy. Air conditioning are provided at specific areas. Energy conservation plays an vital role in maintaining the sustainability. It is observed that the Organization has replaced all the tube light with CFL / LED lamps, has proper metering and submetering facilities, availability of BEE star rated appliances in Air cooler, lift, AC, generator, etc., Solar water heater and panels are implemented to conserve energy. Instruments and meters are properly maintained and calibrated at regular intervals or annual maintenance plan is observed as one of the energy saving opportunity. Adequate energy saving awareness programmes are conducted to the stakeholders. Emissions and leaks are monitored through operation and maintenance manual.

- Low emitting lights are fixed as per the LPD mentioned in National Building Code (NBC) Part -11(Approach to Sustainability) for safety and comfort.
- External and internal signage lifts are differentiated to conserve energy.
- 'Danger' and 'warning boards' are available near generator and UPS.
- Building Integrated Photovoltaic system like power storage system, backup power supplies, wiring and safety disconnects are available.
- Adequate HVAC and day lighting facilities are observed.
- Outside air is introduced through windows for ventilation in the conditioned spaces.
- Provision of sub meters to monitor energy consumption is not available need to be installed.
- Three star rated appliances (AC, Air cooler, Refrigerator, etc.,) are procured to conserve energy.
- Awareness posters like 'Turn off when not in use', 'Save Energy', etc., to be place to promote awareness for conserving energy in the campus.
- All the artificial lighting system are monitored and controlled through partial availability of sensors.
- No emissions and leaks are observed
- Operation and maintenance manual are observed in the on-site.
- Instruments and equipment are properly calibrated and maintained.
- Noise level observed in the different location resulted in normal range.
- Adequate training and awareness programmes are conducted to the stakeholders for energy conservation.
- To optimize the energy campus has implemented solar panel, operation and maintenance, etc.
- Standard Operating Procedure for electrical instruments are not available in the campus.

4.2.1. Energy Efficient Design and Process (NBC Checkpoint 3.5, 3.6 & 3.8.)

In the campus, it is observed that for lighting, cooling and ventilation renewable sources of energy like solar panel, water heater, etc., are used. Local resources are made available in post occupant stage as per the operation and maintenance plan. Standard Operating Procedures for UPS, AC are available to conserve energy and to avoid damages.

Solar panel observed in the campus

4. ENERGY AUDIT

4.1. Introduction

An energy audit is a survey in which the study of energy flows for the purpose of conservation is examined at an organization. It refers to a technique or system that seeks to reduce the amount of energy used in the Organization without impacting the output. The audit includes suggestions of alternative means and methods for achieving energy savings to a greater extend. Conventionally, electrical energy is generated by means of fossil fuels, hydraulic and wind energy. The availability of fossil fuels and their depletion rate, insist the need for alternate energy systems and conservation of conventional electricenergy. In general, the primary objective of an energy auditing and management of energy consumption is to offer goods or services at the lowest possible cost and with the least amount of environmental impact.

Energy Conservation Building Code (ECBC) is established in the year 2017, which provides minimum requirements for the energy-efficient design and construction of buildings across India. It also provides two additional sets of incremental requirements for buildings to achieve enhanced levels of energy efficiency that go beyond the minimum requirements. Bureau of Energy Efficiency (BEE) came into force in 2002 towards implementation of energy saving practices in an organization. Energy-efficiency labels are information affixed to manufactured products and usually communicate the product energy performance.

BEE Star Rating Scheme is based on actual performance of the building as well as equipment in terms of specific energy usage termed as 'Energy Performance Indicator' by means of star ratings labelled items used which will be useful for energy savings in a sustainable manner (Mishra and Patel, 2016). Energy audit programme provide aid in maintaining a focus on energy price variations, energy supply availability and efficiency, determining an appropriate energy mix, identifying energy-saving technology, retrofitting for energy-saving equipment and so on (Gnanamangai *et al.*, 2021). In general, an energy audit process dealt with the driving energy conservation concepts into reality by giving technically possible solutions within a specified time limit while considering the economic and other organizational issues. It also dealt with the uncover ways to cut operating expenses or reduce energy use per unit of production interms of savings. It serves as a "benchmark" for managing energy in the organization for planning more energy-efficient use across the board.

4.2. Energy audit observations

During onsite audit following departments were verified for physical facility availability.

- Adequate awareness programmes are organized and conducted to the stakeholders for the proper handling and maintenance of the appliances.
- Adequate external and vertical shading are provided to conserve energy.
- Natural ventilation through windows and shading is available adequately to reduce the energy consumption.
- It is observed that large foliage trees are planted inside the campus to reduce noise pollution.

Voltage intensity measured at the Campus

4.2.9. Operation and Maintenance (NBC Checkpoint 13)

During commissioning and handover, operation and maintenance plan is under process to implement.

EVENT REPORT

Program Title	**Sapling Plantation Drive**
Program theme	NSS CAMP
Duration of Event	3 hrs
Organized by	Department of ECE in Association with Dr.A.P.JAbdulkalam Dreams Trust and NSS Unit
Date and Time	30th July 2024, 10.00 a.m
Co-ordinator	Dr.Periyaswamy Prof-Mech and Ms. R. Nirmala, AP-ECE
NSS brochures Links	https://www.instagram.com/p/C9913KdP1kY/?igsh=MWtzN2FsbTRpcW5jdA==
	https://www.facebook.com/share/p/ayMy7TYgGyiu4qNy/?mibextid=qi2Omg
	https://www.linkedin.com/posts/spiherchennai_climateaction-spiher-nss-activity-7223303002139283456-S9xR?utm_source=share&utm_medium=member_android
	https://x.com/SpiherIndia/status/1817537477793779891?t=QAd691DV45Su3ZfYqE4V0g&s=19
Convenor	Dr. G. P. Ramesh Prof & Head, ECE, SPIHER
Venue	Kannappalayam Village Government School
Key Points Discussed	□ **Environmental Impact**: Improving air quality, supporting biodiversity, controlling erosion, and contributing to climate regulation. □ **Educational Value**: Enhancing students' understanding of ecology, botany, and environmental responsibility.

	□ **Community Engagement**: Strengthening community ties and promoting collective action for environmental conservation.
Objectives	Sapling plantation drive is well-organized and impactful, fostering a sense of environmental stewardship among students and improving the overall health of the ecosystem.
Outcome of the program / Benefits	Sapling plantation drive in a village school has the potential to create significant positive impacts across various areas, contributing to environmental sustainability, educational enrichment, and community well-being.
Total no. of students participated	**32**
No. of faculty members participated	**3**
No of External Members	**4 (**Collaborate with local environmental organizations- Dr.A.P.JAbdulkalam Dreams Trust **S.Udyakumar, A.Mathew** . Kannappalayam Ward member **Devi Nithyanandhan, Jamuna** - Head master Kannappalayam Government School are the External member involved in Sapling Plantation Drive.)

PUBLICITY MATERIAL

2

■ டாக்டர்.அப்துல் கலாம் ஐயா அவர்களின் நினைவு நாளை முன்னிட்டு செயின்ட் பீட்டர்ஸ் இன்ஸ்டிடியூட் ஆஃப் ஹையர் எஜுகேஷன் அண்ட் ரிசர்ச் NSS மாணவ மாணவிகள், DR.APJ ABDUL KALAM 2021 DREAM TRUST - கீரின் டிரிம்ஸ் பவுண்டேசன் இணைந்து, கண்ணப்பாளையம் கிராம அரசுப் பள்ளி வளாகத்தில் மரக்கன்றுகள் நடும் நிகழ்ச்சி சிறப்பாக நேற்று காலை நடைபெற்றது. இந்நிகழ்ச்சியில் டாக்டர். பி. பெரியசாமி (NSS COORDINATOR), திரு. ஆர். நிர்மலா (NSS), திரு. S.உதயகுமார் மற்றும் திரு. மேத்யூ (டாக்டர். ஏ.பி.ஜே. அப்துல் கலாம் 2021 டீரிம் டிரஸ்ட் ஆகியோர் கலந்து கொண்டனர் சிறப்பித்தார்கள். மேலும் தேவி நித்யானேந்தம் (கண்ணம்பாளையம்வார்டு உறுப்பினர்), மற்றும் ஜமுனா (அரசு பள்ளித் தலைமையாசிரியை கண்ணப்பாளையம் கிராமம் ஆகியோர் கலந்து கொண்டு சிறப்பித்தார்கள்.

Startup Name: THENNAL AIR FILTERS PRIVATE LIMITED

Mr. PONRAJ RAVI RAMKUMAR, Director

Transforming environmental sustainability through innovative carbon capture technologies.

TITLE: Removal of CO2 using Direct Air Carbon Capture Techniques

Incubation Agreement:

भारतीय गैर न्यायिक
एक सौ रुपये
Rs. 100
रु. 100
ONE HUNDRED RUPEES
भारत INDIA
INDIA NON JUDICIAL

தமிழ்நாடு तमिलनाडु TAMILNADU 14 JUN 2024
Thennal Air Filters Pvt Ltd
DL 509602
o.12144,B-1,98
S. KAVITHA
STAMP VENDOR
231, M.K.N ROAD, ALANDUR

INCUBATION AGREEMENT

BETWEEN

St. PETER'S ENGINEERING COLLEGE TECHNOLOGY BUSINESS INCUBATOR

AND

M/s THENNAL AIR FILTERS PRIVATE LIMITED

This Incubation Agreement is executed at Chennai on this 23.05.2025.

1. St. PETER'S ENGINEERING COLLEGE TECHNOLOGY BUSINESS INCUBATOR, a company registered under THE TAMILNADU SOCIETIES REGISTRATION ACT, 1975 (TAMIL NADU ACT 27 OF 1975) (Si.No: 53/2009) with its registered office at Tonakela Camp Road, Avadi, Chennai - 600054. (Hereinafter called as SPEC-TBI and represented by its Chief Executive Officer and authorized signatory as the FIRST PARTY)

AND

2. M/s THENNAL AIR FILTERS PRIVATE LIMITED is a company with its registered office, No 4/37, 16th Street, Thillai Ganga Nagar, Nanganallur, Chennai – 600061, Tamil Nadu, INDIA (Hereinafter called as "**Incubatee**") Mobile No: 9710071471, email; thennalairfilters@gmail.com and represented through its authorized signatory Mr. Ponraj Ravi Ramkumar resident of India as the SECOND PARTY.

(Hence the both parties called as "Parties)

For THENNAL AIR FILTERS PVT LTD

Director

Recitals:

WHEREAS **St.PETER'S ENGINEERING COLLEGE TECHNOLOGY BUSINESS INCUBATOR**, registered under 'SOCIETIES REGISTRATION ACT 1975' Si.No: 53/2009, is an umbrella for promotion of entrepreneurship and provides support for technology – based entrepreneurship with the main objective of promoting partnership with new technology entrepreneurs and start-up companies and provide incubation services to different start-ups in the Knowledge and Technology based area and aims at creating a complete and comprehensive ecosystem to promote and nurture innovative enterprises.

WHEREAS **M/s THENNAL AIR FILTERS PRIVATE LIMITED** is desirous of availing the incubation services and has applied for the incubation services through its incubation application dated 23.05.2025 and its business plan [as appended in Schedule 1]

NOW THIS Incubation AGREEMENT WITNESS AS UNDER

Purpose of this Agreement:

The purpose of this Agreement is to have clear understanding between the Incubator and the Incubatee during the course of the association between them.

The Chief Executive Officer, **St. PETER'S ENGINEERING COLLEGE TECHNOLOGY BUSINESS INCUBATOR** has approved the incubation application of **M/s THENNAL AIR FILTERS PRIVATE LIMITED** on the payment of Incubation Service charges and documentation charges for availing the incubation Services at ST.PETER'S ENGINEERING COLLEGE TECHNOLOGY BUSINESS INCUBATOR pursuant to the detailed terms and conditions of this agreement.

Scope of Services:

SPEC-TBI will provide following incubation services to the Incubatee:-

1.1 Laboratory Infrastructure

SPEC-TBI will facilitate access to the Laboratory infrastructure of the Institute, St.PETER'S INSTITUTE OF HIGHER EDUCATION AND RESEARCH (SPIHER) on request of the Incubatee for specific activity as per the regulations of the Institute and the Incubator.

1.2 Other Services

The Incubation services will also include: -

- Pool of mentors, experts in technology, legal, financial and related matters (only advisory), with or without consideration
- Trainings and workshops
- Organizing events to help incubatee in networking and showcasing their technologies
- Meetings with visitors of SPIHER (such as alumni, Students, Research Scholars, VCs, industry professionals etc.)
- Other benefits of the Ecosystem

For THENNAL AIR FILTERS PVT LTD

Director

Technology Business Incubator
Avadi, Chennai 600 054

2.Rules and Regulations of Incubation:

Except as otherwise set forth in this agreement, the Incubatee hereby agrees to comply and follow the Rules and Regulations, framed by SPEC-TBI for the Incubation Services, specified in the detail and appended hereto Schedule 1 forms part of this agreement and unless other provided in this agreement, is hereby accepted by the Incubatee in its entirety and the Incubatee and its directors/Promoters hereby indemnify SPEC-TBI and undertake to remain responsible for all dues payable or losses suffered only on account of any act, negligence, default directly attributable on the part of the Incubatee and its Directors and employees and determined judicially to be so.

3.Period of Incubation

The total period of the incubation (hereafter called incubation period) will be for 1 (one) year from the date of signing. The incubation period can be extended only by SPEC-TBI at its sole discretion.

4.Termination of the agreement

SPEC-TBI reserves the right to terminate this agreement even during the Incubation Period and/or to deny access to the Incubation services and the premises, after giving a Fifteen days' notice, in the following circumstances: -

a) Where the incubatee violates any of the terms and conditions of this Agreement and Rules and regulations as may be framed by SPEC-TBI, from time to time; or

b) Commits any fraud, theft or any other offense punishable under law; or

c) Unsatisfactory performance of the incubatee as per the determination of the SPEC-TBI Advisory Board

d) Where the incubatee violates any rules and regulations of SPEC-TBI.

e) Such other circumstances as may deem fit in the interest of the parties to this agreement.

Upon termination of the Agreement, the Incubatee shall be prohibited from accessing the Incubation premises (If any) as set out in Schedule 2 and the Incubation Premises, provided by SPEC-TBI to the incubatee, will be sealed. This form of exit from the incubator would be considered an abnormal exit and SPEC-TBI will be entitled to forfeit the security deposit (If any), provided by the Incubatee.

5.Consideration

5.1 Amendments: SPEC-TBI may change the above rates from time to time at its sole discretion and date of implementation of the amended charges shall be applicable with immediate effect.

5.2 Consequences of default: In the event, if the Incubatee fails to make the half yearly/annually payment and/or other charges and rates for infrastructure and facilities, as mentioned above, continuously for a period of three months, this agreement shall be deemed to be terminated and the incubatee shall vacate the Incubation Premises (If any) immediately. Under these circumstances, SPEC-TBI reserves the right to seal the Incubation Premises of the Incubatee.

Technology Business Incubator Avadi Chennai 600 054

For THENNAL AIR FILTERS PVT LTD

Director

Exemption:-

However, the Chief Executive Officer of SPEC-TBI may at his sole discretion, based on the sufficient causes submitted by the Incubatee for the delay in making the half yearly/annually payment continuously for three months; or any other relevant reasons, may relax this delay and may permit the Incubatee to avail the incubation services on clearance of all the dues, charges, rates etc. of SPEC-TBI either with or without interest of 20% p.a. on such pending dues, as a penalty for the late payment, subject to such terms and conditions as may be imposed by him.

6. No Guarantee of Results

SPEC-TBI does not undertake responsibility, but shall endeavor for

a) Ensuring success of the Incubatee, its products/ process/ services or marketability.

b) Ensuring quality of support and services provided by SPEC-TBI to the complete satisfaction of the Incubatee or their promoters/ founders

c) Ensuring quality of services of the consultants engaged by the Incubatee through SPEC-TBI network. Incubatee will have to apply its judgment before getting in to a relationship with them

d) The incubatee companies agree that SPEC-TBI or their employees shall not be held liable for any reason on account of the above.

7. Separate Agreement fo. Seed Money Support \ Innovation Grant etc.

i. The Incubatee undertakes that SPEC-TBI does not guarantee for the Seed Money Support or any Grant or Debt support to the Incubatee with reference to the different Funding Programs of SPEC-TBI and that the Incubatee shall submit its application as per the eligibility criteria of the said programs and the selection of the Incubatee for the funding shall be completely independent, subject to the different eligibility norms of the said Funding programs and the Incubatee, on selection, shall have to execute separate agreements for these programs. However SPEC-TBI will update the Incubatee for these funding programs on a time to time basis

ii. Success Fees.

SPEC-TBI shall charge success fees of 10% on the total funds raised through Government Schemes/Angel/Venture/Private Entity with the support of SPEC-TBI.

8. Intellectual Property Rights

Any Intellectual property rights [IPRs] developed by the Incubatee during the Incubation period will be the property of the Incubatee only. If such IPRs are created only with the direct financial investment involvement of the SPEC-TBI than any agreement between the Incubatee and SPEC-TBI specifying the sharing rights for the IPRs will hold good. The Incubatee will be required to execute a separate agreement for licensing or assignment of any IPRs, under the shared ownership of which lies with SPEC-TBI.

9. Liability towards third party

Cannot be held legally responsible if the incubatee is involved in any litigation with a third party over any legal issue whatsoever, during the incubation period.

10.Indemnification

For THENNAL AIR FILTERS PVT LTD

Director

Technology Business Incubator

SPEC-TBI shall not accept any responsibility to compensate anyone as a result of any accident or damage (electrical / explosion etc.) taking place at the incubation premises or at any place, directly resulting from Incubatees activities. The victims could be the incubatee or their employees, other persons working in St.Peter's Institute of Higher Education and Research Campus premises or any visitors to the SPEC-TBI. Where any such accident or damage is directly attributable to the act or omission of the incubatee and determined judicially to be so, then paying any compensation to those who have suffered arising out of such a contingency shall be the sole responsibility of the incubatee. Where any such accident or damage is directly attributable to the act or omission of the incubate and determined judicially to be so, it shall be the responsibility of the incubatee alone to compensate for any loss caused to the property of the SPEC-TBI. Furthermore, SPEC-TBI shall be responsible for any accident or directly attributable to the act or omission of SPEC-TBI or its employees or its representatives that the Incubatee or his assignees/representatives might meet within the course of their work within the premises of SPEC-TBI or any premises of SPIHER Campus.

11. Assignment

The Incubatee and St. PETER'S ENGINEERING COLLEGE TECHNOLOGY BUSINESS INCUBATOR shall have no right to assign their respective rights hereunder or transfer their respective rights and obligations, in whole or in part, to any third party.

12. Variation

Notwithstanding anything contained herein above or in the 'Rules and Regulations for the Incubation Agreement' annexed thereto, St. PETER'S ENGINEERING COLLEGE TECHNOLOGY BUSINESS INCUBATOR shall/may with the consent of the Incubatee and after proper negotiations with the Incubatee amend the terms of this Agreement (or of any of the documents referred to in this Agreement) at such circumstances as it may deem fit and the Incubatee shall be bound by the said amendments. The amendments shall be applicable only after the Incubatee is notified of the amendments.

13. Entire Agreement

This Agreement together with any agreement specifically executed pursuant to this Agreement constitutes the whole and only agreement between the Parties relating to the Incubation Services. This Agreement supersedes and extinguishes any prior drafts, agreements, undertakings, representations, warranties and arrangements of any nature whatsoever, whether or not in writing, relating thereto.

14. Applicability of Laws:

This Agreement shall be construed, governed by, interpreted and applied in accordance with the Laws of India.

15. Settlement of Disputes

Any/all disputes between the Incubatee shall be referred for arbitration to the person(s) so nominated jointly SPEC-TBI and the Incubatee under the Indian Arbitration & Conciliation Act whose decision shall be final and binding upon the parties. The place of arbitration shall be Caennai.

16. Lien: SPEC-TBI shall have any lien on the assets (If any) of the Incubatee at the incubation centre till such time that the Incubatee clears all the outstanding dues.

In witness whereof parties hereto have signed this Incubation Agreement on the date and year mentioned hereinbefore.

Business Incubator Technology

For THENNAL AIR FILTERS PVT LTD

Director

For & on behalf of St. PETER'S ENGINEERING COLLEGE TECHNOLOGY BUSINESS INCUBATOR **Dr.L.MAHESH KUMAR** **Signature** **Name : Dr.L.MAHESH KUMAR** **Designation :** Chief Executive Officer **Date : 23.05.2025** **Place of signing:** SPEC TBI **Witness;-** 1.	For & on behalf of M/s THENNAL AIR FILTERS PRIVATE LIMITED **Mr. PONRAJ RAVI RAMKUMAR** **Signature** **Name: PONRAJ RAVI RAMKUMAR** **Designation: Director** **Date: 23.05.2025** **Place of signing:** SPEC TBI **Witness;-** 1. .....

Schedule 1

Rules and Regulations for the Incubation

1. **Eligibility for Incubation**

   The Incubatee has to be a registered company.
   It is hereby informed that Section 8 Company is not eligible to be incubated at SPEC-TBI.

2. **Proven track record of the promoters and Directors of the Incubatee**

   a) The Directors and promoters of the company must not have any default, showing in the data of Credit Information Bureau (India) Limited [CIBIL]. Default showing in CIBIL because of some disputes or genuine reasons can be relaxed by the Chief Executive Officer, SPEC-TBI subject to any condition that may be imposed by him.

   b) All the directors, in the board of directors, on the effective date of this agreement must be qualified under Companies Act 2013 or any other relevant Act or Laws of India.

   c) The directors and promoters must not have committed any criminal offense or must not be under any criminal prosecution under any laws of INDIA.

3. **Inspection rights:** SPEC-TBI has the right to inspect and examine the premises (If any) allotted to the Incubatee at any point of time during the incubation period/stay at Incubation Premises. On the completion of the Incubation or when the Incubatee leaves SPEC-TBI due to any reason, all the furniture, space and any other facilities provided shall be surrendered in good condition. All costs incurred for such restoration to good condition shall be borne by the Incubatee and in case, SPEC-TBI has to incur any further expenditure to get the equipment or the room back into good condition then the same shall be recovered from the Incubatee and/or its directors or promoters. All dues should be cleared by the Incubatee before it leaves the incubation otherwise, all outstanding dues shall be recovered from the Incubatee or its directors and/or promoters.

4. **Reporting requirements: -**

   The Incubatee shall be required to deliver the items mentioned below as part of the Incubation in accordance with the following provisions: -

   1.1 Documentation.

   The incubatee will be required to submit all the required documents in regards with the company such as a) certificate of incorporation, b) Memorandum of Association (MOA) c) Articles of Association (AOA) d) Shareholding pattern e) ID and Address proof of the directors and the promoters. The incubatee also agrees to intimate SPEC-TBI regarding any alteration in the MOA, AOA and the shareholding pattern as when the alteration is initiated.

   1.2 Monthly report

   The incubatee is required to submit its monthly report in terms of its financials; revenue generates, gross sales, potential customers/clients approached, foreign collaborations, contracts\MoU entered into, details of the employees, employees hired and fired, assets purchased or disposed of, status of the implementation of the business plan and its strategies, progress on the incubation projects or any other relevant information prescribed by SPEC-TBI.

For THENNAL AIR FILTERS PVT LTD

Director

1.3 Mid Term Report

The incubatee is required to submit its unaudited/audited financial statement every six months within 7 days of the subsequent month.

1.4 Annual report

The incubatee is required to submit its financial statement and cash flow statement duly audited by the statutory auditors of the company with their Audit report and the report of the Board of Directors, with SPEC-TBI by the year. Incubatee is also required to ensure timely filings of the annual returns and the balance sheet with Income Tax Authorities and The Registrar of Companies within the prescribed time-limit as specified by Income Tax Act and Companies Act.

1.5 Participation in the Business review meetings\Diagnostic penal

The Incubatee hereby agrees to participate in the business review meetings, diagnostic penal as and when held by SPEC-TBI will intimate the Incubatee for these review meetings through a 6 (six) days advance notice, comprising the details and the presentations required to be submitted by the Incubatee. The venue, timings and the mode of attending the meeting (In Person or through Video Conferencing etc.) will be decided by SPEC-TBI.

1.6 Event based reporting:-

The Incubatee hereby agrees to keep SPEC-TBI informed for following events

- ✔Change of name of the company
- ✔Conversion from Private Limited to Public Limited company
- ✔Listing in any recognised stock exchange of India
- ✔Any major change in the business plan
- ✔Changes in the shareholding pattern
- ✔Changes in the board of directors

5. **INVESTMENT BY THIRD PARTIES:**

   The Incubatee shall keep SPEC-TBI informed in writing every time it proposes to bring in further investment or funds in, either from the existing shareholders or from third party investors at any time after the Effective Date of this agreement and will have to share the Term Sheet\Shareholder's Agreement\ Investment Agreement with SPEC-TBI and will have to obtain its approval before entering into the said agreement.

6. SPEC-TBI will not take any responsibility to provide any valuation certificate to the Incubatee and can only connect the Incubatee with different merchant bankers, certified valuers etc. in this regard, the consideration and procedure of valuation will be decided by the Incubatee itself only and SPEC-TBI will have no role to intervene in settling or negotiating the consideration payable by the Incubatee to these merchant bankers, certified valuers etc.

7. The Incubatee is required to abide by the laws of INDIA and will obtain all the trade licenses, permits and sanctions independently, wherever required, as prescribed under

For THENNAL AIR FILTERS PVT LTD

Director

the Indian Laws in order to run the business. SPEC-TBI is not responsible to get all these licenses and permits sanctioned from the Government.

8. **Exit**

The Incubatee will be required to leave the incubator under the following circumstances:

- ✔ After the completion of the Incubation including extended incubation period, if any.
- ✔ Underperformance or in-ability to perform business as evaluated and decided by SPEC-TBI on case to case basis
- ✔ Irresolvable promoters' disputes in opinion of SPEC-TBI on case to case basis
- ✔ Violation of any Statue, rules and regulations of SPEC-TBI in the opinion of SPEC-TBI on a case to case basis.
- ✔ When the company enters in an acquisition, merger or amalgamation deal or reorganization deal resulting in a substantial change in the profile of the company, its promoters, directors, shareholders, products or business plan.
- ✔ Incubatee plans for a public issue in the opinion of SPEC-TBI on case to case basis
- ✔ Change in promoters'/ founders' team in the opinion of SPEC-TBI on a case to case basis.
- ✔ Any change of more than 50% of equity ownership unless approved by SPEC-TBI, in the opinion of SPEC-TBI on case to case basis* (optional)
- ✔ Any other reason for which SPEC-TBI may find it necessary for an incubatee resident company to leave.
- ✔ In case an incubatee wants to leave the incubator for any reason with one month's notice.

Notwithstanding anything written anywhere, SPEC-TBI s decision in connection with the exit of an incubatee company shall be final and shall not be disputed by the incubatee.

9. The Incubatee is not authorized to use the logo of either SPEC-TBI unless a written permission is granted by SPEC-TBI or SPEC-TBI on this behalf
10. The Incubatee is required to abide by the rules and regulations of SPEC-TBI.
11. The Incubatee shall undertake Research & Development, Design/Testing, prototype development from Incubation premises but shall not carry out warehousing, storage, marketing sales or other commercial routine activity including fundraising in the SPEC-TBI campus.
12. The Incubatee should observe that noise levels are kept at minimum and no abnormal noise by any machine or by their employees or visitors should be made. Any complaint of high noise level will result in appropriate action by SPEC-TBI.

For THENNAL AIR FILTERS PVT LTD

Director

13. The Incubatee is required to observe health and safety standards. No hazardous material can be brought inside the SPEC-TBI campus\Incubation Premises without the prior approval of SPEC-TBI.

14. No Incubatee can display notices or signage except in the space or Boards provided for such signage by SPEC-TBI.

15. It is the responsibility of the Incubatee and their employees to use the common facilities e.g. comm on area, fax & other machines etc. with due diligence and care.

16. Incubatees required to keep SPEC-TBI informed about any visitor from abroad, foreign collaboration and/or foreign partner or director, and abide by the rules/procedures in vogue in SPEC-TBI.

Schedule 2

Facilities to the incubatees subject to the Rules and Regulations and as mentioned in clause 3 of the Agreement.

1. Mentoring and Nurturing Services by St Peters Institute of Higher Education and Research (Domain specific Experts) – on mutually agreed basis
2. Students Interns from St Peters Institute of Higher Education and Research - on mutually agreed basis
3. Marketing guidance
4. Assistance to apply for funding.
5. Participation in Gue st Lectures/ Workshops organized by SPEC-TBI/ SPIHER (only in Free sessions)

For THENNAL AIR FILTERS PVT LTD.

Director

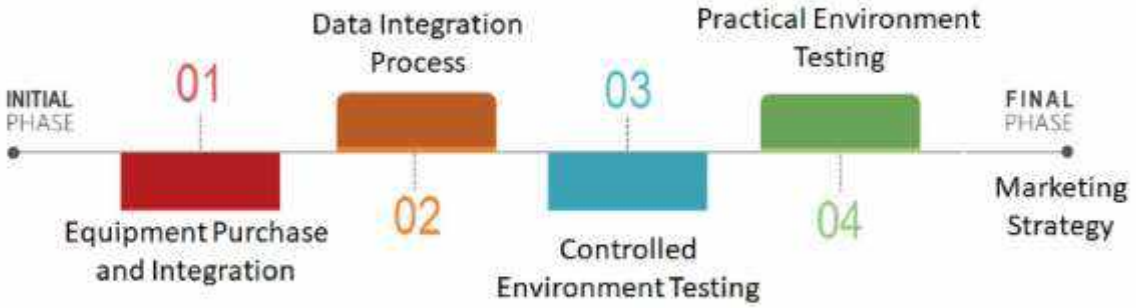
Agreement Signed on 14-06-2024

Note:

SPIHER as formerly as St.Peter's Engineering College Technology Business Incubator.

Report:

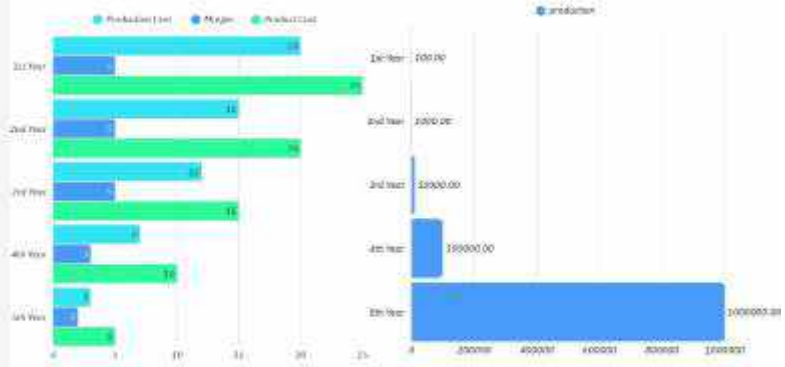
Proposed Plan



Financials

Revenue Model

Plan A Units Sale	Plan B Pouch Sale	Plan C CO2 Sale
Rs.5k to 20k B2C & B2B	Rs.500 to 5k B2C (Recurring)	Standard Market Price B2B (Recurring)



in Thousands INR

EXPENSE

Unit Production

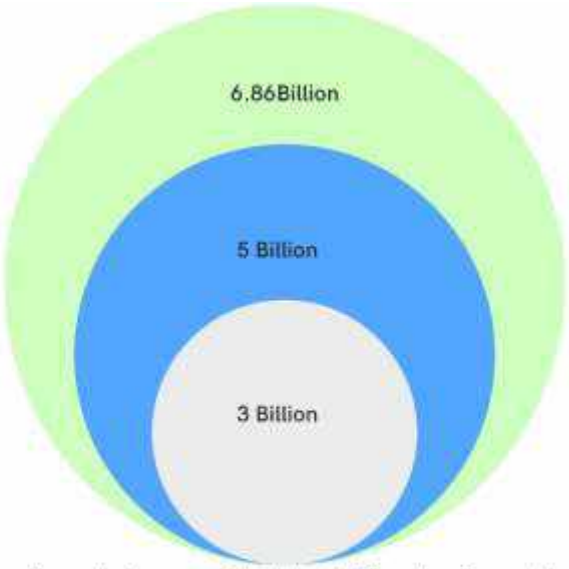
FINANCIALS

Size of the Market

Total Available Market (TAM):
$6.86 Billion

Serviceable Available Market (SAM):
$5 Billion

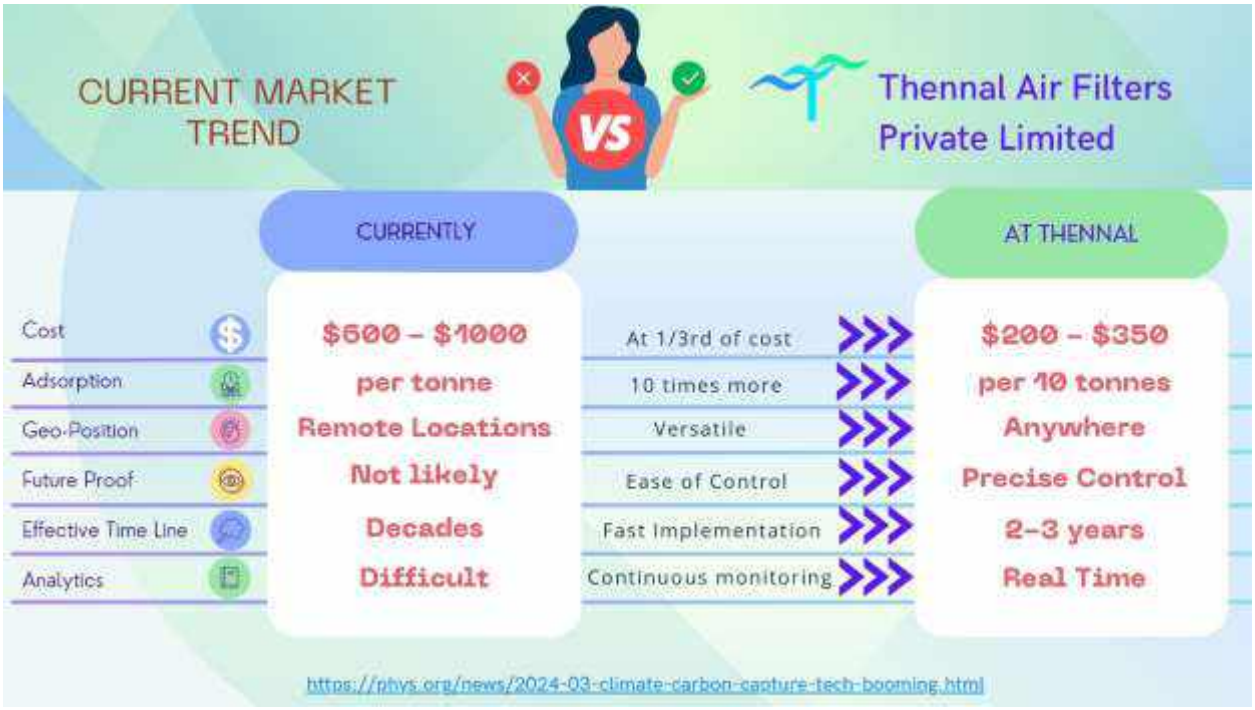
Serviceable Obtainable Market (SOM):
$3 Billion



https://www.maximizemarketresearch.com/market-report/global-direct-air-carbon-capture-technology-market/80672/
https://www.statista.com/statistics/1414965/global-direct-air-capture-market-size/

Thennal Air Filters
Private Limited

Competitive Advantage 1 Patented Nanotechnology	**Competitive Advantage 2** Compact
Competitive Advantage 3 Efficient	**Competitive Advantage 4** Scalability



MARKET

Thennal Air Filters
Private Limited

OTHER FILTERS ACTIVATED CARBONS	THENNAL FILTERS UNIQUE CARBON NANOMATERIAL STRUCTURE
Sophisticated Structures	NANO ENGINEERED Structures
Large Volume	95% Smaller Volume
High Specific Surface Area	High Specific Surface Area
Inefficient CO2 capture	High Density Active Sites
Low Industrial Scalability	High Industrial Scalability
Random Pore Size	Narrow pore size

COMPETITOR LANDSCAPE

	Company	Origin	Product	Technology	Application	Advantages	Disadvantages	Funds Raised
7	Carbon Collect	Ireland	Yes	Mechanical Tree	Outdoor	Passive DAC	Heating, indoor inefficient	$12M
8	Carbon Capture	UK	No	Amine MOF sorbents	Outdoor	Plug & Play sorbents	Production Scalability of MOF	$35M
9	Climeworks	Switzerland	Yes	Chemical filters	Outdoor	Long storage, carbfix	Heating, chemicals	$824M
10	Skytree	USA	Yes	Sorbents	Outdoor	Sorbent use	Heating of Sorbent	$6M
11	Carbon Engineering	Canada	Yes	Chemical Reaction	Outdoor	Photosynthetic model	Chemicals and Natural gas	$110M
12	Thenral	India	No	Nano-engineered Carbon Xerogel Sorbents	Modular, Indoor	Electrifiable Sorbents, Indoor Efficient, scalable and compact	-	-

COMPETITOR LANDSCAPE

	Company	Origin	Product	Technology	Application	Advantages	Disadvantages	Funds Raised
1	Heirloom Carbon	USA	No	Limestone Hydroxides	Outdoor	Cheap raw materials	Crushing, heating	$55M
2	Mission Zero	UK	No	Ion selective electrochemical separation	Outdoor	Efficient	Scalability	$11M
3	Sustaera	USA	No	Nano structured sorbents	Modular, Outdoor	Solar and wind powered	Steam Heating, thin layered	$10M
4	Noya	USA	No	Activated Carbon	Outdoor	Cheap raw materials	Heating and non-mesoporous	$11M
5	Verdox	USA	No	Electro-swing	Outdoor, Indoor	Efficient	Carbon Nanotubes and thin electrode	$82M
6	Carbon Infinity	UK	No	Nano structured Sorbents	Indoor, Outdoor	Efficient, DACtories	Scalability, thin electrodes	$59k

DACC GAINT CLIMEWORKS

NOT A INDOOR FRIENDLY CONCEPT

Thennal Air Filters Private Limited

Direct Competitors	Indirect Competitors
Carbon Infinity	Climeworks
Verdox	Heirloom Carbon
Sustaera	Carbon Engineering
Noya	Skytree
Carbon Capture	
Carbon Collect	

COMPETITIONS

Thennal Air Filters
Private Limited

PROTOTYPE DEVELOPEMENT

We are constantly iterating our 'CarbaXe' designs to improve the Power Efficiency, Re-usability, Data quality, User Friendly and Environment Friendly Carbon Negative Product

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CELEBRATING 33 YEARS Teaching Excellence

A+ NAAC

Thennal Air Filters
Private Limited

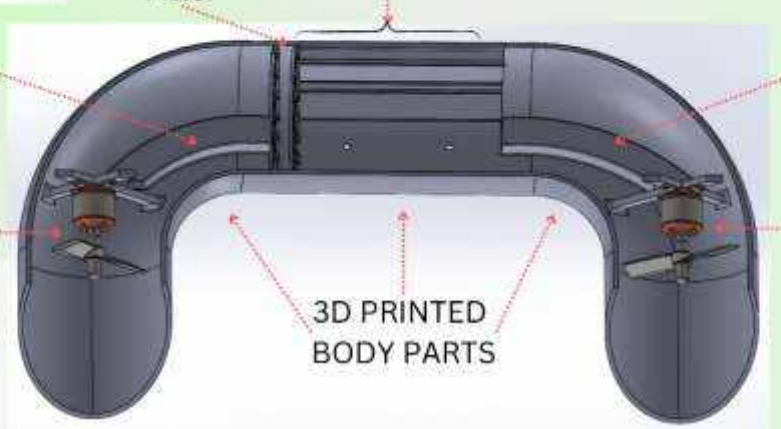
PROTOTYPE DEVELOPMENT

ELECTRONICS
Batteries
Microcontrollers
Power Controllers
Display
Connectors

Nanomaterial Filter

SENSOR 1

SENSOR 2



INLET FAN

OUTLET FAN

3D PRINTED BODY PARTS

FORECAST ON CO2 AIR POLLUTION

New record daily global average temperature reached in July 2024

The Earth has just experienced its warmest day in recent history, according to C3S data. This article...

CopernicusECMWF

ipcc

Climate Change 2022: Impacts, Adaptation and Vulnerability

Intergovernmental Panel on Climate Change Working Group II contribution to the Sixth...

IPCC

iea

Air quality and climate policy integration in India – Analysis

Air quality and climate policy integration in India - Analysis and key findings. A report by the...

IEA

Climate change indicators reached record levels in 2023

The state of the climate in 2023 gave ominous new significance to the phrase "off the charts."

World Meteorological Organization · Mar 18, 2024

https://www.un.org/en/climate-action/un-issues-red-alert
https://www.iea.org/reports/air-quality-and-climate-policy-integration-in-india
https://wmo.int/news/media-centre/climate-change-indicators-reached-record-levels

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A+ NAAC

MAJOR CAUSE OF ROAD CAR ACCIDENTS

Lack of Concentration is reflected as Induced Sleepiness in Drivers, due to high CO2 concentration (>2000 ppm) vis-a-vis lack of Oxygen to Brain

https://www.emro.who.int/emhj-volume-28-2022/volume-28-issue-9/risk-assessment-of-road-traffic-accidents-related-to-sleepiness-during-driving-a-systematic-review.html

https://www.thehindu.com/news/national/kerala/sleep-deprived-drivers-responsible-for-40-of-road-accidents-say-transport-officials/article61629032.ece

https://morth.nic.in/road-accident-in-india

https://www.nhtsa.gov/risky-driving/drowsy-driving

World Health Organization
Eastern Mediterranean Region

Health topics | Data and statistics | Media centre | Information resources | Countries | Programmes | About Us

Eastern Mediterranean Health Journal | All issues | Volume 28 2022 | Volume 28 issue 9 | Risk assessment of road traffic accidents relate systematic review

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Risk assessment of road traffic accidents related to sleepiness during driving: a systematic review

Review

PDF version

Shahzad Saleem[1]

[1]Department of Community Medicine, King Edward Medical University, Lahore, Punjab, Pakistan (Correspondence to: S. Saleem: drshirdel786@gmail.com).

Abstract

Background Injuries due to accidental crash are the 9th leading cause of death worldwide. Sleepiness results in disrupted neurological function and is a major risk factor for road traffic accidents.

Aims This systematic review assessed the relationship between sleepiness during driving and road traffic accidents.

Methods A systematic review was conducted using online databases such as Wiley Online Library, JSTOR, Medline, and PubMed. Full-text, English language articles published between May 2000 and November 2020 were retrieved. Road traffic accident was set as the outcome of interest and sleepiness during driving as the exposure. The review included studies containing adjusted risk estimates (95% confidence interval). Ten cross-sectional studies (N = 55,545), 5 case-control studies (N = 3621), and 2 cohort studies (N = 16,870) were included.

Results Over 50% of the participants in the different studies experienced sleep deprivation ranging from 3.5% to 67.3%. Abe et al. reported the highest (58%) frequency of sleepiness during driving in their cross-sectional study in Japan, and Nabi et al. reported the lowest (1.1%) in their cohort study in France.

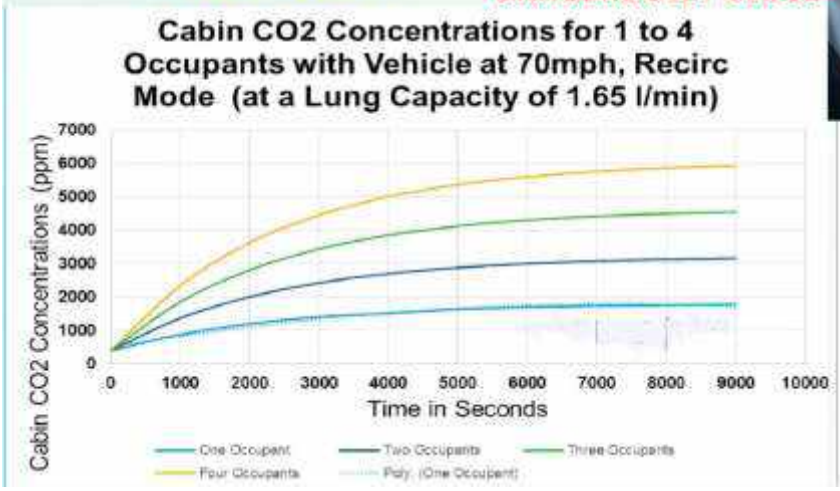
Conclusion: Sleepiness and sleep deprivation were related to road traffic accidents; and

WHERE IS THE NEED

1. IN CARS AND TRUCKS!!!
2. IN AEROPLANES!!!
3. IN AC ROOMS!!!

CO2

DANGEROUSLY CLOSE



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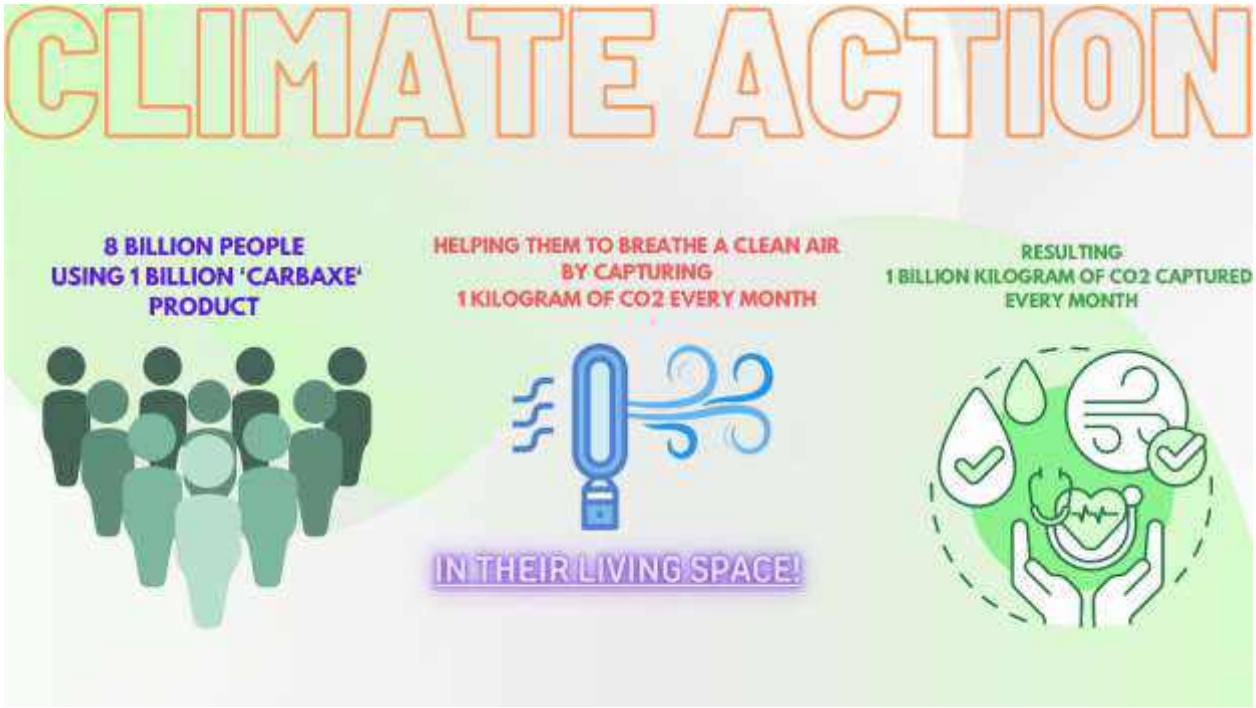
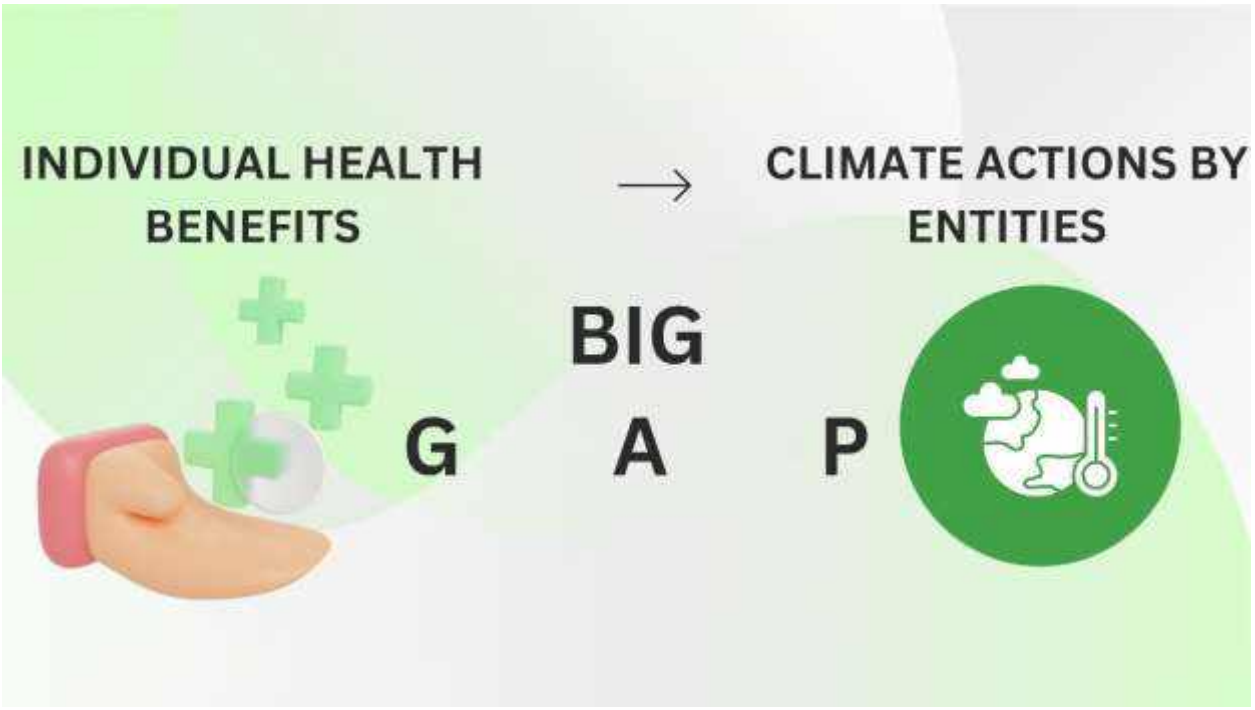
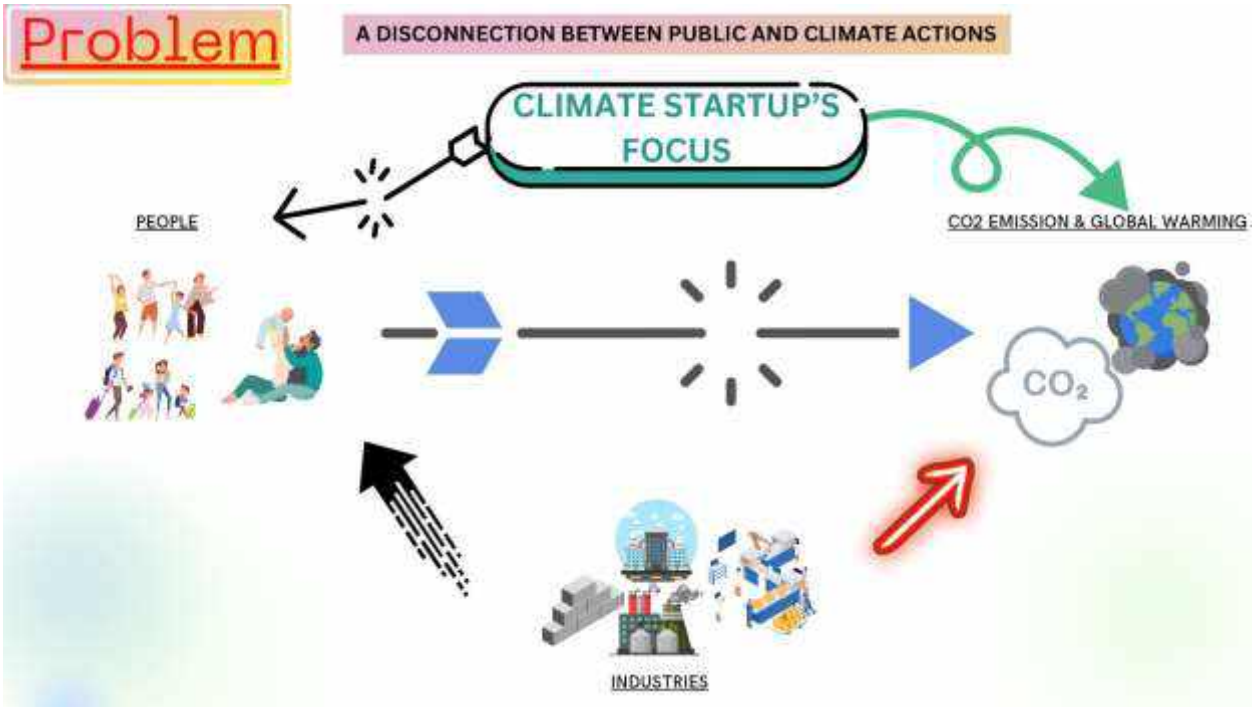



INDIVIDUAL HEALTH BENEFITS
CLIMATE ACTIONS BY ENTITIES
BIG
G A P


Problem
A DISCONNECTION BETWEEN PUBLIC AND CLIMATE ACTIONS
CLIMATE STARTUP'S FOCUS
PEOPLE
CO2 EMISSION & GLOBAL WARMING
CO_2
INDUSTRIES

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PROBLEM STATEMENT

Thennal Air Filters Private Limited
4/37, 16th Street, Thillai Ganga Nagar, Chennai - 600061
www.thennal.com
info@thennal.com
9710071471

TITLE: Removal of CO2 using Direct Air Carbon Capture Techniques

THENNAL

THENNAL AIR FILTERS PRIVATE LIMITED

A GREEN Tech – Clean Tech - Climate TECH START UP

Incorporation Completed

Ramkumar P R
Founder & CEO
THENNAL AIR FILTERS PRIVATE LIMITED

Date of Incorporation: 12.10.2024

Impact

Climate

Reduced CO2
In few decades of practice, CO2 level can be reduced to pre-industrial level of 280 ppm

Negative Carbon Foot Print
Individuals can contribute to climate action by having negative carbon foot-print in their daily lives

Sustainable Balanced Future
For centuries to come, humans can maintain critical balance with environmental eco-system, by themselves neutralizing their carbon foot-print

Social

Survival
140 million people in cities can survive extreme climate and air pollution condition as in Delhi like cities.

Safety
Number of Accidents on road could be reduced by 50%

Better Future
Number of patients in hospital with respiratory illness could be reduce d by 80%, especially Children.

Team

Ramkumar.P.R

Founder & Chief Executive Officer
Nanotechnology Specialist
12+ years in Nano Science and Technology Research

Namagal.S

Research & Development
Specialist in Nano Materials
7+ years in Materials Science Reearch
Full-time Member

Sujatha.S

Chief Operational Officer
3+ years experience in programming
Team Leader at Newgen
Full-Time Memeber

TEAM

Impact

Climate

Reduced CO2
In few decades of practice, CO2 level can be reduced to pre-industrial level of 280 ppm

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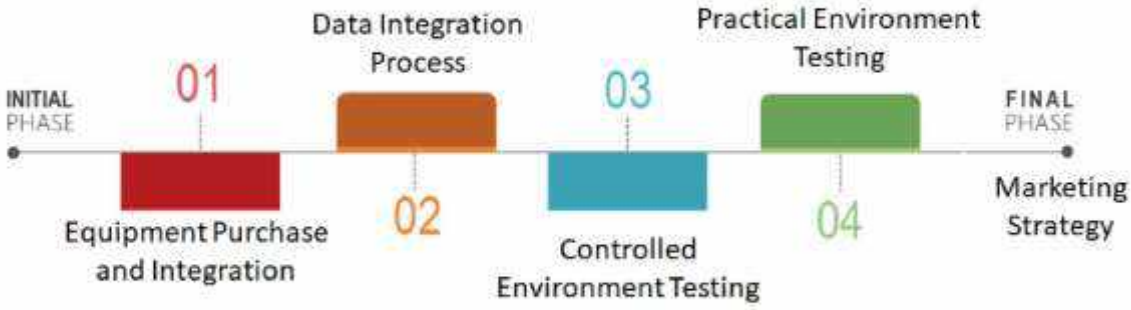
Proposed Plan



Financials

Revenue Model

Plan A Units Sale	Plan B Pouch Sale	Plan C CO2 Sale
Rs.5k to 20k B2C & B2B	Rs.500 to 5k B2C (Recurring)	Standard Market Price B2B (Recurring)

in Thousands INR

EXPENSE

Unit Production

FINANCIALS

Size of the Market

Total Available Market (TAM):
$6.86 Billion

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Serviceable Obtainable Market (SOM):
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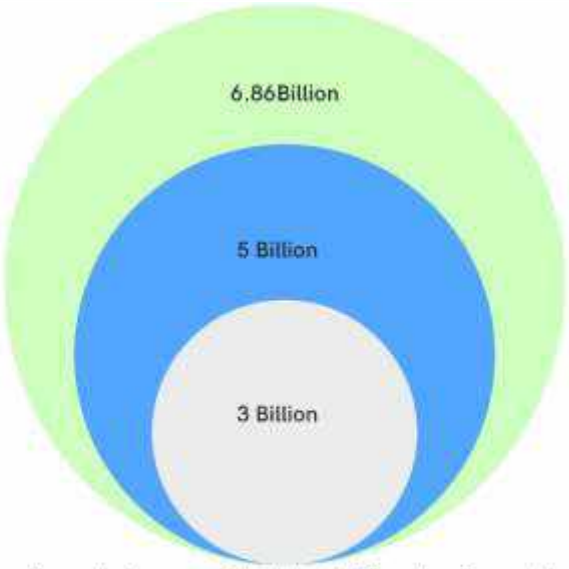
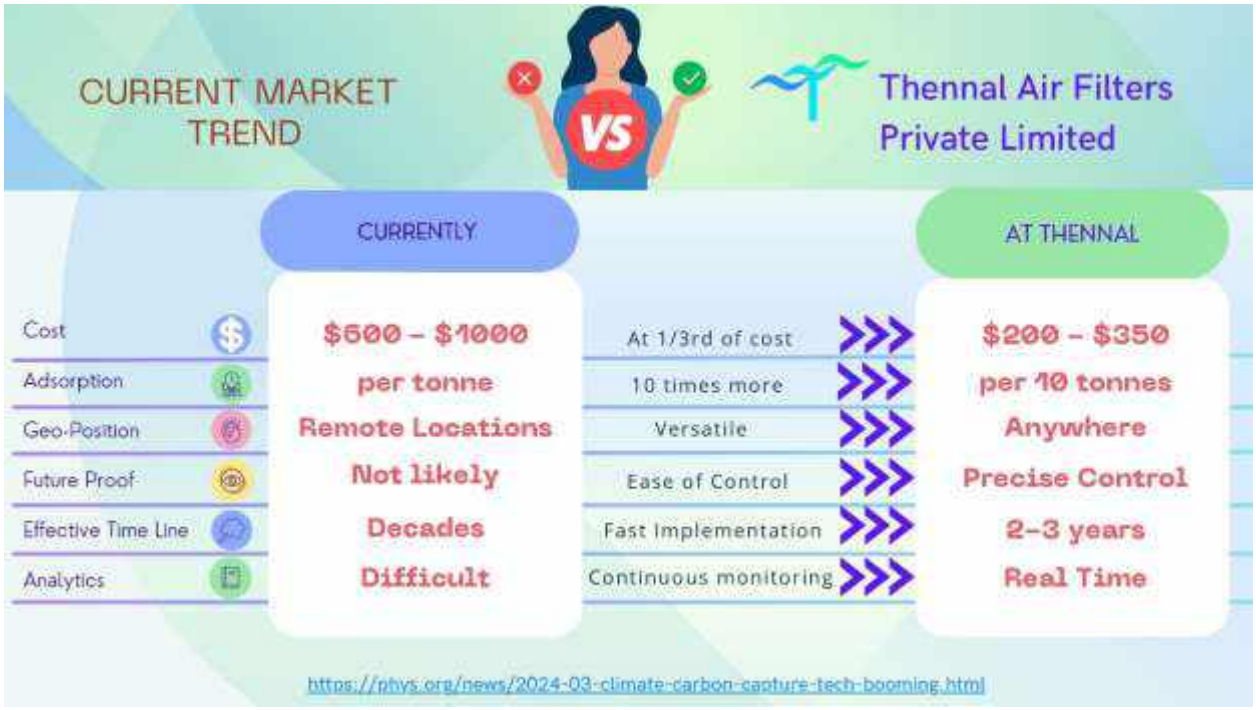


https://www.maximizemarketresearch.com/market-report/global-direct-air-carbon-capture-technology-market/80672/
https://www.statista.com/statistics/1414965/global-direct-air-capture-market-size/

Thennal Air Filters
Private Limited

Competitive Advantage 1 Patented Nanotechnology	Competitive Advantage 2 Compact
Competitive Advantage 3 Efficient	Competitive Advantage 4 Scalability


CURRENT MARKET TREND
VS
Thennal Air Filters Private Limited
CURRENTLY
AT THENNAL
Cost
$500 – $1000
At 1/3rd of cost
$200 – $350
Adsorption
per tonne
10 times more
per 10 tonnes
Geo-Position
Remote Locations
Versatile
Anywhere
Future Proof
Not likely
Ease of Control
Precise Control
Effective Time Line
Decades
Fast Implementation
2–3 years
Analytics
Difficult
Continuous monitoring
Real Time
https://phys.org/news/2024-03-climate-carbon-capture-tech-booming.html

MARKET

Thennal Air Filters
Private Limited

OTHER FILTERS ACTIVATED CARBONS	THENNAL FILTERS UNIQUE CARBON NANOMATERIAL STRUCTURE
Sophisticated Structures	NANO ENGINEERED Structures
Large Volume	95% Smaller Volume
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COMPETITOR LANDSCAPE

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5	Verdox	USA	No	Electro-swing	Outdoor, Indoor	Efficient	Carbon Nanotubes and thin electrode	$82M
6	Carbon Infinity	UK	No	Nano structured Sorbents	Indoor, Outdoor	Efficient, DACtories	Scalability, thin electrodes	$59k

DACC GAINT CLIMEWORKS

NOT A INDOOR FRIENDLY CONCEPT


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Department of Computer Science and Engineering

BEST PRACTICE REPORT

Air Quality Monitoring and Data Analysis

1. Objectives

- To design and develop an indigenous air quality monitoring system integrated with IoT and deep learning.
- To provide accurate, real-time air pollution data for diverse environments—industrial, residential, and solid waste disposal sites.
- To assist the Ministry of Environment, Forest and Climate Change (MoEF) in natural resource conservation through advanced data-driven environmental monitoring.
- To promote interdisciplinary research combining AI, sensor technology, and environmental science.

2. Context

The CSE Department recognized the critical need for low-cost, indigenous technology to monitor air pollution across Indian cities. Conventional monitoring systems were limited by cost, spatial coverage, and lack of predictive accuracy.

To address this, the department initiated a research project supported by the MoEF, focusing on smart sensors, drone-based monitoring, and AI-driven forecasting models. The project reflects the department's commitment to technological innovation for environmental sustainability.

3. The Practice

- The project implemented an integrated framework combining Nano-sensor design for pollutant detection (e.g., CO_2, SO_2, NO_2, VOCs, PM2.5).
- IoT and UAV integration for remote data collection across varying altitudes.
- Deep learning models (Bi-GRU and FSA algorithms) to predict pollution trends with high accuracy.
- Data visualization tools for real-time environmental monitoring.

Faculty and students collaboratively developed prototypes, conducted field testing in Manali, Chennai, and validated the model's performance against real-time data. The project achieved a high level of precision with RMSE values between 1.35–1.63 across test zones. The developed model is also used to monitor the emission level within the SPIHER campus and the reading obtained are maintained within tolerable limits striving to achieve Net Zero.

4. Evidence of Success

- Enhanced Monitoring Accuracy: The indigenous system provided more reliable readings than imported alternatives, supporting data-driven interventions for pollution control.
- Early Detection of Pollution Hotspots: Real-time analysis enabled identification of environmental threats and rapid response strategies.
- Optimized Resource Allocation: The system's analytics guided policymakers to prioritize funding for high-risk zones.
- Policy and Public Engagement: Visualized air quality data increased public awareness through digital platforms, promoting community-level action.
- Capacity Building: Collaborative research among academia, government, and industry enhanced skill development in IoT, AI, and environmental engineering.

Additionally, the project resulted in high-impact publications in Q1 journals such as Sustainability and Sustainable Cities and Society, demonstrating strong academic dissemination.

5. Problems Encountered and Solutions

Challenges	Impact	Solution
Complex sensor calibration	Inconsistent pollutant data	Iterative testing and AI-based correction models
Drone operational constraints	Limited spatial coverage	Improved UAV design and flight path optimization
Large dataset handling	Computational overhead	Adoption of cloud-based data storage and parallel computing
Limited awareness of indigenous technology	Low early adoption	Awareness programs and training workshops for stakeholders

6. Impact and Future Plans

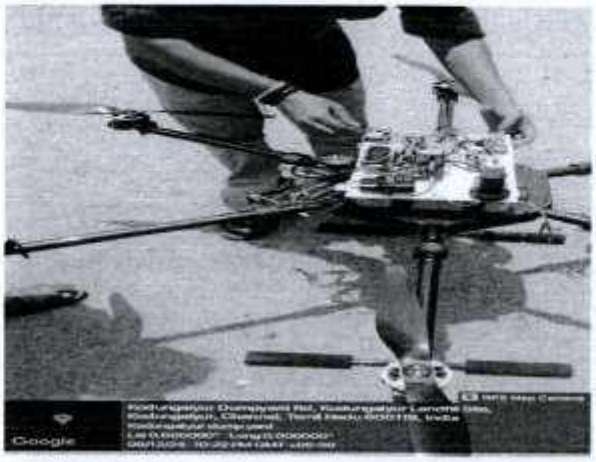
The project's success has established a research ecosystem in the CSE Department focusing on AI for environmental intelligence.
The outcomes contribute directly to national missions on sustainability and smart cities and also used to monitor the emission level in the campus regularly
Future work includes:

- Expanding pollutant categories for broader environmental modeling.
- Integrating the system into urban planning dashboards for city administrations.
- Collaborating with other HEIs to replicate the technology.

7. Conclusion

This initiative exemplifies the CSE Department's best practice in applying advanced computing to solve real-world environmental challenges. It bridges technology and sustainability, producing tangible benefits for research, policy, and society. The project aligns perfectly with the MoEF's mission to protect the environment through innovation, capacity building, and data-driven governance.

GLIMPSES OF THE AIR QUALITY MONITORING EQUIPMENT USED WITHIN SPIHER CAMPUS TO MONITOR AIR QUALITY



Best Practice Report on Smart Solar Initiative for Green Energy Campus

Best Practices Report: Solar Panel Erection

1. Objectives of the Practice

• To harness renewable energy resources and promote sustainable power generation within the campus.

• To reduce dependence on conventional grid electricity and lower the institution's carbon footprint.

• To provide students with practical exposure to solar photovoltaic (PV) systems and installation techniques.

• To encourage research, innovation, and awareness in renewable energy technologies.

• To support institutional alignment with SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action).

2. Context

The growing global energy demand and environmental degradation due to fossil fuel use have emphasized the importance of renewable energy sources. The campus experiences significant power consumption due to laboratories, classrooms, and administrative facilities. To address this, the Department of Electrical and Electronics Engineering initiated a Solar Panel Erection Practice aimed at generating a portion of the campus energy demand through clean, renewable sources. The major challenge was to identify feasible rooftop areas, manage funding, and ensure proper integration of the solar PV system with the existing electrical network.

3. The Practice

• Phase 1 – Feasibility Study: Conducted an energy demand analysis and rooftop suitability assessment for solar panel installation. Load profile studies and shadow analysis were performed to determine the optimal panel orientation.

• Phase 2 – Design and Planning: Designed a grid-connected solar PV system with appropriate capacity. Components included PV modules, inverters, mounting structures, and protection devices.

• Phase 3 – Installation and Erection: Panels were installed on suitable building rooftops following safety and electrical standards. Faculty and students from the EEE department actively participated in the wiring, inverter setup, and commissioning stages.

• Phase 4 – Monitoring and Maintenance: A real-time monitoring system was established to track energy generation, efficiency, and load sharing. Regular cleaning and performance checks were scheduled for sustained output.

• Phase 5 – Awareness and Training: Students were trained on system design, inverter configuration, and maintenance procedures through workshops and live demonstrations.

4. Evidence of Success

• Commissioning of a 10 kW rooftop solar PV system on campus.

• Reduction of electricity bills by 10–12% within six months of operation.

• Avoidance of approximately 5 tons of CO_2 emissions annually.

• Students developed academic projects and internships focused on solar technologies.
• The initiative was appreciated in IQAC reviews and presented as a best practice in institutional audits.

5. Problems Encountered and Solutions

Challenges	Solutions Implemented
Limited initial funding for solar panel procurement	Received partial funding under institutional green initiative budget; phased installation implemented.
Structural constraints on some building rooftops	Conducted load-bearing analysis and selected suitable rooftops with structural reinforcement.
Maintenance issues due to dust accumulation	Scheduled regular cleaning and panel inspection using student volunteer groups.
Lack of expertise in inverter configuration	Faculty underwent a short-term training program in solar PV system integration.

6. Impact and Future Plans
• Strengthened institutional commitment toward green energy and sustainable operations.
• Enhanced technical competency of students in renewable energy systems.
• Reduced dependence on conventional power supply, resulting in cost and energy savings.
• Plans to expand the capacity to 25 kW to cover a larger portion of the campus energy needs.
• Proposal to integrate solar power with IoT-based energy monitoring and battery storage systems for improved reliability.
• Encouragement for students to pursue mini-projects and research papers in solar energy applications.

7. Conclusion

The Solar Panel Erection Practice stands as a successful initiative demonstrating the institution's dedication to sustainability, innovation, and experiential learning. It not only supports environmental conservation but also provides students with valuable technical skills in renewable energy engineering. With continued expansion and integration, this practice will contribute to a carbon-neutral and self-sustained campus in the coming years.

Month/ year	SPIHER	SPCET	School	Arts college
01/2024	330604.00	79405.00	102710.00	44708.00
02/2024	422515.00	105034.00	155566.00	44525.00
03/2024	468475.00	119376.00	157738.00	51522.00
04/2024	467102.00	127523.00	167873.00	50496.00
05/2024	482638.00	131905.00	164633.00	49279.00
06/2024	380154.00	127116.00	162764.00	49149.00
07/2024	500392.00	117515.00	139847.00	64688.00
08/2024	501065.00	146026.00	163521.00	56435.00
09/2024	497960.00	166273.00	183536.00	55139.00
10/2024	477610.00	141071.00	163096.00	57546.00
11/2024	434093.00	147776.00	189837.00	58062.00
12/2024	370628	131261.00	154463.00	51017.00
01/2025				

Solar power 10KW SPIHER consumption details

Month/year	Monthly wise consumption units	Total Consumption units
01/2024	1000	6525
02/2024	1082	7607
03/2024	1131	8738
04/2024	1014	9752
05/2024	907	10679
06/2014	1035	11714
07/2024	1046	12760
08/2024	1051	13811
09/2024	959	14770
10/2024	766	15536
11/2024	665	16101
12/2024	536	16637
01/2025	563	17200
02/2025	930	18130
03/2025	1186	19271
04/2025	1214	20845
05/2025	1099	21651
06/2025	612	22263
07/2025	99	22362
08/2025	38	22400
09/2025	50	22450
10/2025		

12.14Per unit

Electrical maintenance department
Electricity bills for Jan to November 2024

Month year	SPIHER	Consumption units
01/2024	330604.00	22604
02/2024	422515.00	33284
03/2024	468475.00	38660
04/2024	467102.00	38492
05/2024	482638.00	40328
06/2024	380154.00	28580
07/2024	503092.00	39884
08/2024	501065.00	40044
09/2024	497960.00	39320
10/2024	477610.00	36292
11/2024	434093.00	32488
total	4965308.00	389980
Total	4965308.00	389980

12.73 Per unit

Electrical maintenance department
Electricity bills for July 2024 to Aug 2025

Month year	SPIHER	Consumption units
08/2024	500562.00	40044
09/2024	497463.00	39320
10/2024	477133.00	36292
11/2024	433659.00	32488
12/2024	370258.00	25352
01/2025	348537.00	23008
02/2025	446273.00	33792
03/2025	529879.00	42800
04/2025	538956.00	43564
05/2025	519289.00	42324
06/2025	373592.00	26104
07/2025	518583.00	40256
08/2025	549198.00	42820
Total	9435382.00	468164

20.15 Per unit

Electrical engineer
Maintenance

2025 St. Peter's college electrical consumption report

Month year	SPIHER		SPCET		school		Art college	
	units	Bill amount	units	Bill amount	units	Bill amount	units	Bill amount
1/2025	23008	348886	3771	106350	8224	149404	1640	55564
2/2025	33792	446719	5583	124597	10428	171528	2160	60778
3/2025	42800	529879	mf	144227	12144	188753	2440	63602
4/2025	43564	538956	mf	144335	10828	175543	1800	57012
5/2025	42324	519289	mf	144321	15096	218385	1800	56917
6/2025	26104	373592	mf	140621	10708	174338	2262	62060
7/2025	40256	518583			13200	205806	3452	76212
8/2025	42820	519198			14148	215631	3716	79176
9/2025	45880	581301			12580	199381	3880	81097
10/2025								

Electrical maintenance department
Electricity bills for July 2024 to July 2025

Month year	SPIHER	Consumption units
07/2024	500562.00	40044
08/2024	497463.00	39320
09/2024	477133.00	36292
10/2024	433659.00	32488
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06/2025	518583.00	40256
07/2025	549198.00	42820
Total	9435382.00	468164

20.15 per unit

Conclusion:

In conclusion, the efforts under SDG 17.3.7 highlight the institution's dedication to strengthening partnerships that directly benefit people and communities. By mobilizing financial resources through collaborative projects, external funding, and cross-sector support, the institution ensures that initiatives aimed at education, research, and community upliftment receive the backing they need to create real impact.

These partnerships are not just financial linkages, they are people-centered connections that expand opportunities, build local capacities, and empower individuals to participate in sustainable development. Through collective effort and shared responsibility, the institution is helping create a future where communities have access to the resources, knowledge, and support systems they need to thrive.