A GREEN CAMPUS
COMPENDIUM
INCUBATION, EXPERIMENTATION
AND DÉMONSTRATION
OF A GREEN FUTURE
A GREEN CAMPUS

COMPENDIUM

INCUBATION, EXPERIMENTATION AND DEMONSTRATION OF A GREEN FUTURE
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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 greency 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 which correlates with real 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 scope. 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, 39,131 colleges, and 107,251 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 new 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. The gains are not limited and confined within the campus boundaries but they also have a multiplier effect across the urban scope. Moreover, this also allows regulatory compliance and cost savings. The green campus movement can unleash unprecedented transformation if achieved at a scale.
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 methodology 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 and environment-friendly practices pertaining to areas of significant environmental concerns, e.g., land, energy, water, 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 the campus faculty, department heads, and technical teams (green teams). They set objectives, baseline, priorities and roles and responsibilities to undertake skill and capacity building, and hold campaigns, open houses, and interactions. Various financial and management schemes are provided support to institutionalise best practices and methodologies pertaining to areas of their unique and region-specific initiatives that campuses have undertaken. This will help their knowledge and ideas reach a wider audience and bring in the much-needed 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; Amritsar Dayanand College, Amritsar, Punjab; SRM University, Chennai; Ramakrishna Mission Vivekananda, Chennai in Tamil Nadu; and CPWD Academy, Gaziabad Uttar Pradesh. While Ramakrishna Mission Vivekananda, Chennai 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, Water, and Waste. Each is assessed through a wide range of parameters. The campuses that have participated in this process have shared with us unique and region-specific initiatives that campuses have undertaken. They are among the frontrunners in their respective campuses. These include Ramakrishna Mission Vivekananda Centenary College, Rahara, West Bengal; Guru Nanak Dev University, Amritsar, Punjab; Amritsar Dayanand College, Amritsar, Punjab; SRM University, Chennai; Ramakrishna Mission Vivekananda, Chennai in Tamil Nadu; and CPWD Academy, Gaziabad Uttar Pradesh. While Ramakrishna Mission Vivekananda, Chennai had already embarked on their green journey before this network was launched, several others started their initiatives with this network.

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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 practices. The compendium has helped to bring together this information to indicate the direction and scale of change. It is notable that these institutions are committing time and resources to make the initiatives more verifiable and monitorable. This compendium has helped to bring about the initiative to integrate these efforts with the curriculum, thus also utilizing the classrooms to enhance practice based learning. It is encouraging that their experiments to help create a strong cross learning platform.

energy efficiency interventions and also help other institutions who want to take up the initiative. For several of them system-wide environmental interventions and also help other institutions who want to take up the initiative. For several of them system-wide environmental interventions and also help other institutions who want to take up the initiative.
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.

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
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 vermiculture pits, to a rooftop rainwater harvesting system and a solar PV system to increase its renewable capacity.

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.

**The Association**

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**Dr Swami Kamalasthananda**
Principal

**The Cost Factor**

<table>
<thead>
<tr>
<th>Amount</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>₹219,369/kwh/yr</td>
<td>Total electricity demand of the college</td>
</tr>
<tr>
<td>₹14,25,903/year</td>
<td>Electricity cost without the solar system</td>
</tr>
<tr>
<td>₹9,55,355/year</td>
<td>Electricity cost with the solar system</td>
</tr>
<tr>
<td>₹7,70,548/year</td>
<td>Savings due to the solar system</td>
</tr>
</tbody>
</table>

**Vision 2019–20**

The college is working to install and functionalize 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

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 convertors, or by vermiculturing. 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 plastics. Its newly constructed 1,000-seater auditorium has steel furniture which can be recycled in the future.
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

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.

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 instigated 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 curb 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.
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.

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.
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.
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.

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.
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 sensibility not only among the students and staff but also their families. The College has been organizing 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 in a manner 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 everyday 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 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 sensitize 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 College has installed solar PV panels that feed 40 solar-powered streetlights inside the campus.

Catching the rain

The campus has a potential rain-catch 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-dealing chambers. The water is then recharged into a harvesting structure which has a 35-m-deep bore well. The College organizes rainwater harvesting sensitisation walks for its students.
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, cococa, cashewnut, ager, ginger and turmeric) 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, cococa, cashewnut, ager, 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.

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

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

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

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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 streams in the adjacent areas.

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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.
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.

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.

Green Initiatives of the Campus

THE CSE-CPWD CONNECT

The National CPWD Academy is an Area measuring over 900 ha. The Academy is located in a climatic zone of Composite and is home to people over 14.56 ha.

Green Campus Compendium

A GREEN CAMPUS COMPENDIUM
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, inventory 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 14 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 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 x 7.4 = 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 x 7.4 = 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.
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.

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.

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.

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.

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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.