

Action for Climate Change Mitigation 2021

Indian Institute of Technology Roorkee



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GREEN COMMITTEE OFFICE

1.0 BACKGROUND

Ministry of Education vide its letter No. 1-11/2013TS-1(Sectt.) dated 05-06-2013 communicated the IIT Council's Green/Sustainable Agenda for Educational Institutions with the following background

- IITs being the premier institutions, have to play a lead role in implementing the Green / Sustainability Agenda in the country by adopting and implementing programmes to reduce their Carbon footprint, recycle the resources, adopt energy efficient measures and include sustainability issues in the teaching programme.
- The Council of IITs decided that each IIT would establish a Green Office, which would carry out a Green Audit of its curriculum and its institutional management practices, such as energy, water, waste, construction projects, natural resource (forest, water etc.) and conservation of bio-diversity.
- It was suggested to implement the greening agenda in a phased manner, but to be initiated at the earliest. The Green office could be located in the Institute's existing department/Centre concerned with sustainable development/climate engineering so that technical resource support is available.
- It could set up a working-group drawn from active faculty/students interested and working on this agenda to create a participatory, transparent process with ownership. It should also involve different department representatives to reflect it's inter-disciplinary and inter dependent concerns. It should also involve external experts from different agencies/ offices/ other organisations engaged meaningfully and constructively with concerns for a green environment.

Developing green policy (vision document) and framework for the institute and facilitating and undertake Greening initiatives are the key responsibilities of the green office. It shall work for the following:

- a) To develop a baseline scenario for the institute (data and info on CO₂ emissions, water use, waste generation, carbon footprint, paper use, etc.)
- b) To develop of green technology packages (installation of SPV, wind mill, waste to energy, rain water harvesting, paper recycling, etc).
- c) To implement of Green Action Plan in phased manner.
- d) To monitor, Reporting, Verification and Evaluation.
- e) Mainstreaming Green Agenda in Education and Teaching.

IIT Roorkee setup first green office and notified the green committee in Feb. 2014. The green committee is chaired by Director and have representatives of state of work, students and faculty with a coordinator (Annexure). Minutes of meeting are uploaded on the website for wider awareness https://www.iitr.ac.in/GP/green_committee.html

2.0 INTRODUCTION

IIT Roorkee is dedicated towards enabling a culture of Sustainable development across the campus and enhance the student and staff experience, thus, creating a global legacy. In order to minimize the adverse impacts of climate change on country's resources and attaining its sustainable development and management, there are needs for developing the rational adaptation strategies and enhancing the capacity to adapt those strategies. IITR aims at doing important work not only on environmental issues but also on social and economic matters, thereby, covering the three dimensions of sustainability and mitigate climatic effects.

3.0 SETTINGS AND INFRASTRUCTURE

- Indian Institute of Technology, Roorkee (IITR) is a ‘Specialized higher education institution’ situated in India. Located in a Tropical wet and dry climate, it has 3 campus sites in total. This urban campus has a total area of 15, 92,438 Sq.m. The ratio of open space area to total area is 82.42%. Total area on campus covered in forest vegetation is about 3.03% while that covered in planted vegetation is about 58.09%. Besides this, the total area on campus for water absorption is about 39%.
- The chart below shows the total number of regular students in the campus:

UG/PG/Ph.D.	Female	Male	Total
UG	626	2959	3585
PG	317	1344	1661
Ph.D.	832	1863	2695
Total	1775	6166	7941

The academic and administrative staffs are as below:

No of faculty as on date: 497 (Professor - 187, Associate Professor - 120, Assistant Professor - 190). The details of Non-faculty are Non-Faculty (Group 'A') – 85, Group B (Technical) - 73, Group B (Admin) - 45, Group C (Technical) - 93, Group C (Admin) - 113 and Group C-MTS - 64

The families of the administrative staff are also considered since they reside inside the campus area taking to a total of 3880 staff members.

Thus the total open space area divided by total campus population is about 111 sq.m/person.

4.0 ACTIONS TAKEN TO MITIGATE CLIMATIC CHANGE IMPACTS

4.1 Energy and Climate Change

IIT Roorkee intends to realize further energy savings by paying close attention to energy management. All departments of the institute have assessed their own energy consumption and realized their own energy-saving potential by means of, for example, insulation, LED lighting, motion and photo sensors for efficient operation of the lighting fixtures and the deployment of sustainable technology. IIT Roorkee aims

towards saving energy by energy management and focussing on renewable energy sources.

- IIT Roorkee has been a pioneer in utilizing solar energy on an academic campus. <https://www.iitr.ac.in/GP/solarification.html>. It is one of the academic institutions which have the comprehensive rooftop solar energy installation and is an excellent showcase of solar technology for all the students, faculty and visitors. The institute has utilized the rooftop area of every building on campus for solar photovoltaic (PV) and solar thermal applications for hostels and residences. The energy generated by the solar PV system is connected to the campus distribution grid, which supplements electricity requirements of various departments. The solar thermal systems are being used for water heating and cooking. The faculty and students have led successful initiatives for energy conservation and reducing carbon footprint using solar energy. The summary of solar installations at IIT Roorkee campus is as follows:

4.1.1 Solar PV system

- Installed in the year 2014, it consists of 27 units of Solar PV systems of various sizes on rooftops of buildings with the total generation capacity of 1.81 MW with electricity generation is about 2.4 million units annually on OPEX.
- A 10 kW solar PV system commissioned at IIT Roorkee Saharanpur Campus in 2014.
- A 47 kW solar PV system commissioned at Noida Campus of IIT Roorkee in November 2016 on OPEX.
- 1.0 MW was commissioned in Sept 2021 with a 25 year power purchase agreement with a RESCO company at a tariff of 34% of grid tariff. Copy of PPA is enclosed.

Thus a total capacity of SPV system in IIT Roorkee in 2.867 MW installed in different years.

4.1.2 Solar water heating system

It consists of a water heating system covering the entire campus at the students' hostels (Bhawans), guest houses, residences, and departments. It generates hot water of about 440, 000 liters per day. It was commissioned in Dec 2014 with a 20 year contract of maintenance.

4.1.3 Solar system for steam cooking

It consists of the solar system for steam cooking at nine hostels. It is equivalent to 4000 – 5000 cylinders of 14.2 kg LPG annually. It was commissioned in Oct 2015 with a 20 year contract of operation and maintenance.

4.1.4 Supervisory Control and Data Acquisition System for Solar Systems

All the solar PV systems have SCADA for monitoring and data generation, and research on PV systems and they have been connected to IIT Roorkee internal distribution-grid.

Thus the campus has more than 3 types of solar energy production. The carbon dioxide deduction is summarized as:

Energy Efficient Interventions	Reduction of Electricity and Carbon
<i>Energy efficient appliances:</i> Air Conditioners, Fans, Lighting and Street Lighting	An overall reduction of 10 % of annual saving of electricity ie 2.2 Million units
Use of Alternate Sources	
Solar PV systems (a) 1.81 MW installed during 2013-14 on CAPEX annual 2.4 Million Units (b) 1.00 MW installed during 2021-22 on RESCO annual 1.2 Million Units Total: 2.81 MW= 3.6 Million units	¹ Annual reduction of 2,844 Ton/CO ²
47 kW systems at IIT Roorkee Noida campus	Annual reduction of 44 Ton/CO ²
Solar water heating system: 4,40,000 Litres of hot water per day equivalent of saving of 5.2 Million units annually	Annual reduction of 4,108 Ton/CO ²
Steam Cooking 61 solar Sheffler dishes of 16 sq m equivalent to 4000 cylinders of 14.2 kg LPG annually eq 0.768 million units of electricity	² Annual reduction of 606 Ton/CO ²
	Total reduction of 7602 Ton/CO ²
Ratio of renewable energy used with respect to total energy consumed 9.5 million units against a total purchased 22 Million Units electricity from grid and 9.5 Million generated and saved	30%

4.2 Measures for Energy Efficiency

All departments of the institute have assess to their energy consumption and realize their energy-saving potential by means of, insulation, LED lighting and the deployment of sustainable technologies etc., achieving a total energy efficiency of 26.42%. There has been an increase of almost 1% in Energy Efficient appliances as a percentage of total appliances. https://www.iitr.ac.in/GP/green_initiatives.html

- Replacement of fluorescent based light fittings by LED Lights in the departments / hostels / lecture halls/ residences.
- In common areas of buildings, a new initiative has been taken to install LED lights having auto-dimming capability. Normally, this LED tube light will glow at 3.5 W,

¹ Central Electricity Authority, Govt of India ,CO2 Baseline Database for the Indian Power Sector User Guide Version 16.0, March 2021

but whenever there is a movement of any person, it will glow to 18 W, thus, saving energy.

- All the electronic appliances being procured and installed such as, fans, air conditioners etc. are 5-star rated with electronic speed regulator.
- There are motion sensors controlled exhaust fans in many washrooms.
- IIT Roorkee is implementing SCADA based smart and sustainable campus. This will entail the creation of a smart energy management system and micro grid with battery energy storage. The project will establish an Integrated Monitoring, Analytics and Control Center (I-MAC) for systems ranging from energy assets to transport, water, and waste. includes the setting up of an integrated energy and digital platform, embodying intelligent and futuristic energy systems to increase energy efficiency, renewable energy use and sustainable transport, minimizing harm to the planet. This also integrates smart power and energy systems, environment, safety, security and disaster management, among other things.
- Along with the energy efficiency, smart building measures related to automation, safety, water, indoor environment, lighting etc. have also been implemented in IITR. These features are established to generate a beneficial environmental impact over the building lifecycle. The total floor area of smart building to the total all floors building area is about 8.02 %.
- Installation of Air sourced based Heat Pump for water heating in a hostel has been done recently. This system can provide a total of 8000 Litre/hr hot water throughout the year utilizing 75% less electricity than an electric geysers.
- IITR implemented the elements of ‘green building’ such as natural ventilation and daylighting, introduction of courtyards in different areas, louvers and small windows on south façade, large glazed windows on north façade, solar panels installed on rooftops, use of energy and water efficient appliances and use of green materials for construction; to name a few. All these features together enhance the energy performance of buildings.
- IITR has implemented programs which aims to reduce all three scopes emissions, namely, Direct GHG emissions, Fugitive emissions and Indirect GHG emissions resulting from the generation of the electricity, incineration or landfill of institution’s solid waste, regular commuting from and to institutions by students and employees.
- The faculty and students have led successful initiatives for energy conservation and reducing carbon footprint using solar energy. The total carbon footprint of the institute is about 17918.2 metric tons (about 1.51 metric ton per person).
- A poster and brochure on solar initiative taken by institute be prepared and circulated among the institute community for creating awareness and utilisation of solar energy in the campus.

4.3 Measures for Waste Handling for Reduction in Carbon Emission

As the waste treatment and recycling activities are major factors in creating a sustainable environment, some programs have been implemented in IITR to manage the waste in an efficient manner.

- IITR has implemented a Door-to-Door garbage collection program in the campus.
- For Manual segregation of solid waste in various location in the IITR campus, Separate dustbins for wet/ organic and dry waste have been installed at various locations in the campus. The residents have been provided separate dustbins for wet and dry waste.
- A solid waste treatment plan is being developed in the campus for treatment and recycling of institute solid waste.
- The IITR community intends to use plastic bottles to create self-watering plants and storehouses for plants.
- Collection and segregation of hazardous e-waste to avoid its incorrect disposal and helping school children to create some innovative craft using e-waste.
- The institute has established a formal policy to reduce the use of paper and plastic.
- To reduce the use of papers, emphasis is given on using digital technologies, reducing paperwork by using electronic communications for administrative and project works. Online submission of project proposals and online database management.
- Creation of web repository of documents to avoid using papers. All the academic processes (eg: procedure for transcripts or mark sheets; notifications regarding courses; important notices, etc.) are uploaded online to reduce the use of paper.
- NSS IIT Roorkee launched the “Swachhta Hi Sewa” initiative which is focused on the theme “Plastic Waste Awareness and Segregation”.
- Free Water Distribution system has been implemented in the campus to reduce the use of plastic water bottles and the use of Tumblers.
- Apart from this, in terms of waste management, the organic waste is treated at the source itself.
- The Eco-Group of IIT Roorkee has collaborated with Resource E-Waste Solutions Pvt. Ltd New Delhi for recycling of Electronic waste within the campus. Phase 1 of the same has already been implemented. In total, 20 bins were ordered, out of which, 13 were placed in the hostel areas and remaining 7 were placed in the main building, library area, student activity centre and multi-activity centre.
- For the collection of inorganic waste, mild steel dustbins and PVC moveable dustbins have been ordered and started being placed in the hostels of IITR campus

- The new bins are placed adjacent to the current bins in the campus, thus making a pair of organic and inorganic bins. The bins are colour-coded (Organic-Green; Inorganic-Blue) to avoid confusion.
- For the Inorganic waste, IITR has contacted a local reseller who is a link between recycling companies and incineration plants. This waste can be handed over to him; he will further segregate it & will send to respective places for recycling or incineration.
- IITR has requested the Uttarakhand Pollution Control Board to provide them with the authorization for storage and disposal of hazardous waste through TSDF agency (CPCB approved).
- In total, about 1-25% of the Institute's waste is being treated.
- Future plans for segregation of solid waste and Bio-methanation of organic part is considered as the option to reduce the waste contribution to the society and retrieving the energy from the waste.
- Feasibility assessment of usage of recycled plastic and other waste as cutlery substitutes.
- Use of recycled paper for administrative work, wherever possible, inside the campus.

Waste Management Interventions	
Recycling of Electronic waste	20 bins
Inorganic waste	100 numbers of 30 litres mild steel dustbins 6 numbers of 1100 litres PVC moveable dustbins
Organic waste	Treated at source itself Bio-methanation and Vermi-composting
Disposal of hazardous waste including disposal of 20-20 years material lying unattended/unprotected	

4.4 Water and Wastewater

The aim of the IITR is to decrease ground water usage, increase conservation programs, manage generated wastewater and protect the habitation.

- For management of wastewater, sewage treatment plant of capacity 3 Million litre per day (MLD) has been constructed at Roorkee campus and 0.5 MLD capacity STP at Saharanpur campus of IIT Roorkee. The STPs are based on the Sequencing Batch Reactor (SBR) process. The system provides high-quality effluent for safe

discharge or non-potable reuse with minimum space and power requirement. Around 39,552 m³ of treated water from STPs outlet is used every month for flushing purposes and an area of 142936 m² at Roorkee campus and 30300 m² at Saharanpur campus is being irrigated with treated wastewater.

- Rain water is recharged directly to the ground through open unpaved areas. IITR has 3,37,696 m² of open area which is used to recharge rain water to the ground.
- The pilot project for Rain Water Harvesting has been taken up at Roorkee campus for which two sites have been identified and the development of rain water harvesting structures has started.
- Water efficient appliance usages are replacing conventional appliances. IITR houses about 31.66% water-efficient appliances. Future plans include water efficient fixtures (taps, shower heads, cisterns, toilets, urinals, lawn sprinklers etc.), be used, whenever/wherever changed are required.
- A water meter is installed to measure the amount of rainwater that has been used. The recycled water is also used for the garden sprinkler system, toilet flushing with a current water consumption of 1MLD.
- Reduction of freshwater consumption and steps being taken to reduce: the metering, appliances, monitoring, reusing 1MLD of treated waste water instead of freshwater.
- Create awareness among the campus fraternity regarding sensible use of water including sweepers, gardeners and cleaners through scheduling of monthly informational emails to serve as visual reminders for water conservation, display banners and pamphlets at various locations inside the campus etc.
- Planning and mitigation of the storm water drainage issues in the campus. Also, the development of drainage arrangement including development of retention in the sports fields, recharging structure, remodelling the outlet drain is being carried out.

Water and Wastewater Management Interventions			
Appliance	Total Number	Total number of water efficient appliances	Percentage water efficiency (%)
WCs	2940	1385	47.10
Wash Basins	3060	540	17.6
Urinals	1090	320	29.35
3,37,696 m ² of open area	Recharge of rain water to ground		
Built rain water harvesting structures			
39552 cu m of treated wastewater at Roorkee campus	Flushing purposes		
142936 sq.m at Roorkee campus	Irrigation		
30300 sq.m at SRE campus	Irrigation		

zone/area to be selected for making 100% metering for monitoring the water consumption and a suitable telescopic tariff

4.5 Transportation

Transportation systems play an important role in carbon emission and pollutant levels in IITR.

- Transportation policies to limit the number of motor vehicles on campus uses of campus buses and bicycles have been implemented to encourage a healthier environment.
- The pedestrian policy has encouraged students and staff to walk around campus and avoid using private vehicles. The use of environmentally friendly public transportation has decreased the carbon footprint around campus.
- Regular shuttle service is provided (by institute or other parties). The future goal is to minimize on campus transportation which would help to reduce carbon footprint through better planning.
- Solar charged battery operated rickshaws are used as shuttle service in IITR.
- Apart from this, Zero Emission Vehicles are available, and provided by the institute at a nominal charge. The total number of Zero Emission Vehicles (ZEV) divided by total campus population is about 0.71.
- The initiatives have resulted in more than 30% decrease in parking area or parking area reduction reaching its limit.
- A Number of Transportation Initiatives is designed to decrease Private Vehicles on Campus such as E-Rickshaws inside campus. uses of bicycles on campus since, students are not allowed to use motorized vehicles, pedestrian friendly paths, and use of electric cars inside the campus etc.
- The campus is designed in such a way that the faculty houses and student residences are within 1 mile from the educational departments and offices. Hence, no cars are required due to the close proximity between different areas.
- IITR has procured 2 electric cars for community inside the campus and nearby areas. Further, IITR community sensitization through poster and brochure on e-vehicle initiative for creating awareness and utilisation of electrical vehicle in the campus.
- Reduction in Diesel and petrol by usage of 2 e-vehicles.

4.6 Biodiversity

- Implemented a mini-forest (Miyawaki forest) having 1100 trees of about 70 species in an area of 300 m² near Saraswati Mandir with cooperation of SayTrees organisation during Sept 2021. Miyawaki, also called the Potted Seedling Method, is an afforestation technique pioneered by Japanese botanist Akira Miyawaki that helps build dense, multi-layered native forests. The approach is supposed to ensure that plant growth is 10 times faster and the resulting plantation is 30 times denser than usual. It requires a very little

space (a minimum of 2 sq m). It involves planting dozens of native (indigenous) species in the same area, and becomes maintenance-free after the first three years. The overall density of the forest is beneficial in lowering temperature, making soil nutritious, supporting local wildlife and sequestration of carbon for a climate challenge since this method is more suited to building sustainable long-standing forests which kind of set up an equilibrium.

- Biodiversity census - a unique step/decision for any campus in urban setting. The biodiversity census has been carried out by Wildlife Institute of India located in Dehradun. The report records and details all the species of flora and fauna present on IITR Campus. This will help IITR in appreciating the natural assets and also to motivate students in keeping healthier environments around them. https://www.iitr.ac.in/GP/pdf/Biodiversity_of_an_Urban_Greenspace_IIT_Roorkee_Report.pdf

4.7 Education and Research

About 6.04% courses in IITR are related to sustainability including climate change; so much so that the institute uses 2.4 % of the total research funds for sustainability related research projects. A significant number of faculty and students work on different aspects of climate change in different departments.

- The average number of indexed publications (Google scholar) on environment and sustainability published annually over the last 3 years, in IITR is about 303.
- Organised Roorkee the first Edition by Biennial Water Conclave Feb 26-28, 2020 on theme Hydrological Aspects of Climate Change. <https://www.iitr.ac.in/rwc2020/>
- Many faculty members of IIT Roorkee are working on the life cycle assessment of the current research practices.
- Tree plantation program on Independence day and World Environment Day
- Health of air should be monitored, So, air pollution monitoring system can be installed as a green initiative in the inside of campus of Roorkee and Saharanpur
- There are about several student organisations related to sustainability, viz., National Service Scheme (NSS), Indian Green Building Council (IGBC) Student Chapter, ECO Group, Unnat Bharat Abhiyan (UBA), AWWA IITR student Chapter aimed at inculcating sustainability and mitigating/reducing ,climate change impacts and the importance of the environment in the campus community, finding solutions pertaining to the fields including proposing sustainable solutions for socio-economic problems by employing entrepreneurial skills.
- IIT Roorkee also have initiated preparing and publishing the annual sustainability report. The recent report is available at https://www.iitr.ac.in/GP/pdf/annual_Sustainability_Report_2020-2021.pdf

5.0 CONCLUSION

IIT Roorkee has implemented strategies under the heads of land, water, energy, waste, environment and education in order to mitigate climate change. IITR has taken significant steps in all these fields to reduce carbon emissions. Not just this, a proportionally significant effort is being put towards educating and training the younger generation of students which will enable us in taking the agenda of environmental sustainability and mitigation of climate change, a long way ahead.

