

Green Audit of



M/s Institute of Aeronautical Engineering ,

Dundigal Road, Dundigal, Hyderabad, Telangana 500043

2021-22

By



SRI GAYATRI ENERGY SERVICES

we support you conserve

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ACKNOWLEDGEMENT

The Green audit conducted is an external audit that aims towards creating awareness healthy and sustainable environment. Though nascent, the initiative is taken up to foster the concept of environmental sustainability .

M/s **Sri Gayatri Energy Services** , Hyderabad places on record its sincere thanks to progressive management of M/s **Institute of Aeronautical Engineering, Dindigul**, Hakimpet , RR Distt. Telangana for entrusting the Green Audit work of their College .

The study team is appreciative of the keen interest and encouragement shown by

Sri Marri Rajasekhar Reddy Chairman, **Sri Ch. Sathi Reddy** Secretary and Correspondent

Sri B Rajeshwar Rao Executive Director & Treasurer

Dr. L V Narasimha Prasad Principal

Disclaimer

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Exceptions

Nothing in this disclaimer notice excludes or limits any warranty implied by law for death, fraud, personal injury through negligence, or anything else which it would not be lawful for to exclude.

We trust the data provided by the M/s **Institute of Aeronautical Engineering , Dindigul RR Dist. Telangana** personnel is true to their best of knowledge and we didn't verify the correctness of it.

Audit Study team

Shri D.S.R.Murthy Senior Energy Auditor

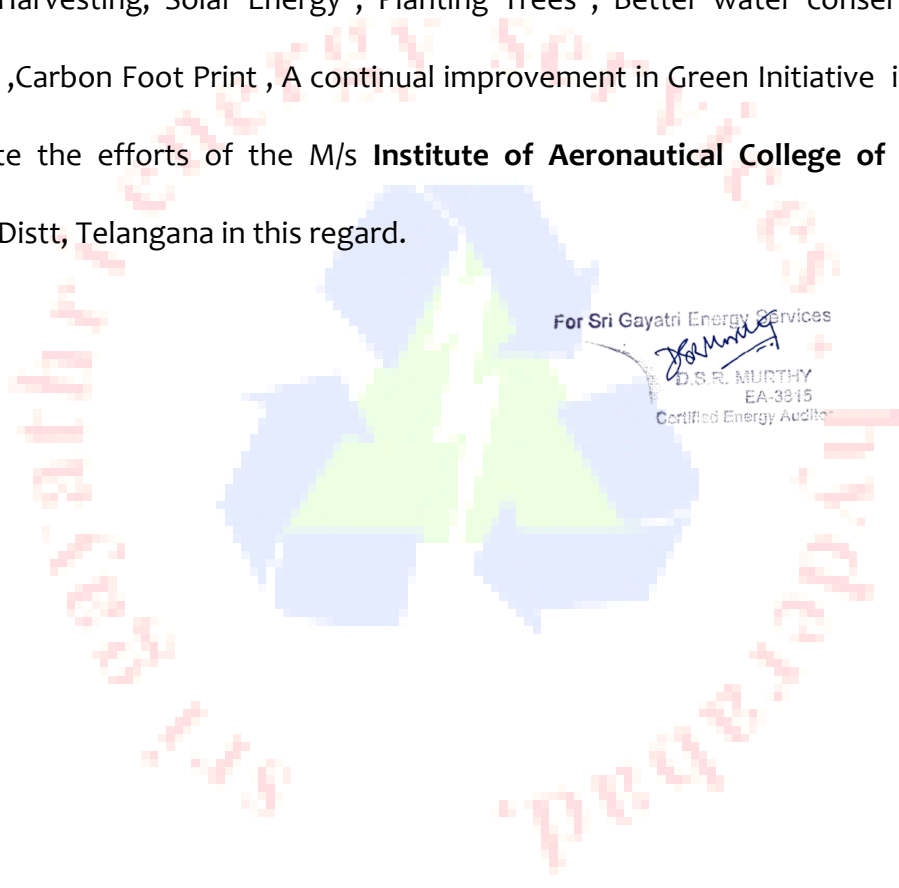
Shri N.Goverdhana Chary Engineer

Shri Ashok Engineer



CERTIFICATE

We here by certify that we carried out Green Audit in the M/s **Institute of Aeronautical College of Engineering**, Dindigul, Hakimpet, RR Distt. Telanagana during 30,31 JULY 2021 and following Observations were presented below. The Management is pro Active towards Green Initiative by Harvesting, Solar Energy , Planting Trees , Better water conservation, Waste Management ,Carbon Foot Print , A continual improvement in Green Initiative is appreciated. We appreciate the efforts of the M/s **Institute of Aeronautical College of Engineering** , Dindigul , RR Distt, Telangana in this regard.



For Sri Gayatri Energy Services
D.S.R. MURTHY
D.S.R. MURTHY
EA-3815
Certified Energy Auditor

Executive Summary of Observations

1. A Detailed Green Audit is carried out at the Campus with following observations.
2. The plantation of Trees is a continual process which is under implementation the total green area coverage is 1.129 Acres which is mandatory for mitigating the Global warming.(Photos enclosed)
3. The Grid Connected Solar PV is installed as part of Renewable energy initiative to the tune of 160 KW in an area of 35,101.086 sft in the campus . There is another 48039.33 sft available for additional solar plant . It is proposed to install Solar PV plant in near future. There by reducing the energy dependence on the Grid .
4. The Water conservation measures are already in place and further advancements are going on like Water harvesting pits are operational at individual buildings rain water soak pits are under construction so that the same can be interconnected to the Water Harvesting pits .
5. Water Wastage – Leaky taps are repaired/replaced, close monitoring of the Water usage closely by maintaining .
6. To treat the Waste Water and recycle it the Institute has installed ETP so that the water wastage can be minimized.
7. Waste Management is segregated in to three categories like
 - i) Bio Degradable Waste (Food Waste) It is proposed to install a Biogas plant of capacity 2 M³ in the campus to generate Bio gas and can be used for cooking in the campus itself . The Procurement is in process , shortly it will be installed. (Enclose Bio gas plant details)
 - ii) Non Bio Degradable Waste (Plastic/Papers and Other) are collected in the dust bins located at various locations in the campus. It is proposed to Ban/ discourage the usage of plastic water bottles inside the campus (Enclose Photos of Dust bins)
 - iii) E Waste Management a MOU is signed with GHMC for picking up the E waste generated annually and dispose the E waste in eco- friendly way . (Enclose copy of MOU)
8. It can be concluded that the Green Audit initiatives are started and College Management recognized the importance and taking proactive steps towards sustainable environment.

GreenAudit scope of work

The Green Audit is carried out in view of assessing all necessary environmental components and their impact on the campus physically by visiting the premises with reference to following.

1. Identifying the Green Area in total area of the campus and process of planting trees so that Heat /Global warming is mitigated. Creating awareness among staff/Students for planting more trees in the campus. A continual drive is created .
2. Water Conservation/ Efficient Usage / Eliminate the water misuse or wastage , Rain Water Harvesting etc
3. Renewable Energy usage to reduce the fossil fuel dependency, Harvest the Solar Power
4. Waste Management which includes Bio Waste/ Non Bio Waste/ E Waste etc
5. Carbon Foot Print – Transportation of Teaching Staff / Non Teaching Staff/ Students

METHODOLOGY

The Green Audit taken up by the college had been divided into two stages:

The Audit Stage: The Audit Stage encompasses of the team selection and the field works to be performed. The Green Audit Team focused on various Issues pertaining to college which have the highest influence on the Green Attributes of the College. The Audit stage also focused on the Methodology adopted. Checklist approach is adopted for transparent evaluation of the topics and increase readability for independent reader.

The Post Audit Stage: The post-audit stage ensures formulation of Draft findings and sent to management response. After getting draft approval, the audit team went for final report formulation.

Project Schedule :

- | | |
|----------------------|-------------|
| 1. Audit | : 1 -2 days |
| 2. Report generation | : 1 Week |

Introduction of the Institution

Institute of Aeronautical Engineering (**IARE**), Hyderabad was established in the year 2000 and is run by Maruthi Educational Society founded by a devoted group of eminent professional and industrialists having a long and outstanding experience in educational system with a mission 'Education for Liberation'. It is the first institute to start B.Tech program in Aeronautical Engineering in the state of Telangana and has gradually transformed itself into an integrated multi-disciplinary technological institute. It is the most preferred institute with 100% admissions in the state of Telangana.

IARE is a prestigious **Autonomous** engineering college offering eleven B.Tech programs Aeronautical Engineering, Computer Science and Engineering (Artificial Intelligence and Machine Learning), Computer Science and Engineering, Computer Science and Engineering (Data Science), Computer Science and Engineering (Cyber Security), Computer Science and Information Technology, Information Technology, Electronics and Communication Engineering, Electrical and Electronics Engineering, Mechanical Engineering, Civil Engineering and six M.Tech programs in engineering and MBA (Master of Business Administration) with 20 years of rich standing in the educational sphere. The institute is approved by AICTE, New Delhi; recognized by Govt. of Telangana; permanently affiliated to Jawaharlal Nehru Technological University Hyderabad (JNTUH); and accredited by National Assessment and Accreditation Council (NAAC) with 'A' Grade. All the seven B.Tech programs are accredited thrice by National Board of Accreditation (NBA), New Delhi since 2008. The institute also received UGC recognition under Sections 2(f) and 12(B) of the UGC Act.

The institute is ranked **170** in Engineering category as per **National Institutional Ranking Framework (NIRF)** – 2020, Ministry of Human Resource Development (MHRD), Govt. of India. This illustrates positive performance and quality standards we maintain in Teaching, Research, Employability, and Innovation. Categorized as 'Band B' institution (rank between 26-50) in category of 'Private or Self-Financed College/Institutes' in Atal Ranking of Institutions on Innovation Achievement (ARIIA) – 2020, as per MHRD's Innovation Cell, Ministry of Education, Govt. of India.

Besides the institute has been ranked by different independent national agencies which include Careers 360 (AAA+), India Today (57), The Week (84), Times of India (76), Competition Success Review (17), Outlook (108), DataQuest (59), Business World (60).

The total number of students is 4952 and that of faculty is 272, out of which, 82 are Ph.D's (33%) ensuring healthy faculty student ratio. The research activity on campus is woven in pursuance of its vision & mission statements around the philosophy of Inspire, Innovate, and Implement to benefit the contemporary society. It unwinds itself into different fields such as environment, aerospace, PLC, CAD/CAM, CNC machining, tool design, welding, embedded systems, and low power VLSI digital system design. Emphasis is also being laid on manufacturing, automation, business analytics, big data, cloud computing, wireless technology, image processing, and next generation networks.

IARE has twelve sponsored research projects, and has received grants of worth Rs. 558 lakhs for research and other activities by different agencies including DST, AICTE, UGC etc. The institute has a record of intellectual property with 850+ research paper publications by faculty as well as students and 1705+ citations, 34 patents in last 5 years. Internal Revenue Generation through consultancy facilitates

and promotes activities pertaining to energy audit, mobile apps, drones in agriculture, agricultural tools, and material testing.

Institute has state of art infrastructural facilities to support teaching-learning, research and administrative services. The institute is spread over **26.72 acres** with built up area of 3,37,500 sft. housing 65+ smart class rooms, 2 ICT studio rooms, 4 flipped classrooms, 4 conference halls, auditorium, 8 research laboratories, 103 academic laboratories, science and technology startup park, technology innovation and incubation center, open air amphitheater, makerspace, community facilitation center, skill development center and library. Campus-wide networking with 600 Mbps internet connectivity, Wi-Fi and CCTV facility is available. To reduce the consumption of electricity efficient lightings are used with solar electric energy of 160 KW on the grid. A captive power of 480 KVA is provided to ensure smooth working of the institute in times of power outage. The institute operates 32 buses for the benefit of students and staff.

STATEMENT OF ASSURANCE

The Green Audit conducted for the Third time in the college. The Management had taken initiative to carryout the Green Audit externally. As mentioned above it is in the process of improving the awareness towards the renewable energy and sustainable development .The conclusions are based on a comparison of the situations as they existed at the time of the audit. The evidences presented are in support of the conclusions.

Goals of the College

In the effort to Enhancing an environmentally literate campus where students can learn the idea of protection of environment and stay healthy. The college Management is proactively working on the several facets of “Green Campus” including Plantation of more trees, Water Conservation, Efficient water usage by eliminating leaking water taps, Installation of ETP, Water Harvesting Pits and interconnecting them to Recharge the Ground Water table . Effective Waste Management which includes Food Waste, Plastic, Paper, Metal Work, Renewable Energy, carbon footprints etc .

1. To create a green campus with focus on above concepts
2. To Harness Solar Power
3. To Conserve Water by eliminating the water leakages , wastage, Rain Water Harvesting
4. To Reduce Waste management through reduction of Food waste generation, Plastic/Paper/Metal waste generation and effective disposal
5. To Reduce the Carbon Foot print
6. Enhancement of college profile



1. **Plantation of Trees** : The college management made it a practice to plant trees across the campus to improve greenery . This is a continual ongoing process and every year a target is taken to plant trees and increase the Green cover inside the campus. The Following are the objectives kept in mind for increasing the Green Area coverage inside the campus and internal in the buildings too.

Reducing Climate Change

If people are good at something, then it is building up excess carbon dioxide in the atmosphere. Harmful CO₂ contributes to climate change, the biggest current problem the world has to deal with. Trees, however, help fight it. They absorb CO₂ removing it from the air and storing it while releasing oxygen. Annually, an acre of trees absorbs the amount of carbon dioxide equal to driving your car 26 000 miles. Trees are our main survival tools; only one tree can produce enough oxygen for four people.

Purifying Air

Trees do purify the air. They absorb pollutant gases such as nitrogen oxides, ozone, ammonia, sulfur dioxide. Trees also absorb odors and act as a filter as little particulates get trapped in leaves. A mature acre of trees can yearly provide oxygen for 18 people.

Cooling Down the Streets

The average global temperature grew by 1.4 F. This happens as tree coverage declines.

Removing trees and replacing them with heat absorbing asphalt roads and buildings makes cities much warmer. Trees are cooling cities by up to 10 F by providing shade and releasing water.

Natural Air Conditioning

Architects and environmentalists came up with the great solution – green roofs. Green roofs are an amazing way to incorporate vegetation to our Premises and provide environmental benefits .Indoor trees do not only have a calming effect, they also act as natural air conditioning.

Saving Water

Except for cooling, trees also help to save water. Because of the shade they provide, water will evaporate slowly from low vegetation. Trees need about 15 water gallons a week to survive, and they release about 200-450 gallons of water per day.

Our Case : Almost 1.129 acres of Tree plantation out of 26 Acres of the campus is having tree plantation and heading for area of Greenery

Renewable Energy : 100 KW Solar PV Grid Connected in an area of **35101.086 sft** and there is available area of **48039.33 sft** for further addition of Solar PV plant.

Among all the benefits of solar energy the most important thing is that solar energy is a truly renewable energy source . It can be harnessed in all areas of the world and is available every day . We can not run out of solar energy energy source.

solar system has generated energy, the energy bills will drop. How much you save on bill will be dependent on the size of the solar system and electricity usage. Moreover, not only will you be saving on the electricity bill, there is also a possibility to receive payments for the surplus energy that you export back to the grid. If you generate more electricity than you use (considering that your solar panel system is connected to the grid).

Some of the key benefits of solar energy on the environment include:

- Using less water. Water is one of our most precious natural resources. ...
- Reducing air pollution. ...
- Help to slow climate change. ...
- Reducing your household's carbon footprint. ...
- Reducing our reliance on fossil fuels.

Our Case : Presently installed 100 KW Grid Connected Solar PV to Harness the Solar Power and further enhancement of solar PV is in the pipe line.

Water Conservation , Harvesting and Management

Per capita water availability of many river basins in India is declining over the years due to sustained population pressure, agriculture and industrial expansion, besides changing climate scenarios. This is particularly evident from the fact that the per capita availability has decreased from 1816 m³/year in 2001 to 1545m³/year in 2011 .

Rainwater harvesting is a technique used for collecting, storing and using rainwater for domestic, agricultural or any other uses. The rainwater is collected from various hard surfaces such as rooftops, runoff from catchments, from streams and water conservation through watershed management or other manmade aboveground hard surfaces. It is an age-old system of collection of rainwater for future use. The harvested water can be stored on surface through ponds and tanks or can be recharged to groundwater .

Protection of Water from Pollution;

If the total fresh water available on the earth remains pollution free, it is sufficient to meet the drinking water needs of the existing population of the world, unfortunately a large portion of fresh water does not remain fit for use of the living world due to increasing economic activities, urbanization etc.

Rational Use of Groundwater:

Groundwater meets 25 per cent of total supply of water in the world, remaining 75 per cent supply is met by surface water sources of rivers, lakes etc. Demand for groundwater goes on increasing in proportion to its available quantity due to which quantity of groundwater goes on decreasing. After exploitation of groundwater, its re-infiltration takes a very long time to complete. Hence, groundwater exploitation should be only in proportion to its recharging capacity.

Increasing Forest Cover:

According to hydrological movements, water is received through rainfall every year different quantities on the surface of the earth. This water flows on the surface and reaches the seas. Some part of rainwater is stored in stable water reservoirs (lakes and tanks), whereas some quantity of water infiltrates into the land and takes the form of groundwater.

Our Case : Constructed Water harvesting Pits 15 No's across the campus and in the process of constructing water drains and interconnecting the same to water harvesting pits to recharge the ground water

Waste Management:

1. **Bio Waste** – Mostly Food Waste is generated from the cooked food at the campus in the canteen . It is proposed to install Bio Gas plant in the campus to generate Bio Gas from the food waste , which can be used in the Food Cooking . The Procurement is in process and is installed shortly.
2. **Non Bio Waste** – Plastic Bottles / Waste Paper / Cardboards/ Batteries etc

Non- biodegradable waste, which cannot be decomposed by biological processes is called non-biodegradable waste. These are of two types - Recyclable: waste having economic values but destined for disposal can be recovered and reused along with their energy value. e g. Plastic, paper, old cloth etc. Non-recyclable: waste which do not have economic value of recovery. e.g. Carbon paper, thermo coal, tetra packs etc. Disposal of non-biodegradable waste is a major concern, not just plastic, a variety of waste being accumulated. There are a few ways to help non-biodegradable waste management. The impact of non biodegradable waste on the environment and also focus on its safe disposal for sustainable environment.

Present Status :Dust bins were provided for the waste disposal the same is collected daily once and handed over the Municipal corporation.

3. E Waste Management

Waste Electrical and Electronic Equipment (WEEE) or E-waste is one of the fastest growing waste streams in the world. In developed countries, it equals 1% of total solid waste on an average. In developing countries, it ranges from 0.01% to 1% of the total municipal solid waste generation. In countries like China and India, though annual generation per capita is less than 1 kg, it is growing at an exponential pace.

Present Status : The College is having an MOU with to dispose the E Waste. Every year the agency will come and pick up the E waste and dispose it in environmental friendly way.

Audit Framework and detailed findings of the Audit

Objective	Observation/ Present status	Remarks / Recommendation
Green Cover - Plantation of Trees	Plantation of trees is started in the campus and the green cover is extended every year in the campus. At Present 1.129 Acres campus is having the Green cover .	A Continual plantation of trees is going on . It is recommended to increase the Green Cover further to another 5 Acres in coming one year.
Renewable Energy – Harness Solar Power , Wind Power etc	A Grid Connected Solar plant is installed with capacity of 160 KW	The Solar PV plant is functional and exporting clean energy to the grid . It is recommended to explore the vacant areas to increase the solar roof top plants to harness more solar energy
Water Conservation – i) Rain Water harvesting ii) Eliminating Leaking Taps iii) Interconnection of Water Soaking pits to Rain harvesting Pits iv) Avoid Misuse/wastage of water	i) Rain water Harvesting pits in place ii) A Dedicated Team working on the repairing the leaking taps across the campus iii) Interconnection process is initiated iv) RO Plant is installed for providing safe drinking water , which generates RO reject water ,this water is used for Gardening. v) Encourage to reduce the water usage vi) Water Sprinkler system installation is initiated to save water	They are functional Most of the taps are repaired , It is recommended to install taps with reduced water flow like shower / Mist . Reward the personnel informing Leaky taps , Paste Labels where ever water is expected to be wasted. Process initiated It is recommended to Install a Aqua Conditioner to reduce the RO Reject. Recommended to install Bio Toilets/Water Less Toilets like ECO Loo which reduces water usage and generates fertilizer from human waste and Natural liquid from the Urine which can be reused for gardening. Under process

<p>Waste Management</p> <p>i) Bio Waste</p> <p>ii) Non Bio Waste</p> <p>iii) E Waste</p>	<p>i) The Bio Waste – Food Waste generated in the canteen is proposed to be feed stock for Bio Gas plant</p> <p>ii) Non Bio Waste – Plastic Bottles / Paper Waste Metals waste is being collected in the dust bins placed across the campus .A GWMC team is visiting the campus on weekly basis and collecting the same.</p> <p>iii) E Waste – All Electronic Junk is generated in the campus in the form of Used Computer key boards/ Mouses/ CPU's/ Damaged Printers etc</p>	<p>i) Process is initiated for Bio gas plant.</p> <p>ii) It is proposed to install plastic bottle crusher, which can be sold as a feed stock for the Plastic industry.</p> <p>iii) Installed Sandy (Sanitary napkin crusher at ladies Toilet) to avoid choking of toilets and wastage to water .</p> <p>iv) An agreement is in place with M/s Ramky Enviro Enginners Ltd, Hyd to pick up the E waste every month</p>
<p>Carbon Foot Print</p> <p>i) Transportation</p>	<p>i) Most staff commute in the College Transport - Buses from City</p> <p>ii) Students commute in the college provided transport - Buses</p>	<p>i) Adequate buses are available for the Staff /students .</p>

References

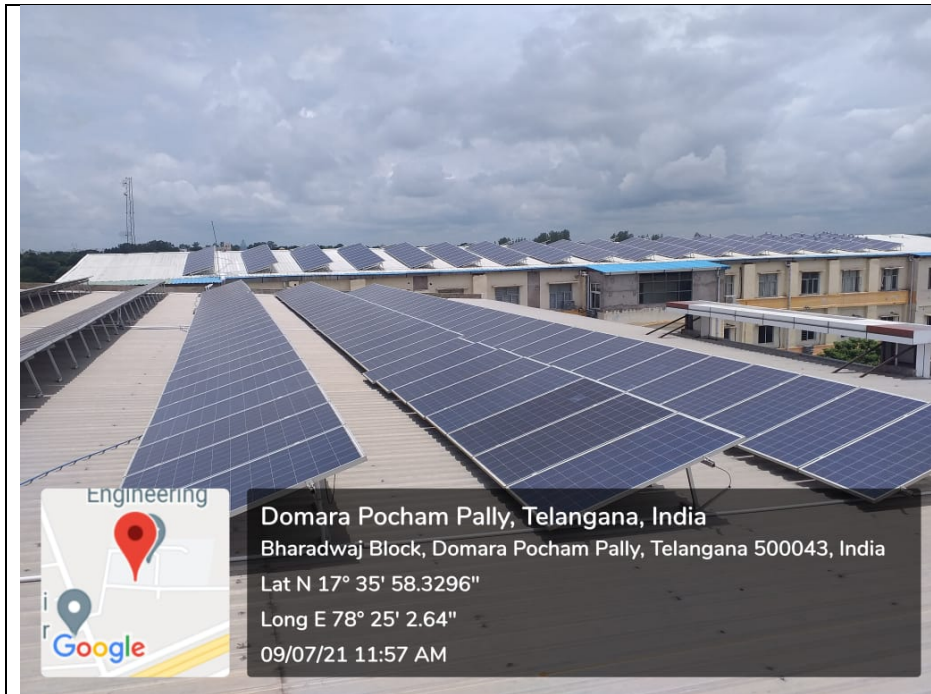
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3. Bio Toilets : <https://www.indiascience.in/videos/bio-toilets-sustainable-solution-for-sanitation-e>
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5. Roof top Rain Water harvesting Guidelines – IS 15797 – 2008
6. Guidelines For Improving Water Use Efficiency in Irrigation, Domestic & Industrial Sectors as Per IS – 1172 - 1993
7. IEC 62891 Solar PV For Grid Interactive system, IEC 61853- Part 1/ IS 16170 : Part 1 for Solar PV Panels
8. Central Public Health and Environmental Engineering Organization (CPHEEO) Manual on Municipal Solid Waste Management.
9. Draft Indian Standard Municipal Solid Waste Management – Segregation, Collection & Utilization at Household/community for Recovery and Recycle as per IS : 9659
10. Indian Guide Lines for Carbon Foot print and reduction strategies <https://indiaghgp.org/project-accounting-protocol-and-guidelines>

Visuals of Plantation of Trees across the campus





Grid Connected Solar PV installed at the Campus



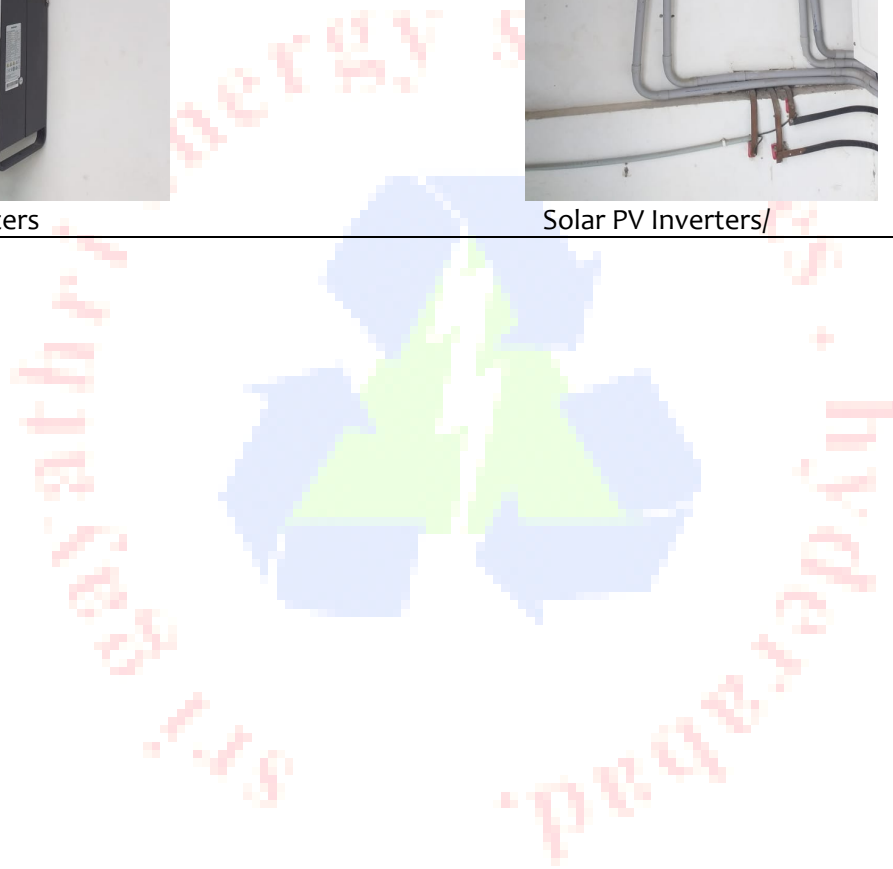
Solar PV Panels on roof top



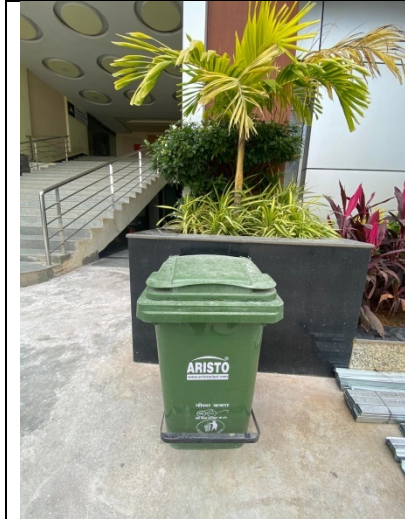
Solar PV Inverters



Solar PV Inverters/



Waste Collections Bins



Waste Management – Bio Degradable

A Bio Gas plant of capacity 2 M³/day is to be installed very shortly , the procurement is in process and expected to be completed in couple of months which will help in reducing the food waste generated in the campus to be utilized completely. (Details Enclosed)



E Waste management :

An agreement has been made with M/s Ramky Enviro Engineers Ltd for disposal of the E Waste which are mentioned below (A detailed MOU is enclosed)

1. Electronic Waste (E-Waste) -The Term E-Waste will refer to the below mentioned electrical and electronic waste for the purpose of this Agreement which includes;
 - a) Computers & Peripherals (CPU, Keyboard, Mouse& Monitor)
 - b) Laptops
 - c) Servers
 - d) PCBs
 - e) Mobiles or Communication devices
 - f) Mother Boards (Computers &Laptops)
 - g) Security Devices
 - h) Telecom Equipment
 - i) Printers & Scanners
 - j) Military Electronic
 - k) Control Systems
 - l) Data Cables and wires
 - m) Batteries
 - n) CD/DVD
 - o) Tube lights and CFL

MOU for E Waste Disposal

తెలంగాణ తెలంగాణ TELANGANA

Sl. No. 5330 Date: 17/04/2021. Rs.100/-

Name: Ch. Sathya Reddy

S/o,W/o,D/o. (late) pulla Reddy

For Whom: Self Ro. Dundigal

S. SreeLaxmi AE 599638

Smt. S. SREELAXMI

LICENSED STAMP VENDOR

LIC. No.:15-21-11/2017, RL. No. 15-21-033/2020

Flat No. G1, Kanchana Residency, Kakatiya Nagar

Chintal, Medchal-Malkajigiri Dist. Ph. 9052295990

AGREEMENT FOR PURCHASE OF E-WASTE

This Agreement for Purchase of E-Waste (Agreement) is entered on this the 24 day of June 2021 at Hyderabad, India.

By and between

Ramky Enviro Engineers Limited, a company incorporated under the Companies Act, 1956, having its registered office at Ramky Grandiose- floor 13, Ramky Towers Complex, Gachibowli, Hyderabad – 500032 represented by its MBD Head–E-waste, Mr. Purushotham Rao Koti, (hereinafter referred to as “Ramky” which expression shall unless contrary to the context mean and include its successors, representatives and permitted assigns)

AND

Institute of Aeronautical Engineering, a institute incorporated under the Companies Act, 1956, having its registered office at Dundigal, Hyderabad & represented by Mr. Dr. L V Narasimha Prasad, (hereinafter referred to as **IARE** which expression shall unless contrary to the context, mean and include its successors, representatives and permitted assigns)

Within this Agreement, Ramky Enviro Engineers Ltd and Institute of Aeronautical Engineering shall together be referred to as Parties and individually as Party.

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Carbon Foot Print

The IARE has total staff(Teaching + Non Teaching) of 292 members, the Co2 emission is 371.04 Kg/day

Members by Two Wheeler – 100 – Co2 emission is 150 .5 Kg /day

Members by College Bus – 170 - Co2 emission is 59.56 Kg/day

Members by Car Pooling – 20 – Co2 emission is 107.32 Kg/day

Members by Individual Car -5 – Co2 emission is 53.66 Kg/day

Students by College Bus -

Note : Assume each member travel a distance of 25 kms to college and 25 kms return to home .

Mode of Transit	CO2 released (per km driven per person)	CO2 released during production of vehicle
Car	271 g	313 g
Bus	101 g	---
Bicycle	16 g (This is from the fuel of the rider - food)	16 g

Carbon Dioxide (CO ₂) Factors:	Pounds CO ₂	Kilograms CO ₂	Pounds CO ₂	Kilograms CO ₂
	Per Unit of Volume or Mass	Volume or Mass	Million Btu	Million Btu

For homes and businesses

Propane	12.70/gallon	5.76/gallon	139.05	63.07
Butane	14.80/gallon	6.71/gallon	143.20	64.95
Butane/Propane Mix	13.70/gallon	6.21/gallon	141.12	64.01
Home Heating and Diesel Fuel (Distillate)	22.40/gallon	10.16/gallon	161.30	73.16

M/s Institute of Aeronautical Engineering, Dindigul, RR Distt. Telangana

Carbon Dioxide (CO ₂) Factors:	Pounds CO ₂	Kilograms CO ₂	Pounds CO ₂	Kilograms CO ₂
	Per Unit of Volume or Mass	Volume or Mass	Million Btu	Million Btu
Kerosene	21.50/gallon	9.75/gallon	159.40	72.30
Coal (All types)	4,631.50/short ton	2,100.82/short ton	210.20	95.35
Natural Gas	117.10/thousand cubic feet	53.12/thousand cubic feet	117.00	53.07
Gasoline	19.60/gallon	8.89/gallon	157.20	71.30
Residual Heating Fuel (Businesses only)	26.00/gallon	11.79/gallon	173.70	78.79
Other transportation fuels				
Jet Fuel	21.10/gallon	9.57/gallon	156.30	70.90
Aviation Gas	18.40/gallon	8.35/gallon	152.60	69.20
Industrial fuels and others not listed above				
Flared natural gas	120.70/thousand cubic feet	54.75/thousand cubic feet	120.60	54.70
Petroleum coke	32.40/gallon	14.70/gallon	225.10	102.10
Other petroleum & miscellaneous	22.09/gallon	10.02/gallon	160.10	72.62
Nonfuel uses				
Asphalt and Road Oil	26.34/gallon	11.95/gallon	166.70	75.61
Lubricants	23.62/gallon	10.72/gallon	163.60	74.21
Petrochemical Feedstocks	24.74/gallon	11.22/gallon	156.60	71.03

Carbon Dioxide (CO ₂) Factors:	Pounds CO ₂	Kilograms CO ₂	Pounds CO ₂	Kilograms CO ₂
	Per Unit of Volume or Mass	Volume or Mass	Million Btu	Million Btu
Special Naphthas (solvents)	20.05/gallon	9.10/gallon	160.50	72.80
Waxes	21.11/gallon	9.57/gallon	160.10	72.62
Coal by type				
Anthracite	5,685.00/short ton	2,578.68/short ton	228.60	103.70
Bituminous	4,931.30/short ton	2,236.80/short ton	205.70	93.30
Subbituminous	3,715.90/short ton	1,685.51/short ton	214.30	97.20
Lignite	2,791.60/short ton	1,266.25/short ton	215.40	97.70
Coke	6,239.68/short ton	2,830.27/short ton	251.60	114.12
Other fuels				
Geothermal (average all generation)	NA	NA	16.99	7.71
Municipal Solid Waste	5,771.00/short ton	2,617.68/short ton	91.90	41.69
Tire-derived fuel	6,160.00/short ton	2,794.13/short ton	189.54	85.97
Waste oil	924.0/barrel	419.12/barrel	210.00	95.25

Source: U.S. Energy Information Administration estimates.

Note: To convert to carbon equivalents multiply by 12/44. Coefficients may vary slightly with estimation method and across time.

Carbon Dioxide Emissions Coefficients by Fuel

[Detailed factors](#) (discontinued)