



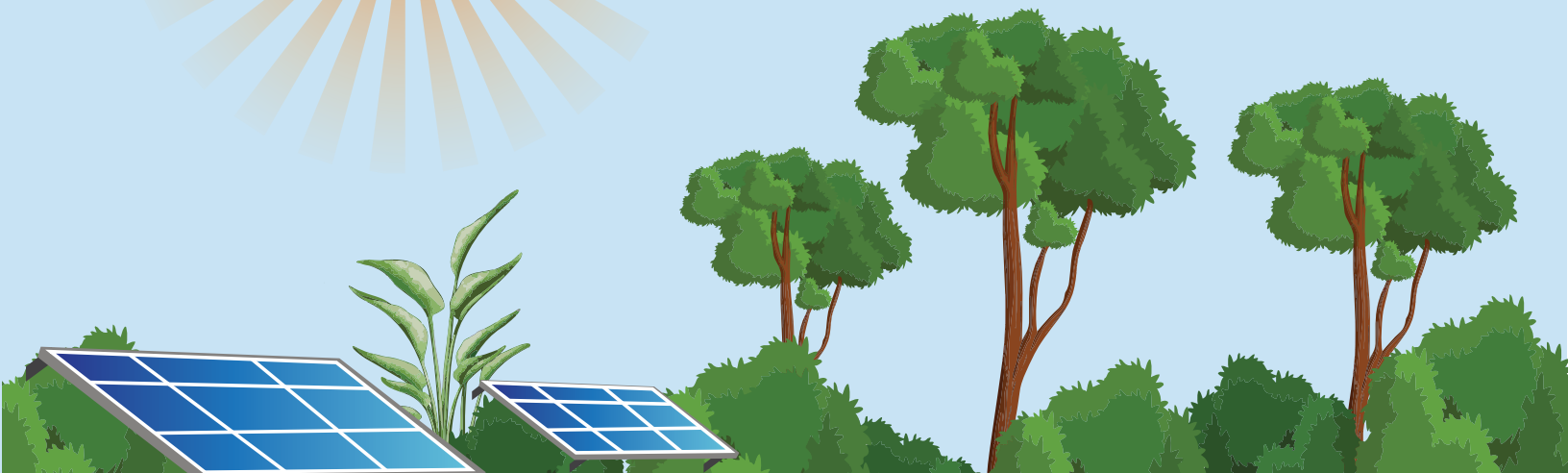
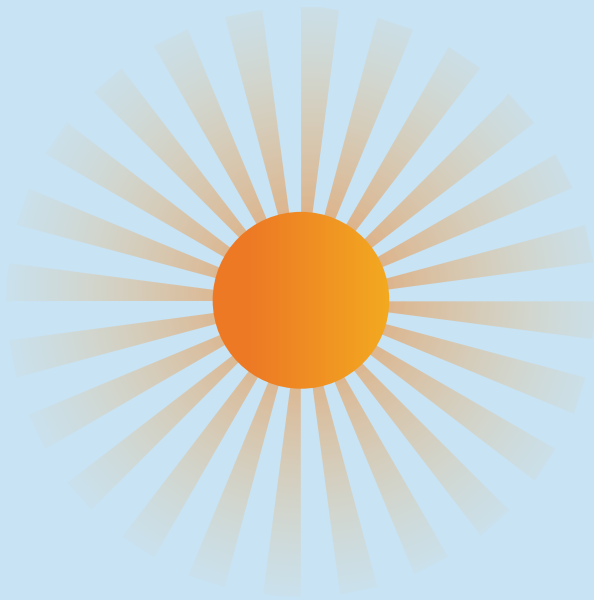
Energy Swaraj Foundation
Energy by Locals for Locals



Ways Academic Institutions Invest in Our Planet



**Are we taking
enough action
for a healthy planet?**



Dear Reader,

The global theme for Earth Day 2022 and 2023 is 'Invest In Our Planet'. There is an urgent need to focus on accelerating solutions to combat our greatest threat, climate change, and to activate everyone—governments, citizens and businesses—to do their part. For the climate is not changing, it has changed.

The questions to ask are: 'Are we taking enough action for a healthy planet? Do we recognise the urgency?' From how things are progressing, the answers to these is, 'Clearly, not enough.'

We cannot address the climate crisis without considering the disadvantages of our continued dependence on oil, coal and gas as energy. Greenhouse gas emissions are generated by burning fossil fuels, resulting in rising CO₂ concentrations in the atmosphere that are 50% higher than at the beginning of the Industrial Revolution. All who use energy are guilty of contributing to climate change; therefore, everyone must contribute to climate change mitigation. Additionally, Earth's resources have been significantly depleted by our thoughtless misuse of them.

On a positive note, remediation is within our reach if we recognise our collective responsibility and help accelerate the transition to an equitable, prosperous green economy for all. The action will get accelerated with awareness and understanding. Where better to start, we thought, than to help widen this at the school level by showcasing examples of beneficial strategies adopted by educational institutions?

Earth Day Network India and the Energy Swaraj Foundation have collaborated on this eBook 'Ways Academic Institutions Invest In Our Planet' to highlight academic institutions that are taking significant actions by implementing strategies to reduce their carbon footprints. Whether switching to renewable energies and focusing on efficient use of energy, installing rainwater harvesting systems, ensuring waste is managed, constructing buildings with traditional methods that retain heat in winter and disperse it in summer, growing the green economy, widening awareness about the importance of achieving the UN's Sustainable Development Goals...and more. Initiatives such as these also help students develop into leaders who are environmentally conscious.



The eBook was launched at the Action for Restoring Environment (ARE) conference, a unique global platform for individuals and professionals to discuss, debate and redefine the actions that would help ensure the sustainability of resources and human life on the planet.

All the strategies and methods described in this eBook are replicable. Contact information for each contributor is provided, should you require additional information.

We hope you enjoy reading the case studies. Many more have been submitted, which we will reserve for subsequent volumes. Should you know of others, do forward them to us at officeofregionaldirector@earthday.org.

Our grateful thanks to Prof Chetan Solanki and the Energy Swaraj Foundation he heads for partnering with us on this eBook, the contributors, editorial team and WYSIWYG Communications for the beautiful design.

Regards,



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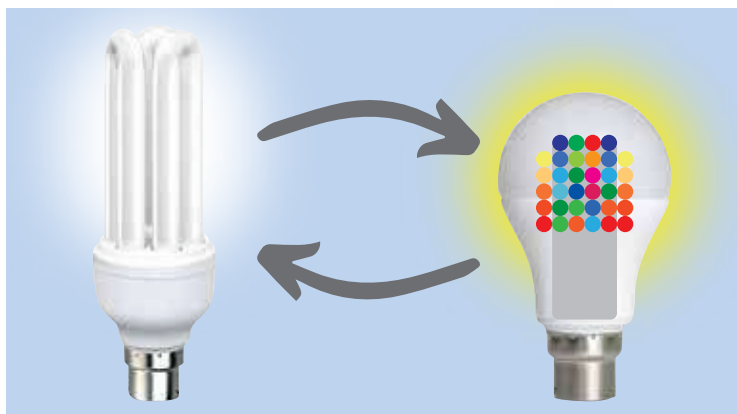
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A Model to Replicate



Prof Chetan Singh Solanki, the 'Solar Man of India', was the person who inspired the AICTE to achieve this with his AMG (Avoid, Minimise and Generate) model.



A Model to Replicate

The All India Council for Technical Information (AICTE) is an advisory body responsible for the planning and development of technical and management education in India with approximately 9,000 institutions and three million students within its ambit.

The AICTE has initiated a holistic approach to reduce the energy footprint at its headquarters, setting an example for its affiliated institutions.

Prof Chetan Singh Solanki, the 'Solar Man of India', was the person who inspired the AICTE to achieve this with his AMG (Avoid, Minimise and Generate) model. Prof Solanki explains, 'Energy in any form has some carbon footprint, even solar energy. So, every time we use energy, there is an impact on the environment. It is comparatively less in the case of solar energy, nevertheless, the impact is non-zero. Adopting the AMG principle, therefore, is imperative.'

On an 11-year Solar Yatra to advocate the scientific soundness of his AMG model, Prof Solanki has pledged to live on a bus for its duration,

criss-crossing the country to apprise the multitudes he addresses at each stop of the need to rely on locally generated energy. His aim is to make one billion people energy and climate literate; encourage one million households to go off-grid; and train one hundred thousand entrepreneurs for last-minute reach.

By adopting the AMG Model, the AICTE managed to reduce electricity use on its campus by 20%. Replacing CFL lights with energy-efficient LED ones accounted for a significant reduction in energy bills. Re-wiring ensured that a single switch did not operate multiple lights. The temperature maintained by the central AC plant is 24°C or above. Additionally, the judicious use of electricity is promoted through awareness drives that include eye-catching posters at high traffic points such as gates and lifts. Housekeeping staff, security guards and janitorial personnel are sensitised to switching off lights and appliances when not needed.

While energy from fossil fuels has provided the impetus for our social and economic growth, it has significantly contributed to climate change on a planetary scale. This is why AICTE has deemed mandatory for its employees a free, online course on energy literacy training developed by Prof Solanki. This greatly helps spread awareness in its community about how energy is generated, what defines clean energy, how much energy each user consumes and how to minimise usage.

Moreover, the rooftops at the AICTE headquarters are painted white to deflect heat, employing a process known as 'cool roofing', which reduces the absorption of solar radiation, thus reducing the temperature inside the building. Cool roofs

also emit heat usually retained by a building, further cooling it. Cutting or trimming trees and hedges is forbidden to reduce the campus' thermal gain. Bare patches are greened and creepers grow on walls facing the sun to reduce solar impact. In addition, the AICTE observes a policy of ensuring that a tree is planted for each student.

To generate energy on-site, a solar water heating system is installed in the campus guest house. An expansion of the system is planned for use in the AICTE canteen to cook and heat food. On an average, the 140 kW rooftop solar power plant generates 16,000 units per month.

To ensure measures are followed, an appointed committee regularly conducts inspections to confirm that the systems needed to reduce energy consumption are in place. Persons are also delegated to audit designated areas. All these AMG efforts by the AICTE serve as models for other institutions to reduce their carbon footprints and energy expenditures.

Satish Kumar

Council Engineer

All India Council for Technical Education

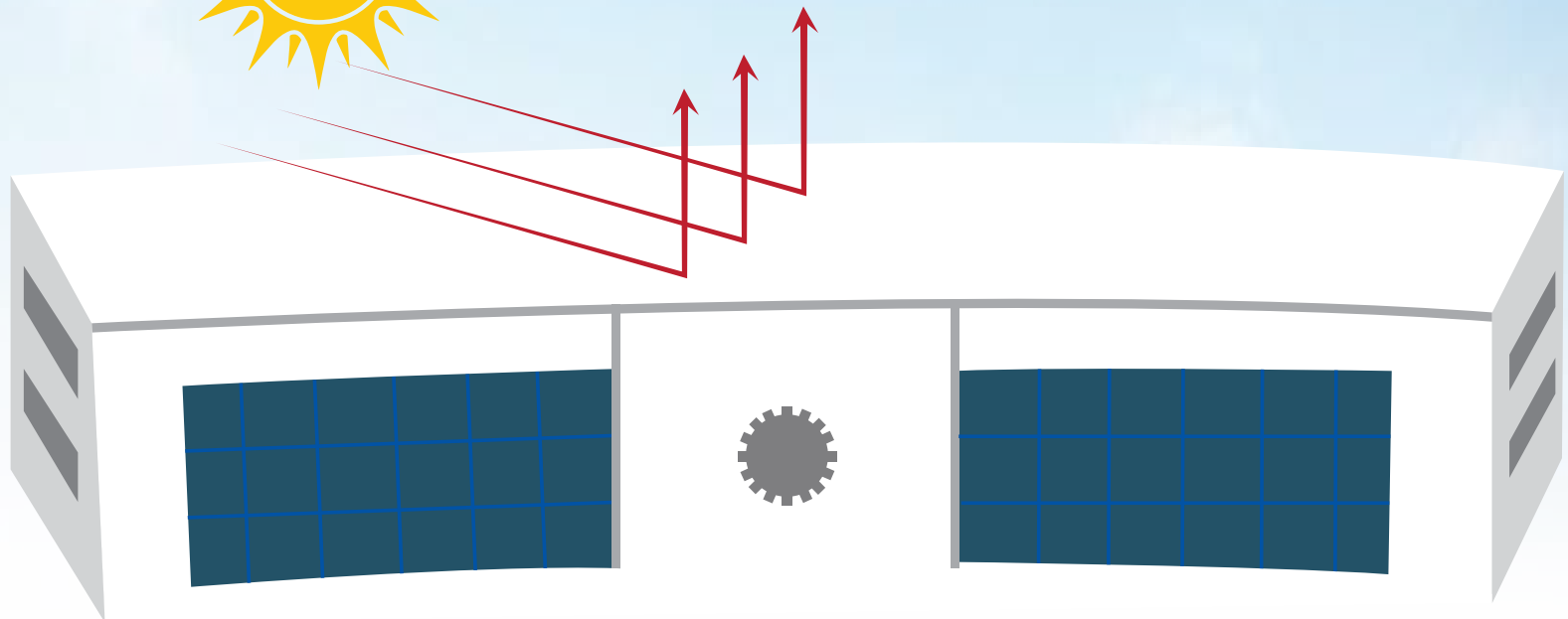
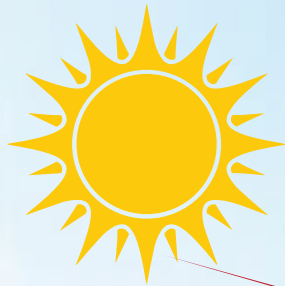
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Cool Roofing at AICTE Headquarters

A Carbon Free Campus



Since its commencement in 2010, the campus has run solely on solar energy, using a solar passive architectural design that minimises energy requirements.



A Carbon Free Campus

Close to Bhikangaon, in rural Madhya Pradesh, is a school with more than 1,000 students from over 40 villages. Known as the Education Park, it aims to provide high-quality, affordable education to them by focusing on the 3 Es—Education, Economy and Energy.

Since its commencement in 2010, the campus has run solely on solar energy, using a solar passive architectural design that minimises energy requirements. A solar photovoltaic system generates the electricity needed to operate computers, printers, lights and fans.

The area is susceptible to power outages, so the main issue while planning the campus was to make it entirely dependent on solar energy. The solution derived from the scientific axiom, 'Energy saved is energy generated.' Based on it, Prof Chetan S Solanki, the founder of the Education Park, formulated his AMG mantra—Avoid, Minimise, Generate.

Resistance to heat gain, particularly in summers, was a critical design imperative. Ventilation

during monsoons also needed to be minded. What resulted was a solar geometric shape for the building with the walls aligned East-West to minimise heat gain from the sides. For better ventilation, the windows were built perpendicular to the natural direction of the summer wind—North-West. Filler slabs at the top also helped reduce heat gain.

Side lighting with daylight windows on both sides and vision windows on one side, provide adequate light to the classrooms. The highly reflectant walls, light shelves and ceilings, as well as glass with high visible transmittance, improve the use of daylight. A passive solar architectural design of light shelves optimises the ingress of natural light into the classroom on the southern side. North-South windows are shaded on both sides, North and South, with deep *chajjas* (sun shades).

Even without the use of ceiling fans, the classrooms are as much as 11°C cooler than the outdoors at the peak of summer.

Even outdoors, courtyards act as environmental modulators by improving thermal performance through features such as doubly loaded green corridors. Moreover, the thousands of trees on the once bare 14-acre campus, pre-cool the air before it enters the building.

All these aspects of solar passive architecture go a long way in mitigating the cost of the solar installation.

According to Prof Solanki, 'If solar passive architectural designs are introduced at the very outset, the energy consumption of the building can be significantly reduced.'

Similarly, up to 80% of the energy requirement, particularly for buildings such as schools, which are only used in the daytime, can be reduced.' He hopes that all academic institutions switch to solar. 'At these temples of knowledge, it is essential to instil young minds with an understanding of sustainability that is both in theory as well as practice.

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A New Currency

The school collects its fees from the children in a single currency—plastic.





A New Currency

Pamohi is a village in the mining district of India's northeastern state Assam. Compelled by the abject poverty of their families, children are often denied basic education and forced to work in the quarries. The Akshar Education Model, founded by Mazin Mukhtar and Parmita Sarma, helps provide quality education to them, including on the environment and entrepreneurship.

The school collects its fees from the children in a single currency—plastic. No, not the credit card variety, but waste plastic. Every week, as payment for tuition, pupils are required to deposit a minimum of 20 waste plastic items collected in or around their homes.

This unique system was conceived when parents were requested to send their children to school with plastic waste collected at home. Almost none complied, so the school decided to offer them the option of paying their wards' fees with plastic waste. Naturally, almost everyone agreed. Amongst other things, the use of the alternate currency has led to students finding pride in their environmental stewardship.

The children are encouraged to influence people's thinking on plastic pollution using the communication techniques taught to them. They explain why burning or discarding plastic is harmful to Earth. The plastic items that cannot be recycled are upcycled into eco-bricks—plastic bottles stuffed with plastic packets and wrappers—for use in construction.

In addition, Akshar has set up a recycling workshop based on designs from the Dutch organisation, Precious Plastic. It includes a plastic shredder, oven moulds as well as extruder and injection machines. These enable the students to manufacture new products from plastic waste—feeding bowls, nursery planters, cosmetic jewellery and more. The workshop develops the students' know-how in operating and maintaining the equipment. According to a teacher at Akshar, 'Our students and teachers no longer view plastic waste as trash. Rather, it has become a valuable raw material in fashioning new products. Now, plastic is precious to them.'

Thus, Akshar blends academic and vocational training to improve both educational as well as employment standards at Pamohi. 'Akshar combines the functions of a school with those



of an employment agency, business incubator and development agency. Students get paid with tokens that enable them to buy essentials such as shoes. 'Older pupils earn by teaching younger children,' Mazin explains. Furthermore, with almost all students securing gainful employment, the school has seen a significant reduction in the number of dropouts. 'We thus inculcate responsibility for the environment and stewardship to support a better community,' Parmita says.

To proliferate its model, Akshar has developed a project—Transforming 100 Government Schools into Sustainable Communities—already involving three government schools in Guwahati. It is also developing a mobile Precious Plastic workshop mounted on a truck which will make practical demonstrations to children in these schools. Akshar's trustees are confident of taking their model to schools not only across India but the world as well.

It has been estimated that Indians daily generate 26,000 tonnes of plastic waste. Akshar's simple yet effective way to manage plastic waste is helping to put a dent in that figure.

Mazin Mukhtar and Parmita Sarma

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A Sustainable Ripple in the Desert



The Rajkumari Ratnavati Girls' School indeed brings together sustainable architecture, culture, growth opportunities for women and tourism—all of which help create a 'ripple in the desert'.





A Sustainable Ripple in the Desert

The Rajkumari Ratnavati Girls' School in Kanoi village is in rural Rajasthan, close to Jaisalmer. The school is part of the larger Jaisalmer Gyaan Centre that aims to empower and educate women by helping them gain economic independence for themselves, their families and their communities. With this in mind, it provides Nursery to Class 10 education (at the moment only till Class 2) for about 400 girl students. This is particularly significant in Rajasthan, where statistics indicate that less than 40% of females are educated.

The school is an awe-inspiring architectural marvel located in the middle of the Thar Desert. It was commissioned by CITTA Education Foundation India, a non-profit organisation that supports development in geographically remote areas for some of the world's most economically challenged and marginalised communities. *Citta* is a Sanskrit word that refers to the mind located in the heart's region.

According to American artist Michael Daube, when perceived clearly, it realises that all things are inter-connected and interdependent. This outlook helps accept that humans need to co-exist with nature.

Diana Kellogg, a New York-based architect designed the school. She says, 'I wanted to create a building about light and community—a structure that resonates with the soul of its people and enforces the natural energies to nurture and heal the women and girls. Using local materials to create infrastructure helped reduce carbon emissions,' she explains.

The school's sandstone building, shaped like an ellipse, blends effortlessly into the landscape. She incorporated traditional designs, relying on the expertise of community craftspersons in hand carving locally available sandstone. The furniture for seating follows the traditional *charpai* (woven webbing of jute stretched on a wooden frame) design. Years of facing the harsh climate of the desert had the locals ingeniously develop screen walls known as *jallis*. These perforated stone or latticed screens have permeable surfaces that allow air to circulate. These are incorporated in the design. The inner walls of the buildings are plastered with lime, which insulates them. One element that is of particular significance is Diana's creativity in constructing a rooftop solar canopy. It has a metal framework that powers the interior lighting and fans and doubles up as a jungle gym for the children. This canopy, along with the *jallis* and the airflow facilitated thanks to them, helps withstand temperatures of up to 50°C, which frequently occur in this area. The oval shapes reduce the distance between

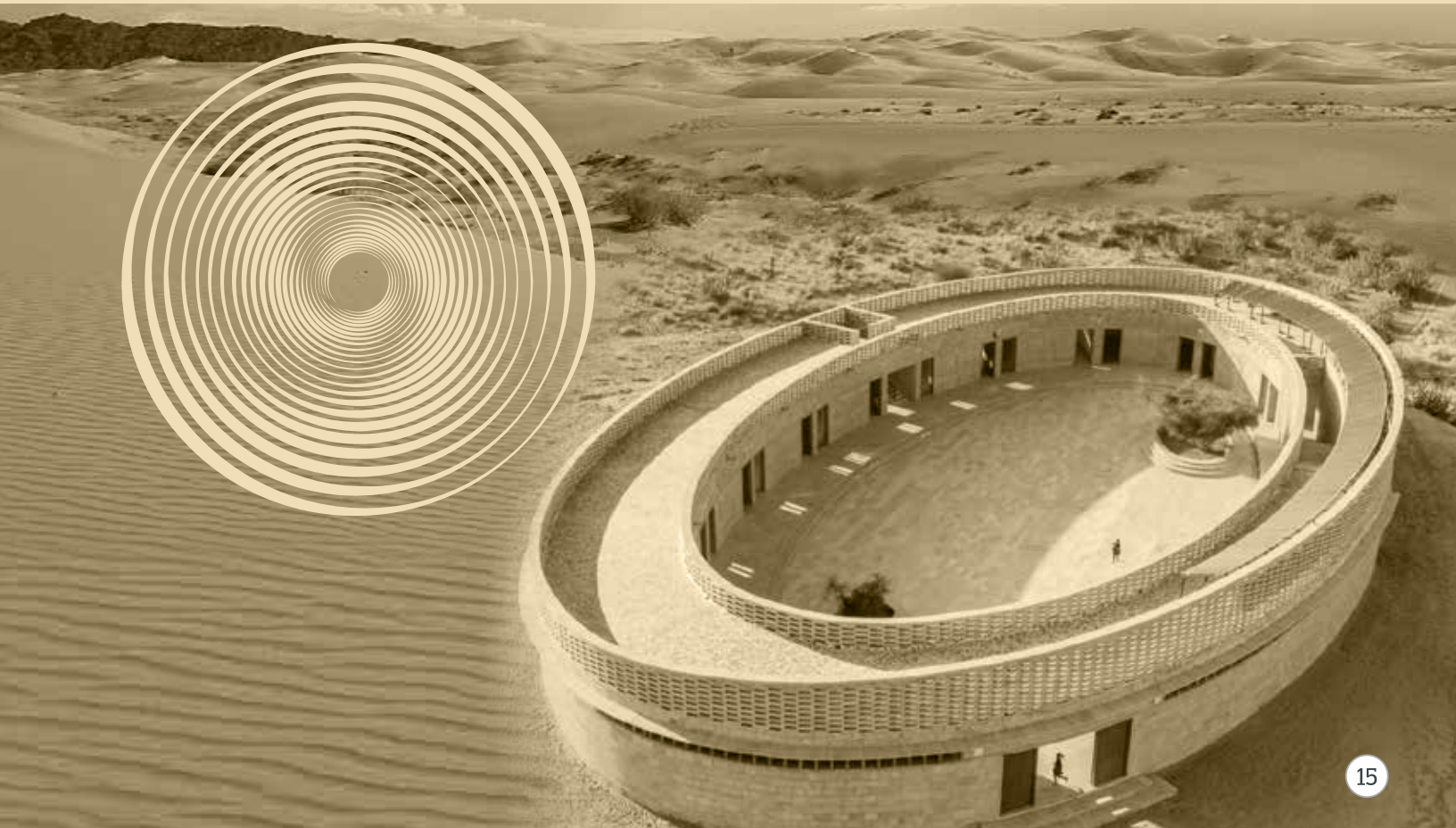
the different sections of the building, thus providing protection from long exposure to the harsh sun. Local, ancient, water-harvesting techniques maximise rainwater use and recycle grey water. The focus on sustainability extends to the school's uniforms, that use non-synthetic materials and the traditional *ajrakh* printing of geometrical designs using woodblocks and natural dyes. Conceptualised by one of India's most famous designers, Sabyasachi, the local craft *ajrakh* is brought back to glory. Michael Daube strongly believes that fashion must be sustainable and thus adopted *ajrakh* for the uniforms. Students are helped to relearn the dying art of *ajrakh* to ensure this environment friendly method of printing continues to find favour in future years.

The Rajkumari Ratnavati Girls' School indeed brings together sustainable architecture, culture, growth opportunities for women and tourism—all of which help create a 'ripple in the desert'.

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Captain Cool is Here

Captain Cool documents the amount of energy needed to run appliances generally used by people—watching television, charging a phone, using a computer, using a washing machine etc. The app calculates your carbon footprint immediately.





Captain Cool is Here

Coal-powered thermoelectric plants are estimated to generate 60–80% of India's energy requirement. This places the CO₂ emissions per unit of energy in the range 0.82–1 Kg per kilowatt-hour (kWh). Apart from polluting the land, water and air, fossil fuels also increase global warming. The 2021 Intergovernmental Panel on Climate Change's estimate of the average global temperature for the next few decades suggests that unless there are rapid reductions of greenhouse gases on a large-scale, limiting the rise of the average global temperature to even 2°C will be completely unfeasible.

Despite this warning, temperatures continue to rise across the world. Switching entirely to clean and renewable sources of power such as solar or wind energy is a viable solution, but is unlikely to be implemented in the short term. In the meantime, the only effective way to lower the globe's carbon footprint is through reduced energy consumption. Mr Panu Halder, a teacher from Bilaspur, Chhattisgarh, worked with students of the local Nature Bodies Eco

Club (Himangi Halder, Poonam Singh and Uttam Kumar Tamboli, in particular) for more than six months to develop an easy-to-use app. They named it the Captain Cool App.

Captain Cool documents the amount of energy needed to run appliances generally used by people—watching television, charging a phone, using a computer, using a washing machine etc. The app is exceptionally user-friendly. All you need to do is select the appliance(s) used and enter their wattages and hours of daily use. The app calculates your carbon footprint immediately.

The team is used to the shock on people's faces when they realise how large their carbon footprint is. 'Don't worry,' they say. 'Green hacks included with the app will help lower it.' For example, buy appliances with a high-energy rating. Another simple and effective way is to reduce the brightness of your computer screen. Lowering the brightness to 70% saves up to 20% energy. Switch from incandescent bulbs to CFLs (Compact Fluorescent Lamps) or LEDs (Light Emitting Diodes). Replacing one 100-watt incandescent bulb with a 20-watt CFL one will reduce annual carbon emissions by 84 Kg. Similarly, reducing TV usage by 2 hours daily will reduce energy consumption by 75.2 kWh.

To calculate the annual saving of emissions, total up your estimated reduction in wattage and multiply it by 0.82 Kg of CO₂/kWh. Imagine, at 4/kWh, the annual savings from watching TV for 2 hours less every day is INR 301! Turn off appliances at their source to prevent energy

from draining out in standby mode. In standby mode, a TV set, set-top box and DVD player use 19.7 Watt per hour. Switching these off will amount to a whopping reduction of 106.1 Kg of CO₂ and INR 4,517.70 in savings annually. Replacing a desktop computer with a laptop also reduces annual CO₂ emissions.

The team initially tested the app by sharing it with a sample group of about 1,300,000 students, all members of the approximately 7,000 Eco Clubs across the state. The feedback was encouraging. Users found it easy to use as the app works in Android and iOS environments and is available in Hindi and English.

Using the Captain Cool app continues to be an eye-opener for many. The shocking energy-use figures that the app brings to light have enthused users to implement ways to reduce their energy use. On Earth Day 2021 (22 April), the students of the Eco Clubs of Chhattisgarh pledged to switch off electrical appliances for 2 hours and calculated how much carbon would be saved from being emitted into our atmosphere.

The App is accessible at naturebodies.in. The Nature Bodies YouTube channel features videos explaining the Green Hacks in greater detail. The students hope that people will regularly use the app, reduce their carbon footprint and help keep global warming within manageable limits. Captain Cool has helped students and others understand, research and become environmental stewards.

Panu Halder

Teacher and Team Leader

Nature Bodies Eco Club

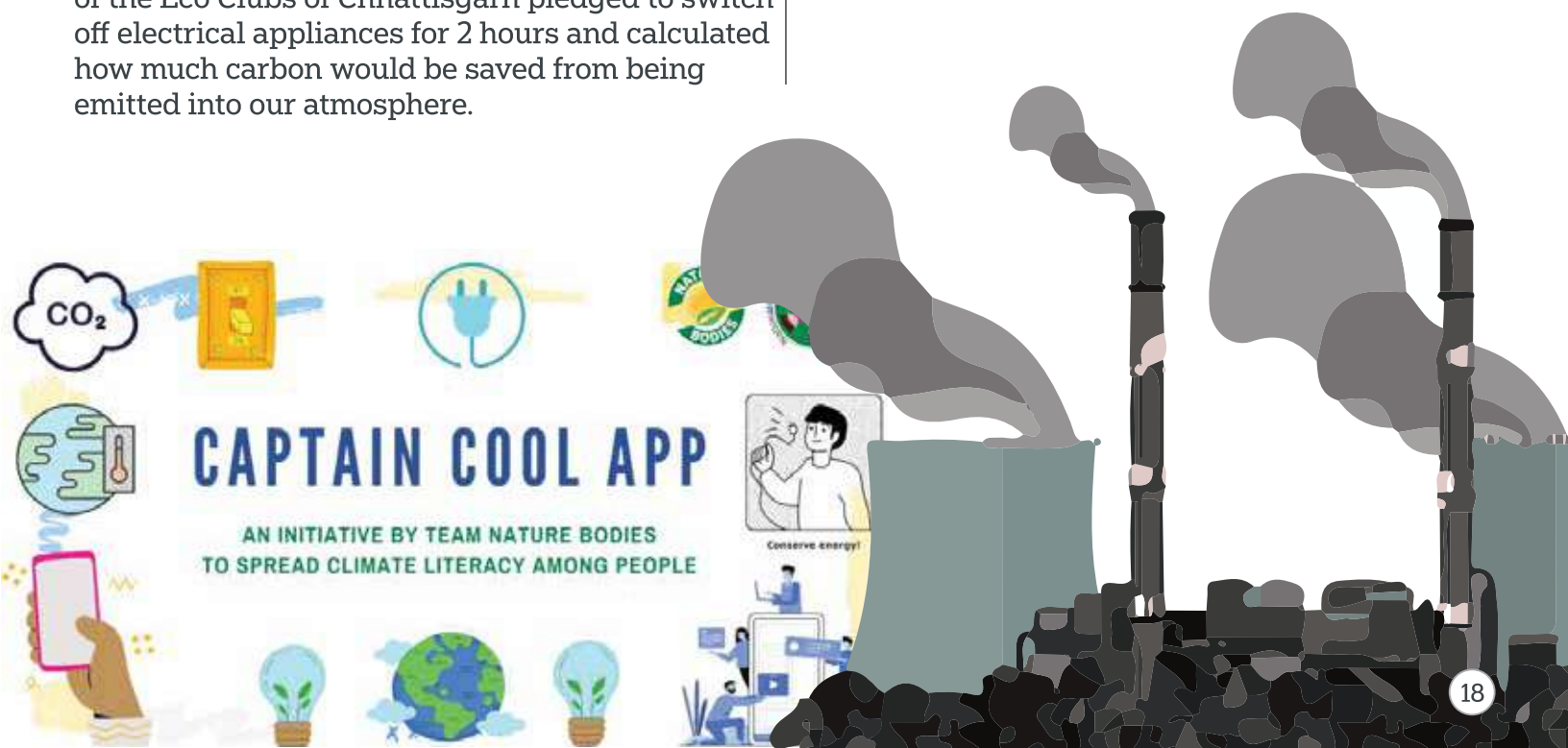
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Care for Our Common Home

SKC initiated Environmental Stewardship and Climate Change Action as a commitment towards working for the reduction of Global Warming.





Care for Our Common Home

On Earth Day 2015, Pope Francis's encyclical, 'Laudato si', called upon all of humanity to 'Care for Our Common Home' and take 'swift and unified global action'.

In response, The Roman Catholic Archdiocese of Calcutta, through Seva Kendra Calcutta (SKC) and the Commission for Environment and Social Justice, took on the mission to switch to solar energy in its many educational institutions.

SKC initiated Environmental Stewardship and Climate Change Action as a commitment towards working for the reduction of Global Warming. Exploring, producing, utilising and advocating the use of solar energy, SKC strives to strengthen the Solar Energy Sector and demonstrates how pollution and costs get reduced by replacing fossil fuels with solar energy.

The SKC model includes the installation of a 100 KWp rooftop Solar Photo Voltaic plant at its training centre in Kolkata, probably the largest solar plant installed by an NGO anywhere in India. The unique feature of the

plant is that the panels form a running roof that covers the terraces of the organisation's buildings. The entire plant is connected to the Calcutta Electric Supply Company (CESC) grid and has an import-export facility. SKC's average energy consumption is 380 units daily. Now that it is met with self-generated solar energy, it saves SKC an average of INR 11 lakh per year, as CESC charges a minimum of INR 8 per unit. Any excess solar power harnessed is sold to the city's energy grid. All this makes for a return on investment in the plant in five years.

The entire roof has become a 'model' to inspire those who visit SKC. In addition to generating energy, the Solar Photo Voltaic plant's panels help keep the floors below cooler in summer while protecting the terrace from waterlogging during the monsoon months.

The challenges faced when implementing the 'Solar Mission' stemmed from people's lack of awareness of the benefits and advantages of rooftop solar PV systems (even among the educated and economically advantaged). SKC helped them understand that it is a misplaced perception to assume that such installations are expensive and not affordable. The maintenance costs, once correctly done, are low.

The work done by SKC has, directly and indirectly, influenced many organisations to follow suit and include educational institutions in other parts of the city and state. It has even made its way to other states. SKC has helped install 120 solar water heating systems. Off-grid rooftop PV systems of different capacities were installed in various institutions of West Bengal, while 28 on-grid PV systems were installed in other states.

Fr Franklin Menezes says, 'Do switch to solar.
It is not as complicated as you might imagine,
and it will pay you great dividends in the long run.'

Fr Franklin Menezes

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Climate Reality Check



Its main goal is to help students understand and address the impacts of climate change, empowering them with knowledge and values that enable them to help mitigate its effects.



Climate Reality Check

Climate education lays the foundation for a green economy and solving climate crises. From educating students, investors and regulators, to creating a generation of entrepreneurs and inventors, to building a global green consumer movement, climate literacy is the key to fast-forwarding solutions for climate change.

The Kamala Nehru Public School (KNPS) in Phagwara, Punjab, has been actively promoting climate education since 2017, when it participated in the International Climate Action Project along with 260 schools from 69 countries. Its main goal is to help students understand and address the impacts of climate change, empowering them with knowledge and values that enable them to help mitigate its effects.

The teachers handled the challenge of teaching them by involving all four stakeholders of climate education—students, teachers, schools and communities.

The Sustainable Development Goals or Global Goals is a collection of 17 interlinked global goals

designed to be a ‘shared blueprint for peace and prosperity for people and the planet, now and into the future.’ The curriculum was decided keeping the UN Sustainable Development Goal 13 (Climate Action) in view. The school’s approach featured special assemblies, annual functions, sports days and learning marketplaces (exhibitions), all focused on SDG 13 Climate Action, with the participation of all 1,600+ students.

Art became the medium to communicate the fact that the mean planetary temperature near its surface has risen by about 1°C over the last century. A 65-foot long poster with the message ‘Climate Action Project Our World Our Future’ was created by the students of Class 7 for the school’s annual sports meet. It was given a standing ovation by the parents.

The school also undertook reforestation in the forest belt to reduce greenhouse gas emissions. On International Peace Day (21 September, 2018) 1,000 Arjuna (a medicinal plant) saplings were planted towards fulfilment of SDG 13. Inspired by the initiative, students planted a further sapling on each of their birthdays, leading to a multiplier effect. The school also collaborated for reforestation with various organisations that supported Climate Education Project. These include the ENO Schoolnet Association, Finland; the Forest Department, Phagwara; and Environment Association, Phagwara.

Efforts extended beyond India with members of the global community invited to promote the Climate Education Project. Twenty International Miss Multinational contestants

from New Zealand, USA, Venezuela, Mexico, Indonesia, Algeria, Belgium, Myanmar, Brazil, France, Zimbabwe, Russia, Malaysia, Ghana, Philippines, Japan and India, planted saplings on the school's premises. Mika Vanhanen, the CEO and Founder of the ENO Schoolnet Association, Finland, joined the tree plantation.

The Kamala Nehru School has adopted 65 villages to increase green cover. So far, students have planted 320 saplings in seven villages in collaboration with a local NGO, teachers and parents. Post COVID-19, this project has been revived and the plan is to cover all 65 villages.

Beyond promoting green cover, the school has also installed 32 solar panels to promote renewable solar energy to mitigate climate change.

Climate education for students moved online during the COVID-19 pandemic, resulting in the RiseUp4Ewaste International Project being declared the international winner at the Microsoft E2 Virtual Summit #TechforGoodChallenge March 2022. It saw participation from 4,008 students and 340 educators from 37 countries. KNPS started the project to create awareness that improper disposal of e-waste in regular landfills illegally, can lead to heavy metals and flame retardants seeping into the soil. When e-waste is exposed to heat, toxic chemicals are released into the air damaging the atmosphere. Electronic waste also contributes to air pollution. Five e-waste recycling industry partners supporting the Climate Education Project were Karo Sambhav, 3R ZeroWaste, Hulladek, Trashin and We the Recycling

Company. About 4,830 Kg of e-waste was collected during the collection drive.

The Kamla Nehru Public School also received the Climate Action Project School of Excellence Award 2021-22, from amongst the world's top 250 schools. Students collaborated with 270,000 students from 146 countries in their shared mission to mitigate climate change. The school is not resting on its laurels, however. 'We plan to sustain our success by continuing with our Climate Education Project. Advocacy, awareness and action to mitigate climate change, continue. We believe that Our Planet; Our Climate is Our Responsibility. So the Climate Education Project to mitigate climate change will remain the top priority in our school,' they say.

Paramjeet Kaur Dhillon

Principal (Administration & Innovation)

Kamla Nehru Public School

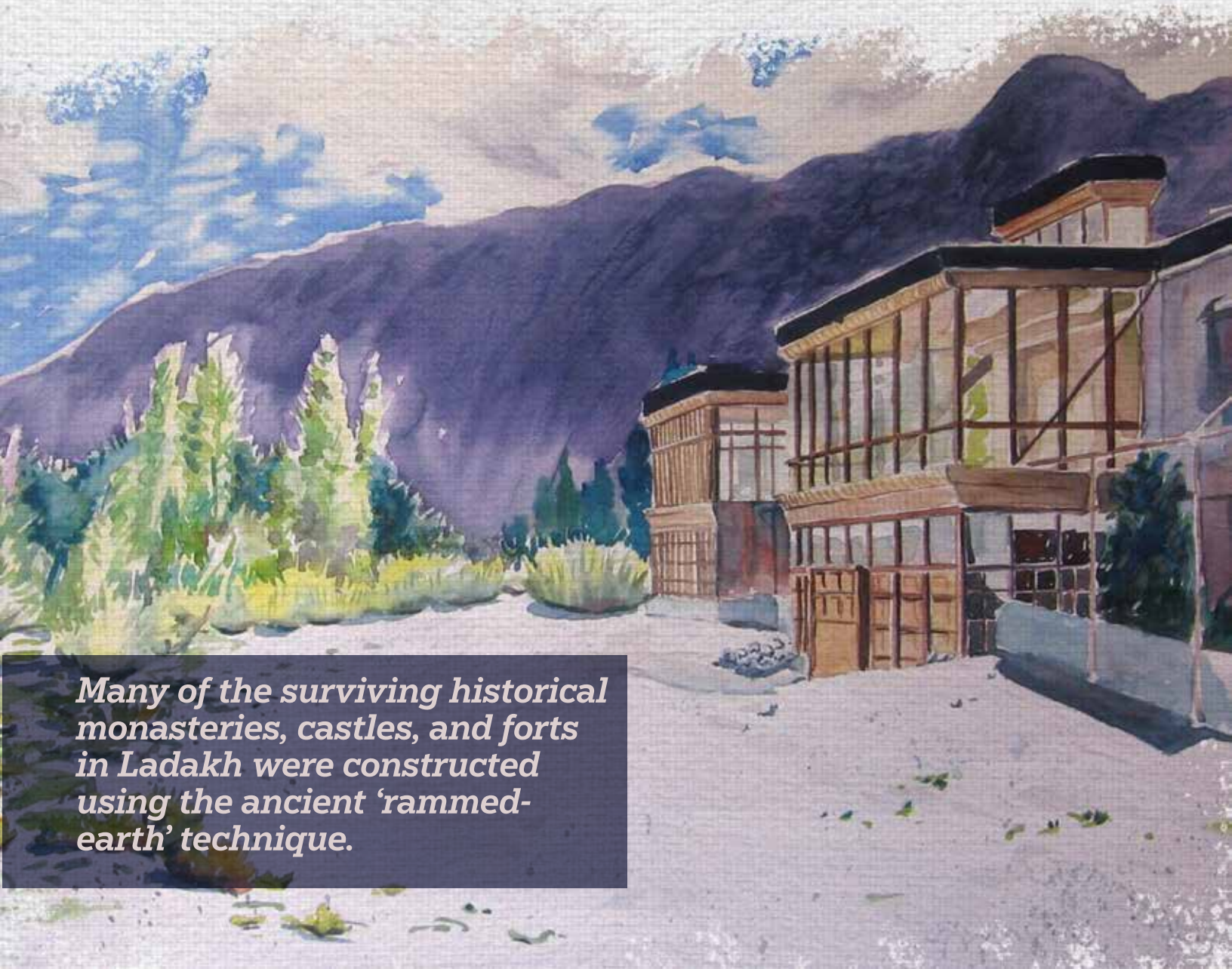
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Climate Responsive Architecture



Many of the surviving historical monasteries, castles, and forts in Ladakh were constructed using the ancient 'rammed-earth' technique.



Climate Responsive Architecture

At a height of 3,500 metres, nestled in the snow-swept plains of the trans-Himalayan desert, lies the campus of the Students' Educational and Cultural Movement of Ladakh (SECMOL). The temperature of the region varies from 20°C in summer to -30°C in winter. Fortunately, it receives over 300 days of sunlight, enabling opportunities to use solar energy.

Many of the surviving historical monasteries, castles and forts in Ladakh were constructed using the ancient 'rammed-earth' technique. They have weathered the harsh elements for centuries. Compared with concrete, mud has proven to be a much better insulator. Estimates maintain that 1 ft mud wall = 2 ft concrete = 4 ft stone.

Because of the challenging terrain and climate, which limit accessibility, and the minimal of debris post-construction, SECMOL's administration decided to adopt the traditional method of passive solar architecture for its school.

The earthen walls are cast within a simple wooden frame. Sand and clay are mixed in time-tested proportions, known to ensure strength, then rammed with pounders. The thick earth walls of the school buildings and the office in Leh are not just constructed for load bearing but also function as thermal mass heat banks. They absorb the excess solar heat during the day and release it into the rooms at night. In summer, the rammed earth keeps the buildings cool. Straw-clay bricks are added to increase insulation further.

The wood waste generated during construction is stuffed into the ceiling to stop thermal loss through the roof. Beneath the floors, layers of various sizes of rocks create insulating air pockets. A top layer of gravel and cement acts as a heat bank. The floors are of slate quarried from nearby mountains. These also absorb excess heat during the day and release it at night.

The thick rammed-earth walls of the school building keep it warm in winter and cool in summer. The outer walls are insulated by a jacket wall outside the main structural wall. A 6" gap between the two walls is filled with low-cost insulation—sawdust, wood shavings, paper and plastic garbage such as bottles and bags. Sometimes, cow dung is used as an insulating plaster. Mixed with the right amount of earth and clay, it makes a strong and thermally effective plaster.

The building is planned linearly facing south. Its main facade has large windows that face sunward as the sun moves low in the southern sky in winter and keeps the building warm. With thick rammed-earth walls that act as heat

banks, the structure absorbs heat from the sun during the day, stores it and releases it into the rooms at night. The structure is sunken 1 metre below the ground on the north side. Since Earth's temperature at this depth is relatively warm in winter and cool in summer, no electricity is required for heating or cooling. Believe it or not, but it is true. When the outside temperature is -25°C in winter, the inside temperature remains a mere 14°C . This is despite the building having no electric connection, nor is fossil fuel burned for heating, even during the peak winter. Its Passive Solar design and rammed-earth construction create comfortable conditions for the nearly 100 students and staff living and working here.

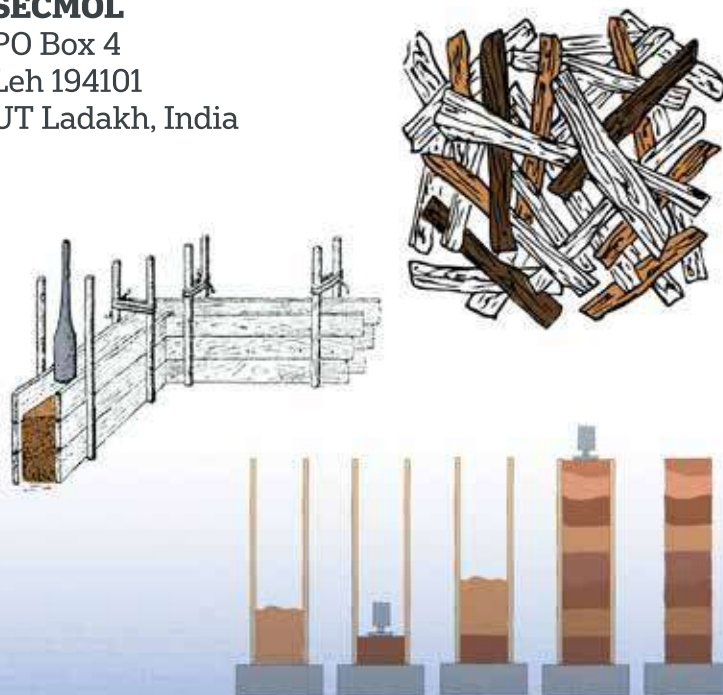
The credit for this amazing miracle goes to Sonam Wangchuk, who designed the structures, a local-born engineer-turned-architect and Ramon Magsaysay award-winning environmentalist, educationist and social reformist. He studied Earthen Architecture at the Craterra School of Architecture in France, after obtaining his Mechanical Engineering degree in India. Sonam, however, gives the credit to the people of Ladakh, from whose ingenuity

emerged this simple and innovative method of coping with the harsh realities of Himalayan living.

In 2016, the SECMOL structure was adjudged to be one of the best nine buildings of earthen construction by the jury of the international TERRA Award.

SECMOL

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REDUCE USE CYCLE



Creating Green Leaders

To create future green leaders, it focuses on providing its students with learning experiences designed to steer them to take action to make our planet healthier, greener and cleaner by focusing on the UN's Sustainable Development Goals (SDGs).





Creating Green Leaders

The Green School Bangalore (TGSB) is one of India's few zero energy, zero carbon and zero-waste schools. To create future green leaders, it focuses on providing its students with learning experiences designed to steer them to take action to make our planet healthier, greener and cleaner by focusing on the UN's Sustainable Development Goals (SDGs).

Toward this end, the administration leads by example. The school's buildings are built on the principles of green architecture. Vertical gardens adorn the built-up areas within the school's three-acre campus. Only locally available natural materials are used in the buildings, the outer surfaces of which require neither paint nor significant upkeep. The masonry selected also helps reduce contaminants and indoor pollution to lessen negative environmental impact. The laterite bricks and honeycomb walls act as natural air ventilators. Added to all this is a design that makes best use of natural light. Solar panels supply energy needs, minimising the carbon footprint.

The campus also features recycling and compost bins, rain barrels, bio-toilets, an organic garden and a corner for cooking without fire. The waste sorted by students daily is put in compost pits. SDG goals depicted on the school's walls constantly remind visitors to be environmentally conscious. Low-flow dual-flush toilets help conserve water.

For practical demonstrations to be in sync with scientific evidence, the Green Curriculum implemented in all classes includes Project-Based and Problem-Based Learning, so that students actively examine real-world issues and challenges and work out solutions. For example, students learn science, literature, maths, geography and more by cultivating an indoor farm, turning their harvest into healthy meals and sharing their ideas with others. Discussions in classrooms about robots, exotic materials and ideas for cross-disciplinary projects; along with projects focusing on aquaponics, hydroponics, vermicomposting and bio-filtration systems; all help students appreciate environment-friendly methods of existence. Research, innovation and decision-making are also encouraged.

The school's community encompasses those beyond the campus as well. Parents run drives on Sundays to help residents of their apartment complexes and localities familiarise themselves with the SDGs and identify environment-friendly initiatives that impact their locations. Even the materials and service vendors are mandated to adopt the SDG goals.

Going beyond, the school has plans for a Bio Bus project and for a plant to extract glycerine from used cooking oil and upcycle it into cakes of soap.

These will serve as practical solutions to mitigate Earth's environmental problems. The 2022 Green School Award will recognise the school's remarkable efforts in an upcoming Green School Conference at SUNY Maritime College, New York City.

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Dreams to Fulfil



SSN's mission to students from the community is to encourage them into becoming stewards for the environment, to reduce the impacts of climate change.



Dreams to Fulfil

Swapnopuron Shiksha Niketan (SSN) is the sole English-medium school located near the unique geographic region of the Sundarbans. The area is the world's largest deltaic zone and is designated a UNESCO World Heritage Site. Its biosphere is replete with an abundance of mangrove and animal species, including the Bengal Tiger. This geographically fragile biosphere is very vulnerable to mounting climate change.

SSN's mission to students from the community is to encourage them into becoming stewards for the environment, to reduce the impacts of climate change, which are only getting worse with every passing day. For instance, statistics confirm that now cyclones strike with greater speed and frequency. It is no wonder the Sundarbans has been given the unfortunate monicker of 'The Cyclone Capital' of the country.

The students at SSN are first-generation learners—children of marginalised communities with limited conventional opportunities for education.

According to Down to Earth magazine, 'These children live in a settlement extremely close to the world's largest mangrove forest often ravaged by cyclones. But most of them had limited understanding of how climate change is linked to these extreme weather events or other environmental problems.' It is SSN's aim to narrow this gap in awareness.

Locals refer to SSN's verdant 1.2-acre campus as an 'Eco Hub', because it teaches students integrated farming in conjunction to the regular school curriculum. They are taught to tend kitchen gardens, cultivate fish and breed fowl. As a result, the community is able to secure vegetables, fish and eggs for its members. Surplus produce is sold at local markets with the proceeds going into the school's coffers.

In 2020, a major cyclonic storm razed many buildings to the ground, while accompanying tidal waves completely inundated the land. Swapnopuron is constructing a new school in Kalitala using Earthbag construction to withstand any future cyclones. This architectural method reinforces structures against strong winds and protects them during flooding. Reinforced Cement Concrete is replaced with natural materials such as earth, lime, wood and bamboo. Bags packed with soil are stacked like masonry and tamped down flat. Barbed wire between the layers of bags reinforces them further.

These buildings are durable, non-toxic and simple to construct; they are also earthquake and flood resilient. Best of all, the architecture doesn't stick out like a sore thumb but blends in with the landscape.

The literacy rate in the Sunderbans is woefully low. The founders of SSN, however, envisage the quality of the education given to their students will bring about positive behavioural changes in the community at large. Then it will truly be 'Swapnopuron'—a Bengali word that translates to 'dreams fulfilled', say the founders.

Satarupa Majumder

Founder Secretary

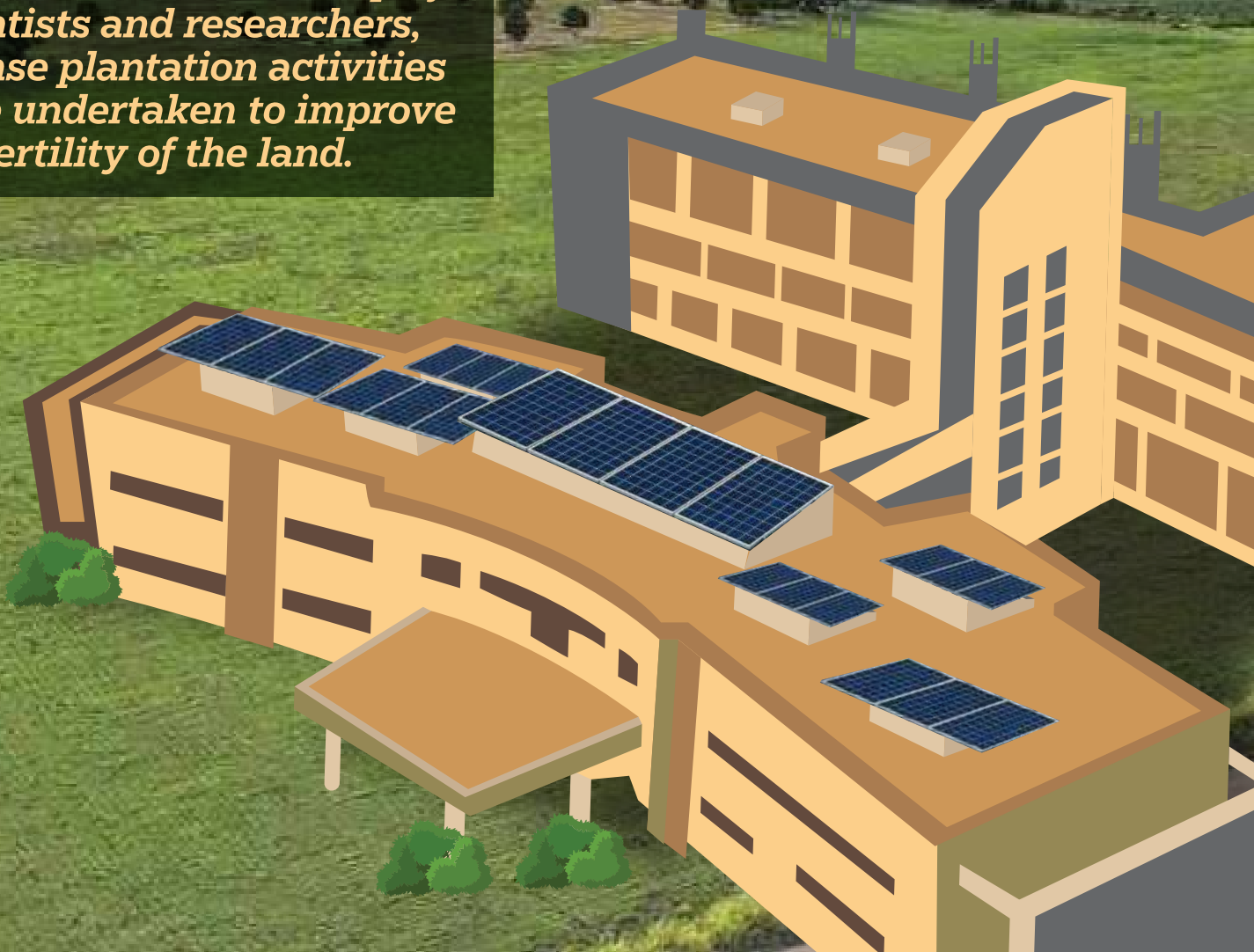
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The Resource Efficient Retreat

When TERI bought the land, it was rocky and devoid of vegetation. With the help of scientists and researchers, intense plantation activities were undertaken to improve the fertility of the land.





The Resource Efficient Retreat

The Energy and Resources Institute researches energy, environment and sustainable development. Commonly referred to as TERI, it has developed an innovative, environment friendly complex named RETREAT. The name is an acronym for 'Resource Efficient TERI Retreat for Environmental Awareness and Training.'

RETREAT is located amidst 36 hectares of beautifully landscaped environs at Gual Pahari, Gurugram, in Haryana State. When TERI bought the land, it was rocky and devoid of vegetation. With the help of scientists and researchers, intense plantation activities were undertaken to improve the fertility of the land. Today, the area is lush—covered with green forests and gardens full of beautiful flowers. Surrounded by this greenery and beauty, RETREAT proudly stands as a model sustainable habitat, a campus of the future.

The brainchild of architect Sanjay Prakash, this architectural wonder has features that result in near-total energy autonomy and minimal resource depletion while continuing to provide a comfortable lifestyle. Its buildings utilise

an array of techniques based on both modern science and traditional knowledge—solar chimneys and earth air tunnels, fully integrated solar photovoltaic systems, a bed of Phragmites (reed plants) to recycle wastewater using the root zone technique, a biomass gasifier fed by firewood, twigs, branches and crop stubble from the campus itself. All this and more help the RETREAT achieve considerable savings in energy consumption and a reduction in its carbon footprint with an estimated saving of CO₂ emissions of about 570 tonnes per year.

The complex has two semi-circular blocks arranged one behind the other. The structures showcase how orientation plays a vital role in 'solar architecture'. Built with longer façades on the East-West axis, the design allows maximum North-South exposure so that the sun's warmth streams in from the south during the chilly winter months. During the hot summer, the harsh heat emanating gets blocked out with the help of shading devices. The north block is slightly concave toward the front, while the south forms a hybrid convex surface facing the winter sun. The installation of innovatively designed skylights helps capture maximum daylight year-round. Insulated walls and roofs finished with broken tiles further reduce the demand for heating. Shading and fenestration, such as *jallies* (a popular Mughal-era construction design), incorporated in the built infrastructure, provide the RETREAT shade in the summer. A grove of deciduous trees planted in the south further cools the building in summer by acting as a sunscreen; in winter, the bare branches of the trees allow the sun's rays a free run to the building. Moreover, the load-bearing structure of reduced steel results in lower embodied energy.

What is particularly unique to the RETREAT is the use of the underground earth-air tunnel system. Four tunnels, each 70 metres long with a diameter of 70 cm, laid at a depth of 4 metres below the ground ensure that, even without air conditioning, the indoor temperature is maintained within the comfortable range of 20–30°C throughout the year. The novel system takes advantage of the relative constancy of the Earth's temperature to provide the rooms with subterranean airflows that maintain the temperatures in those ranges. Temperatures recorded at roughly 4 metres below the surface in Gurugram reflect a stable average annual measure of 26°C, even though with the change of seasons surface temperatures in the area fluctuate anywhere from 10°C to over 40°C. The RETREAT takes advantage of the fact that underground structures are not exposed to the sun, so they do not heat up as much. In addition, the insulation provided by the surrounding earth helps in maintaining a more or less constant temperature. This ancient knowledge was incorporated in structures centuries ago, as evidenced in historical buildings such as the 17th century Red Fort in Delhi.

To circulate the air, rooms have solar chimneys through which warm air rises and escapes by creating an air current. Blowers fitted in the tunnels push cool air upwards to replace the vacuum created by the escaped warm air. Ammonia-based chlorofluorocarbon-free chillers augment the system for dehumidification and additional cooling during the monsoon season, keeping in mind that there is a drop in efficiency during humid conditions as the tunnels cannot remove the excess humidity from the air. No wonder the energy needed for heating,

ventilation and air conditioning is reduced to 96 kW when the demand would have been around 280 kW in the usual course.

The RETREAT proves that sustainable habitats are not utopian but a reality cast in brick and mortar. However, the RETREAT is an evolving experiment. TERI has systems in place to constantly monitor the performance of the buildings. An elaborate, extensive and sensitive network of sensors linked to a central station provides data 24 hours a day, 365 days a year to research, analyse and find answers to the question 'How well does the RETREAT perform under varying ambient conditions—in winter, summer, on bright days, cloudy days, at varying levels of occupancy etc?' The findings help TERI pinpoint successes and identify areas for improvement so that future buildings incorporate upgraded designs and more effective systems of operation.

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Energy Management System

MAHE runs central air conditioning systems that use water-cooled screw chillers, unitary air conditioner controls and an automation system for buildings with sensors.





Energy Management System

Manipal Institute of Technology (MIT) is a constituent unit of the Manipal Academy of Higher Education (MAHE), deemed a university. It has devised various strategies to achieve sustainable development in waste management, water management, lung spaces and energy management.

In 2016, the Manipal campus formally implemented an Energy Management system. The initial tasks were to improve the energy quality (by replacing the old units with energy-efficient ones), optimise load through auto-synchronisation panels, and install energy-efficient power equipment. For example, MAHE runs central air conditioning systems that use water-cooled screw chillers, unitary air-conditioner controls and an automation system for buildings with sensors.

MAHE has clearly defined processes to plan and review methods and procedures. For review, MAHE implements the following: a) measurement and analysis of energy use and consumption by identifying existing current energy sources as well as an evaluation of past and present

consumption; b) based on this, areas of significant energy use are identified; c) facilities, equipment, systems, processes and personnel working for or on behalf of the university that affect significant energy use and consumption are also documented; d) based on all this, estimates for future energy consumption are determined.

The university's Energy Monitoring Hub (EMH) monitors centralised sub-stations and air conditioning plants. Key focus areas are maximum load reduction, the introduction of measures to improve the quality of power through replacement with energy-efficient transformers, pumps, detuned filters for capacitor banks, Compact Fluorescent Lamp/Light Emitting Diodes, auto synchronisation panels for load optimisation and energy-efficient equipment as certified by the Bureau of Energy Efficiency (BEE).

A data collection plan appropriate to the size, complexity, resources and measuring equipment is set up. It documents the source and frequency of data collection and who will be responsible for data collection. Data collection relates relevant variables to Sustainable Energy Units (SEUs); energy consumption and operational criteria related to SEUs; and static factors and data specified in the action plan as a minimum. Equipment used for monitoring and measuring the key components ensures accuracy and repeatability. Documentation establishing the said accuracy and repeatability is also retained. Real-time data availability enables efficient monitoring and quick troubleshooting. MAHE plans to enhance this platform to integrate remote controls from the EMH. This data is reviewed and updated by responsible experts every six months.

Phase-wise replacement of dated air conditioning units with power-efficient units in the HVAC (Heating Ventilation and Air Conditioning) systems were undertaken. For efficient cooling, automatic switching ON and OFF depending on occupancy or a fixed schedule is installed, replacing old systems. All hostel blocks have Solar Water Heaters. An array of solar collectors (made of copper absorbers/evacuated tubes) are laid and water is passed through them. The water is heated and stored in an insulated storage tank.

As the tank is insulated, the heat loss is minimal. Thus, hot water is available 24x7. This greatly reduces dependence on conventional energy sources, mitigating carbon emissions and promoting sustainable energy use.

Green energy use in campuses accounts for 70% of total consumption, thus reducing 31,028 metric tonnes (MT) of Carbon Dioxide Emissions (CDE), and self-generated solar power prevented 1,697 MT of CDE into the atmosphere. Moreover, the use of Electric Vehicles (EVs) “ for transport and campus patrols, solar rooftop PV systems and solar rooftop hot water systems, further reduce fossil fuel-based emissions.

These measures have significantly reduced MAHE's carbon footprint. This year, the UI Green Metric Ranking Agency placed MAHE as the greenest suburban campus in India, 137th overall and 47th in the suburban category.

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Garden of Natural Sounds

This mesmerising amalgamation of natural beauty and sound helps rejuvenate the minds of those who visit Anunaad—an ideal place to meditate, reflect, introspect, or revel in nature.



Garden of Natural Sounds

The Indian Institute of Management Indore is devoted towards protecting the environment and nature. It takes every possible step to ensure its campus is eco-friendly, while prioritising the physical and mental well-being of its community.

Over the last few years, it has landscaped many erstwhile vacant plots into pastoral idylls such as the Spiritual Garden, Zen Garden, Organic Garden and Sanjeevani—the Horticulture Cell.

Their latest addition—Anunaad—was inaugurated on 21 June, 2022, World Music Day (coincidentally, also International Yoga Day) by IIM Indore Director Prof Himanshu Rai.

Sprawling over 12,000 sq ft, the campus is home to 5,000 colourful and sweet-smelling flowering plants. These include varieties such as rose, night queen, jasmine and others. Windchimes, sourced from the Musical Instruments and Research Centre in Auroville (Tamil Nadu), add happy vibes to the surroundings. This mesmerising amalgamation of natural beauty and sound helps rejuvenate the minds of those

who visit Anunaad—an ideal place to meditate, reflect, introspect, or revel in nature.

In keeping with IIM Indore's environment-friendly outlook, much of the material used in the garden is recycled construction waste generated by the campus. The institution has also designated units to produce/manage wet waste, ensuring the ready availability of natural fertiliser. The campus is popularly referred to as 'Planet-I' for it is an ecosystem that provides a habitat for many species and makes for an ideal home for the business school's residents.

'Sound and music help keep our minds at peace and relieve stress, and Anunaad provides a platform of solace to everyone; bringing mental peace and joy to all with its aromatic plants and musical vibes,' says Prof Himanshu Rai.

Other institutions can also replicate this easily implementable idea to create an atmosphere conducive to higher learning; one that takes away from the stresses of everyday life, allowing campus-goers a chance to take a breather from the highly competitive world of management.

IIM Indore is not resting on its laurels, however. Plans are in place to treat the senses to further such spaces, bolstering the institution's place as a leader in this field.

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Growing Earth's Canopy

Their idea was to plant indigenous, food-bearing trees naturally resistant to drought. The success of their model led them to train others to replicate it.

2003

Today



Growing Earth's Canopy

The Rozins, Aviram, Yorit and their daughter Osher, founded Sadhana Forest in 2003 in Auroville, a township near Puducherry. Their aim was to help mitigate climate change by enabling water and food security in areas affected by drought. Their idea was to plant indigenous, food-bearing trees naturally resistant to drought. The success of their model led them to train others to replicate it.

Their first campus helped reforest 70 acres of severely degraded land by creating a vibrant, indigenous Tropical Dry Evergreen Forest (TDEF); such forests are on the verge of extinction. Only 0.01% of what used to be a vast forest currently exists in small patches in South India. By using a variety of water conservation and reforestation techniques, the Rozins were able to transform the barren landscape into a lush, forest teeming with biodiversity. The thousands of trees planted spawned many more naturally.

Most of the work goes into water conservation. The land must be prepared to prevent runoffs, so that sufficient rainwater can be harvested

to irrigate trees. Sadhana Forest has hundreds of small bunds around trees, dozens of kilometres of contour bunding, as well as a few large ponds to help sustain the vegetation.

The family started a second Sadhana Forest, in Haiti, after an earthquake devastated the country in 2010. Settling in Anse-a-Pitres, a small town in the south-eastern corner of Haiti, the Rozins joined hands with local communities to plant indigenous, food-bearing trees. They also built a solar-powered mill to grind the highly nutritious Maya Nuts (*Brosimum alicastrum*) harvested from the trees.

In 2014, a third Sadhana Forest was inaugurated with the Samburu tribe, a semi-nomadic people living in remote, arid parts of northern Kenya. With their habitation increasingly at risk of deforestation, drought and desertification, they suffer from food insecurity. The concept is similar to the one in Haiti.

In 2020, Sadhana Forest established itself in Meghalaya, Northeast India. The terrain here is hilly and the weather rainy. Overmining of coal has led to deforestation and the erosion and land degradation that come with it. A mobile reforestation unit—two solar-panel fitted buses—travelled from village to village to provide training in water conservation and tree planting.

Next on the cards for the Rozins was working with the local Himba tribe in Northwestern Namibia to plant indigenous, food-bearing trees.

Sadhana Forest collaborates with several academic institutions in Europe and the US on scientific research. In Haiti, they conducted a study on oxalogenesis, a process by which

certain trees can transform atmospheric carbon (CO₂) into limestone (CaCO₃) with the assistance of bacteria. Once stored in the soil as rock, this carbon is more stable than organic carbon and will remain there even if the trees are cut down or burnt. In Mexico, research demonstrated that the Maya Nut tree performs oxalogenesis. Several partners collaborated on the study. They include Bournemouth University (UK), Université de Lausanne (Switzerland) and Universidad Autónoma de Yucatán (Mexico).

Sadhana Forest is a volunteer-run organisation. In a usual year, it hosts about 1,500 volunteers, making it one of the world's largest residential environmental volunteer projects. Aviram calls it 'An extreme example of human diversity.'

He explains, 'We get volunteers from over 50 countries here yearly, people of various ages and physical capabilities, eating, working and living together, in very close quarters. That has helped create the community's resilience and enabled us to start projects elsewhere.'

Come volunteer at Sadhana Forest to learn how to turn your campus verdant as well.

Aviram Rozin

International Director

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Holistic Learning

To encourage a sense of ownership and responsibility towards the planet, the teachers, students and administrators combine efforts to maintain the school campus as a community. In the process, students learn the intricacies of managing the on-site systems.





Holistic Learning

A short drive from Kodaikanal, in the beautiful Palani Hills of Tamil Nadu, is located the Sholai School. It nestles in the 100-acre campus of the Centre for Learning, Organic Agriculture and Appropriate Technology (CLOAAT), which includes an area certified as an organic farm by the Control Union of the Netherlands.

The school buildings are surrounded by teeming bio-diverse flora, fauna and avian species. Myriad birds and wildlife such as the Malabar Giant Squirrel, Flying Squirrel, Deer, Elephant, and Gaur inhabit or frequent the grounds. Karuna Jenkins, Trustee of the Sholai School, proudly says, 'We are fortunate to have a diversity of flora that makes up the habitat of these wild creatures, as well as a variety of fruit trees, a coffee and pepper plantation and vegetable gardens that provide fresh produce to our community kitchen.'

The school is residential: its students, teachers, administrators and support staff spend most of the year on campus. Inspired by the teachings of renowned philosopher Jiddu Krishnamurti, the trustees of the Sholai School maintain

that this unique microcosm provides a holistic education. To encourage a sense of ownership and responsibility towards the planet, the teachers, students and administrators combine efforts to maintain the school campus as a community. In the process, students learn the intricacies of managing the on-site systems.

The campus is entirely off-the-grid to preserve its natural beauty, thanks to an array of renewable energy systems, including 89 solar panels, a micro-hydro plant and biogas. The students are conscious of their carbon footprints and ensure these remain minimal and that no one carelessly wastes any energy. For example, endless hours of computer or mobile use are a no-no. These activities are restricted to designated hours. During the rainy season, since sunshine is scant, the requirement for more careful energy use is evident. Therefore, it is natural for students at the Sholai School to use electric lights only when absolutely required—switching off lights and electrical appliances when not in use becomes second nature to the students.

In the summer, when water is scarce, impacting the crops grown, the students automatically limit their water use further. Upon depletion of the storage tanks, they resort to water from a well that requires manual pumping. Rainwater harvesting, organic farming and waste segregation are other green measures adopted at Sholai. There are no cleaners or janitors; everybody segregates their waste, which is sorted into 16 categories in the Recycling Room and managed. Over the last three decades, every bit of waste has been scientifically managed, making it a zero-waste campus. Meals are made from the fresh produce. The school also runs a dairy unit.

Many students from urban environments unconsciously bring habits not in tune with the Sholai ethos and systems. The school's weekly meetings provide a forum for community members to discuss concerns, solve issues and serve as a reminder to be more mindful.

Living close to nature instils in children a sensitivity to the elements. Everyone on campus learns to co-exist with and care for nature. Over time, they understand that Earth's resources are finite and precious. These habits lead to sustainable development becoming ingrained in their psyche. Classes on environmental studies, natural sciences and organic farming awaken in them an awareness of the delicate and vital balance humans share with the living biosphere. Every morning, the whole school, including teachers and students, work together on the farm. Connecting with the Earth and learning to care for plants and their living environment fosters a deep connection to the living world, which remains with the students even after they leave school. In the physics and engineering classes, teachers help the students understand the science behind the technologies used on campus and explain ways to maintain these in running order. Other courses, such as English and social studies, direct students' attention to anthropogenic activities that negatively impact our planet.

'Self-enquiry and attentiveness to relationships are encouraged in both students and teachers. We hope the students continue to build on the foundation laid in their formative years at Sholai,' says Karuna. The Sholai School has proven to exemplify how to make the youth climate literate and appreciative

of sustainable and regenerative energy sources. 'Growing up studying these sustainable systems, students experience both the joys and challenges of living consciously with minimal impact on the natural environment,' Karuna is happy to note.

Karuna Jenkins

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Inadequate Turns Adequate

In 2010, IIM Bangalore installed rainwater harvesting systems. The water was pumped to overhead tanks from the sumps and supplied to various parts of the campus to fulfil non-domestic needs.





Inadequate Turns Adequate

IIM Bangalore's 100-acre campus has developed into a natural habitat with 25,000 trees of various species, thousands of birds and other creatures. This natural idyll is also home to over 1,000 students, faculty and staff.

Some years ago, the institution experienced a severe shortage of water owing to the fact that all the borewells on its campus had run dry. As a result, it came to rely wholly on the municipal authorities for its supply of water. Naturally, water bills rose exponentially compared to when the borewells were operational. To add to their woes, the water supply from the municipal corporation was intermittent at best.

In 2010, IIM Bangalore installed rainwater harvesting systems. Initially, six systems were installed. The water collected was held in five 50,000 litre capacity sumps and one 100,000 litre capacity sump. The water was pumped to overhead tanks from the sumps and supplied to various parts of the campus to fulfil non-domestic needs.

Estimates indicated that 100 recharge wells are needed to capture the entire surface runoff of the campus. Of these, 57 have already been commissioned. Most of them are new, while a few defunct wells have also been revived. During heavy rains, overflows from the sumps are directed into the wells. The total runoff received by the wells annually is 1,425,420 litres. This has led to the water table rising to 6.5 metres compared to 20 metres earlier. The remaining 43 wells will be commissioned over the next 2-3 years.

For wastewater treatment, the institute has installed a Sewage Treatment Plant (STP) equipped with Sequencing Batch Reactor (SBR) technology and a capacity of 600,000 litres per day. The STP yields 200,000-250,000 litres of treated water daily to meet IIMB's gardening needs.

The construction of the STP was a major event. IIMB conducted a detailed cost-benefit analysis prior to building it. Selecting the right technology and site was paramount. Utmost care was taken to ensure existing sewage channels weren't damaged. Unfortunately, a cloudburst damaged a few of these and bypass lines had to be set up immediately.

Despite all these challenges, the work was completed in two years. It included sourcing and installing equipment, testing, commissioning and stabilising everything within a budget of INR 25,000,000.

Regular maintenance ensures that the systems run properly. The recharge and open wells are overhauled annually to maintain their percolation capacities. The dense foliage

of the campus is held back from entering the mouths of the wells through frequent clearing of iron grills. The rooftops and sumps are regularly cleaned in the dry season to prepare for the rains. In addition, new initiatives are undertaken almost every year to enable IIMB to remain water sufficient. These include multiple small initiatives to save water, such as foot-pedal systems for washbasins, taps equipped with sensors or aerators, installation of bio-urinals etc.

Thanks to all these initiatives, the monthly water bill at IIMB has reduced by a third, despite a significant increase in campus residents. IIMB's target of becoming water positive looks right round the corner.

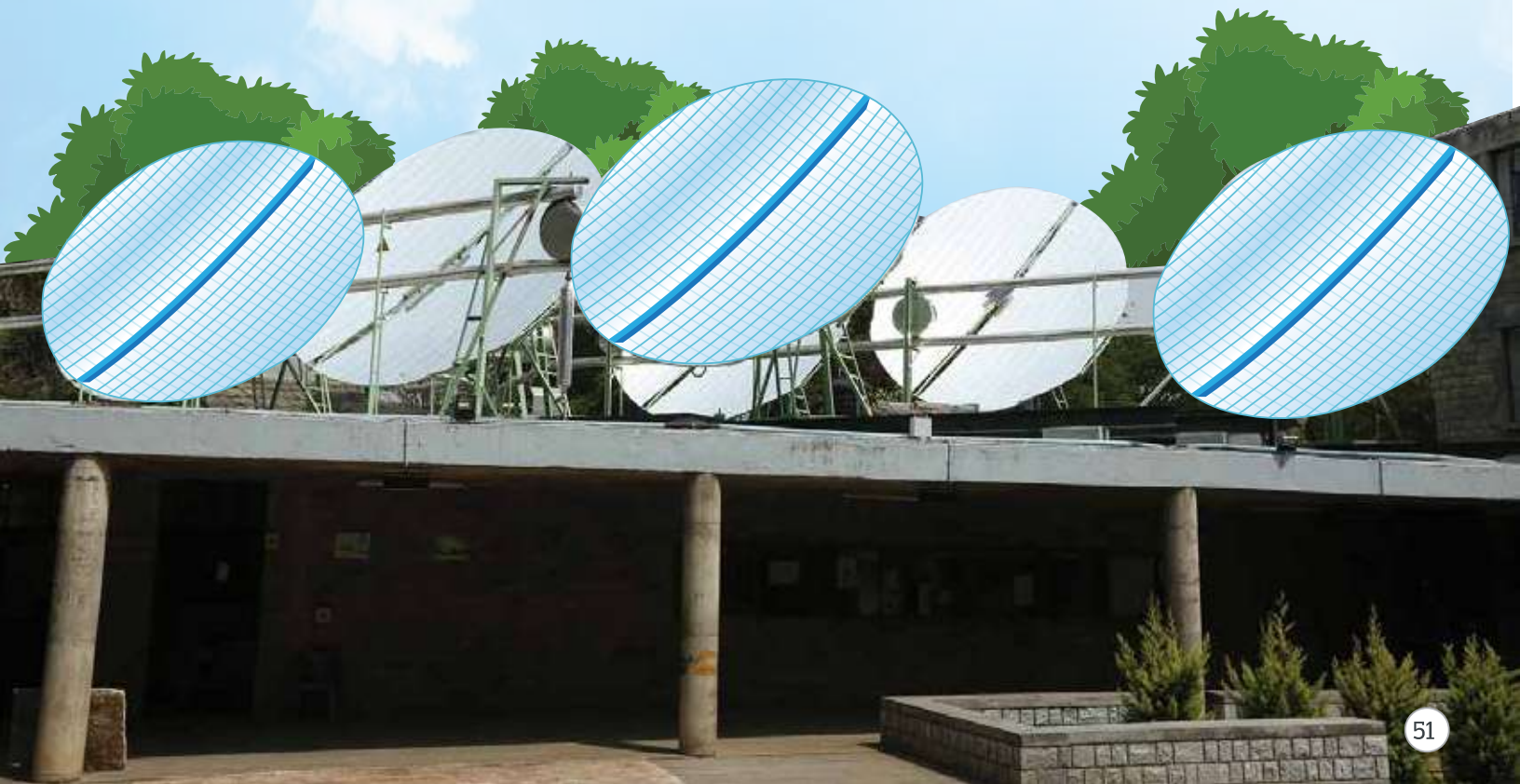
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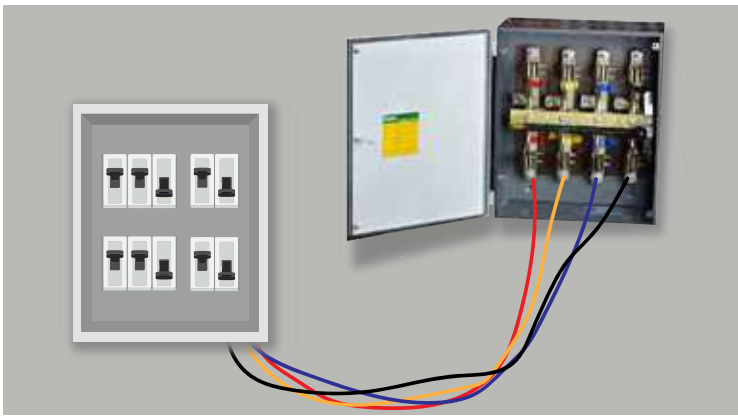
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Industrial Internet of Things



Connected devices communicate through gateways (physical servers) that filter data and transmit it to other devices and software applications. A cloud based smart meter is linked to the IIoT, which is remotely accessible.



Industrial Internet of Things

The Chennai campus of Vinayaka Mission's Research Foundation (VMRF)—Aarupadai Veedu Institute of Technology (AVIT)—runs on renewable energy. A rigorous regimen of monitoring consumption and adjusting strategies accordingly, ensures that demand does not exceed supply. To achieve this, the Institute's Department of Electrical and Electronics Engineering integrates information technology with energy management.

AVIT achieved this by adopting an automated Distributed Control System (DCS) with geographically distributed control elements, moving away from its erstwhile centralised control system. Localised controllers are placed in various sections of the plant's control areas. A dedicated controller controls each process, element, or machine, or group of machines. Each data receiver and monitor is linked to the DCS via a high-speed communication network.

The system operates with IIoT (Industrial Internet of Things), the defining feature of which is that data is transferred without human-to-human or human-to-computer interaction. Connected

devices communicate through gateways (physical servers) that filter data and transmit it to other devices and software applications. A cloud based smart meter is linked to the IIoT, which is remotely accessible.

Based on the data, several steps were taken, such as replacing CFL lamps with LEDs. A Sensor-Based Energy Conservation System was set up in the Staff Room, which switches off lights and fans when the space is not being used. Towards green mobility, the students designed e-cycles for commuting within the campus; furthermore, solar-powered charging stations were also set up. In the vicinity of the administrative building, you will find a Solar Tree for charging laptops and mobiles. Even the lawnmowers used on campus are solar powered! Battery-less UPS systems using mechanical flywheels supply back-up power. Solar inverters for lights in the Siemens Integrated Engineering Research Lab switch on during power cuts. Hands-on training sessions are conducted for students on assembling solar powered study lamps. Energy literacy training is given at the Aadhavan Energy Swaraj Club to all students to create awareness about climate change and the actions needed to mitigate its effects. Thus, AVIT manages to meet the entire demand for its campus with a supply of green energy.

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The Magic of 18 Saplings



Rajesh explains, 'I had read somewhere that a man inhales as much oxygen throughout his life as that generated by 18 plants. So, I ask the students to donate 18 plants as admission fee.'





The Magic of 18 Saplings

Rajesh Kumar Suman is a 34-year-old keen environment activist with deep concerns about climate change. He set up Green Pathshala BSS Club in 2008 in Rosera town in North Bihar, the very heartland of the state. His aim was to tackle global warming and unemployment in one fell swoop. BSS provides coaching to locals to enable them to compete for the extremely competitive entrance exams for government and other jobs. Such a facility was non-existent in this remote area, resulting in locals rarely qualifying for the jobs, further driving up already high unemployment figures.

How does Rajesh achieve his aim? The answer is so well-thought-out, yet so simple, for fees charged at BSS is merely 18 plants! Something that will help grow the dwindling green cover and is also affordable. With this, he aims to build awareness among the youth of Bihar about the importance of environmental conservation. 'How will the people survive unless they conserve the environment?' he asks. 'It's everyone's responsibility to save the environment,' he emphasises.

Over the past 14 years, the institute has received around 170,000 saplings from students. These are planted in various districts of Bihar such

as Samastipur, Begusarai, Darbhanga, Khagaria and Muzaffarpur.

Rajesh explains, 'I had read somewhere that a man inhales as much oxygen throughout his life as that generated by 18 plants. So, I ask the students to donate 18 plants as admission fee.'

The 18-sapling rule is not cast in stone, Rajesh explains. Students can also send him a selfie with planted saplings. Also, for those who don't have land of their own, he advises planting in open spaces and recommends planting fruit-bearing trees. 'Their harvests can benefit the community financially from the sale of yields and as supplements to nutrition,' he says.

But how does the institute function without charging money? Rajesh says they have volunteer teachers who have other paying jobs. He himself earns his living from farming. However, it wasn't easy in the beginning when the villagers boycotted him.

Piyush Kumar, the son of a grocer in Rosera, a municipal town along the Burhi Gandak river in Samastipur district, is today employed with the Indian Income Tax department and can vouch for it. 'But for this institute, I wouldn't have got the opportunity to study further. It has shaped my career and secured my future,' he says.

The training he received at BSS helped him clear the government of India's highly competitive entrance exam at the very first attempt.

Since its inception, 10,000 youths have benefitted from the coaching given at BSS. Around 650 qualified for government jobs, while many others have got employment in the private sector. What a remarkable way to 'Invest in Our Planet'.

Rajesh Kumar Suman (Oxygen Man)

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The Solar Mamas of the World

Barefoot's signature training course in solar engineering is a first-of-its-kind global network. It allows women to participate fully in the sustainable development of their communities, irrespective of their level of education.





The Solar Mamas of the World

Established in 1972, Barefoot College is headquartered at Tilonia in Rajasthan. It is a community-based grassroots organisation that works to help marginalised communities become self-sufficient and sustainable. Barefoot's approach is to build an alternative to the top-down model. It does this by providing last mile options in quality digital education the world over, despite deficiencies of power, connectivity, or staff. Sanjit Bunker Roy, the founder of Barefoot College, says his approach is 'low cost, decentralised and community-driven. I believe in capitalising on the resources already present in the villages,' he says.

Barefoot's signature training course in solar engineering is a first-of-its-kind global network. It allows women to participate fully in the sustainable development of their communities, irrespective of their level of education. The initiative enables women to build, install and maintain solar panels and batteries to provide renewable sources of energy for their communities. The training lasts

for a couple of months. Visual learning tools, such as colour-coded pictures and manuals, are mainly used for the training.

On completion of their training, the Solar Engineers return to their villages to bring clean power and light to the communities. They oversee the construction of Rural Electrification Workshops, which also serve as a base for storing their solar equipment and tools. A Village Electrification and Energy Committee is established to manage orders from families who want to implement solar lighting systems in their homes. Besides installing and managing these, the Solar Mamas also train other women in their villages so that there is a widening of knowledge.

These women are making an important contribution to the country's power needs. Rural Indians comprise 72% of the population and continue to depend on fossil fuels. This will be a setback for our environmental goals unless there is a greater and faster transfer to renewable sources.

Take the case of Barefoot College. Their 355 kW solar power system generates 518 MW of energy per year. In the last ten years, the campus has generated 5.1 GW of energy, which is enough to power 5,500 Indian households for a year, based on the national average of 900 kWh per year. Over the course of a decade, Barefoot College saved 1.7 million litres of kerosene, which is equivalent to 2,339 metric tonnes of firewood, or 2.6 million LPG cylinders. Barefoot College offsets 444 tonnes of carbon dioxide, 319 tons of sulphur dioxide and 2.1 tonnes of nitrous oxide from entering the atmosphere every year.

The first Solar Mama was selected in 2000. Since then, 1,700 Solar Mamas have been trained in 95 least-developed countries. Over 1,100 villages have been given access to solar power with 68,000 houses benefitting from the programme. A total of 45 million litres of kerosene have been saved from being emitted into the environment as greenhouse gases.



No
Problem



Jordan
Solar Mama_Rafea



One Women
At a Time



PM Modi's Speech
on Solar Mamas

Barefoot College is an amazing example of faith in humanity. They have been able to capitalise on the wealth of human resources available in remote, less privileged communities, circumventing the barrier of formal education. Solar Mamas is a shining example of providing opportunities to all. 'We want to create future leaders empowered to steer and advance the development of their communities,' they say. And they have.

Sanjit Bunker Roy

Founder

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Upcycled Vertical Gardens

Vertical gardens are economical and nature-friendly, nourishing the soil with water that drips down from the plants that hang in pots. The school even recycles peels from fruit and vegetables as potent organic fertilisers for the garden.





Upcycled Vertical Gardens

Kolkata is one of the most densely populated cities in the world. Unplanned growth has left very little open and green spaces. This has also led to Kolkata being one of the fastest warming cities globally. One of the primary factors for this is the 'heat island effect.' The air quality is also of grave concern.

School campuses in cities have little space for gardens, as classrooms and playing fields are unfortunately given greater importance over green spaces. A well-maintained garden with beautiful flowers and plants creates a healthy learning environment. The Shri Shikshayatan campus in the heart of Kolkata, amidst high-rise buildings, had similar space constraints. They rose to the challenge with the idea of creating a vertical garden!

A vertical garden is a vertically suspended panel on which plants are grown using hydroponics. These unique structures can either be freestanding or attached to a wall so that buildings can have living green walls or plant walls. Vertical gardens are an excellent alternative to potted

plants in the built environment. Potted plants provide flexibility in placement, but they take up space and require maintenance. Vertical gardens take up very little, if any, floor space.

In the absence of green belts, vertical gardens are a great solution to counter the 'heat island effect' and improve the ambient air quality. Not only does the garden beautify the area, but it also leaves a positive effect on mental and physical health. Furthermore, as vertical gardens use less water, fertilisers, pesticides and absorb more carbon dioxide per square foot than traditional gardens, students understand that they are contributing towards sustainable development goals.

Reduce, Reuse and Recycle is a mantra at Shri Shikshayatan. The students follow the process of gathering, processing and reusing materials into something useful. This is vital for reducing litter, cleaning the environment and producing new products. They segregate waste in different coloured bins: green for wet and biodegradable waste; blue for plastic wrappers and non biodegradable scraps; and yellow for papers and glass bottles. Plastic waste, which is a global concern, is creatively reused here. Plastic bottles make for excellent planters and are useful in vertical gardens.

The students used their ingenuity to make the vertical gardens on their campus. They gathered unused iron mesh to hang the planters around the premises. Parallel to that, damaged wash basins were upcycled into flowerbeds which made for an appealing view of plants of different shades, colourful flowers and butterflies

that are drawn to the gardens. Vertical gardens are economical and nature friendly, nourishing the soil with water that drips down from the plants that hang in pots. The school even recycles peels from fruit and vegetables as potent organic fertilisers for the garden.

Exterior vertical gardens also give buildings great protection and insulation from temperature fluctuations, UV radiation and heavy rain. In the summer, exterior vertical gardens use a process called evapotranspiration, which helps cool the air around them.

Students of Shri Shikshayatan are eco-conscious of building a greener future and even do without air conditioners in the classrooms. By taking these measures, they reduce their carbon footprint. The school administration and the students are equally aware of their responsibility towards society, the planet and their health.

Cities, that are also growing vertically for want of space, need solutions such as vertical gardens. Studies show that people with easy access to views of greenery or nature, exhibit greater creativity and overall mental health. A green wall could be that nature connection for students in the concrete jungle.

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Zero Garbage Campus

These include the biogas project, bio sanitiser project, sanitary napkins disposal project as well as the making of natural fertiliser by threading fallen leaves.





Zero Garbage Campus

Committed to the empowerment of women for the last 126 years, the Maharshi Karve Stree Shikshan Samstha (MKSSS) in Pune has always led by example. It was established in 1896 by visionary social reformer Bharat Ratna Maharshi Dhondo Keshav Karve to provide housing for underprivileged women. Today, the institution's 65 academic units, from nurseries to colleges, provide formal education to about 35,000 women and girls in a variety of subjects, including engineering, nursing, architecture and fashion technology. Apart from this, it also runs a bakery, research centres, hostels for working women and skill development centres.

MKSSS is spread across six cities in Maharashtra. Its campus in Karve Nagar, Pune, is its largest base and has various schools, colleges, canteens and hostels for girls. Its buildings are surrounded by a dense canopy of about 3,000 trees spread over a total area of 120,000 sq ft. The staff, students and visitors on campus generate 1.5-2 tonnes of waste per day. Given their increasing activities and expansions, the management of this waste became a matter of great concern for the

institution. To address this issue and create a sustainable solution, it has undertaken a number of innovative initiatives aimed at efficiently achieving this task. These include the biogas project, bio sanitiser project, sanitary napkins disposal project as well as the making of natural fertiliser by threading fallen leaves. All these initiatives have turned out to be practical, implementable, cost-effective and—most importantly—environmentally sustainable.

While the waste management practices were underway, waste segregation at source became an issue. The difficulty lay in behavioural and other factors. To address this, the Samstha undertook awareness drives, training programmes and also provided separate bins. Their waste management practices yielded results with the campus now declared a 'Zero Waste-Zero Garbage Campus.'

The food waste generated from the girls' hostels is collected for further treatment to manufacture biogas. This biogas is used in the Samstha's bakery. Around 300-400 Kg of food waste is collected daily and put in the biogas unit for further processing. This food waste yields approximately 35-40 Kg of biogas daily, which is equivalent to the traditional Liquid Petroleum Gas (LPG) cylinders used domestically.

This biogas is supplied to the kitchens of the hostels and canteens. It has created multiple benefits, ranging from waste management to fuel. Cleanliness of the campus and awareness of hygienic practices are additional benefits. Women are at the forefront of all these activities, which have also created employment opportunities for them.

Further, the leaves and other green waste generated from the trees in the Samstha are collected every day. This collected waste is treated through the threading process in the Samstha campus for various purposes. The prime objective, however, is the manufacture of organic fertiliser. For this, threader machines are deployed and operated as required.

The Samstha has also created three organic farms or kitchen gardens in sizes of 2,000 sq ft, 1,500 sq ft and 5,000 sq ft. Fruit, vegetables and other daily kitchen needs are met by them. The organic fertilisers manufactured through threading of the green waste are used to grow organic produce.

MKSSS has been a pioneer of social reform through women's education. The waste management practices in the Samstha are an addition to their legacy of sustainability. Various other initiatives of climate action and sustainable development have also resulted in industrial partnerships. Overall, the Samstha's policy of creating synergies and win-win situations for environmental protection is a model for other institutes to follow.

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