What is Green Sense?

*Sensitivity towards environment that is addressed in our decisions, practices and general lifestyle*
What is a Green Campus?
IIT (BHU) EMBRACES SOLAR WITH CLEANMAX SOLAR
What is a Green Campus?
IDEOLOGY

Ethos  Education  Practice  Ethics  Values  Culture

Environment
WHY GREEN CAMPUS?

- Estimated 231 Million Tons Equivalent CO₂ emission every year from campuses.
- Need for water, land and biodiversity will be equally enormous.
- Educational institutions are pivotal in laying the foundation of environmental ethics.
SUSTAINABLE DEVELOPMENT GOALS
CAMPUS AND SDG’S

Campuses can improve people’s health and wellbeing.

Campuses can use renewable energy, becoming cheaper to run.

Campuses can promote green infrastructure which create jobs and boosts the economy.

Campuses can spur innovation, transform industries and contribute to climate resilient infrastructure.

Campuses can lay foundation to sustainable communities.

Campuses can demonstrate circular principles where resources aren’t wasted.

Campuses have the potential to reduce emissions and help combat climate change.

GOALS

EDUCATIONAL CAMPUS

3 GOOD HEALTH AND WELL-BEING
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
AAETI

PROCESS

Assign responsibilities

Prepare an inventory

Develop a baseline scenario

Set targets

Take action
PROCESS

Assign responsibilities
- Secure management support
- Establish a team

Prepare an inventory
- Set boundaries for evaluation
- Identify sources that affect environmental quality

Develop a baseline scenario
- Select a base year
- Obtain appropriate data
- Ensure data quality
**PROCESS**

- **Set Targets**
  - Identify intervention/reduction areas
  - Chalk out an action plan
  - Set a target year and target level

- **Take Action**
  - Implement the action plan
  - Monitor progress regularly and frequently

- **Report Results**
  - Report the change over baseline
  - Disseminate information for sensitization
PROCESS

Assign responsibilities

Prepare an inventory

Develop a baseline scenario

Set targets

Take action
ASSIGN RESPONSIBILITIES

- Green team/office/ club
- Representation
- Frequency of meeting
- Resources
- Roles & responsibilities

Green Mandate
PROCESS

Assign responsibilities

Prepare an inventory

Develop a baseline scenario

Set targets

Take action
5 THEMES

- Consumption
- Conservation
- Operations & Maintenance

Land
Energy
Water
Air
Waste
• Consumption
• Conservation
• Operations & Maintenance

LAND
Building area elements

- Carpet Area
- Wall Area
- Service Area
- Floor Area
Covered Area, Pervious open, Impervious open

- Covered Area
- Pervious open
- Impervious open
Surfaces

- Landscaped and green finish
- Water body/swimming pool
- Polyurethane coating (Terrace)
- Plain Concrete
- Propylene tile
- Acrylic layering
Heat Island Effect

LATE AFTERNOON TEMPERATURE

- Rural
- Suburban Residential
- Commercial
- Downtown
- Urban Residential
- Park
- Suburban Residential
- Rural Farmland

°F
92
85
°C
-33
-32
-31
-30
Heat Island Effect
Land Exercise

- Pervious Open
- Impervious Open
- Covered

- Heat Island Effect

- Landscaping
• Consumption
• Conservation
• Operations & Maintenance
EPI – Energy Performance Index
EPI – Energy Performance Index

Energy Consumed Annually (KWh)

Built Up Area (sq.m.)

\[
\text{Energy Performance Index} = \frac{\text{Energy Consumed Annually (KWh)}}{\text{Built Up Area (sq.m.)}}
\]

\[
\text{AAETI} = 62.7 \text{ KWh/sq.m./yr.}
\]
### EPI – Energy Performance Index

**EPI** = \( \frac{\text{54267 KWh}}{\text{2160 Sqm}} \) = **26 KWh/Sqm yr.**

<table>
<thead>
<tr>
<th>Meter No</th>
<th>Time</th>
<th>Previous Reading</th>
<th>Present Reading</th>
<th>MF</th>
<th>Unit Consumed</th>
<th>Estimated/Adj. Unit</th>
<th>Max Demand (KVA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>GTE00005</td>
<td>N</td>
<td>110382.00</td>
<td>127336.00</td>
<td>1.00</td>
<td>16954.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>GTE00005</td>
<td>E</td>
<td>18143.00</td>
<td>20910.00</td>
<td>1.00</td>
<td>2767.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Bill Month**
- **Amount due after due date (Rs.)**
  - MAR, 2017: 119182.00
  - APR, 2017: 39374.00
  - 29.08.2017: 29081.00
  - 09.10.2017: 0.00

**Monthly Rebates (Rs.)**
- DEC, 2017: 26334.00
- JAN, 2018: 32334.00
Renewable Penetration

Solar Penetration \( = \frac{180 \text{ Kwp}}{720 \text{ Kw}} = 25\% \)

\[ \text{Solar Penetration} = \frac{\text{Installed Solar Capacity (KWp)}}{\text{Connected Load (KW)}} \]
AAETI current solar penetration

Solar Penetration = \frac{72 \text{ KWp}}{350 \text{ KW}}

AAETI after 2\textsuperscript{nd} Phase

Net Zero Energy Building
Window Wall Ratio

\[
\text{Window Wall Ratio} = \frac{\text{Window Area on a facade}}{\text{Total external Surface of wall}}
\]
AAETI

ENERGY

Consumption – Passive Technique

Natural Ventilation

Night Purge

OR
Light shelves in corridors allow natural light to filter in and allow hot air to escape.
Response time, Procurement, Retrofit, Controls, Temperature setting

**Response Time & Procurement:** Service Level Agreement, BEE star rated appliances

**Retrofit:**
3 stage cooling at AAETI
Response time, Procurement, Retrofit, Controls, Temperature setting

**Controls**: Variable Frequency Drive, Occupancy Sensors, submeters, smart meters
Energy exercise

• Passive Design features
• Window Wall Ratio
• Energy efficient fixtures
• Materials:
  1. Colour
  2. Properties
• Consumption
• Conservation
• Operations & Maintenance
Per Capita Water Consumption = \frac{Total Water Consumed}{Number of People}
Water Source Indicator

- Municipal
- Water Body
- Under Ground Water
- Recycled Waste Water
- Stored Rain Water
Harvesting Rain Water

Do you harvest rain water?

- Recharge Wells
- Storage Tanks

Capacities (Kilo Litres)
Consumption – Passive Techniques

Harvesting Rain Water
Harvesting Rain Water

Rain Water Recharge Wells

9 Rain Water Recharge Wells were added on the site.
AAETI is designed to treat 8 KLD through Decentralised Waste Water System

- Waste Water Recycling

Capacities (Kilo Litres)
Pervious area helps greatly!

Total area of the Site: 39,100 sq.m.
Response Time & Procurement: Service level agreement, efficient fixtures, monitoring and leak reportage

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%
Water exercise

• Runoff reduction

• Water efficient fixtures

• Waste Water Recycling
  1. Technology 1
  2. Technology 2
  3. Technology 3 etc.
• 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
## Air quality index

<table>
<thead>
<tr>
<th>AQI Category (Range)</th>
<th>PM$_{10}$ 24-hr</th>
<th>PM$_{2.5}$ 24-hr</th>
<th>NO$_2$ 24-hr</th>
<th>O$_3$ 8-hr</th>
<th>CO 8-hr (mg/m$^3$)</th>
<th>SO$_2$ 24-hr</th>
<th>NH$_3$ 24-hr</th>
<th>Pb 24-hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good (0-50)</td>
<td>0-50</td>
<td>0-30</td>
<td>0-40</td>
<td>0-50</td>
<td>0-1.0</td>
<td>0-40</td>
<td>0-200</td>
<td>0-0.5</td>
</tr>
<tr>
<td>Satisfactory (51-100)</td>
<td>51-100</td>
<td>31-60</td>
<td>41-80</td>
<td>51-100</td>
<td>1.1-2.0</td>
<td>41-80</td>
<td>201-400</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Moderately polluted (101-200)</td>
<td>101-250</td>
<td>61-90</td>
<td>81-180</td>
<td>101-168</td>
<td>2.1-10</td>
<td>81-380</td>
<td>401-800</td>
<td>1.1-2.0</td>
</tr>
<tr>
<td>Poor (201-300)</td>
<td>251-350</td>
<td>91-120</td>
<td>181-280</td>
<td>169-208</td>
<td>10-17</td>
<td>381-800</td>
<td>801-1200</td>
<td>2.1-3.0</td>
</tr>
<tr>
<td>Very poor (301-400)</td>
<td>351-430</td>
<td>121-250</td>
<td>281-400</td>
<td>209-748*</td>
<td>17-34</td>
<td>801-1600</td>
<td>1200-1800</td>
<td>3.1-3.5</td>
</tr>
<tr>
<td>Severe (401-500)</td>
<td>430+</td>
<td>250+</td>
<td>400+</td>
<td>748+*</td>
<td>34+</td>
<td>1600+</td>
<td>1800+</td>
<td>3.5+</td>
</tr>
</tbody>
</table>
Air quality index

- PM 2.5 Average | PM 10 Average
- Data on particulate matter for first week of April

Last year, the Environmental Preference Index ranked India 174 out of 178 countries for air quality. A WHO survey last year found that 13 of the most polluted 20 were in India.
Air quality index

PM$_{2.5}$ (24-Hourly Average) Trend counter in Delhi-NCR as on 31-01-2018 04:00 Hrs as per Graded Response Action Plan (GRAP)-(Compared With Value: 300 ug/m$^{3}$)

PM$_{10}$ vs Time

From: 22-12-2017 04:00  To: 31-01-2018 04:00
Indoor air quality

Housekeeping and pest control activities

Acrylic layering, Vinyl sheets, Wooden board

Health Hazards of VOCs

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
**Response Time:** Service level agreement

**Procurement:** Cleaner fuels, Low emission machinery, Low VOC paints, Low chemical content housekeeping and pest control products

**Retrofit:** More Efficient machines, Electric charging points, bike racks

**Controls:** Vehicle free campus, Time Controlled Heating/cooling, Gas leakage sensors, smoke detectors
Initiatives, Communication

WASTE

- Consumption
- Conservation
- Operations & Maintenance
Per Capita Waste Produced per day = \( \frac{\text{Total Waste Produced (gms/day)}}{\text{Number of People}} \)
Total municipal solid waste (MSW) in 2014

- 62,000,000 tonnes (T)
  - Hazardous waste: 7,900,000 T
  - Plastic waste: 5,600,000 T
  - E-waste: 1,500,000 T
  - Bio medical waste: 170,000 T
SOLID WASTE

Waste Typologies

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

Garbage segregation categories

Campus collection points and capacities

Understanding your waste system

Transportation dynamics: who transports, frequency and authorized vendors

Where does it go in the end?
Waste Management

- Collection
- Segregation
- Treatment
- Disposal

Correct Path:
- Segregation
- Collection
- Transport
- Treatment
- Disposal

Incorrect Path:
- Collection
- Segregation
- Treatment
- Disposal
Waste Management

- Segregation
- Primary collection
- Secondary collection
- Processing/Treatment
- Material recovery
- Disposal
- Buyer
SOLID WASTE

Passive Techniques

Organic Waste

RE-USE & RECYCLE THIS
Sell to Scrap Dealer

LANDFILL
Give to Municipal Truck

DISPOSE SAFELY
Find the right agency

10% Reuse
20% Recyclable Waste
10% Toxic

Cover keeps heat in and prevents water from entering.

Inside the heap, microorganisms breakdown the organic materials which generates heat.

Waste has small gaps; keep heat in, they allow air circulation.

Mold and rot microbes contain black crumbly compost.

Keep broken and dry straw allow air in.

Graphite cuttings and straw allow air in.
Passive Techniques

Organic Waste

Mandatory to compost in site with built area above 20,000 sqm.

Pit Composting

Mechanised Composting

Vermi Composting

- **Wet waste-kitchen/horticulture**: Green bin
  - In situ composting/biogas plant

- **Plastic waste recyclable**: Blue bin
  - Stored and given to a authorised vendor/dealer at regular intervals

- **Plastic waste non-recyclable**: Orange bin
  - Stored and given to a authorised vendor/dealer at regular intervals/options to eliminate

- **Paper/cardboard**: Yellow bin
  - Stored and given to a authorised vendor/dealer at regular intervals

- **Metal/glass**: Black bin
  - Stored and given to a authorised vendor/dealer at regular intervals

- **Any other waste-textile rubber, markers, hazardous waste**: Red bin
  - Stored and given to a authorised vendor/dealer at regular intervals

- **Sanitary waste**: Grey bin
  - Sent to the common biomedical waste treatment facility (CBMWTF)
Waste exercise

- Waste Segregation
- Construction and Demolition waste reduction
PROCESS

1. Assign responsibilities
2. Prepare an inventory
3. Develop a baseline scenario
4. Set targets
5. Take action
# Green strategy

<table>
<thead>
<tr>
<th>Level</th>
<th>Policy</th>
<th>Organising</th>
<th>Commitment</th>
<th>Performance measurement</th>
<th>Communicating</th>
<th>Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Green action plan in place</td>
<td>Fully integrated into management system</td>
<td>Tailored capacity building on priority basis</td>
<td>Measurement against targets</td>
<td>Extensive communication and effective reporting (external)</td>
<td>Routine resource commitment</td>
</tr>
<tr>
<td>3</td>
<td>Formal policy but no active involvement</td>
<td>Designation of responsibility and accountability</td>
<td>Mapping of capacity needs and execution</td>
<td>Monthly monitoring and reporting with inferences</td>
<td>Mandatory staff briefing on performance reportage</td>
<td>Low-medium cost measures taken on need basis</td>
</tr>
<tr>
<td>2</td>
<td>Unadopted policy (draft)</td>
<td>Individual delegation</td>
<td>Ad hoc internal training for nominated staff</td>
<td>Monthly monitoring / tracking</td>
<td>Some institutional channel used to communicate green issues</td>
<td>Low-cost measures taken</td>
</tr>
<tr>
<td>1</td>
<td>Unwritten set of rules</td>
<td>Informal setup</td>
<td>Occasionally attend courses</td>
<td>Occasional review of bills</td>
<td>Occasional setups used for promotion</td>
<td>Only no-cost measures taken</td>
</tr>
<tr>
<td>0</td>
<td>No explicit green policy</td>
<td>No delegation on green campus</td>
<td>No capacity building on green campus considered</td>
<td>No measurement of costs or consumption</td>
<td>No communication or promotion of green issues</td>
<td>No greening investments</td>
</tr>
</tbody>
</table>