

**A GREEN CAMPUS
COMPENDIUM
INCUBATION, EXPERIMENTATION
AND DEMONSTRATION
OF A GREEN FUTURE**

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efficiency



Solar
power



Passive
design



Rainwater
harvesting



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management



Campaign



Policy



Agro-forestry



Shared
mobility



Low carbon
mobility



Disposable
free



Wastewater
treatment



Green cover

INTRODUCTION

Anumita Roychowdhury and Rajneesh Sareen

Why green campus?

India is desperately seeking solutions to several environmental challenges that have undermined overall health and wellbeing. These challenges are related to contamination of air, water and soil, vulnerability of regions to climate change and extreme weather events, resource inefficiency and wastefulness, and erosion of local biodiversity. It has not yet been possible to adopt cohesive planning to enable resource efficient, inclusive, and sustainable approaches within larger urban systems. Several sectoral policies have emerged to provide a regulatory guidance framework for integrated and well-aligned interventions to enhance environmental management for improved liveability, health and climate responses of cities. However, demonstrating that change on a city-wide basis has still remained a challenge.

What can be a better laboratory for experimenting, incubating and demonstrating this change than the microcosm of institutional campuses that are complete ecosystems? There are large number of institutional campuses of varying shapes and sizes—schools, colleges, etc.—which can adopt a system wide approach to environmental sustainability, promote environmentally responsible practices and behaviour, experiment with innovative solutions, combine learning and practical application, and add educational values.

An aware citizenry of these campuses can consciously

and deliberately unleash improvement in all aspects of the ecosystem. Simple steps and a collective environmental audit can reduce inefficiencies in use of water and energy, reduce waste, promote local greenery to conserve biodiversity and reduce heat island effect, improve water holding capacity, promote alternative sources of energy, and achieve considerable resource savings. This can even lead to curriculum based hands-on problem solving experience for the campus residents while promoting real life work experience and education.

The gains are not limited and confined within the campus boundaries but they also have a multiplier effect across the urban scape. Moreover, this also allows regulatory compliance and cost savings. The green campus movement can unleash unprecedented transformation if achieved at a scale.

What is CSE's green campus initiative?

The good news is that this change has taken root in several campuses across the country. While most of these are still very nascent, some have progressed considerably, and the direction of change is firm and certain.

To support and encourage this trend and push the sustainability agenda in campuses, the Centre for Science and Environment (CSE) launched its Green Campus Initiative in 2017. CSE believes educational institutions serve as important incubators for developing a 'green' sense among students and teachers and create a new generation of professionals to drive the future change. Green sense is the sensitivity towards environment that is addressed in our decisions, practices and general lifestyle.

Imagine the scale of this laboratory. There are 993

universities, 39931 colleges, and 10725 stand-alone institutions in the country according to the All India Survey on Higher Education 2018–19. Inculcating these campuses and its inhabitants with the green sense, which goes beyond environmental education, can substantially help mitigate the country's resource burden and deteriorating environment.

More and more universities are acknowledging green sense and are now aiming to reflect it in day-to-day practices on the campus. They are transforming places of formal learning into low carbon habitats that are resource prudent and less wasteful.

Even the governments are supporting this transformation with their guidelines and mandates. For instance, Ministry of Environment and Forests and Climate Change is shaping its programme on green campuses. Indian government's National Assessment and Accreditation Council (NAAC) has included an environmental sustainability criterion in their rating of educational institutions. Multilateral agencies like UNEP are now making a guidance framework for green campuses.

CSE's Green Campus Initiative was launched to acknowledge these efforts, and to come up with a reliable method by which campuses can organise, measure and keep track of their efforts. The initiative also serves as a forum for institutions to exchange ideas, knowledge and lessons and to demonstrate good practices for cross-learning. Learning from each other's failed experiments and best practices can eventually enable resource savings, reduce waste generation and achieve other co-benefits.

Meanwhile, we understand that the NAAC rating criteria can be further improved to incentivize green

initiatives by campuses. For example, spearheading campuses should get due credit. Campuses that are able to adapt the quickest to changing environmental needs should get credit. CSE is developing a green rating criteria for campuses to catalyse this change.

Making change happen

CSE's Green Campus Initiative is an enabling platform for those educational campuses which strive to embark upon or continue their journey of resource prudent practices and methodologies pertaining to areas of significant environmental concerns, e.g. land, energy, water, waste, air etc.

Practitioners are not only capacitated for this role but are provided support to institutionalise best practices in selected campuses. It's a process driven exercise which generally starts with early stage interactions with management, community and technical teams (green teams). They set objectives, baselines, priorities and roles and responsibilities to undertake skill and capacity building, and hold campaigns, open houses, and interactions. Various financial and management responsibilities join hands in different compositions to establish a functional green educational initiative.

CSE plays the role of a facilitator and knowledge provider under the initiative. In this long journey, CSE starts off with sensitizing educational institutions and imparting the green sense to educators. Campuses then express their motivation to work under CSE's initiative. CSE develops this group by training them on methods and techniques to evaluate their campus and identify opportunities to improve using our knowledge resources. This includes multiple visits to the campuses and

meetings with the decision makers to influence them to work towards greening their campus. This process gradually evolves institutional structures such as green teams or committees with clear roles and responsibilities.

After institutionalisation, CSE helps develop the formal structure with a constitution which sets out their commitment or vision and clearly defines the roles and responsibilities of different actors and the scope of their work. CSE helps campuses identify projects required to realise their objectives on the ground and extends related technical and economic know-how. The entire process informs the institution, instils confidence and enables it to take action. This action includes preparing project or grant proposals which the team may pitch internally or externally to public funding institutions.

Any kind of project implementation needs expertise. CSE connects the institutions with experts and facilitates implementation of the projects. When projects mature, it is critical for the campuses to be versed with their upkeep procedures. CSE's Anil Agarwal Environment Training Institute (AAETI) plays an instrumental role in familiarising institutions with efficient operations and maintenance. The facility enables demonstration-based learning along with intensive capacity building. CSE regularly takes the institutions to AAETI to meet their specific requirements.

The journey

CSE prepared a toolkit—Green Sense: Educational Campus Inventory—that helps campuses to understand and document the ways in which they consume resources and generate waste. The toolkit includes questions on the themes of land, energy, air, water, and waste relating to

consumption, conservation, operations and awareness. This documentation establishes a baseline scenario for a campus, which informs the institution on areas that could be prioritised for action. This prioritisation gives a clear mandate and goals to campuses aimed at improving their environmental performance.

The toolkit was launched in August 2017 in Kolkata in a Regional Knowledge Conclave hosted by St. Xavier's College, Kolkata. Since then, a number of workshops have been organised in different parts of India to sensitise more than 500 educators, according to CSE's Environment Education unit. For instance, a number of workshops in Delhi, a south regional conclave at JSS college in Mysuru, a north regional conclave at Guru Nanak Dev University in Amritsar and national conclaves at the Anil Agarwal Environment Training Institute.

The initiative completed its second year in 2019. This continuous engagement has helped to bring more and more institutions to participate and celebrate change. Institutions like Gargi College (Delhi University), St. Xavier's in Bhubaneswar, Ramakrishna Mission Vivekananda Centenary College in Rahara, and National CPWD Academy in Ghaziabad, are the ones that have been a part of this journey or associated with the journey since the beginning. Then there are the ones who came on-board recently such as Assam Don Bosco University and TKMM College, Alleppey district.

The institutions are taking nuanced steps for sustainability at their own pace. While some of the campuses have just started forming their green teams/committees, some of them are actively campaigning towards identified issues. While a few are drafting their plans to switch to low-carbon approaches, a few have

already procured and installed such infrastructure under their greening regime. Regardless of their nature and extent, these initiatives have a strong bearing on continuity and commitment. Regular documentation, evaluation, monitoring and responsive action require much dedication to ensure impact.

Showcasing change

This compendium is the beginning of an effort to bring together the initiatives taken by campuses that are part of the CSE's network. It captures the common but also the unique and region-specific initiatives that campuses have undertaken. This will help their knowledge and ideas reach a wider audience and bring in the next set of change-makers.

This compendium has showcased initiatives of five educational institutions in their respective campuses. They are among the frontrunners in the network. These include Ramakrishna Mission Vivekananda Centenary College, Rahara, West Bengal; Guru Nanak Dev University, Amritsar, Punjab; Assam Don Bosco University, Guwahati; Gargi College, New Delhi; and national CPWD Academy, Gaziabad Uttar Pradesh. While Ramakrishna Mission Vivekananda Centenary College had already embarked on their green journey before this network was launched, several others started their initiatives with this network.

This compendium compiles and classifies their initiatives in five segments: Energy, Land, Air, Water and Waste. Each is assessed through a wide range of parameters. The campuses that have participated in this process have shared with enthusiasm information on a wide variety of their initiatives.

Energy—Passive building design strategies, energy efficient fixtures, renewable energy generation, campaigns/workshops encouraging responsible energy use.

Land—Green gardening strategies like mulching, drip irrigation and hydrozoning, land utilization through agroforestry or kitchen gardening, tree density, land permeability, cultivation using native, drought-tolerant plants as well as campaigns/workshops educating people.

Air—Green mobility and infrastructure provisioning it, indoor plantations, use of non-toxic chemicals, campaigns/workshops encouraging students and staff to switch to non-motorized transportation or public bike sharing, etc.

Water—Initiatives to encourage responsible water management via rainwater harvesting, wastewater treatment systems, water efficient fixtures installed in the campus, campaigns/workshops encouraging responsible water use.

Waste—Waste Segregation, inorganic waste management, organic waste treatment, campaigns/workshops educating students regarding waste segregation, single-use plastics, etc. and policies adopted for solid waste minimization and management.

Apart from these parameters, the campuses are also assessed on aspects such as policies, campaigns, and awareness programmes, among others. Policies such as specifying sustainability criteria in procurement rules are low hanging fruits which do not always require cost-intensive physical infrastructural changes but can be as impactful in bringing about resource efficiency and sufficiency.

Even though the initiatives in these five campuses

are fairly new and are in different stages of progress, interesting changes have started. Ramakrishna Mission Vivekananda Centenary College with its installed solar systems has already incurred energy savings worth Rs 4.70 lakh a year while its effort to conserve biodiversity is also impressive. Guru Nanak Dev University is already treating 2.5 million litres of wastewater. About 60 per cent of its solid waste is segregated and sold. Gargi College has started a zero waste campaign called “Bring your mug” to cut down plastic waste. It has installed a rainwater-harvesting system with a capacity of 606,000 litres. Assam Don Bosco University has initiated agro forestry at a massive scale to conserve biodiversity. It has also created an artificial lake spread across 10 acres. The Academy and training institute of the Central Public Works Department in Gaziabad has achieved significant electricity savings with its energy efficiency measures like LED lights and star rated electrical appliances. It has got cost benefit of Rs 14 lakh in energy savings just in eight months. It is harvesting 215 million litres of rainwater—roof water contributes about 22 per cent of this potential and the landscape about 45 per cent. These new initiatives have already demonstrated verifiable change.

The learning

The most remarkable aspect of this initiative is the eagerness of participating institutions to share data and information which can help them strengthen their own interventions and also help other institutions who want to take up the initiative.

The green campuses included in this compendium have developed their respective strategic plans. Several of them have teams of teachers and students that

work closely with the administrative staff. This opens up the opportunity to integrate these efforts with their curriculum, thus also utilising the classrooms to enhance practice based learning. It is encouraging that the faculty and students, as well as the institutional authorities, are committing time and resources to make the change happen. They are generating and assessing information on the environmental performance of the institution and the campus through an environmental audit approach. This requires scrutiny of daily operations to track pollution prevention, managing waste streams and energy use, and promoting environmentally friendly practices.

To bring more precision they are also generating data to track the quantum of change that has been possible. Thus, making the initiatives more verifiable and monitorable. This compendium has helped to bring together this information to indicate the direction and scale of change. It is notable that these institutions are accessing professional and expert help to design systems and seeking knowledge support to enhance their action.

Wherever possible the institutions are leveraging available state government or central government programmes and funding for resource efficiency and decentralized renewable energy. They have mobilised resources to implement various schemes and meet the cost of change.

For several of them system-wide environmental management is a long term commitment and they are continually and progressively working according to the results of the environmental audit. Securing this commitment is critical for the scale of change in the future.

Way forward

It is deeply hoped that while these campuses will take their initiative forward, become front runners and set the highest possible goals for environmental sustainability, more campuses will come forward to launch or scale up green campus initiatives and share information on their experiments to help create a strong cross learning platform.

It is also expected that this bottom-up learning will further help to strengthen the top-level policies on resource efficiency and sufficiency to take the green campus movement forward. NAAC rating of educational institutions can integrate a range of comprehensive parameters to strengthen the process and catalyse bigger change.

With an expanding network of campuses nationwide, CSE will take this initiative forward and continue to inform and evaluate the emerging initiatives and award campuses based on their respective achievements. With this system, campuses will learn the benefits of resource savings and improved wellbeing that the larger urban centres need to emulate.



Population

800+



Area

24.28 ha



Climatic zone

Warm and humid

RAMAKRISHNA MISSION VIVEKANANDA CENTENARY COLLEGE

Ramakrishna Mission Vivekananda Centenary College (RKMVCC) is in Rahara in the state of West Bengal. Popularly known as Rahara VC college, it is approximately 19 km from Kolkata. The college started functioning in July 1963.

'GREEN' INITIATIVES OF THE CAMPUS



Energy

RKMVCC has had an energy audit done by the Indian Institute of Social Welfare and Business Management, Kolkata. The audit has led to the adoption of energy saving measures. Tubelights have been replaced with LED lighting fixtures; older fans replaced with more energy-efficient fans. Occupancy sensors have been installed to control lighting systems.

The college has rooftop solar with a capacity of 72 kiloWatt-peak (kWp). It has also installed solar-powered heaters.

Passive design

The campus uses high thermal mass in its building walls, while the form of the buildings provides good ventilation. This has a direct



THE ASSOCIATION

The college has been associated with CSE for over three years now, and we are really honoured to have this association. Our staff members actively communicate with CSE for conducting several events through the year. Going forward, we want to undertake many innovations in the area of environment on our campus.

DR SWAMI KAMALASTHANANDA
Principal

CSE's association with RKMVCC began at a Regional Conclave held in August 2017 in Kolkata, where CSE launched its Green Campus toolkit. Many colleges of West Bengal, including RKMVCC, had attended this launch. Following this, the college initiated the process of data collection with support from CSE.

CSE extended knowledge support to help the college undertake a number of 'green' measures—ranging from installation of mechanical composters and vermicomposting pits, to a rooftop rainwater harvesting system and a solar PV system to increase its renewable capacity.



impact on energy consumption as the building's air-conditioned spaces get restricted to only the seminar halls and laboratories.

Moreover, the large water bodies and high tree density on the campus and around it help bring down the ambient temperatures.

Catching the rain

The college has installed a rainwater harvesting (RWH) system, which caters to 20 per cent of the demand. The water that is harvested is used for experimental gardens in the Botany Department and for horticulture. The rooftop water is diverted to ponds.

Waste to restore

Organic waste on the campus is turned into compost using waste converters, or by vermicomposting. The campus uses a paper shredder to cut down the used paper into smaller pieces, which is then sold to a recycler who uses it in the packaging sector.

RKMVCC is committed not to use furniture made of plastic. Its newly constructed 1,000-seater auditorium has steel furniture which can be recycled in the future.

VISION 2019-20

The college is working to install and functionalise the following on its campus:

- Solid waste management system
- Rooftop rainwater harvesting system
- Underground rainwater recharge system
- Kitchen emissions management system
- Automatic roof cooling system

THE COST FACTOR >>



219,369 kWh/year

Total electricity demand of the college



₹6.5/kWh

Rate of electricity



72,392 kWh/year

Electricity generated by the college's solar system



₹14,25,903/year

Electricity cost without the solar system



₹9,55,355/year

Electricity cost with the solar system



₹4,70,548/year

Savings due to the solar system



Population

12,200



Area

200 ha



Climatic zone

Composite

GURU NANAK DEV UNIVERSITY

Guru Nanak Dev University (GNDU) was established in November 1969 to commemorate the 500th birth centenary of Guru Nanak. Spread over 500 acres and catering to thousands of students, GNDU has set up a University Centre for Sustainability to propagate the agenda of sustainability in education, lifestyles and professional practice.

'GREEN' INITIATIVES OF THE CAMPUS



CSE AND GNDU—THE ASSOCIATION

Jaspal Singh Sandhu, vice chancellor, GNDU says, "we want a healthy and good quality of life for our children and students on the campus. Global experience shows efforts of governments and local agencies can bring about change in air quality. We too can turn the situation around, and the University is committed to bring about that change, starting from our own campus." The engagement with CSE, initiated in March 2017, has helped them do just that.

CSE has conducted some programmes on campus, the most notable of which has been CSE director general Sunita Narain's lecture on climate change, delivered at GNDU. CSE has also organised a Regional Conclave here, where educators from institutions across North India were hosted by the University to demonstrate the green features of the campus. The University declares: "GNDU takes pride that we have enabled cross-



GNDU has always believed in treading lightly on the earth and sensitivity towards environment has been a part of the campus culture. The engagement with CSE that started in March 2017 has helped in realising this belief to a good extent. In a time of nearly three years, the University witnessed quite a bit from the programmes conducted by CSE, most notable of which was Dr Sunita Narain's lecture on climate change at GNDU.

DR SARBJOT S. BEHL
Dean, Academic Affairs

learning for these institutions, and we are thankful to CSE for creating such platforms. We are fortunate to have faculty members whose meticulous work and determination for a green campus is being furthered to different institutions, for instance a pilot vermi-technology project was set up at the National CPWD Academy by GNDU, facilitated by CSE.”

Recently, the University was ranked a ‘Swachh Campus’ among the big campuses in India; it was also awarded for being the second most clean University among all government universities in the country.

The University’s Centre for Sustainable Habitat, with active training and knowledge support from CSE, has initiated pilot projects such as evaluation of sustainability in heritage buildings, quality of water in the campus, and quality of life in smart cities under RUSA2. The University has also started new courses on Master of Architecture (Sustainable Built Environment) and Master of Planning (Transport), and strengthened the curriculum of existing courses in the Planning and Architecture departments.



Sustainable mobility

Restrictions on cars: In 2017–18, GNDU instituted a strict ‘no-cars on campus’ policy for students. An RFID tagging system has been operationalised, which bars non-tagged vehicles from entering the campus beyond its large parking lots at the two gates of the University.

Bicycle sharing: A public bike sharing programme on the campus encourages students and staff to use bicycles instead of motorised vehicles. Smart bicycles are made available at a rate of Rs 175 per month, or a single trip for Rs 5 per 30 minutes, or a multiple single day trip for Rs 23. The University has set up bicycle docking stations across the campus to ease connectivity. The cycles are GPS-enabled and monitored, and can be booked through an app.

E-rickshaws: E-rickshaws are allowed to ply inside the campus to aid in mobility of the staff and students.

Green infrastructure: Provisions like tree-lined and shaded cycle tracks and bicycle stands have been

built along all the main routes on the campus.

Energy

GNDU has taken a few no-cost policy measures to curtail energy consumption on the campus. For example, use of ACs has been restricted to laboratories, assembly halls and offices of heads of departments.

Passive design

The majority of the building blocks in the campus are north-south oriented. This is the most appropriate orientation for a building according to the climate, as the northern and southern façades face less direct sunlight compared to the east-west façade.

The fenestrations have been provided with appropriate shading features with recessed windows and sun-shading devices that cut down the direct solar gain, while allowing natural ventilation and daylight. The University’s library building is an excellent example of the use of these features.

A GREEN CAMPUS COMPENDIUM

Academic buildings in the campus utilise the courtyard planning principles. This form takes advantage of the massing of the blocks surrounding the courtyard, keeping the central area shaded during most times, thus providing a relatively comfortable open community space.

The walls of the buildings in the campus utilise cavities up to 480 mm in width. This helps keep the heat out, making the buildings energy-efficient and ensuring thermal comfort inside the built form.

Solar power

GNDU has installed a 1.48 megaWatt (MW) solar PV plant on its campus. However, the Solar Energy Corporation of India has earmarked a total of 3.3 MW to be produced by the campus—the University is working towards reaching that target. The solar plant's implementation and management (for 25 years) has been outsourced to a Delhi-based private company, which will provide energy to the University at a subsidised rate of Rs 3.32 per unit.

Water

Rainwater harvesting: The campus has two rainwater harvesting (RWH) wells. Rooftop rainwater is directed to these wells through a drainage network. The campus has also adopted a mechanism of channeling rainwater towards large and open areas—the purpose is to enable maximum percolation of the rainwater into the ground.

Wastewater management: GNDU has its own wastewater treatment facility, with a current capacity to treat 2.5 million litres daily (MLD). The capacity can be augmented to 5 MLD in future if required. The treated water is used to irrigate the grounds of the campus.

Permeable pathways

Walkways have been made permeable as well to allow percolation and to absorb less heat.

Green cover

The campus maintains a botanical garden spread over 25 acres, and is a member of the Botanical Gardens Conservation International, UK. A glass house has been built for ferns, orchids, succulents, high altitude and tissue culture plants. The garden is home



to 200 plant species, and about 20,000 native trees, shrubs and climbers. The total number of trees on the campus is about 50,000. The University organises sapling distribution and plantation campaigns every year.

Mulching is used as a gardening strategy. It helps stop evaporation, and insulates the soil from the external climate. It also helps prevent compaction of soil, thereby contributing to the ecosystem needed for healthy trees.

Solid waste

The University's 400 residential units, 15 canteens, seven hostels and 40 departments generate about 200 kg of waste every day. About 60 per cent of this waste is segregated and sold to a private operator. Color-coded bins, each one having a capacity of 50 litres, have been placed all over the campus for disposal of waste.

To manage organic waste, GNDU has set up two vermi-compost technology units in its Botanical Garden. These units also function as educational and demonstration sites for staff and students. The University is planning to install a biogas plant that would use organic waste, initially only that generated by the hostels on campus. The biogas generated will be used onsite, in the hostel kitchens.

VISION 2019–20

The newly established University Centre for Sustainable Habitat will focus on

- Reducing planetary footprints and emissions
- Reducing resource consumption and waste
- The centre will aid research that will help environmental sustainability in the campus

GARGI COLLEGE

GARGI COLLEGE
UNIVERSITY OF DELHI

College with Potential for Excellence
Certified by University Grants Commission

Star College Grant
Awarded by Deptt. of Biotechnology
Ministry of Science & Technology



Population

4,500



Area

3.71 ha



Climatic zone

Composite

GARGI COLLEGE

Gargi College was established in July 1967 by the Delhi Administration to promote higher education among young women. The College offers an excellent example of how campaigns and policies can trigger change without the need for any major infrastructural modifications. A dedicated and passionate ‘green’ initiatives team, coupled with strong awareness campaigns, workshops and open-house talks have turned Gargi College into one of the more environmentally-conscious campuses in the capital.

‘GREEN’ INITIATIVES OF THE CAMPUS



CSE AND GARGI – THE ASSOCIATION

In 2017, CSE and Gargi College signed an MoU under the Green Campus Initiative. The association has resulted in extensive sensitisation of the faculty, students and staff of the College. It has helped them plan campaigns, and has trained them to generate knowledge for understanding the environmental performance of their campus—by preparing baselines, benchmarking, methods for improvement, strategies, etc. Most importantly, all this has been made a part of the College’s curriculum.

For instance, CSE has trained a batch of third year students of the Bachelor in Elementary Education course to collect data and prepare an environmental baseline for the campus. The batch has been evaluated for this exercise as a part of the course curriculum.



AVNI
THE ECO CLUB
 GARGI COLLEGE, UNIVERSITY OF DELHI
presents
A VISIT TO THE RAIN WATER
HARVESTING UNITS IN THE COLLEGE
guided by
Dr. Shashi Tyagi
 (Teacher- Convener, Eco Club)

Date: January 25, 2019
 Time: ECA (12:30pm)
 Venue: All are requested to assemble outside Botany Lab

Sakshi Kabra
 Student Convener
 (Eco Club)

Parul Bhati
 Student Co - Convener
 (Eco Club)



“ The collaboration with CSE has given a fresh impetus to our efforts in making Gargi a ‘green’ campus. We have benefitted from the training, support and direction provided by CSE—especially beneficial has been the training on eco-audit. The collaboration with CSE has deepened our understanding of critical environmental issues and helped us design our workshops and campaigns. ”

Dr Promila Kumar
 Principal

मेरा MUG

A zero-waste campus

Gargi College generates 325 litres of waste every day. Segregation is a key mantra on the campus, which has 69 colour-coded bins—52 (green bins) of these are for biodegradable waste and wet organic waste; 10 blue ones are for paper waste; three yellow ones are for lightweight packaging, plastics and metal; and four red bins are for hazardous wastes. The kitchen waste collected from the campus is turned into compost in five on-site composting pits.

The College is also experimenting with a biogas plant using the kitchen waste.

To become a zero-waste campus, initiatives like banning the use of plastic bags, straws and caps inside the campus have been undertaken. Campaigns such as ‘Bring Your Own Mug’ sensitize students and teachers to reduce the use of plastic as much as possible. Another campaign called ‘Own a Cup’ encourages students to collect 70 plastic cups, which the student can then exchange for a mug.

Education and awareness

The campus authorities, in association with the College's green committee Avni, have been regularly hosting campaigns and workshops with a vision to generate environmental sensitivity in not only the students and staff but also their families.

The College has been organising plantation drives in which more than 1,000 saplings have been distributed. The campus has also adopted a trend of gifting potted plants to its special guests and visitors with a vision to encourage tree plantation. A Sacred Garden has been set up in the College, where trees considered to be sacred in India have been documented. The College has also documented the botanical and zoological diversity (bird life) on the campus.

A 'Pathfinder Award' has been introduced: it is given to students who find innovative solutions to every-day problems. The initiative is aimed at encouraging student research on environmental subjects. Some of the subjects which have featured as Pathfinder research projects include alternatives to sanitary napkins, hazards of aluminium leeching, ecological

awareness in schools, green fashion, hazards of packaged food and benefits of organic food, etc.

The College's 'Mera Mug' programme has been one such Pathfinder project for researching on solid waste management on campus. Under it, students collected information related to solid waste management and conducted awareness programmes to sensitise their compatriots on waste management, with the focus on single-use plastics. The use of colour-coded bins, rainwater harvesting, solar panels, biogas plants and compost pits were assessed in this project. After the research, the students working under Mera Mug hosted a social media awareness campaign as well.

The College Eco Club regularly conducts workshops in which students are encouraged to prepare their own soaps and shampoos. This has had far-reaching results as it encourages them to consume less packaging even beyond the campus.

Harnessing the sun

The campus has installed solar PV panels that feed 40 solar-powered streetlights inside the campus.



Catching the rain

The campus has a potential rain-catching area (including the rooftop and surface area) of 1,600 square metres. It has a rainwater harvesting system with a capacity of 606 cubic metres or 606,000 litres. Rainwater is harvested at three separate locations on the campus.

The rooftop rainwater is first channelised into collection-desilting chambers. The water is then recharged into a harvesting structure which has a 35-m-deep bore well. The College organises rainwater harvesting sensitisation walks for its students.

VISION

Gargi College aims at achieving a 'zero waste campus' through campaigns and policies. The campus and its green team aim to create awareness among stakeholders towards a 'clean and green consciousness' by involving them in programmes, discussions and debates.



Population

900



Area

111 ha



Climatic zone

Composite

ASSAM DON BOSCO UNIVERSITY

Established in 2008, Assam Don Bosco University in Guwahati is the first university in India from the worldwide family of the Don Bosco Society. The University is committed to building up an eco-friendly campus, with its focus on sustainable management of water and land resources, efficiency in energy management, and conservation of the ecosystems, habitat, flora and fauna within its boundaries.

'GREEN' INITIATIVES OF THE CAMPUS



CSE AND ASSAM DON BOSCO UNIVERSITY—THE ASSOCIATION

CSE began its association with the University very recently. In March 2019, the Assam Don Bosco University (ADBU) registered itself with CSE's Green Educators Network. One of the first collaborations has been to include the University and its work in this inventory of green campuses. A CSE team has visited ADBU and acknowledged the 'green' features on campus; it has sensitised the faculty members on the methodology for collecting performance data. Following this, ADBU has started organising data in an informed manner that enables better decision making and achievement of the University's vision to become a sustainable campus.

CSE has invited ADBU faculty members to attend CSE's National Knowledge Conclave.



Agroforestry

The University began its work on creating a 'green' campus with its acquisition in 2008 of the Tapesia Gardens, an abandoned tea estate in its neighbourhood. A policy—An Eco-friendly Campus Policy of Assam Don Bosco University—has now been framed which lays down the guidelines to be followed.

The University is home to a variety of exotic species of birds, plants and trees. The campus has devoted a large area to plantations and agroforestry. Shaded walkways, decorative trees, and well landscaped and maintained lawns featuring shelters for birds are the key features of the campus. Initiatives have been deliberately taken to maximise benefits from the available land.

The University has embarked on a plantation drive spread over 190 acres of its campus at Tapesia. MOUs have been signed with five National Boards (coffee, rubber, coconut, cashew nut and tea) for demonstration plantations of 4 ha each, to serve the following purposes:

- Demonstration of model plantation
- Seed and sapling production
- Extension work in the neighbouring villages
- Research on hybridisation

- Mass multiplication
- Pest resistance

Variegated cropping of tea, coconut, rubber, cocoa, cashewnut, agar, ginger and turmeric has been established as livelihood projects within the scope of demonstration farms and seed gardens to promote scientific research in crop development and inter-cropping. Once they start yielding, the university will promote such plantations in the nearby villages and facilitate farmers' cooperatives by providing them with managerial and marketing expertise.

Marginal strips of unused land at the Azara Campus are being utilised for a small kitchen garden, and for planting bananas and papayas. Over 20,000 trees and plants of various types have been planted in the campus over the last 10 years alone.

The campus regularly hosts campaigns to sensitise students and staff towards environmental sustainability. Regular plantation drives are held.

Energy efficiency

The campus has taken important initiatives in minimising the use of conventional energy sources by switching on to energy-efficient lighting fixtures. Air conditioning



DEMONSTRATION FARMS

Frontline Technology Demonstration Farms within the University, equipped with new and sustainable farming techniques, will demonstrate the utility of the produce and the financial possibilities of variegated agroforestry to students, their parents and visitors to the University.

has been restricted to very few rooms. The University has entrusted the Departments of Electrical and Electronics Engineering to conduct an energy audit in the campus.

The campus has a total connected load of 621 KW. It has installed a solar PV plant of 320 kWp to make use of the available rooftop area—this meets 52 per cent of the University's power demand at peak performance.

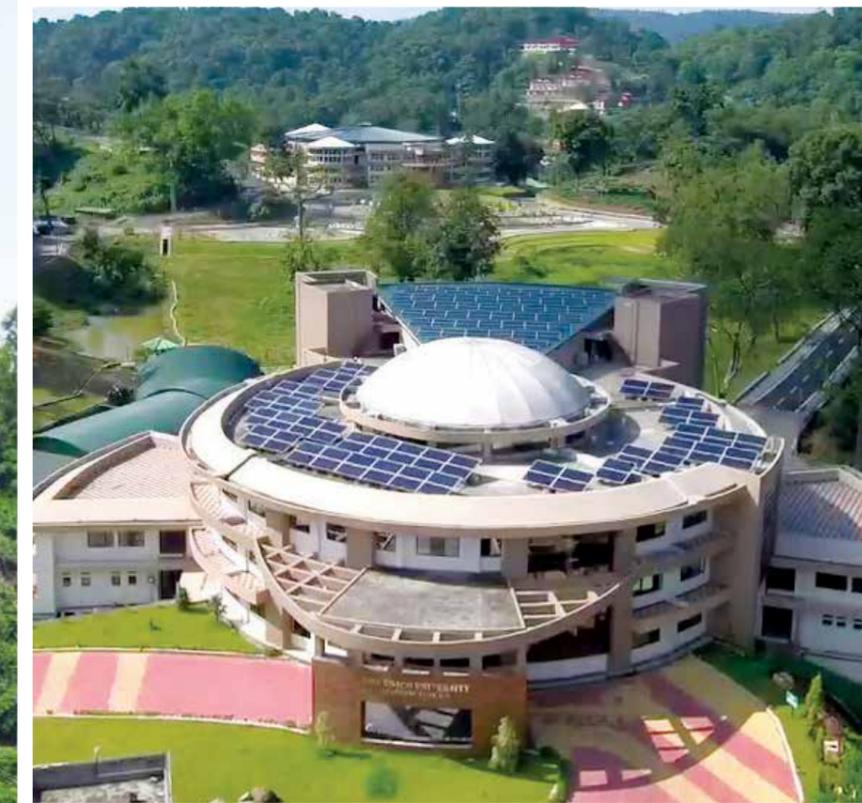
Passive design

The campus has incorporated passive building design features by using shaded windows and pergolas as shading devices. The design of the windows and doors with grills has been done in a way to facilitate natural ventilation. As an experimental feature, an earth-air tunnel is used in the academic blocks. The model will be replicated throughout the campus if it delivers the desired benefits.

Catching the rain

The University has invested in significant resources to ensure water harvesting and sustainable water and storm water management. It has created an artificial freshwater lake spread over 10 acres, with an average depth of 30 feet, by constructing a check dam across a permanent small stream that passes through the campus and tapping several perennial springs in the adjacent areas.

The campus has three bore wells that cater to its water requirements. Five minor reservoirs, each with an area of an acre or more and 15–20 feet in depth, have been created with bunds/check dams around existing permanent springs. By utilising these, the campus looks forward to the possibility of building micro-hydel power plants in the coming years. Assam falls in a flood-prone zone; the reservoirs help in water harvesting, storm-water



management and replenishment of the groundwater table. Apart from this, four freshwater fisheries, each covering 4 acres, hold the water during floods.

To allow water to percolate and to reduce runoffs, pervious walkways have been provided all over the campus. They also help in reducing the amount of heat that is absorbed by the hard paved areas.

VISION

To create and sustain an eco-friendly campus with clear-cut goals and priorities in the management of water resources, energy sources and consumption, preservation of flora and fauna, conservation of ecosystems and wildlife, and productive use of the land for all.



Population

over **900**



Area

14.56 ha



Climatic zone

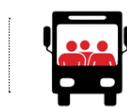
Composite

NATIONAL CPWD ACADEMY

The National CPWD Academy in Kamala Nehru Nagar, Ghaziabad, has been declared a 'Centre of Excellence' by the Union Ministry of New and Renewable Energy for promoting sustainable and 'green' building and construction qualities. The Academy has undertaken initiatives to become energy-efficient, harvest rainwater, and manage its solid waste.



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THE CSE-CPWD CONNECT

While CSE and CPWD have been working together for some years towards building capacity of CPWD's architects and engineers, the Academy came on board CSE's Green Campus Initiative only recently. The National CPWD Academy plays host to engineers and architects from all around the country employed by the CPWD for regular training programmes. A green transformation of the campus is vital, as it acts as a demonstration for good sustainable practices to be learnt and executed on a national scale. The CPWD is expanding its initiative of environmental sensitisation with CSE as a knowledge partner.

With CSE's collaboration and help, the National CPWD Academy has committed itself to reducing its resource footprint on its training campus. A Green Committee has been set up at the Academy, which meets every month to monitor progress and expedite decisions related to sustainability of the campus; CSE is a member of this committee and has been providing regular knowledge support since its constitution. This includes preparation of a baseline scenario, inventorisation and performance benchmarking of the campus, and implementation of pilot projects.

Apart from extensive capacity building, CSE has provided ample exposure to CPWD officials through live demonstrations on efficient operations and technologies for a green campus. As a result, some of the notable initiatives taken up by the Academy include segregation and onsite treatment of their organic waste, upgradation and upkeep of the rainwater harvesting infrastructure, investment in energy-efficient appliances, on-site treatment of wastewater generated on the campus, etc.

An event, 'My Ability for Sustainability', held in June 2019, was attended by around 100 CPWD officers and participants from different RWAs. Following this initiative, a Cabinet mandate for bringing sustainability

into 100 residential colonies of CPWD has been initiated—the focus of this lies on solid waste management, rainwater harvesting and solar energy generation.

Energy efficiency

The Academy has switched to energy-efficient LED lighting fixtures. As per the power consumption details provided by the campus, this shift was able to save the Academy 19,153 kWh in terms of energy. The initiative has led to a cost benefit of approximately Rs 1.4 lakh in energy bills over a period of eight months (from March to October 2018— see box).

The campus has also replaced its conventional ACs and fans with BEE 5-star rated appliances procured through EESL under the ESCO mode. A total of 97 AC units and 50 fans were replaced, saving 45,498 kWh approximately. This initiative has led to a cost benefit of Rs 3.36 lakh in energy bills (see box).

The Academy has installed four 1,000-lpd solar water heaters over its hostel roof; these heaters are used in winters. For street and park lighting on the campus, there is solar-based lighting which reduces the dependence on external supply of electricity.

The CPWD Directorate regularly issues circulars reminding its personnel about responsible energy use.



REAPING FROM REPLACEMENT

The Academy has replaced 157 conventional light fixtures such as tubelights, CFLs and flood lights with energy-efficient LED technology. The analysis period chosen is March–October 2018 (excluding holidays) and a working day of eight hours—a total 219 days with 1,264 hours of operation time.

- Total energy requirement before upgradation: 33,331 kWh
- Total energy requirement after upgradation: 14,178 kWh
- Energy savings (in units of kWh): $33,331 - 14,178 = 19,153$ kWh
- Electricity rate: Rs 7.4/kWh
- Energy savings: $19,153 \times 7.4 = \text{Rs } 1,41,735$

The Academy also replaced 97 conventional ACs and 50 fans with BEE 5-star rated appliances.

- Total energy requirement before upgradation: 2,23,627 kWh
- Total energy requirement after upgradation: 1,78,129 kWh
- Energy savings (in units of kWh): $2,23,627 - 1,78,129 = 45,498$ kWh
- Electricity rate: Rs 7.4/kWh
- Energy savings in Rs: $45,498 \times 7.4 = \text{Rs } 3,36,685$

Passive architecture

The form of the campus follows a courtyard typology with water bodies or plants in the centre. The space avoids direct sunlight and remains cooler than unshaded open spaces. The walls facing the courtyard are shaded by a continuous corridor. This is combined with an optimised window-wall ratio in the campus as per the standards set in ECBC 2017.

The campus buildings have thick walls, providing them with thermal mass, which helps in reducing the air conditioning load by naturally cooling the buildings.

Catching the rain

The campus can harvest a total of 21.5 million litres of rainwater annually if it makes use of the available rooftop area and open spaces on its premises.



With the environment deteriorating, we realise there is a need to push our efforts towards sustainable development. CSE is helping us realise this vision by playing a pivotal role in CPWD's capacity building as well as in translating knowledge into practice. This engagement enabled regular monitoring of the campus through a Green Committee and CSE being a part of this committee has provided requisite technical knowledge support.

MR SHASHIKANT
Additional DG (PRD)



The available rooftop area in the academy contributes to more than 22 per cent of the total potential, while the paved areas in the form of roads and pavements contribute to over 45 per cent of the potential. Open and unpaved areas covered with grass occupy the largest portion of the land in the Academy, but due to the permeable nature of the soil, only 10 per cent of it becomes runoff and can be collected as harvested water.

The campus has installed four rainwater harvesting pits. These are recharge pits-cum-twin bore wells, fitted with de-silting chambers.

Shared mobility

To help its staff to commute, the Academy runs a regular bus service between the campus and three nearby metro stations. Participants in the training programmes and the staff are encouraged to use the shared transportation service in order to cut down on the use of private vehicles.

Wastewater treatment

The Academy is currently constructing a sewage treatment plant (STP) with a capacity for treating 1.5 lakh litres of



wastewater. The sludge, which is the residue of the treatment process, will be used as a fertiliser in horticultural practices in a nearby plant nursery. An external company will be entrusted with the responsibility of ensuring the upkeep and efficient running of the system.

Managing solid waste

Organic waste: The campus is in the process of installing a mechanical composting unit for treating organic waste on-site. It has already installed a vermi-composting unit for demonstration purposes.

E-waste and paper waste: The Academy has third-party collaborations for management of its electronic and paper waste. Old records and other paper waste of the campus are sent to the Multi-Disciplinary Training Centre of the Khadi and Village Industries Commission for recycling—in March 2019, 630 kg of paper waste was recycled by the campus. For managing discarded appliances like desktops, laptops, printers, etc. the campus has an alliance with E-Waste Recyclers India, a government-authorised e-waste management company. In October 2018, the company recycled 1,026 kg of e-waste for the Academy.

VISION

National CPWD Academy is gradually shifting towards a zero-waste campus by adopting efficient resource management practices like efficient use of water, in house treatment of sewage, use of treated water for horticulture, installation of solar panels on the rooftop of academic and hostel buildings, etc. for achieving a truly Green Campus.

The Green Initiatives of the National CPWD Academy are a learning model for the architects and engineers nationwide who come to attend the training in the academy. The Academy hence aims to become an icon of best practices and emerging technologies for sustainability in the built environment.

India currently faces an urgent environmental crisis. The Green Campus Initiative is one of the many ways in which India's environmental challenges are being addressed. The five campuses showcased in this book are the trailblazers who have taken the responsibility of trying new methods and sharing the results of those experiments. They realize the potential and possibility of building green institutions across the country which can become major contributors to the realization of a sustainable future for us all.

These five campuses show us that environmental sustainability is neither technologically nor economically prohibitive. The only thing required is the will and commitment of truly interested parties. Working in all areas of the environment—land, air, water, energy and waste—these campuses have achieved spectacular results in not only reducing pollution but also in reducing costs and improving the sense of well-being of their residents. This book is an attempt to show that their example can be followed and should be followed by campuses all over the country.



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