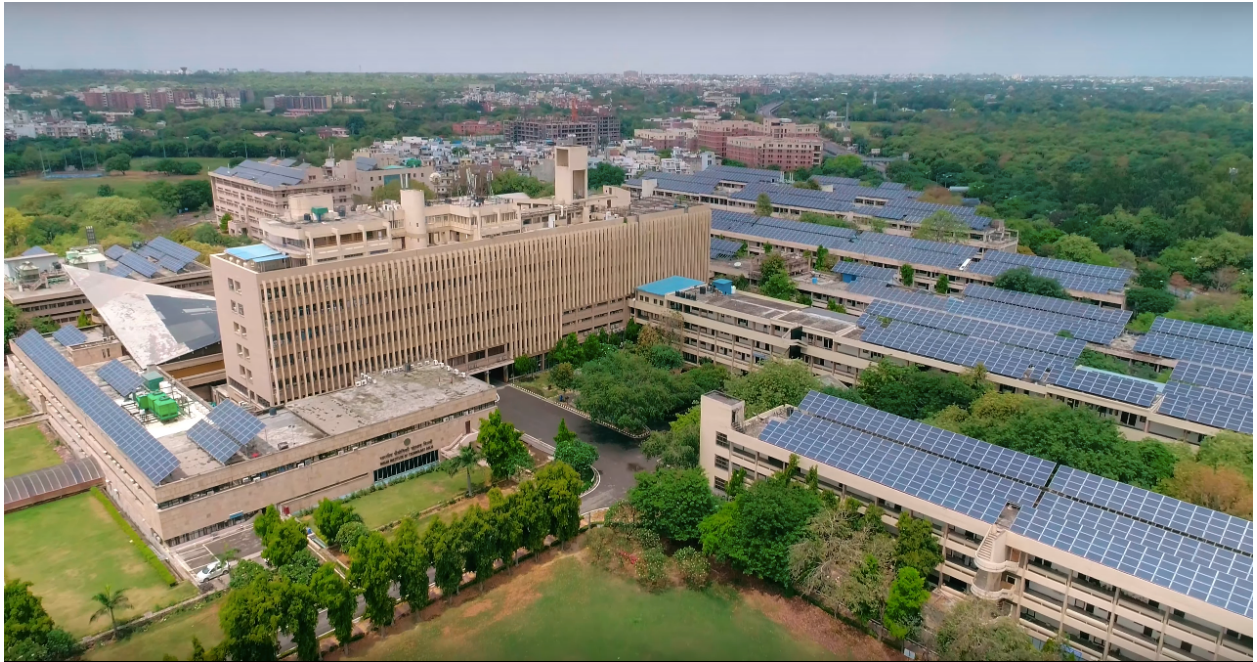


# IIT DELHI CLIMATE ACTION PLAN



2023

## FOREWORD



Dear Friends of IIT Delhi,

As a good global citizen, IIT Delhi is committed to finding sustainable and affordable solutions to the climate change problem. This also aligns with our mandate as a leading Centrally Funded Technical Institution to solve the nations' problems and prepare a workforce that can continue to serve the nation. We use this guiding principle in our multi-pronged approach to tackle the problem of climate change.

The mainstay of our efforts is a robust Climate Action Plan that establishes a roadmap to reduce emissions from the 2022 baseline by 50% by 2050 and achieve NetZero by 2070. We have already started taking concrete steps to achieve our ambitious goals. First, our green campus is leading by example. We have reduced our carbon footprint in the power sector by using 2.8 MW of peak solar available from campus rooftop installations. We have also introduced a range of practises such as bicycle rentals, hybrid rickshaws, CNG buses and electric vehicle charging stations to reduce our carbon emissions. We have developed a robust solid waste management program that includes separation at source, recycling, composting and biogas generation from biodegradable waste. As a result, only 50% of our solid waste reaches the landfills thereby reducing the emission of methane, a potent greenhouse gas.

Second, we have a vibrant research program that tries to understand the causes of climate change, develops cutting-edge, affordable solutions for climate change mitigation and adaptation, and designs policies to deploy such solutions. Atmospheric scientists in our institute are studying the patterns of climate change over India and building models to simulate these patterns. These models can even test different mitigation and adaptation strategies to evaluate their efficacy. Our engineers are engaged in research on better and cheaper wind turbines, solar panels, fuel cells, and electric vehicles, as well as software to manage them. All of these are geared towards reducing our carbon footprint. And of course, our work on disruptive technologies in energy storage and carbon sequestration is a giant step into a potentially carbon-free society.

Third, we are training the workforce of the future. Every year we graduate more than a thousand engineers and scientists equipped with skills to solve problems of today and tomorrow. Many of these students come out of programs that are directly relevant for climate change including

Atmospheric and Oceanic Sciences, Energy Sciences and Management, Environmental Engineering, and Water Resource Engineering. Furthermore, most students take courses or do projects on topics that have a direct bearing on sustainability and climate change.

Finally, we have created an enterprise-friendly ecosystem. We encourage our students and faculty to launch their own start-ups and provide them with incubation facilities. Many of these are already working on finding solutions to the climate change problem. We are ramping up our support for knowledge-based entrepreneurship by launching the new Research and Innovation Park managed by the Foundation for Innovation and Technology Transfer. We fully expect to support many more start-ups working on climate and sustainability issues.

We acknowledge that global warming is a formidable problem that will be solved only with sustained effort that must last for a long time to come. The actions taken by us so far are just the beginning. Our plans for the future include full accounting of our carbon emissions and developing a pathway to achieve Net Zero. We promise to continue these efforts to ensure a safe future for the coming generations



Somnath Baidya Roy  
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03.04.2023

## 1. CLIMATE ACTION PLAN

Climate change is perhaps the greatest environmental challenge faced by the world today. Science shows that climate change is primarily caused by increase in GreenHouse Gas (GHG) concentrations in the atmosphere. Hence, the primary tool in our arsenal to combat climate change is reduction of GHG emissions. The IIT Delhi Climate Action Plan is a step-by-step roadmap to combat climate change. The four cornerstones of this plan are given below:

- A. identify a emissions baseline, reduce emission with respect to the baseline and achieve NetZero earlier than the national deadline of 2070. The progress in emission reduction will be evaluated every two years and the plan will be updated every five years.
- B. Develop a complete emission inventory of all campuses of IIT Delhi. This will allow us to identify the sectors that contribute the most to our total emissions.
- C. Identify pathways to achieve the emission reduction goals using state of the art modelling tools that can optimize various available strategies. Apart from emission reduction, these strategies will also include carbon sequestration. Actively engage in developing new technology to enhance the strategies at our disposal.
- D. Establish synergies of our climate policy with our plans for future growth, in particular for the new campuses.

Our Climate Action Plan sends a strong signal to the global community that IIT Delhi is playing an active role as a good global citizen to solve a global problem. is an ambitious effort that will require the support of the entire IIT Delhi community. We are confident in our ability to execute this plan to achieve our climate goals and be a role model for academic institutions worldwide.

## 2. CURRENT STATUS

### A. Energy Management

Despite growing power needs for an expanding campus and the recent addition of two new campuses, IIT Delhi has made large strides in reducing our carbon footprint in the electricity sector. In 2021, IIT Delhi was the first Centrally Funded Technical Institute to reduce its carbon footprint in power consumption by almost 50% with rooftop solar installations on academic buildings on the main campus (~2.8 MWp) as well as 2 MW hydropower from a Jammu & Kashmir based generator. The power purchase agreement is currently in abeyance to resolve contractual

issues. We expect it to be back in operation soon. Table 1 provides more details on our power consumption for 2022.

<b>TABLE 1: IIT Delhi power data for 2022</b>	
<b>Total electricity consumption</b>	3,59,00,000 kWh
<b>Solar PV generated on campus</b>	37,00,000 kWh
<b>Total carbon emissions saved</b> Assuming 1kWh Coal based generation emits 0.81 kg of CO <sub>2</sub>	2960 Tonnes

### **B. Energy Efficiency Measures**

Electrical fixtures (including lighting) and air conditioning units around campus are being systematically replaced with more efficient replacements to take advantage of increases in energy efficiency. Our new Lecture Hall Complex that covers 15% of our academic area has received 5-star Griha rating. Upcoming buildings in the academic area have been designed with air conditioning systems having a Coefficient of Performance (COP) of 3.1 to 4.2 at full load for VRF ACs and 5.4 to 6.3 for the water-cooled chiller. Most of the fenestration installations are Griha compliant.

The IIT Delhi supercomputer Padum uses chilled water-cooling technology and other innovative energy-saving measures making it a “green” supercomputer. When it was inaugurated in 2015, it was ranked 28th in the Green500 list of the world’s most energy-efficient supercomputers.

### **C. Solid Waste Management to Protect Environment**

IIT Delhi has improved its solid waste management in recent years. Waste from domestic, hostels and horticultural sources are collected from campus and biodegradable waste and recyclable waste are segregated. Biodegradable waste is used in biogas generation. A pilot-scale biogas production plant having a capacity of 25 m<sup>3</sup>/day has been established in the *Mahatma Gandhi Gramodaya Parisar* of IIT Delhi. This plant uses 250 kg of kitchen waste per day, segregated waste collected from various households and hostels inside the campus to produce biogas and compressed biomethane as demonstration models of proper waste management to produce fuel and biofertilizer for in-campus horticultural application. This activity was taken up under the institute’s initiative “Working Group on Waste Management”. The biogas produced by this plant

is being upgraded to natural gas quality fuel in a biogas purification and bottling plant situated in Biogas Production and Upgradation Laboratory. It uses a water scrubbing-based system (20 Nm<sup>3</sup>/h of biogas) that has been patented by IIT Delhi. Further, the upgraded CBG is being used as vehicular fuel to substitute CNG.



Segregated kitchen waste in IIT Delhi campus



View of anaerobic digester running on kitchen waste

Horticultural waste is composted and used extensively on campus to conserve soil carbon. After segregating for recycling, only 50% of our solid waste reaches the landfills thereby minimising methane emissions. We are working with an NGO Chintan in this regard and plan to become a zero-waste campus soon.



Biogas enrichment and bottling facility



CBG filling in car

#### **D. Water Conservation and Management**

IITD has set up a 1.5 MLD Sewage Treatment Plant (STP) that reduces untreated water discharge from the main campus that treats. Currently, the STP treats about 0.8 MLD of wastewater. The grey water from the STP is extensively used for horticulture on campus. We have also initiated a comprehensive rainwater harvesting program.

## E. Campus Mobility

The IIT Delhi campus has been rapidly transitioning its preferred mobility and is quickly gearing up for the coming surge of electric vehicles.



In July 2019, cycle rickshaws on campus were converted to battery powered E-rickshaws enabling the operators to transition from human-powered to battery-powered mobility. Currently, about 10 such e-rickshaws operate on campus. Battery powered blue Yulu e-bikes have become a hit on campus with more than 100 e-bikes

easily available at designated locations for users to rent for short rides around campus and nearby Metro stations and shopping centres.



Three free charging points for electric vehicles have been installed on campus having both AC and fast-charging DC options. More are planned to provide charging points in the residential areas as well as for use by the transport unit.

Visitors to campus can also avail of battery powered shuttle service from the visitor's parking lot to the academic area. CNG powered buses ply on campus and provide transport once a day to IITD's Sonipat Campus.

## 2. ACADEMIC SYNERGIES

IIT Delhi's mission includes the generation of new knowledge by engaging in cutting-edge research and to promote academic growth by offering state-of-the-art undergraduate, postgraduate, and doctoral programmes. Based on an informed perception of Indian, regional, and global needs, the institute has identified areas relating to energy, climate, and sustainability to concentrate its efforts both in the area of cutting-edge collaborative research and to develop human potential to its fullest extent so that intellectually capable and imaginatively gifted leaders can emerge.

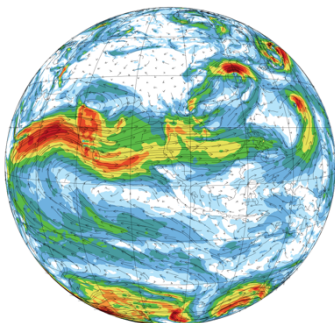
### A. Teaching and Learning

Being an academic institution, IIT Delhi makes a broader impact on understanding climate change and finding solutions through teaching and research programs. The Department of Energy Science and Engineering offers a B.Tech., three M. Tech., M.S.(R) and Doctoral (Ph.D.) programmes focused on training the manpower to meet India's energy transition. IIT Delhi offers more than 30 courses related to various aspects of climate change, ranging from the science of climate change to impacts, adaptation, and mitigation technologies (such as renewable energy and carbon capture & storage) and policy responses to climate change. These courses are offered both at the undergraduate and postgraduate levels. A large fraction of scientific human resources in climate science in India have been educated at IIT Delhi. IIT Delhi faculty actively contribute to the development of policy frameworks to address climate change at local, national, and international levels

### B. Research and Innovation

#### Climate Science

IIT Delhi faculty are doing research on a wide range of problems in climate science, such as physical understanding of regional and global changes in climate, climate modelling, climate change detection and attribution, effects of land use land cover changes on regional climate, renewable energy meteorology, and effects of climate change on health, agriculture, water resources, transportation etc. Currently, IIT Delhi is carrying out eight externally funded projects on physical climate change and another seven projects that investigate the impacts of climate change on the health, energy, water, and food sectors.





## Renewable Energy

Renewable energy is a key area of research across various units of IIT Delhi. Ongoing research areas include Renewable Energy Meteorology, Solar Photovoltaic Devices, Solar Thermal Energy Systems, Electrical Power and Renewable Energy Systems, Energy Storage, Wind and Hydro Energy, Internal Combustion Engines and Alternative Fuels, Bioenergy and Energy System Simulation. Climate scientists are analysing atmospheric data to estimate availability of wind and solar resources. Meteorologists are building new models using numerical and artificial intelligence techniques to forecast wind and solar energy availability at multiple time scales to help in the grid-integration of renewable energy. Engineers are designing new materials and components for solar panels and wind turbines. One particularly exciting project is taking a second look at vertical axis wind turbines that are cheaper to maintain and operate. The Renew Power Centre of Excellence for Energy and Environment has been set up in 2017 with industry funding to facilitate real-world application of scientific advances made in our laboratories.

## Energy Storage Platform on Batteries (ESPOB)

The DST-IITD ESPOB Centre established in 2018 is a consortium of 6 Institutes led by IIT Delhi. The ESPOB Centre is actively working on following energy storage technologies. Flow Batteries, Supercapacitors, Fuel Cells, Electrolyser, Li-ion, Na-ion, Mg-ion and Al-ion batteries as well as Li Recovery. The Sustainable Environenergy Research Lab (SERL) in the Department of Chemical Engineering is working on Vanadium Redox Flow Battery (VRFB). The team has installed a charging kiosk in powered by a VRFB prototype for charging personal gadgets with plan to scale up to a e-vehicle charging facility.

## Electric Mobility

The institute has a dedicated unit, the Centre for Automotive Research and Tribology, to work on electric mobility. Researchers at the centre design electronic controllers and health monitoring systems, batteries, and charging systems for electric vehicles. The centre is about to start an MTech degree in Electric Mobility to build the workforce for the future.

## Micro-grid Technologies

Major research on Microgrid management, control, protection, and security is carried out by faculty of IIT DELHI. There is a plan to set up a micro-grid at IITD Hauz Khas campus as well as Sonipat campus in the near future. One IUSSTF / DST funded project of around 7 Crore, with a major component on microgrid is ongoing.

## Biogas

The Indian Institute of Technology Delhi has started an initiative for making campus clean and green, by utilising the biodegradable waste generated in the campus (hostel and household areas). The biodegradable waste is being used for energy production and to cut down the greenhouse gases emissions providing sustainable development along with the cleanliness of the campus. The Biogas Development and Training Centre (BDTC) is an initiative of the Centre for Rural Development and Technology, IIT Delhi is engaged in the research and development of biogas-related technologies.

## Waste-to-wealth research and carbon capture and conversion

Circular economy provides vision to minimise the negative environmental impact and maximises resource recycling (energy and materials) from waste streams. Research is being carried out in developing eco-friendly processes to mitigate various waste streams such as electronic waste, plastic waste and agro waste. For electronic waste, we have developed a closed-loop process by integrating pyrolysis and low-temperature roasting techniques to recycle valuable metals such as Cu, Ag, & Au. Conversion of RDF (Produce from municipal solid waste processing) and agro-waste is also going on in the laboratory to produce hydrogen rich syngas and other value added energy carriers. A pilot scale reactor having capacity of 50 kg/day has been designed and installed at IIT Delhi campus to treat electronic waste and plastic waste streams. Apart from waste mitigation and resource recovery, there is also a focus on capture and conversion of CO<sub>2</sub>. For the capture purpose vacuum pressure swing adsorption technique is being utilised and the development of efficient adsorbent for the selective CO<sub>2</sub> capture from flue gases is being investigated. For the conversion aspects thermo-catalytic, photo-catalytic and photo-electro-catalytic processes for its conversion to desired fuels and chemicals are being studied. The aim is to maximise the conversion and production of valuable fuels/chemicals to meet the rising energy demands.

## Public Policy

The School of Public Policy has multiple strands of work relating to climate change. In terms of climate mitigation, faculty members are working on a diverse range of topics, including just transition, renewables integration, and industrial transformations. There also is a research partnership with the Harvard Kennedy School on deep decarbonization. SPP is also exploring similar partnerships with other entities. In climate adaptation, there is some ongoing work on

disaster management as well as adaptation in agriculture. We also are working with CAS on examining ways to strengthen the climate science-policy interface. Faculty members also engage with domestic policy makers and other stakeholders. Internationally, they have been involved in the IPCC AR6, in a US National Academies' study on solar geoengineering and the UN's Global Sustainable Development Report 2023.

### **C. Start-ups incubated at IIT Delhi**

IIT Delhi provides an ecosystem for new ideas and technologies to be incubated and accelerated. Numerous start-ups are currently working on aspects related to climate change, renewable energy, and environment.

#### **Tensor Dynamics**

Tensor Dynamics uses advanced weather data and numerical models ensembled with deep learning techniques to solve emerging problems arising due to weather variability and climate change in energy, agriculture, transportation, and other sectors industries. Their first product SKYCASTER™, a weather forecast API platform, allows precision scheduling of wind and solar power to reduce curtailment risks for the power grid and reduce penalties for independent power producers.

#### **AHODS Technologies**

The start-up has developed a patented AHODS (Advanced Hydrogen On Demand System) for fuel efficiency and emissions minimisation. The AHODS system can be installed on vehicles and can produce Hydrogen which can be used directly as fuel without the need for its storage on the vehicle. Currently, the start-up is validating the prototype on a test vehicle where the fuel is used in combination with the generated hydrogen to provide a higher fuel efficiency and lesser emissions.

#### **BatX Energies**

BatX Energies has established coherent R&D with green thinking as their driving force, which resulted in state-of-the-art technology proprietary and cost-effective "zero-emission-zero-waste" technology for recycling and recovering lithium, nickel, manganese, and cobalt up to 95 percent purity from Lithium Ion Batteries. BatX is driving Eco-green for the lithium-ion battery ecosystem, has prevented 220K tons of lithium-ion battery wastes from going into the soil and was able to reduce the pollution caused by the mining of these critical metals.

## Accacia

Accacia is an AI-enabled platform to help real estate and infrastructure organisations (developers, asset managers, financial institutions, operators, and governments) meet their net-zero goals. Their platform automates the measurement of scope 1, 2 and 3 carbon emissions for operating assets and embodied carbon for under-construction assets. A platform uniquely designed for real estate and infrastructure sectors, it also helps asset managers track environment-related climate risks for their portfolios. The combined assessment of transitional and environmental risks allows them to generate targeted decarbonization plans for the assets and accurately quantify the climate risks on the assets. It has already been deployed over 20 million square feet of real estate in Asia.

## 3. FUTURE ACTIONS

We will build on the first steps detailed above to further advance our climate goals. Some of the future actions that we have planned for the immediate future include:

- A. Next 2 years: Identify a baseline for emission reduction and develop an emission inventory of all IIT Delhi campuses.
- B. Next 3 years: Preliminary SCOPE 1 emissions indicate that the power sector is responsible for most of our emissions. To accelerate our intervention in this sector. For this purpose, we plan to add about 2.5 MWp solar capacity on campus and 1MW from hydropower to the electricity mix. Additionally, we will also enter into a Power Purchase Agreement with a waste-to-energy plant for 1MW to augment these.
- C. Next 5 years: Identify pathways to achieve our emission reduction goals using advanced computer models.

