GREEN CAMPUS INITIATIVE
CSE’s Green Campus Initiative

- First workshop in Delhi in March 2017.
- Demand for an organized process to understand their campus and conduct green audits
CSE’s Green Campus Initiative

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- Demand for an organized process to understand their campus and conduct green audits

- Consumption
- Conservation
- Operations & Maintenance
• Consumption
• Conservation
• Operations & Maintenance
Covered Area

- Pervious open
- Impervious open
- Covered Area
Shaded OAT
Shaded parking
Shaded streets
Outdoor activities
On-ground PV
Roof-top PV
Peripheral tree buffer
Minimize hard-paved areas
Impervious
Open
Pervious
Open
Tree Canopy Area
Land Utilisation
• Consumption
• Conservation
• Operations & Maintenance
EPI – Energy Performance Index

Energy Performance Index = Energy Consumed Annually (KWh) / Built Up Area (sq.m.)

AAETI
62.7
KWh/sq.m./yr.
RMVCC Kolkata = \frac{54267 \text{ KWh}}{2160 \text{ Sqm}} = 26 \text{ KWh/Sq m/yr.}
Passive Features

Orientation

Shading

Window Wall Ratio
• Consumption
• Conservation
• Operations & Maintenance

WATER
Per Capita Water Consumption

\[
\text{Per Capita Water Consumption} = \frac{\text{Total Water Consumed}}{\text{Number of People}}
\]

Sources of Water
- Municipal
- Water Body
- Under Ground Water
- Waste Water Recycle
- Stored Rain Water
**Water Balance Chart**

**Daily water consumption balance chart (non-rainy days)**

- **Fresh water Requirement Well:** 76 KLD
- **Water requirement (non-flushing):** 55 KLD
- **Water requirement (flushing):** 17 KLD
- **Swimming pool:** 6 KLD
- **Space cooling:** 15 KLD
- **Horticulture:** 57 KLD
- **Grey water:** 37.4 KLD
- **Black water:** 17 KLD
- **Wastewater generation @ 85% of water consumption**
- **Filter:**
- **20.4 KLD grey water and 17 KLD black water + additional stored rainwater (19.81 KLD)**
• Consumption
• Conservation
• Operations & Maintenance
Factors affecting air quality

Source of Fuel Consumption

• Vehicles
• DG Sets
• Kitchen
• Heating

Pollutants

• (Toxic) Dust
• Waste burning
• Construction and demolition

Major Pollutants:

• PM$_{2.5}$
• PM$_{10}$
• SO$_2$
• NO$_x$
• CO
• O$_3$
• NH$_3$
• Pb
Indoor air quality

Housekeeping and pest control activities

Indoor court surfaces

Paints & Varnishes

Health Hazards of VOCs
VOLATILE Organic Compounds

Immediate
- Eye & Respiratory Tract Irritation
- Headaches
- Dizziness
- Visual Disorders
- Memory Impairment

Up to 6 years
- Eye, Nose, and Throat Irritation
- Headaches
- Loss of Coordination
- Nausea
- Damage to Liver, Kidney, and Central Nervous System
- Cancer
Initiatives, Communication

**Initiatives**: Policies, Action plans, Sustainability Framework, Reduction commitments, Fines, Clean Mobility Plan, Pedestrianization, Car Free day, green infrastructure.

St. Edmund’s

St. Xavier’s Bhubaneswar
• Consumption
• Conservation
• Operations & Maintenance
Per Capita Waste Produced per day = \frac{\text{Total Waste Produced (gms/day)}}{\text{Number of People}}
Waste Typologies

- Solid Waste Management Rules 2016
- Plastic Waste Management Rules 2016
- Hazardous Waste Management Rules 2016
- E-Waste Management Rules 2016
Waste Management

Understanding your waste system

Garbage segregation categories

Campus collection points and capacities

Transportation dynamics: who transports, frequency and authorized vendors

Where does it go in the end?
Waste Management

- Segregation
- Primary collection
- Secondary collection
- Processing/Treatment
- Material recovery
- Disposal
- Buyer
On-campus processes

Engagement and handholding under the initiative

1. Assign responsibilities
2. Prepare an inventory
3. Develop a baseline scenario
4. Set targets
5. Take action
Nationwide engagement

January 2018
Nationwide engagement

September 2018
Nationwide engagement

November 2018
Nationwide engagement
Key questions

- How to bring the diverse campuses on a same measuring platform?
- How to recognize innovations?
- How to reflect campuses’ efforts best?
What is a green campus?

- Ethos
- Education
- Practice
- Ethics
- Values
- Culture

Environment
Selected campuses
Handholding with the selected campuses

Ramakrishna Mission Vivekananda Centenary College
Handholding with the selected campuses

National CPWD Academy

Gargi College

Guru Nanak Dev University

National CPWD Academy
CSE’s Green Rating System
A GREEN CAMPUS COMPENDIUM: INCUBATION, EXPERIMENTATION AND DEMONSTRATION OF A GREEN FUTURE
• Solar Energy
• Biogas Plant
• Wheeling to the grid

• Sensor Based Energy Conservation
• Use of LED/ power efficient equipments

• Energy Generation
• Efficient Fixtures
• Passive Design
• AC/Mixed Mode/Naturally Ventilated
• Awareness Programmes
• Policy
WASTE

- Solid waste management
- Biomedical waste mgmnt
- Hazardous chemicals and radioactive waste mgmnt
- E-waste management
- Waste recycling system
- Ban on use of plastic
- Liquid waste management

Cleanliness in and around the campus and waste minimization.

- Environment-friendly activities adopted and practiced by the campus

- Waste Segregation
- Organic Waste Treatment
  - E-Waste
  - Paper recycling
  - Disposable Free Campus
  - Policy
  - Awareness Programmes
- Rainwater harvesting
- Borewell/ Open well recharge
- Construction of tanks and bunds
- Waste Water Recycling
- Maintenance of water bodies and distribution system in the campus

- Water conservation and management including waste water management and reuse, rain water harvesting, etc.
- Environment-friendly activities adopted and practiced by the campus

- Rainwater Harvesting
- Waste Water Recycling
- Water Efficient Fixtures
- Awareness Programmes
- Policy
AAETI

AIR

- Restricted entry of automobiles
- Use of Bicycles/ Battery powered vehicles
- Pedestrian Friendly pathways
- Indoor Air Quality
- Non Motorized Vehicles/ Shared Mobility
- Green Transport Infrastructure
- Awareness Programmes
- Policy
• Landscaping with trees and plants

• Greenery within the campus to provide pollution free air and carbon-sink.
  - Environment-friendly activities adopted and practiced by the campus.

• Land-use for self sufficiency

• Tree Density
  - Pervious Surfaces
  - Awareness programmes
  - Green Gardening Strategies
About the compendium
This compendium tries to showcase the initiatives taken up by educational campuses in the country, it consists of green initiatives taken in five sections: Energy, Land, Air, Water and Waste. Each section is assessed through a wide range of parameters some of which are mentioned below.

Each category has 3 sub sets:
- **Efficient Consumption**: To ensure the optimum utilization of resources.
- **Conservation**: To ensure that the replenishment potential of the resource is met and to award the generation of a resource being produced in a sustainable manner.
- **Operation/Maintenance and Policy**: To ensure that losses caused due to faults maintenance issues are minimized and good policies are rewarded.
Need of green initiatives/green campus programme:

✓ To instill collective responsibility towards sustained resource utilization
✓ To encourage transparent monitoring of resource consumption patterns and waste generation to benchmark environmental performance.
✓ Weave responsible communities committed to environment that would contribute to environmental challenges, thus, fostering an environmentally aware and responsible generation of citizens.
Tree Density
Don Bosco University, Assam

Agarwood Plantation covering 4 Hectares of land in the campus
Cocoa and Rubber Plantations done in the campus
Agroforestry / Kitchen Gardening
Green Gardening Strategies

As the organic mulch breaks down, nutrients are released into the soil.

Mulch keeps sunlight out, minimizing evaporation. This helps retain water and keep moisture at the roots.

Without sun, weed seeds cannot germinate, they will remain dormant.

Mulch insulates plant roots, protecting them from temperature fluctuations from the environment.

Heat builds up and moisture is lost to evaporation.

Rain and wind cause soil to erode.
**STEP 1:** Locate your campus on Google Earth or a similar software

**STEP 2:** Mark your campus using the measure tool

**STEP 3:** Note the Total Site Area
<table>
<thead>
<tr>
<th>Covered Area (Building 1)</th>
<th>Covered Area (Building 2)</th>
<th>Covered Area (Building n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Add all the building footprint areas to arrive at covered area</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Covered area definition**

**Total Covered area**
Total paved/road area

Add all the non pervious areas to arrive at total non pervious area

Pervious and non pervious definition, what constitutes what
Total Site Area - Total Covered area - Total Impervious paved area = Pervious open area

Subtract the Total Covered area and the Total impervious area from site area to arrive at pervious open area
AAETI

ENERGY

- Consumption
- Conservation
- Operations & Maintenance

Energy Generation

Passive Design

AC/ Non AC/ Mixed Mode

Efficient fixtures

Awareness Programmes

Policy
Passive Features

Orientation

Shading

Window Wall Ratio
Click on this circular icon to orient the image in a way that north faces up.
Tell me 3 things wrong with this?

Window Wall Ratio

- 90%
- 80%
- 50%
- 60%
- 40%
Effect of A High Window-Wall-Ratio
Crevice and shading elements in built form
Window Wall Ratio = \frac{Window Area on a facade}{Total exterior exposed Surface of wall}
**STEP 1:** Take picture of a façade of the building of which Window Wall Ratio is being calculated.

**Window Wall Ratio**

$$\text{Window Wall Ratio} = \frac{\text{Window Area on a facade}}{\text{Total exterior exposed Surface of facade}}$$

**STEP 2:** Mark the windows onto the façade.

**STEP 3:** Mark the Area of the rest of the façade, including the windows.
Search And Compare

**STEP 1**

Select All

- Room Air Conditioner (Fixed Speed)
- Ceiling Fan
- Colour Television
- Computer
- Direct Cool Refrigerator
- Distribution Transformer
- Domestic Gas Stove
- Frost Free Refrigerator
- General Purpose Industrial Motor
- Monoset Pump
- Openwell Submersible Pump Set
- Stationary Type Water Heater
- Submersible Pump Set
- TFL
- Washing Machine (Semi/Top Load/Front Load)

**LED LAMPS**

- Room Air Conditioner (Variable Speed)
- Chillers
- Microwave Oven

**STEP 2**

**Lamp**

- Select All
- 10
- 10.5
- 11
- 12
- 13
- 14
- 15

**Star Rating**

- Select All
- 2
- 3
- 4
- 5
### STEP 3: Comparing LED lights

<table>
<thead>
<tr>
<th></th>
<th>Halolux ASTRON STAR 15W</th>
<th>LUXER LBPCB15HG</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lamp Power (Watts)</strong></td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td><strong>Equivalent Incandescent lamp power (Watts)</strong></td>
<td>100</td>
<td>81</td>
</tr>
<tr>
<td><strong>Light output (Lumens)</strong></td>
<td>2000</td>
<td>1800</td>
</tr>
<tr>
<td><strong>Life (hours)</strong></td>
<td>25000</td>
<td>50000</td>
</tr>
<tr>
<td><strong>Rated luminous efficacy (lm/W)</strong></td>
<td>133.33</td>
<td>120.00</td>
</tr>
</tbody>
</table>

**Critical to check:** Higher Luminous efficacy denotes higher efficiency.

- **Same Star Rating**
- **Same Energy Usage**
- **Different Output**
STEP 3: Comparing Fans

- **Same Star Rating**
- **Different Output**
- **Same Energy Usage**
- **Critical to check: Higher Service Value denotes higher equipment efficiency**
Efficient cooling systems

- Heat exchanger
- Warm outside air
- Wetted pad or any other evaporative media
- Cool, dry air
- Cooling coil
- Chilled water supply from chiller
- Reheating coil
- Cool, dry air

Indirect evaporative cooling only wet season
Direct evaporative cooling only dry season

Two Stage
Three Stage
Efficiency fixtures and controls

Day Time / Light OFF  Day Time / Light OFF  Day Time / Light OFF

Night / Light OFF  Night / Light ON  Night / Light OFF
Renewable Energy

Xavier’s Bhubaneswar

\[
\text{Solar Penetration} = \frac{180 \text{ Kwp}}{720 \text{ Kw}} = 25\%
\]

Installed Solar Capacity (KWP) = Connected Load (KW)
STEP 1: Note the Connected or Sanctioned Load of the building or Campus (depends on how your campus receives its electricity bills.)

Sanctioned Load: 105 (KVA)

STEP 2: Note the total peak power of a PV system. This can easily be found from the administration. The unit for this would be KWp or MWp or GWp (Kilo/Mega/Giga Watt Peak)

STEP 3: Calculate the Total Solar Penetration of Solar

\[
\text{Solar Penetration} = \frac{\text{Installed Solar Capacity (KWp)}}{\text{Connected Load (KW)}}
\]
Guru Nanak Dev University, Amritsar

Solar energy plant of 3 MW capacity
Privately operated and maintained at no cost as identified by the Solar Energy Corporation of India
Power sold at a subsidized rate of Rs. 3.32 per unit to the campus
The campus has installed a Solar PV plant of 320 kwp
Solar panels with a capacity of 72 kWp on the college roof
Policy measures
Procurement Policy

5-Star Rated
Awareness

St. Edmund’s

St. Xavier’s Kolkata

Check List Before Leaving

- All Taps Have been Shut Off
- All Computers Have been Shut Off
- All Electrical devices / Power sockets have been Switched off
- All Light Switch to be Shut Off
- All Classrooms & Laboratories are locked properly

St. Xavier College

Revenue

682.10 K INR

CO₂ avoided

68.21 Ton

*INR 8/kWh.
*0.8 Kg/kWh
AAETI WATER

- Consumption
- Conservation
- Operations & Maintenance

Harnessing/harvesting Natural Resources

- Rainwater harvesting
- Waste Water Treatment
- Water Efficient fixtures
- Awareness Programmes

Efficient Consumption

Operation/Maintenance and Policy

Policy
Do you harvest rain water?

- Recharge Wells
- Storage Tanks

Capacities (Kilo Litres)
Rain water harvested in a pond and is used for horticulture purposed throughout the year.
The campus has one artificial lake and 5 minor reservoirs to conserve water.
Rain water harvesting system of Gargi college with harvest potential of 606 KL
AAETI is designed to treat 8 KLD through Decentralised Waste Water System

- Waste Water Recycling

Capacities (Kilo Litres)
Water Efficient Fixtures

Retrofit & Controls:

Flow restrictors: 5.6 – 8.3 litres per minute. Saving potential – 80%

Automatic faucet: Saving potential – 75%. Reduces vandalism and damage.

Aerators: 2-8 litres per minute. Saving potential – 30%

Smart Meter
What Are Aerators and What Do They Do?

Aerators are small parts placed on the end of faucets. Typically they are small mesh screens that break up the flow of water into multiple small streams, adding air in between. By diluting the water stream with air, aerators significantly reduce the volume of water flowing from your faucet. They do this while maintaining the feeling of a high-pressure flow. Aerators also reduce splashing in sinks.


Existing taps can be retrofitted with aerators to bring down flow rate (denoted by LPM) of a fixture. Aerated, laminar, spray and mist aerators are different types of water saving devices that can be applied on the existing faucets depending on the kind of use.
Calculate the flow of water from a faucet in Liters Per Minute

Calculating the water flow from a faucet would require a timer (easily found on a phone) and a bucket/container with a known capacity.

Open the tap full blast, place the container underneath the flow and note the amount of time it takes (in seconds) to fill the container.

**Example:** 15 liter bucket takes 30 seconds to fill
15 liters --- 30 seconds = 15 / 30 * 60 = 30 liters per minute average flow rate.

Now repeat the calculation after placing an aerator on the faucet.
Critical to check: A lower Liters Per Minute (LPM) value denotes less amount of water flowing through the fixture.

Comparing flow rates of faucets (Liters Per Minute)

<table>
<thead>
<tr>
<th>PARTICULAR</th>
<th>Flow Rate in LPM at</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.5 BAR</td>
</tr>
<tr>
<td>Single Lever Extended Basin Mixer 85mm With Popup Waste System</td>
<td>6.35</td>
</tr>
<tr>
<td>Single Lever Extended Basin Mixer 95mm Without Popup Waste System</td>
<td>6.35</td>
</tr>
<tr>
<td>Single Lever Tall Boy With 150mm Extension Body</td>
<td>7.28</td>
</tr>
<tr>
<td>Exposed Part Kit Of Single Lever Basin Mixer Wall Mounted</td>
<td>6.51</td>
</tr>
<tr>
<td>Single Lever Wall Mixer With Provision Of Hand Shower</td>
<td>9.34</td>
</tr>
<tr>
<td>Single Lever Exposed Shower Mixer</td>
<td>13.06</td>
</tr>
<tr>
<td>Single Lever Exposed Shower Mixer</td>
<td>13.06</td>
</tr>
<tr>
<td>Single Lever Concealed Deusch Mixer With Provision For Connection To Oh Shower Only</td>
<td>11.08</td>
</tr>
<tr>
<td>Single Lever Concealed Deusch Mixer With Provision For Connection To Spout Only</td>
<td>10.04</td>
</tr>
<tr>
<td>Single Lever Sink Mixer With Swinging Spout</td>
<td>6.08</td>
</tr>
<tr>
<td>Single Lever Sink Mixer With Swinging Spout</td>
<td>6.21</td>
</tr>
<tr>
<td>Pillar Cock</td>
<td>6.45</td>
</tr>
<tr>
<td>Pillar Cock With 140mm Extension Body</td>
<td>6.45</td>
</tr>
<tr>
<td>Two Concealed Stop Cocks With Basin Spout</td>
<td>6.86</td>
</tr>
<tr>
<td>Single Concealed Stopcock With Basin Spout</td>
<td>6.33</td>
</tr>
<tr>
<td>4-Way Diverter For Concealed Fitting</td>
<td>20.46</td>
</tr>
<tr>
<td>Concealed 4-Way Diverter Set</td>
<td>16.88</td>
</tr>
<tr>
<td>Bib Cock</td>
<td>6.31</td>
</tr>
<tr>
<td>2 Way Bib Cock</td>
<td>5.91</td>
</tr>
<tr>
<td>Angular Stop Cock</td>
<td>22.27</td>
</tr>
<tr>
<td>Flush Cock</td>
<td>37.72</td>
</tr>
<tr>
<td>CATALOGUE NO</td>
<td>SIZE</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td>69 x 36 x 71 cm</td>
</tr>
<tr>
<td>COLOR</td>
<td></td>
</tr>
<tr>
<td>Starwhite</td>
<td></td>
</tr>
<tr>
<td>Ivory</td>
<td></td>
</tr>
<tr>
<td>BRAND</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>WARRANTY</td>
<td></td>
</tr>
<tr>
<td>10 Years for Ceramic</td>
<td></td>
</tr>
<tr>
<td>FLUSHING</td>
<td></td>
</tr>
<tr>
<td>2/4 litres flush</td>
<td></td>
</tr>
</tbody>
</table>

Critical to check: Denotes the amount of water needed for flushing.
Procurement Policy

5-Star Rated
AAETI

AIR

- Consumption
- Conservation
- Operations & Maintenance

Harnessing/harvesting Natural Resources

Indoor Air Quality

Non Motorized Vehicles / Shared Mobility

Green Transport Infrastructure

Efficient Consumption

Operation/Maintenance and Policy

Awareness Programmes

Policy
Indoor Air quality
Housekeeping and pest control activities

Paints & Varnishes

Health Hazards of VOCs
VOLATILE Organic Compounds

Immediate
- Eye & Respiratory Tract Irritation
- Headaches
- Dizziness
- Visual Disorders
- Memory Impairment

Up to 6 years
- Eye, Nose, and Throat Irritation
- Headaches
- Loss of Coordination
- Nausea
- Damage to Liver, Kidney, and Central Nervous System
- Cancer
Under a car free campus policy, lane demarcation and circulation completed.
Shared Mobility
Guru Nanak Dev University, Amritsar

Public bike sharing service
Facilitates intra-campus low-carbon mobility
Green Transportation Infrastructure
Awareness Campaigns

St. Edmund’s

St. Xavier’s Bhubaneswar
WASTE

- Consumption
- Conservation
- Operations & Maintenance

Waste Segregation
有机废物处理
一次性免费校园
电子废物及纸张回收
政策
意识计划

Operation/Maintenance and Policy
Efficient Consumption
#break free from plastic
Campus Pledge
Segregation

- Biodegradable (Wet)
- Non-biodegradable (Dry)
- Domestic Hazardous
- E-Waste
Organic Waste Treatment
Ramakrishna Mission Vivekananda College, Kolkata

Vermi-Compost facility. The compost is used in the experimental garden and horticulture.
Disposable free
As an initiative to ban single-use plastic in the campus, “Bring Your Own Mug” has been launched as a campaign that encourages students to bring their own mugs into the campus.
The campus authorities in association with the green committee “Avni” has been regularly hosting campaigns and workshops.
The assessment encourages campuses to set a goal for each of the category, this is important so as to have a clear vision on the basis of which concrete steps can be taken.