



AAETI

Anil Agarwal Environment Training Institute

Green Sense : Educational Campus
Inventory

What is Green Sense?

The absorption from surroundings that guides/ shapes/ prioritises our practices related to the environment



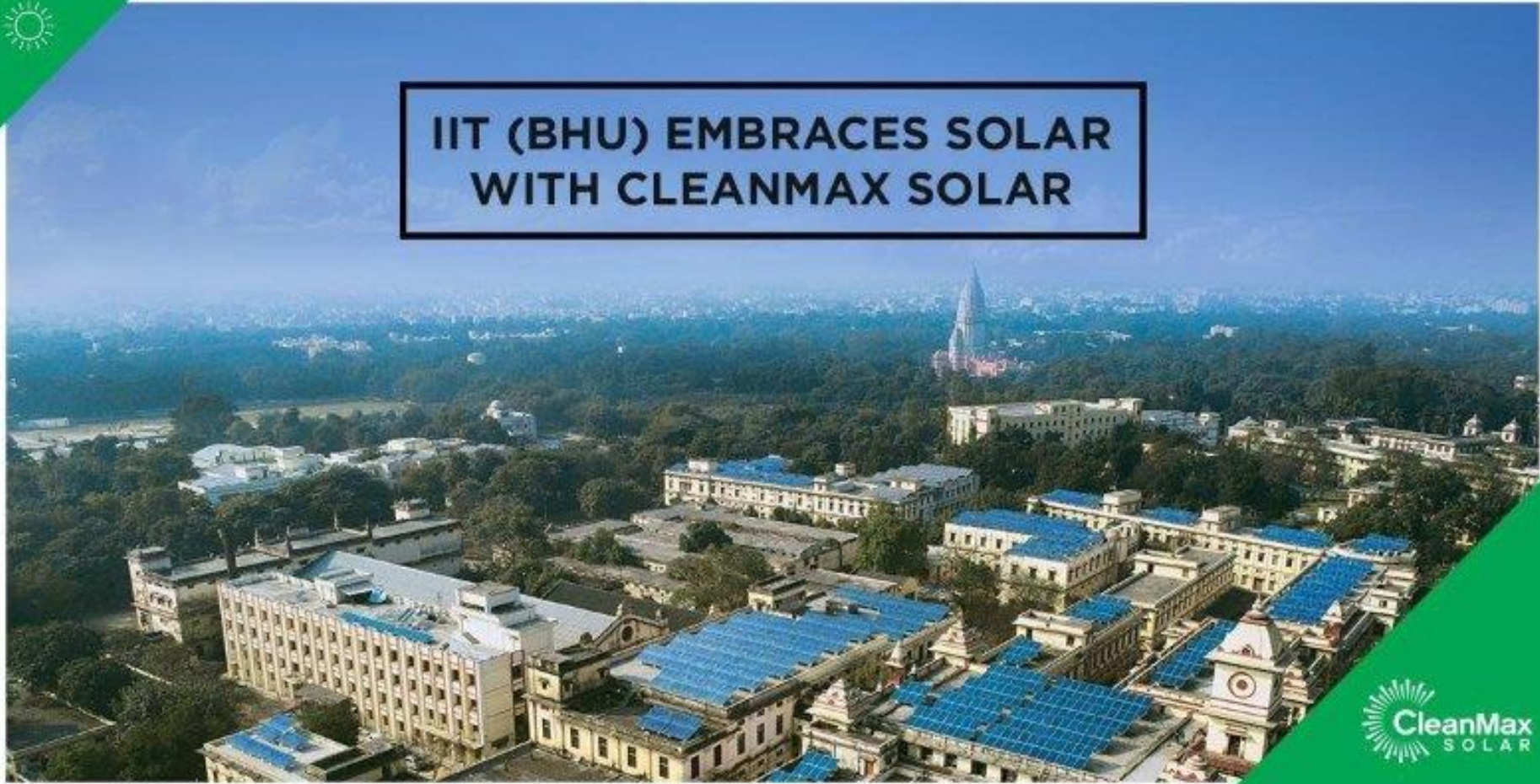
AAET



Environmental
Sustainability

2015 SUSTAINABILITY

IIT (BHU) EMBRACES SOLAR WITH CLEANMAX SOLAR



CleanMax
SOLAR

Princeton University

@TigersGoGreen

What is a Green Campus?

IDEOLOGY



-
- | Category | Count |
|-------------------|-------|
| Central Uni. | 45 |
| State Uni. | 318 |
| Pvt. Uni. | 185 |
| deemed to be Uni. | 129 |
| autonomous inst. | 55 |
| regd. colleges | 37204 |

[illegible]

SUSTAINABLE DEVELOPMENT GOALS



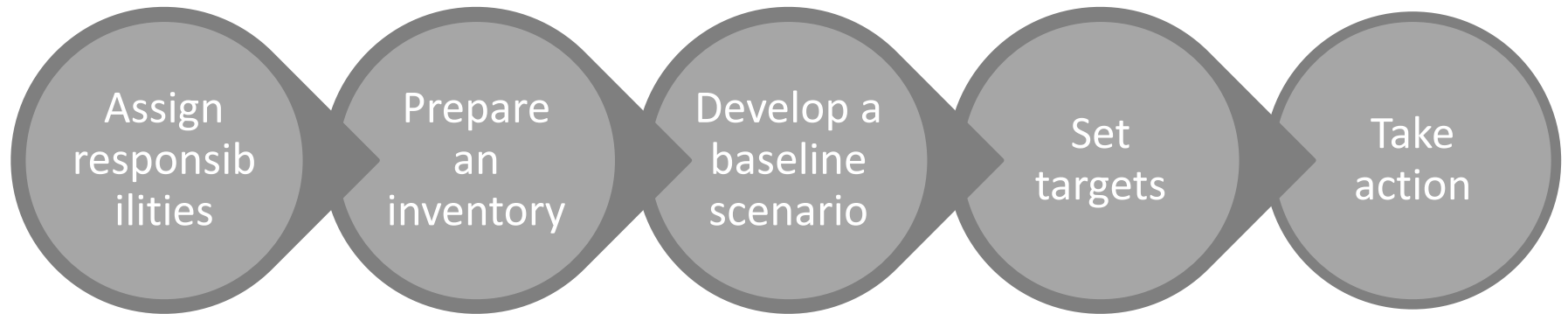
CAMPUS AND SDG'S

EDUCATIONAL CAMPUS

SUSTAINABLE DEVELOPMENT GOALS



PROCESS



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

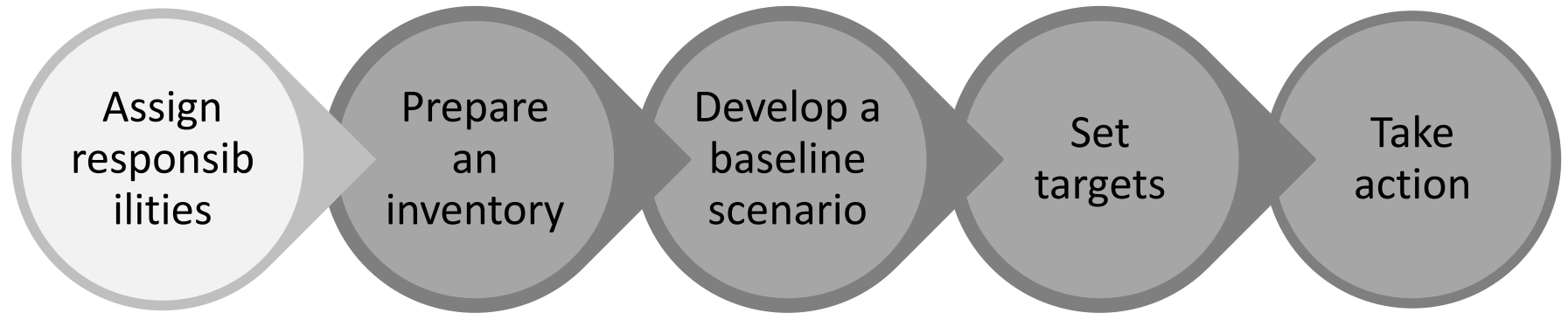
Take
Action

- Implement the action plan
- Monitor progress regularly and frequently

Report
Results

- Report the change over baseline
- Disseminate information for sensitization

PROCESS

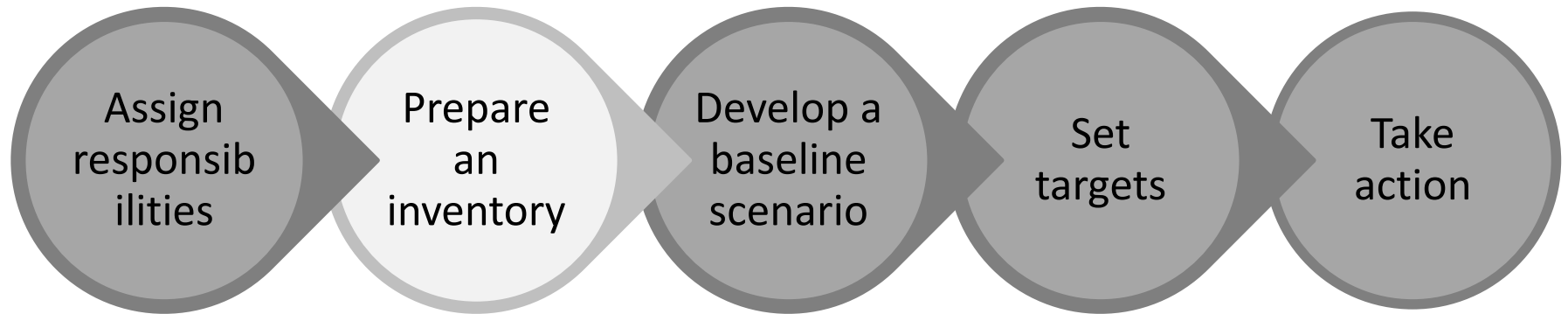


ASSIGN RESPONSIBILITIES

Green Mandate

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

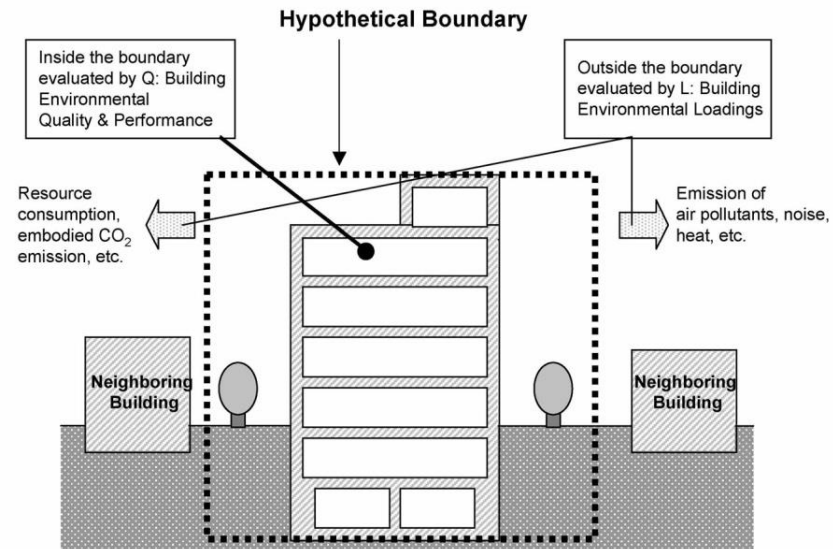
PROCESS



INVENTORY

Measure and
Monitor

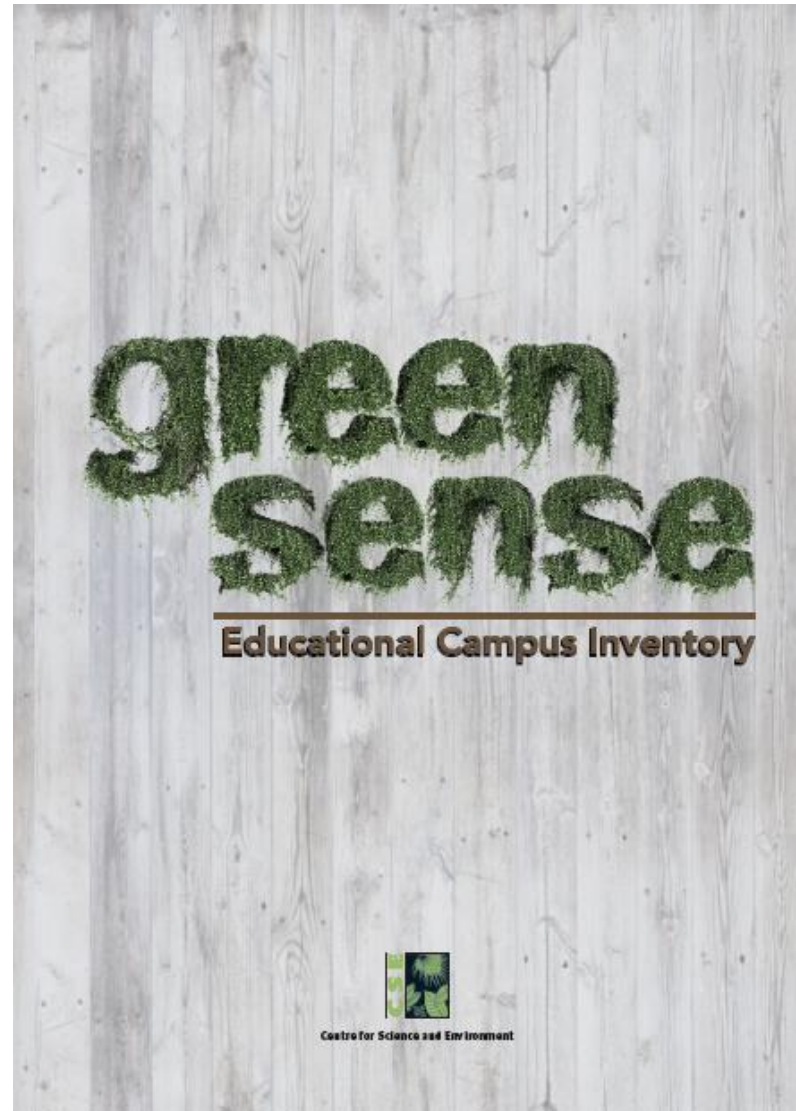
- Environment Impact Assessment
- Risk assessment
- Eco-audit
- Ecological footprint
- Environmental vision/mission
- Environmental goals + action plan
- Green ratings



LIKELIHOOD/ PROBABILITY	SEVERITY/CONSEQUENCE			
	NEGLECTIBLE	MARGINAL	CRITICAL	CATASTROPHIC
	Frequent			High
	Probable			
	Occasional	Medium		
	Remote			
	Improbable	Low		

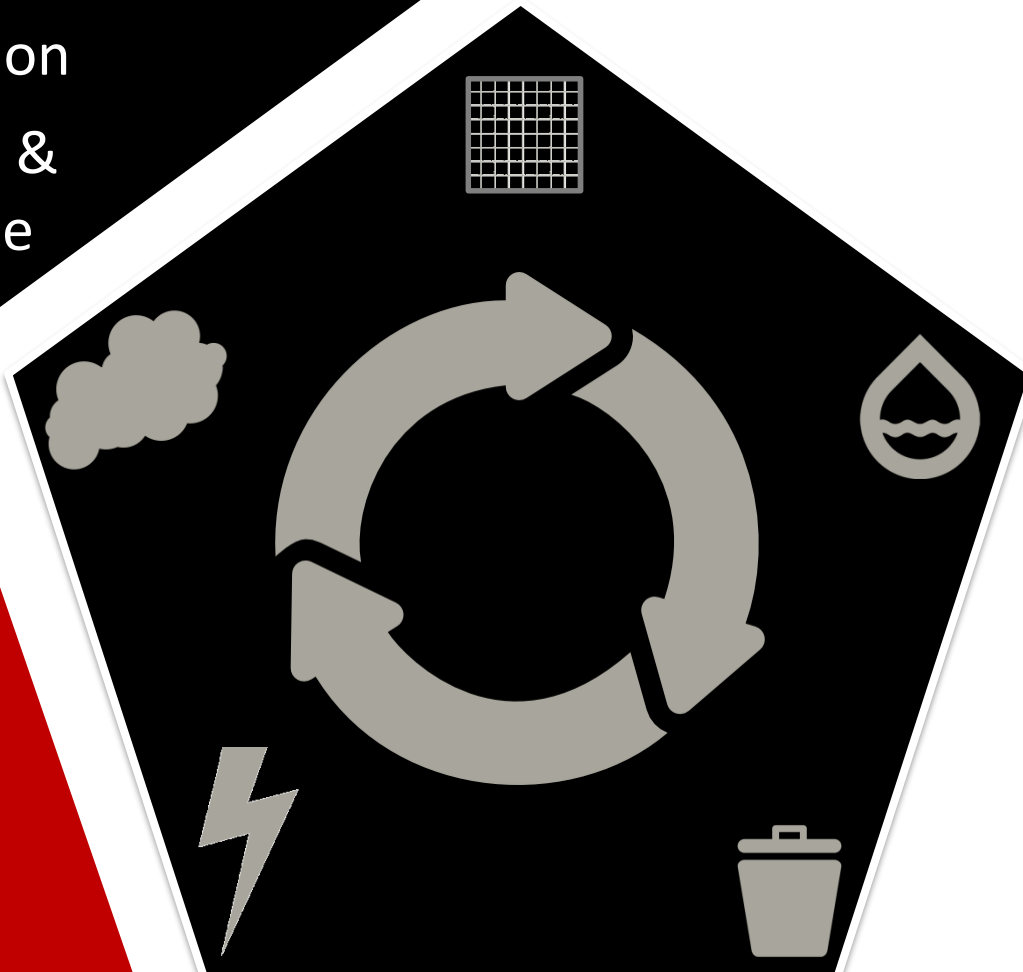


INVENTORY



5 THEMES

- Consumption
- Conservation
- Operations & Maintenance



Land

Energy

Water

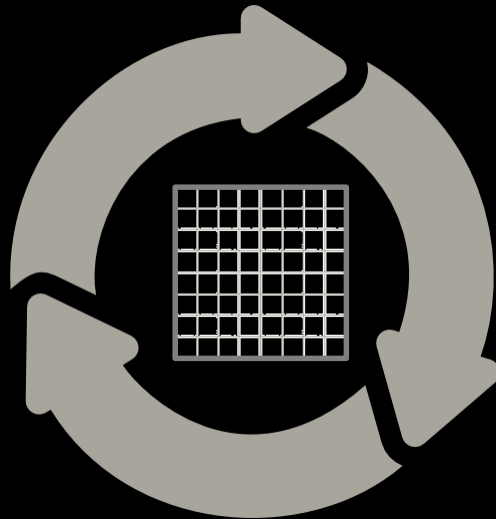
Air

Waste

AAETI

LAND

- Consumption
- Conservation
- Operations & Maintenance

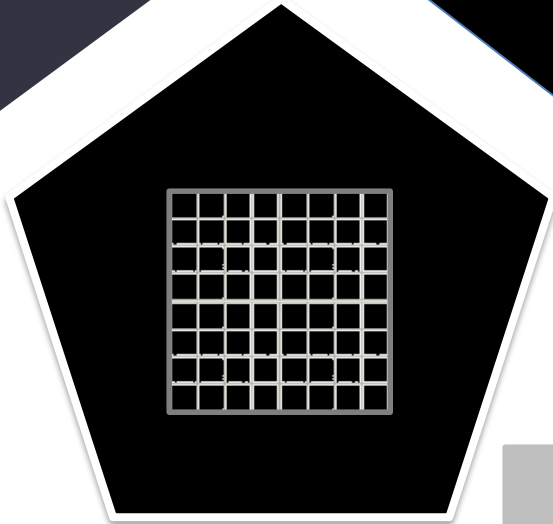


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LAND

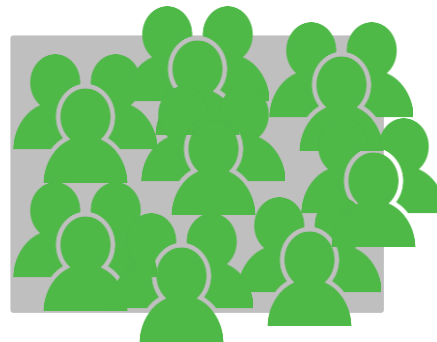
Consumption

Land use, people and occupancy



CARRYING
CAPACITY

OPTIMIZATION

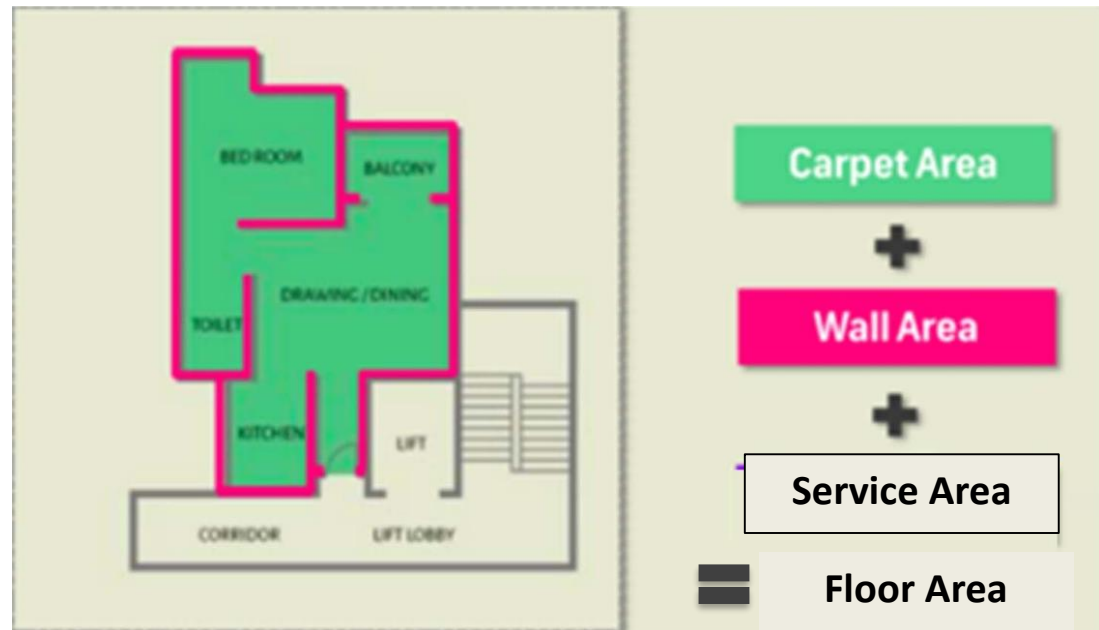
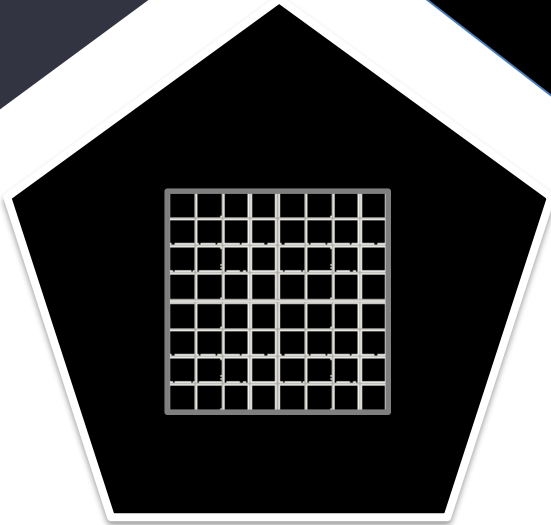


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LAND

Consumption

Building area elements

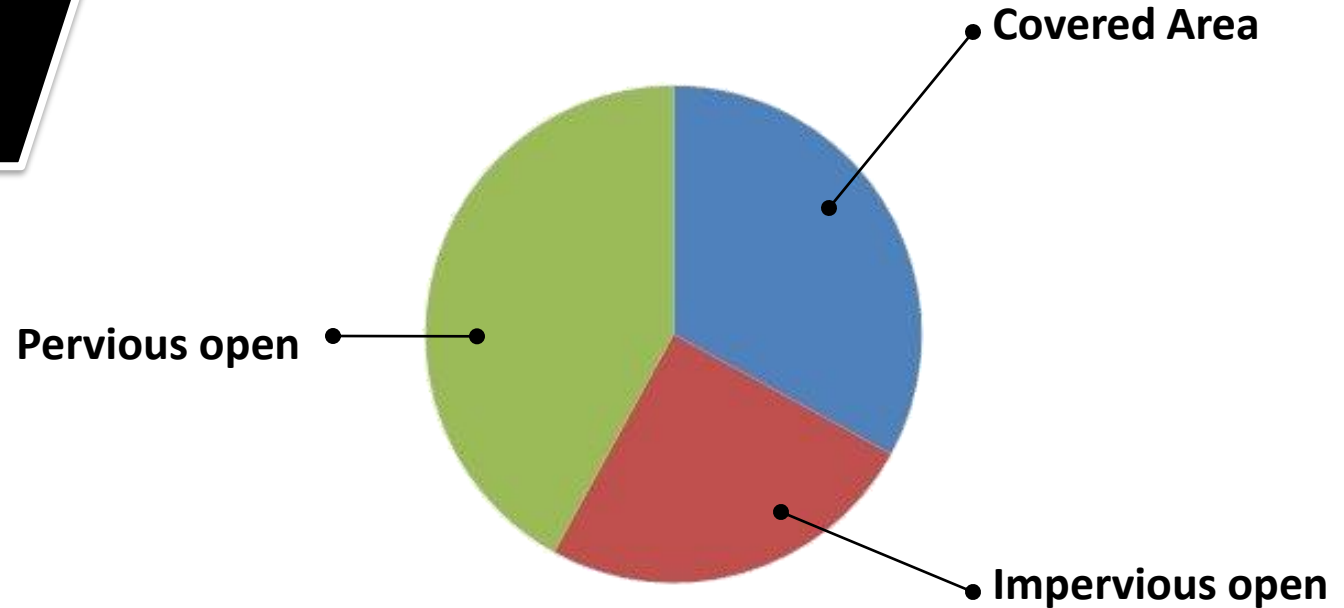
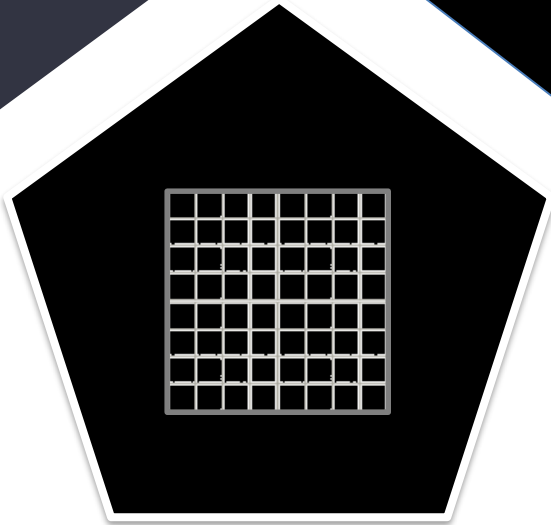


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LAND

Consumption

Covered Area, Pervious open,
Impervious open

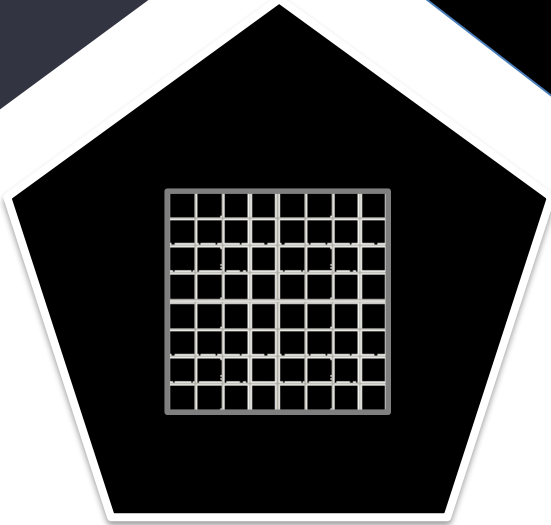


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LAND

Consumption

Covered Area



Covered Area

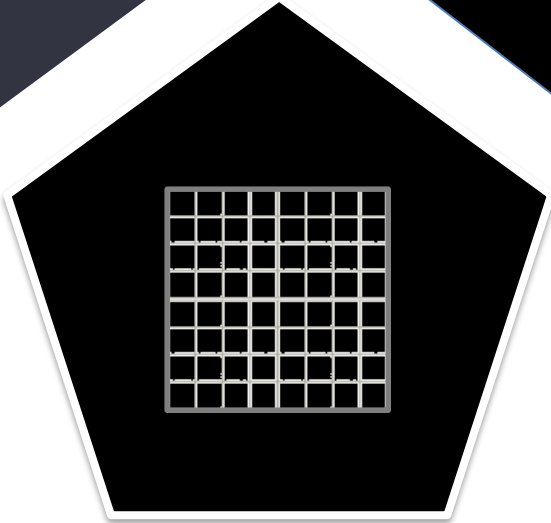


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LAND

Consumption

Impervious Open



Impervious
Open

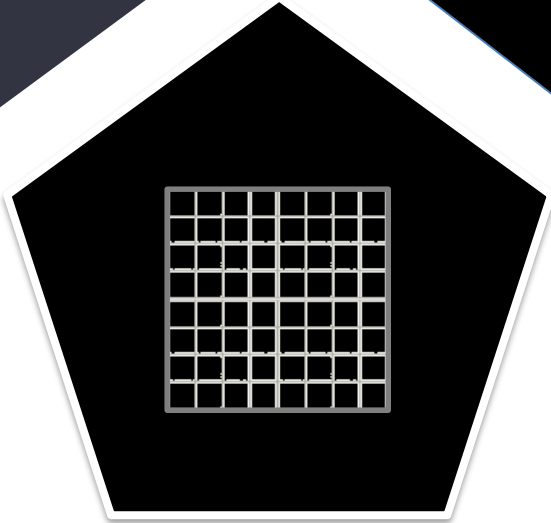


AAETI

LAND

Consumption

Pervious Open



Pervious
Open

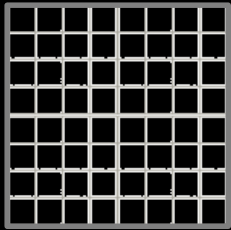


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LAND

Consumption

Surfaces



Terrace
surfaces



Landscaped and green finish



Reflective/heat-resistant tiles



Polyurethane coating



Outdoor court
surfaces



Cement concrete



Propylene tile



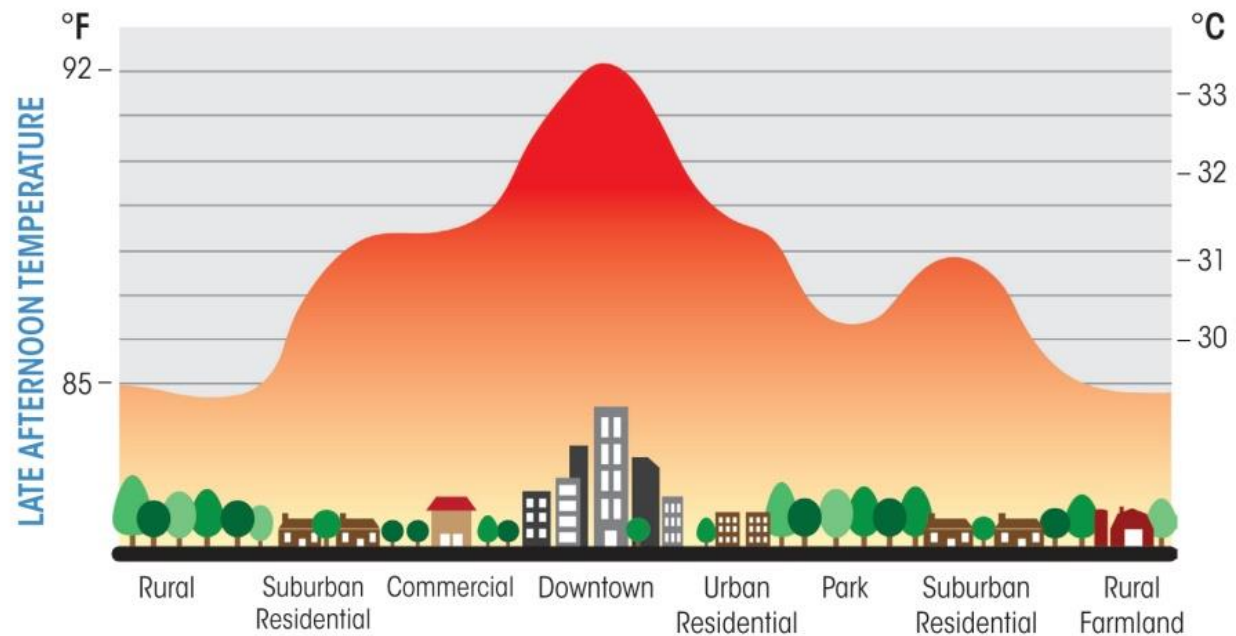
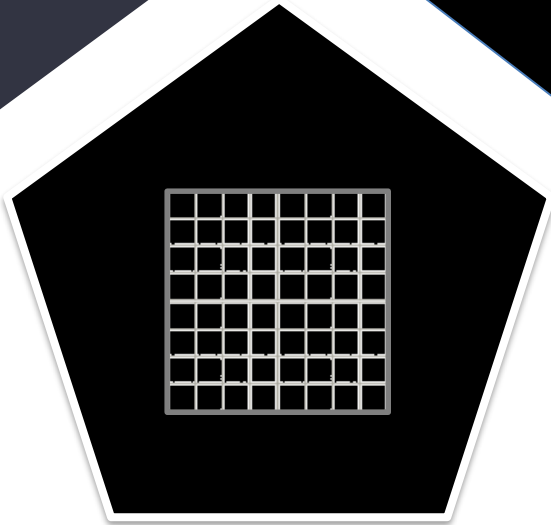
Acrylic layering

AAETI

LAND

Consumption

Heat Island Effect

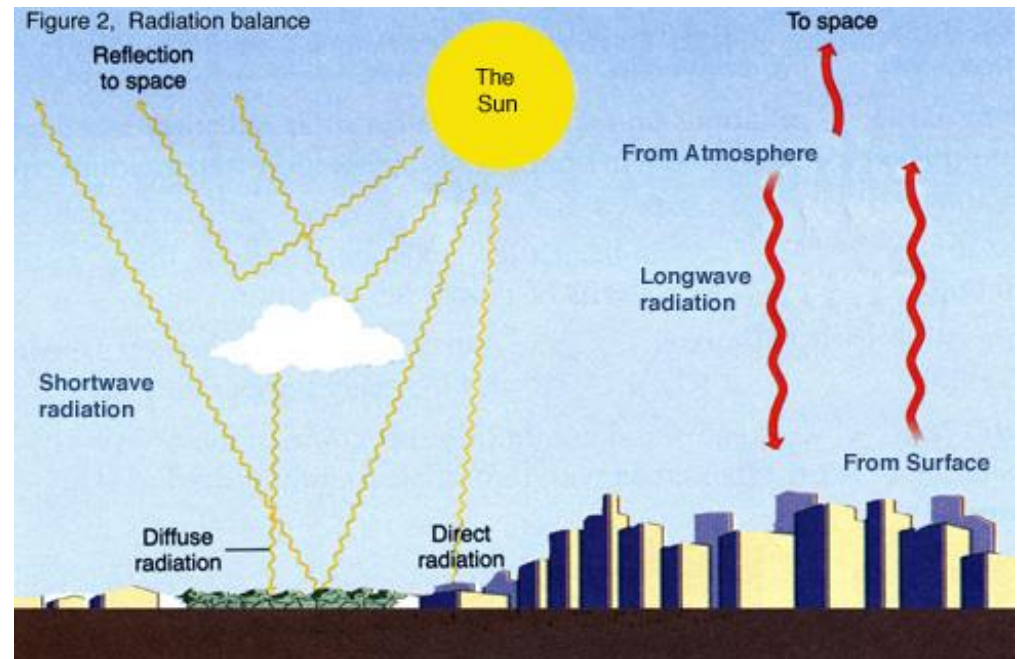
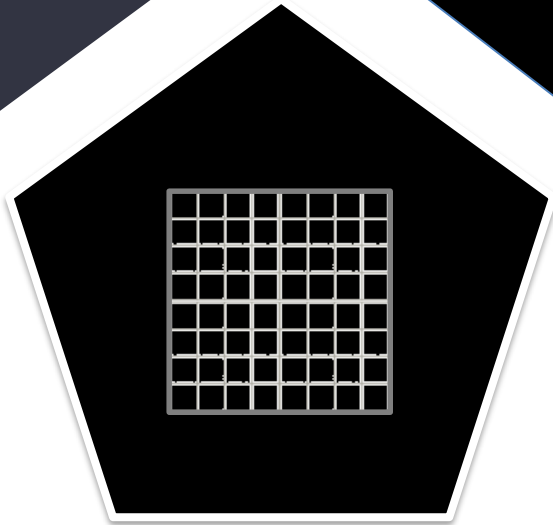


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LAND

Consumption

Heat Island Effect

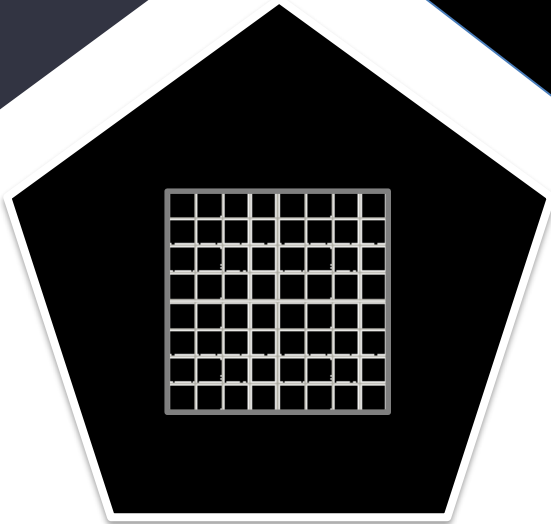


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LAND

Conservation

Heat Island Effect



Shaded OAT



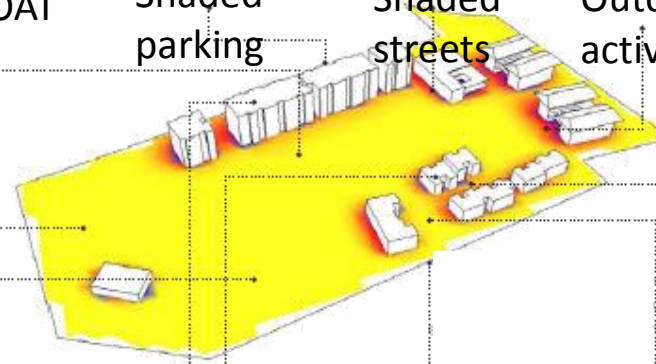
Shaded parking



Shaded streets



Outdoor activities



On-ground PV



Roof-top PV



Peripheral tree buffer



Minimize hard-paved areas

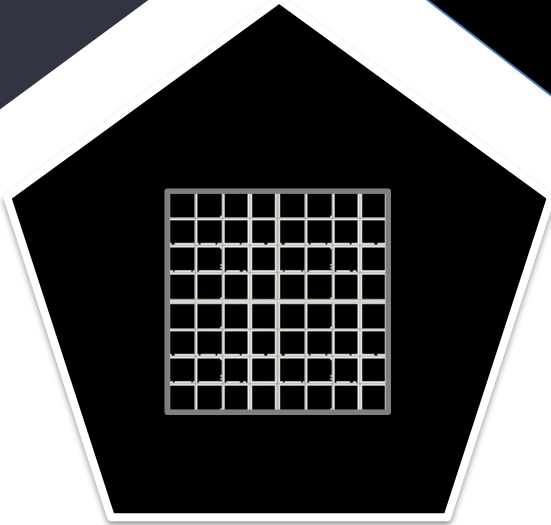


AAETI

LAND

Conservation

Pervious Open



**Impervious
Open**

**Pervious
Open**

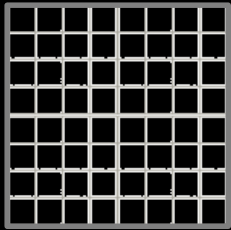


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LAND

Conservation

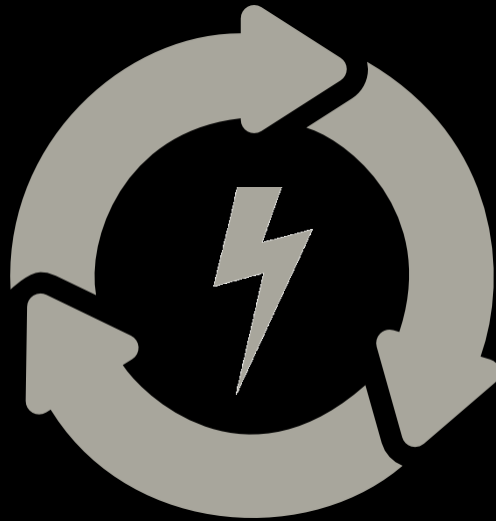
Green area mapping: Shared cases



AAETI

ENERGY

- Consumption
- Conservation
- Operations & Maintenance



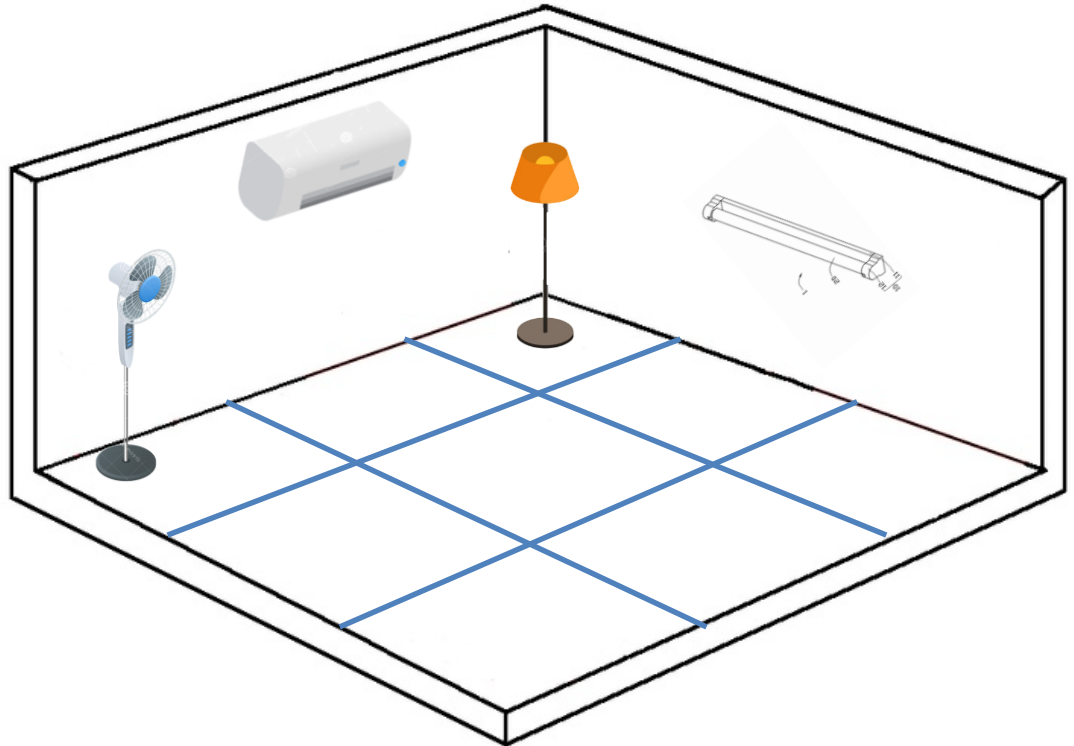
AAETI

ENERGY

Consumption



EPI – Energy Performance Index



AAETI

ENERGY

Consumption

EPI – Energy Performance Index



AAETI

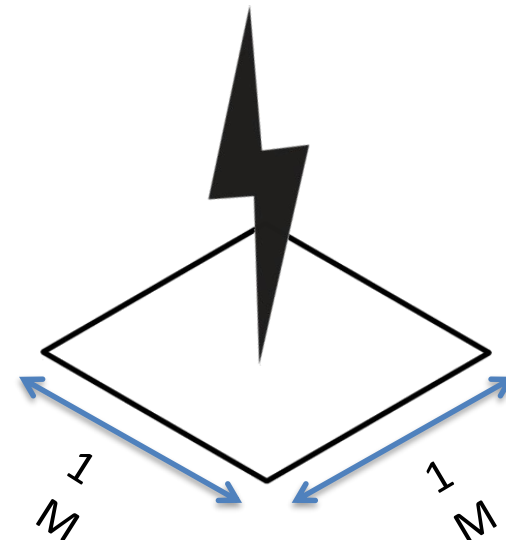
ENERGY

Consumption



EPI – Energy Performance Index

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



$$\text{AAETI} = 62.7 \text{ KWh/sq.m./yr.}$$

AAETI

ENERGY

Consumption - Monitoring



EPI – Energy Performance Index

Meter No	Time	Previous Reading	Present Reading	MF	Unit consumed	Estimated/ Adj. Unit	Max Demand (KVA)
GTE00005	N	110382.00	127336.00	1.00	16954.00	0.00	
GTE00005	E	18143.00	20910.00	1.00	2767.00	0.00	
Bill Month				MAR, 2017	APR, 2017	XXX	
Amount due after due date(Rs.)				119182.00	39374.00	0.00	
Due dates to avail Monthly Rebates				29.08.2017	09.10.2017		
Monthly Rebates(Rs.)							

$$\text{RMVCC Kolkata} = \frac{54267 \text{ KWh}}{2160 \text{ Sqm}} = 26 \text{ KWh/Sqm/yr.}$$

Meter No	Time	Previous Reading	Present Reading	MF	Unit consumed	Estimated/ Adj. Unit	Max Demand (KVA)
GTE00005	N	138026.00	147421.00	1.00	9395.00	0.00	
GTE00005	E	21380.00	21804.00	1.00	424.00	0.00	
Bill Month				DEC, 2017	JAN, 2018	XXX	
Amount due after due date(Rs.)				26334.00	26334.00	0.00	
Due dates to avail Monthly Rebates				28.12.2017			
Monthly Rebates(Rs.)							



AAETI

ENERGY

Consumption – Passive Techniques

Renewable Penetration

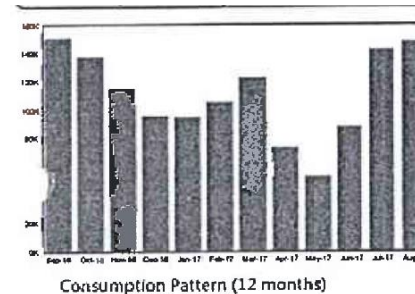


Xavier's Bhubaneswar

$$\text{Solar Penetration} = \frac{180 \text{ Kw}}{720 \text{ Kw}} = 25\%$$



$$\text{Solar Penetration} = \frac{\text{Installed Solar Capacity (KWp)}}{\text{Connected Load (KW)}}$$



Previous Reading Date	: 27 Aug 2017
Current Reading Date	: 25 Sep 2017
Period	: 29 Days
Power Factor	: 0.9958
Fall in P Factor	: 0.0000
T/F Loss Units/Demand	: 0.00 / 0.00
Billed Demand	: 633.60
Units Billed	: 140,600.00
Meter Status	: Normal / OK
Bill Basis	: Actual

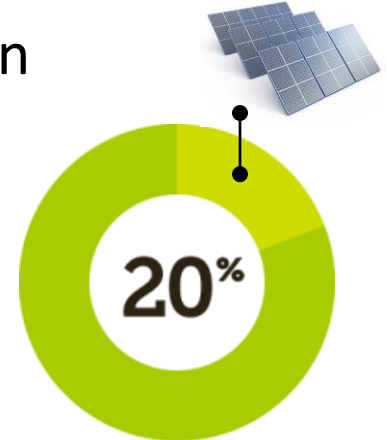
Previous Consumptions		Meter Change Details		Connection Details	
Month	Units	FR Status		Consumer Status	SK
Aug 2017	148000.00	FR KWH		Connected Load	720.00 KW
Jul 2017	142800.00	FR KVAH		Category	SPP
Jun 2017	88400.00	FR MD		Tariff Type	HT/SPP/>=110
May 2017	53800.00	FR Tod1		Supply Type	11.00 HV
Apr 2017	72800.00	IR KWH		Meter Make	3ph Static TV+ MU
Mar 2017	122640.00	IR KVAH		Meter Serial No.	CSD30240
		IR Tod1		SD Amount	2,49,118.00
Slab Calculation					

Solar Penetration



AAETI current solar penetration

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

AAETI after 2nd Phase

Net Zero Energy Building



Window Wall Ratio

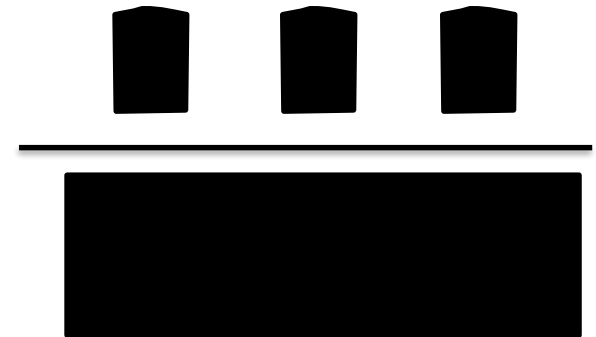


Window Wall
Ratio

=

Window Area
on a facade

Total external
Surface of wall



AAETI

ENERGY

Consumption – Passive Technique

Window Wall Ratio



Xavier's
Bhubaneswar – 35%



RMVCC Kolkata – 40%



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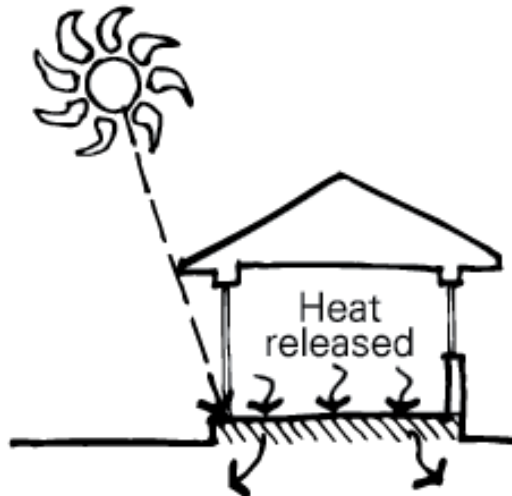
ENERGY

Consumption – Passive Technique

Natural Ventilation



OR



Night Purge



AAETI

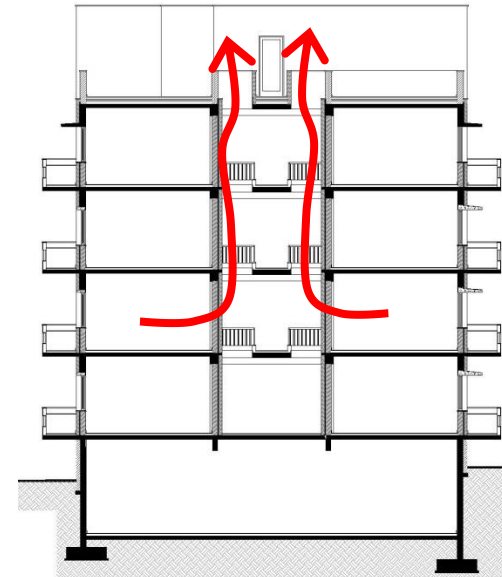
ENERGY

Consumption – Passive Technique

Natural Ventilation



Light shelves in
corridors allow
natural light to
filter in and
allow hot air to
escape



AAETI

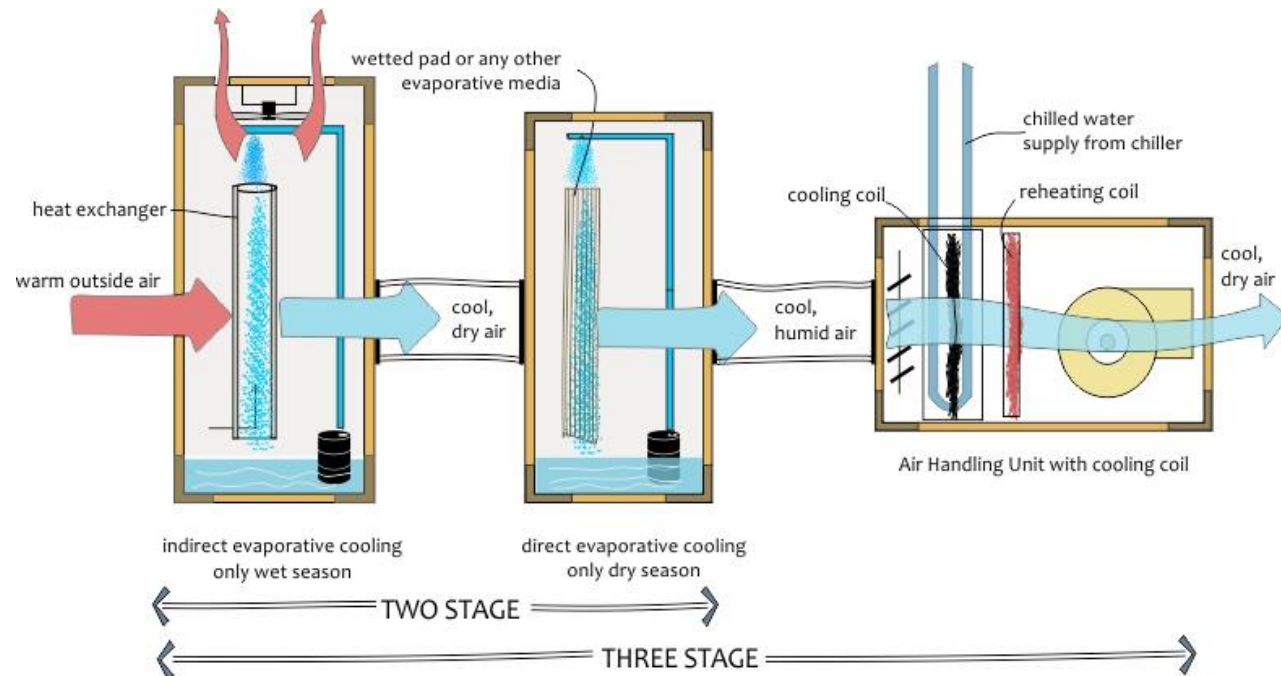
ENERGY

Operation and
Maintenance



Response time, Procurement, Retrofit,
Controls, Temperature setting

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



Retrofit:
3 stage
cooling
at AAETI



AAETI

ENERGY

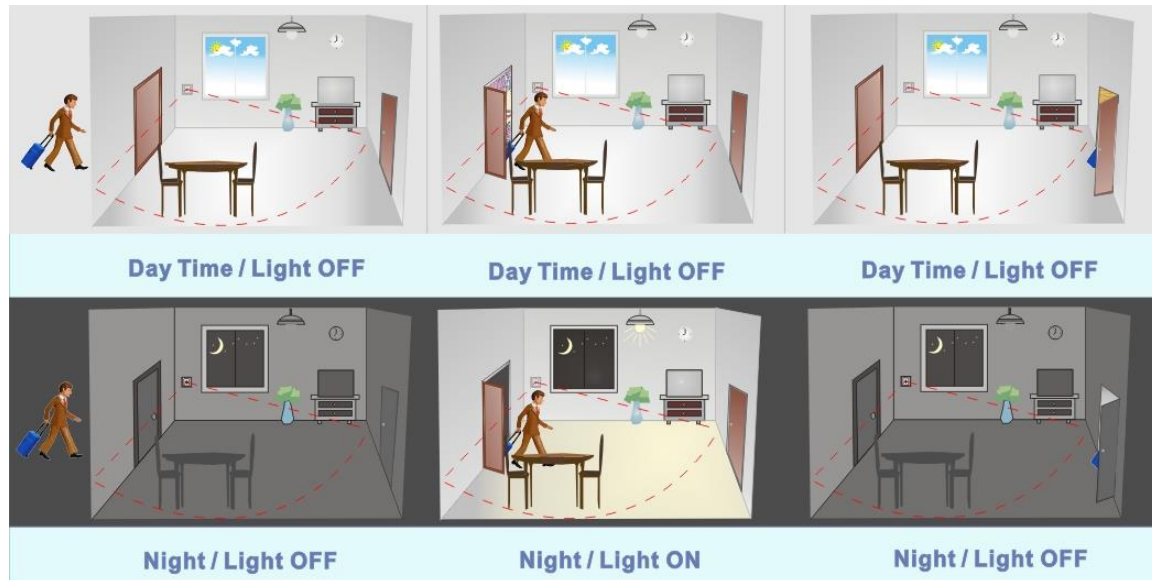
Operation and Maintenance



RMVCC has 10 sqm and 1% lighting load sensed by occupancy sensors

Response time, Procurement, Retrofit, Controls, Temperature setting

Controls : Variable Frequency Drive, Occupancy Sensors, submeters, smart meters



AAETI

ENERGY

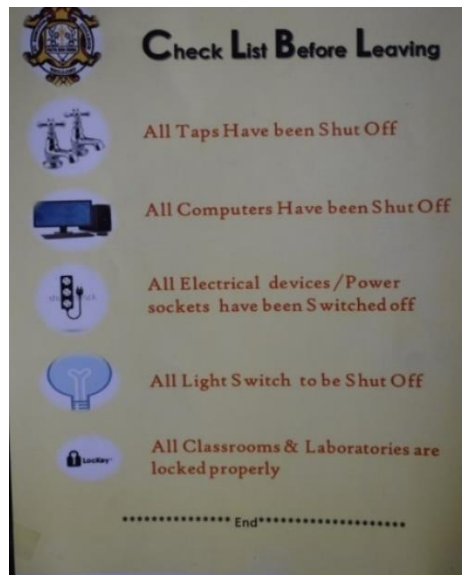
Conservation



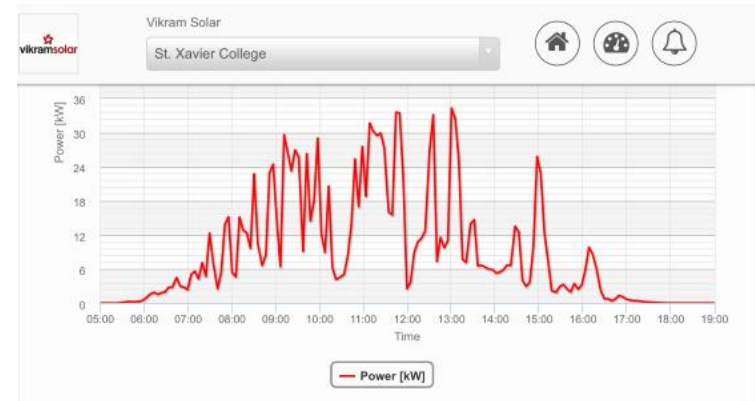
Initiatives, Communication

Initiative : Policies, Action plans, Sustainability Framework, Reduction commitments, Fines.

St. Edmund's



St. Xavier's Kolkata



Revenue

682.10 K INR



CO₂ avoided

68.21 Ton

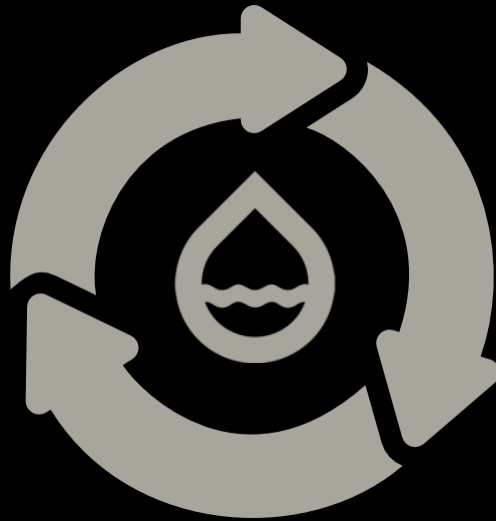
*INR 8/kWh.

*0.8 Kg/kWh

AAETI

WATER

- Consumption
- Conservation
- Operations & Maintenance



AAETI

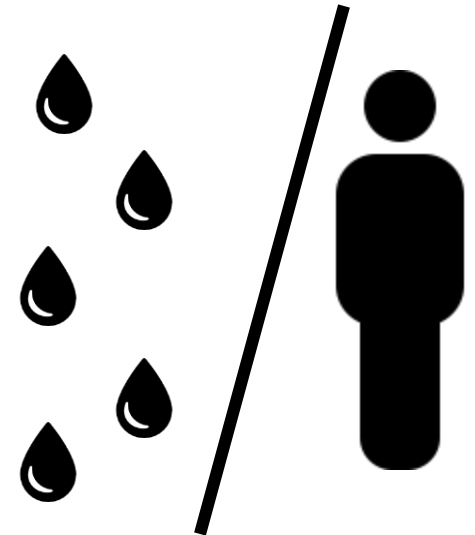
WATER

Consumption -
Monitoring

Per Capita Water Consumption



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



AAETI

WATER

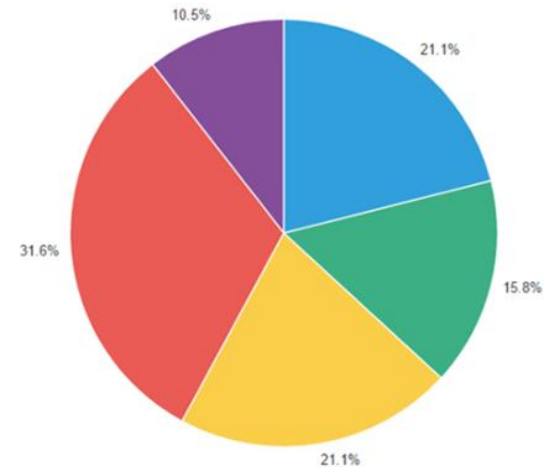
Consumption - Monitoring

Water Source Indicator



Sources of Water

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



Harvesting Rain Water

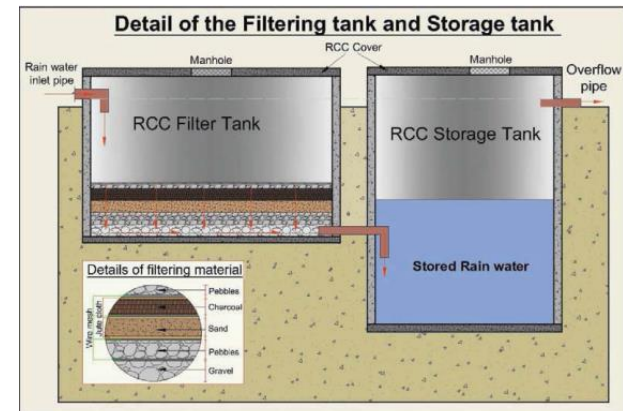
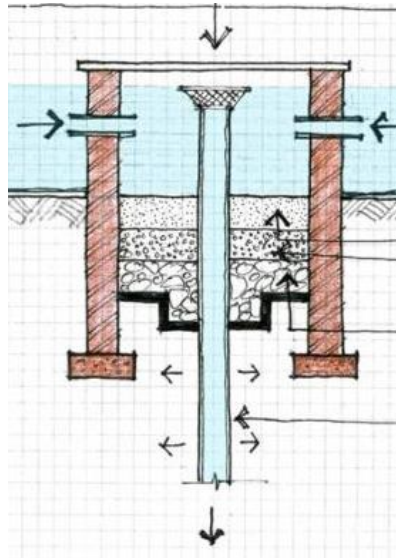
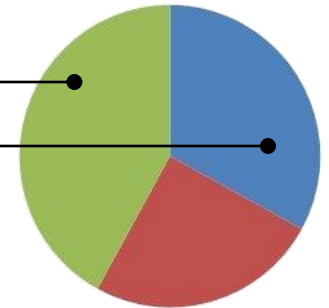


Sources of Water

Do you harvest rain water ?

- Recharge Wells
- Storage Tanks

Capacities (Kilo Litres)



AAETI

WATER

Consumption – Passive Techniques

Waste Water Recycling

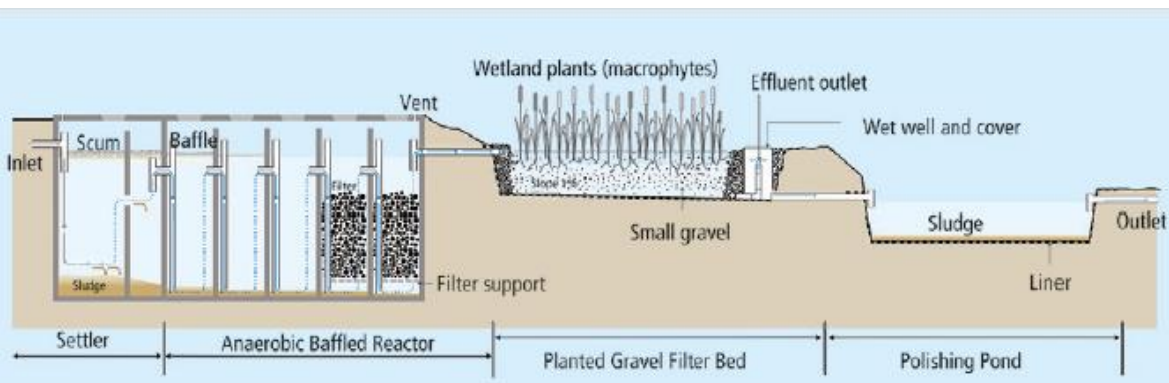
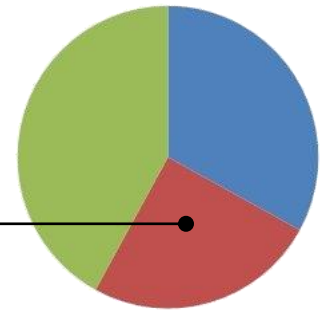


Sources of Water

AAETI is designed to treat 8 KLD through Decentralised Waste Water System

•Waste Water Recycling

Capacities (Kilo Litres)

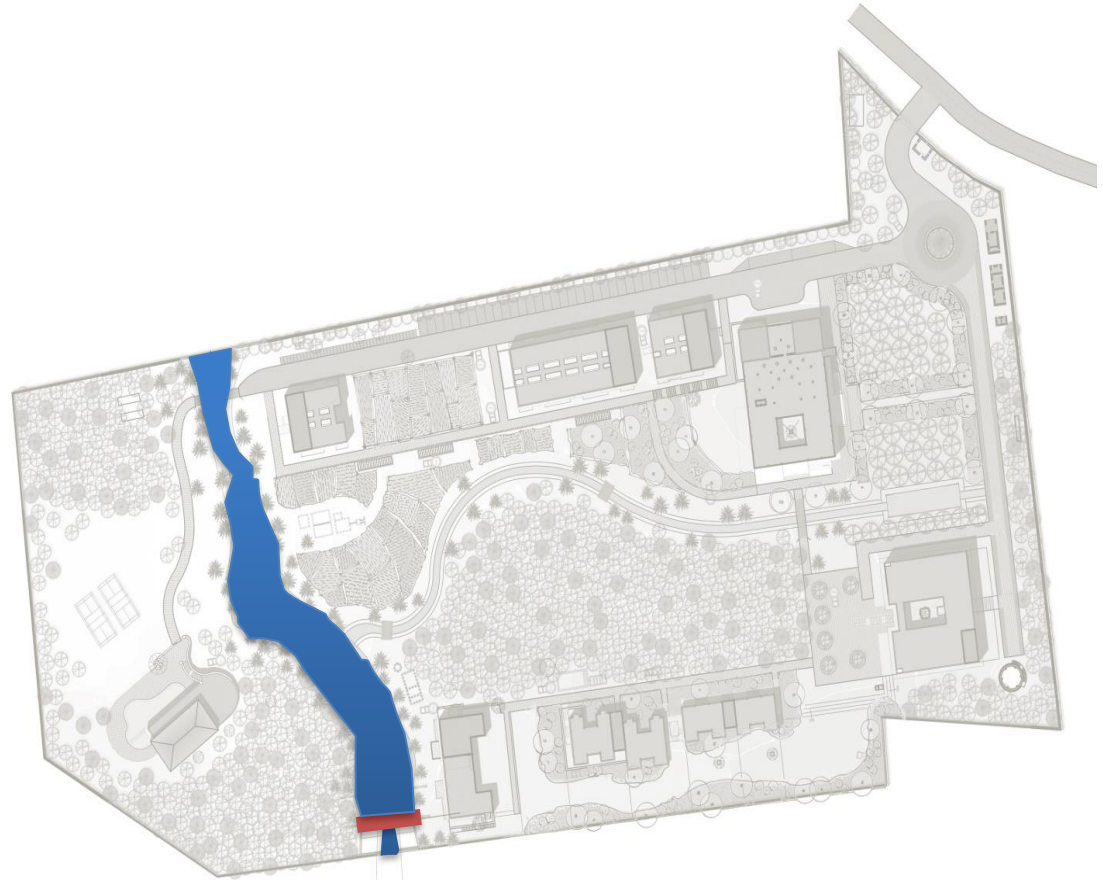


AAETI

WATER

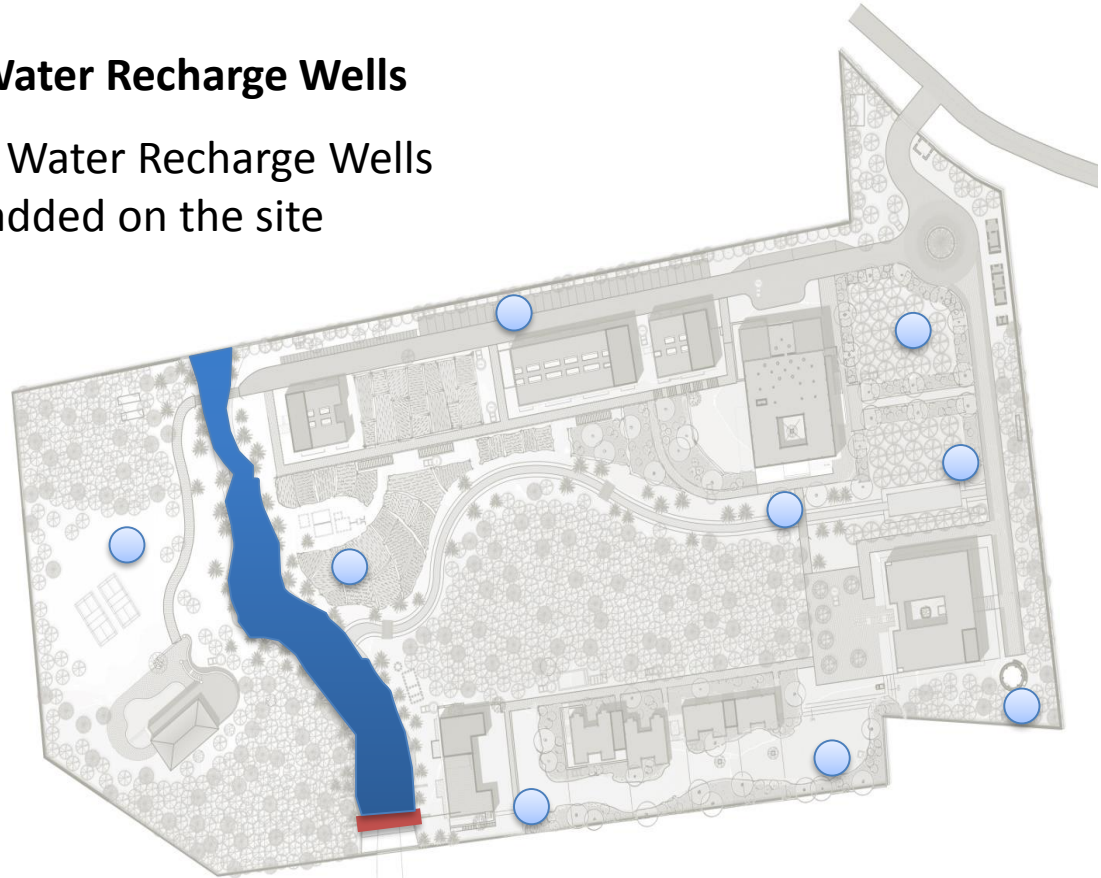
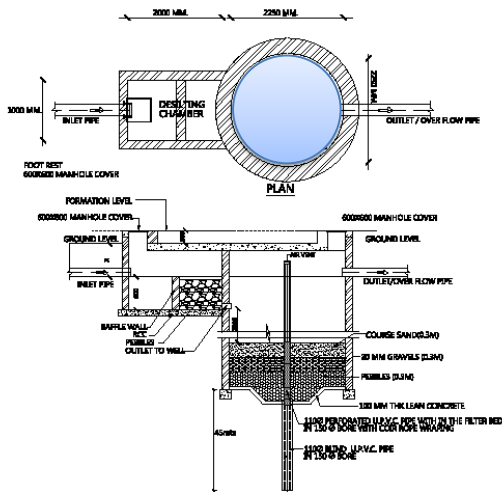
Consumption – Passive Techniques

Harvesting Rain Water





9 Rain Water Recharge Wells were added on the site



AAETI

WATER

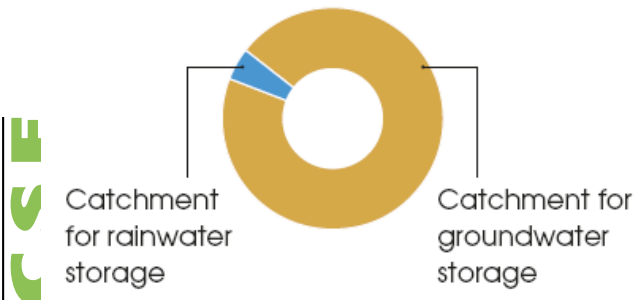
Consumption – Passive Techniques

AAETI water balance

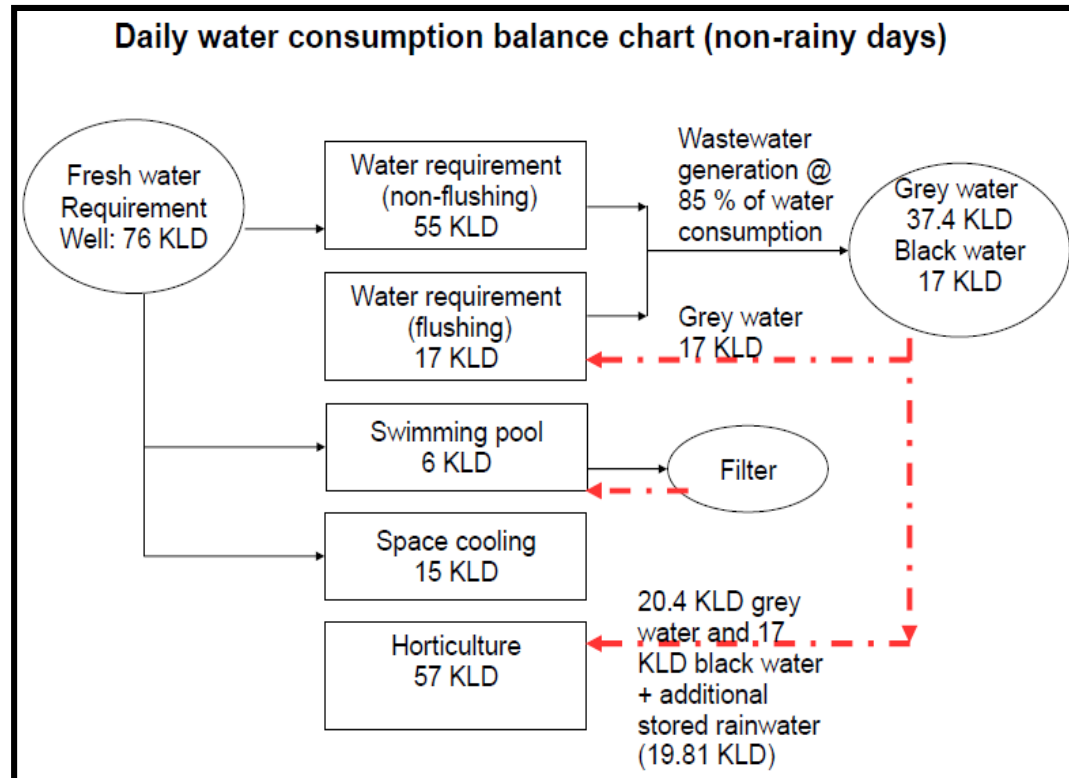


Pervious area helps greatly!

Total area of the Site: 39,100 sq.mt.



Daily water consumption balance chart (non-rainy days)



Response time, Procurement, Retrofit, Controls



Response Time & Procurement : Service level agreement, efficient fixtures, monitoring and leak reportage

Retrofit & Controls:



Smart Meter

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%

AAETI

AIR

- 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}
- PM₁₀
- SO₂
- NO_x
- CO
- O₃
- NH₃
- Pb

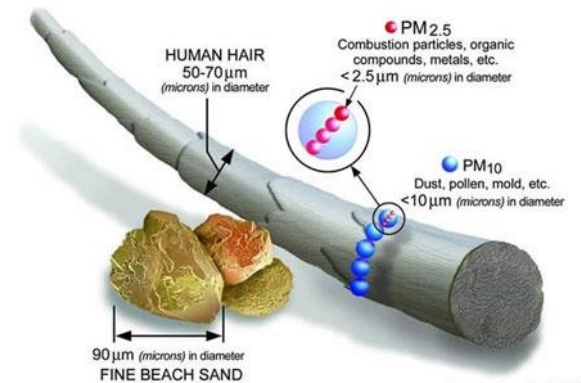


Image courtesy of the U.S. EPA

AAETI

AIR

Consumption - Monitoring

Air quality index



AQI Category (Range)	PM ₁₀ 24-hr	PM _{2.5} 24-hr	NO ₂ 24-hr	O ₃ 8-hr	CO 8-hr (mg/ m ³)	SO ₂ 24-hr	NH ₃ 24-hr	Pb 24-hr
Good (0-50)	0-50	0-30	0-40	0-50	0-1.0	0-40	0-200	0-0.5
Satisfactory (51-100)	51-100	31-60	41-80	51-100	1.1-2.0	41-80	201-400	0.5 -1.0
Moderately polluted (101-200)	101-250	61-90	81-180	101-168	2.1- 10	81-380	401-800	1.1-2.0
Poor (201-300)	251-350	91-120	181-280	169-208	10-17	381-800	801-1200	2.1-3.0
Very poor (301-400)	351-430	121-250	281-400	209-748*	17-34	801-1600	1200-1800	3.1-3.5
Severe (401-500)	430 +	250+	400+	748+*	34+	1600+	1800+	3.5+

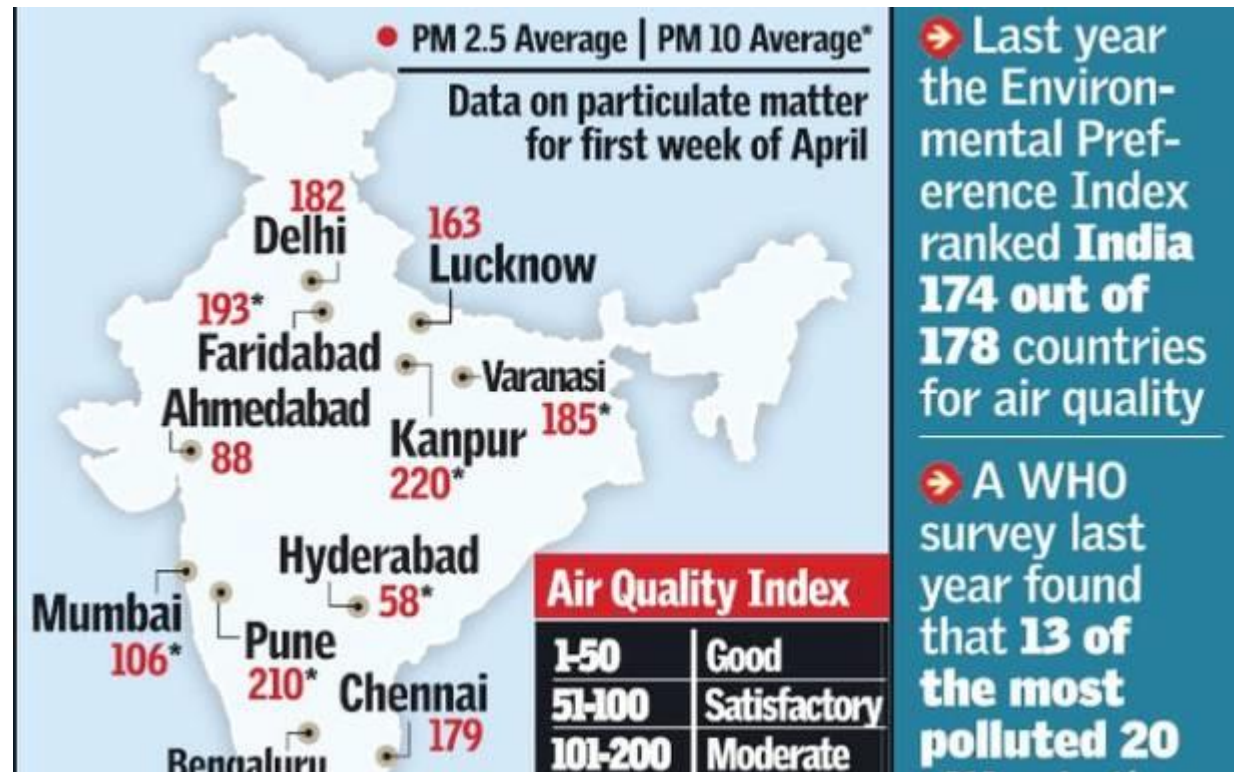


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AIR

Consumption - Monitoring

Air quality index

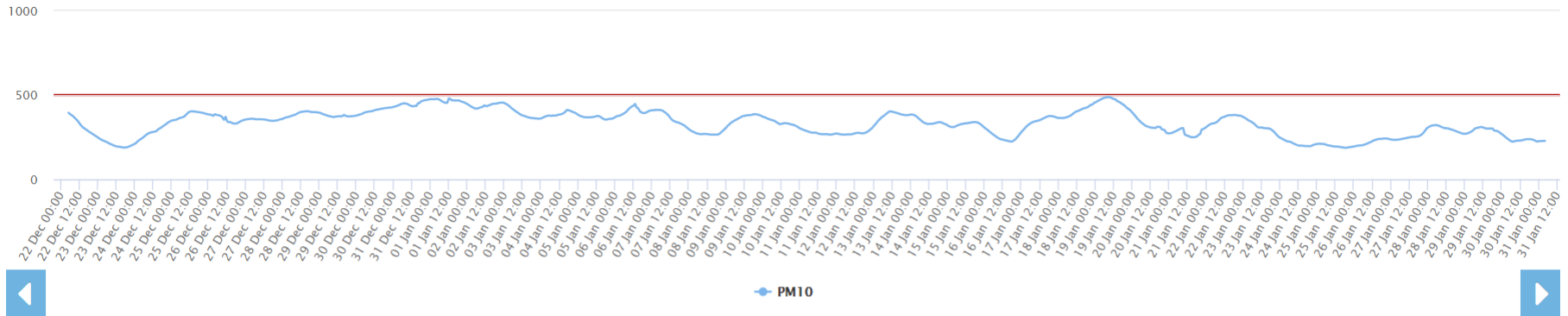


AAETI

AIR

Consumption - Monitoring

Air quality index

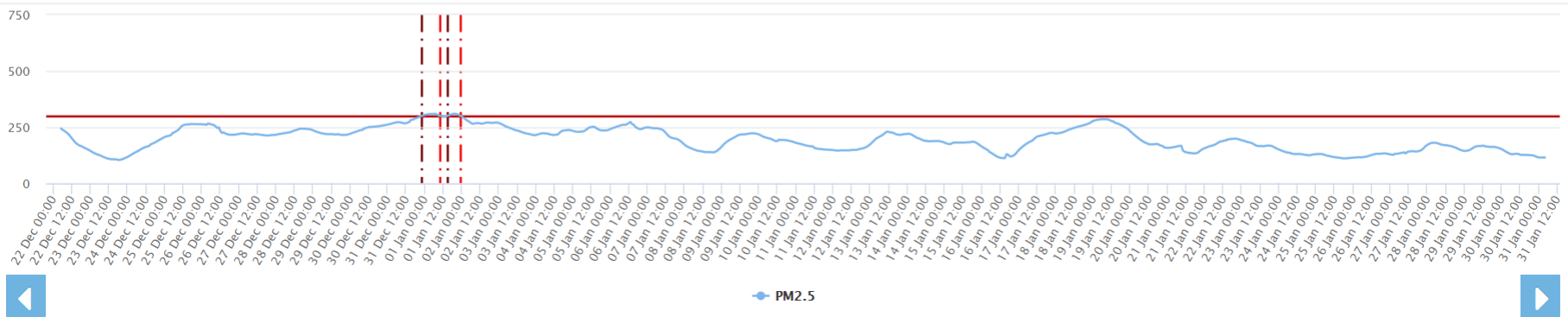


PM2.5 (24Hourly Average) Trend counter in Delhi-NCR as on 31-01-2018 04:00 Hrs as per Graded Response Action Plan (GRAP)-(Compared With Value: 300 $\mu\text{g}/\text{m}^3$)

PM2.5 vs Time

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

0
Hours



AAETI

AIR

Consumption

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



Indoor court
surfaces



Acrylic paint on cement floor



Vinyl sheets



Wooden board

AAETI

AIR

Operation and Maintenance

Response time, Procurement, Retrofit, Controls



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



AAETI

AIR

Conservation

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



AAETI

SOLID WASTE

Consumption

Waste Generation



Per Capita Waste
Produced per day =

$$\frac{\text{Total Waste Produced (gms/day)}}{\text{Number of People}}$$



AAETI

SOLID WASTE

Consumption

Waste Generation



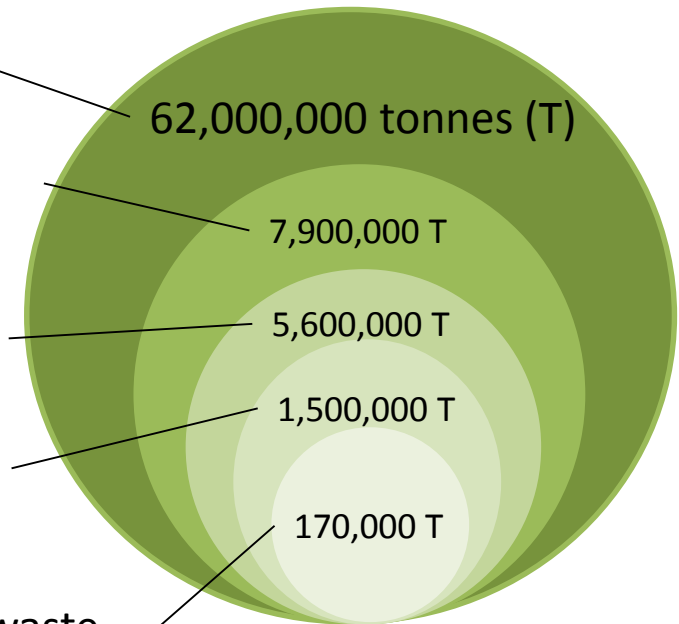
Total municipal solid waste
(MSW) in 2014

Hazardous waste

Plastic waste

E-waste

Bio medical waste



AAETI

SOLID WASTE

Consumption

Waste Typologies



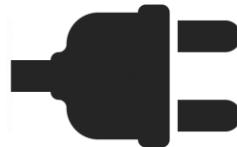
Solid Waste
Management
Rules 2016



Plastic Waste
Management
Rules 2016



Hazardous Waste
Management
Rules 2016



E-Waste
Management
Rules 2016



Bio-medical
Waste
Management
Rules 2016



Construction &
Demolition (C&D)
Waste
Management Rules
2016



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SOLID WASTE

Operations and Maintenance

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?

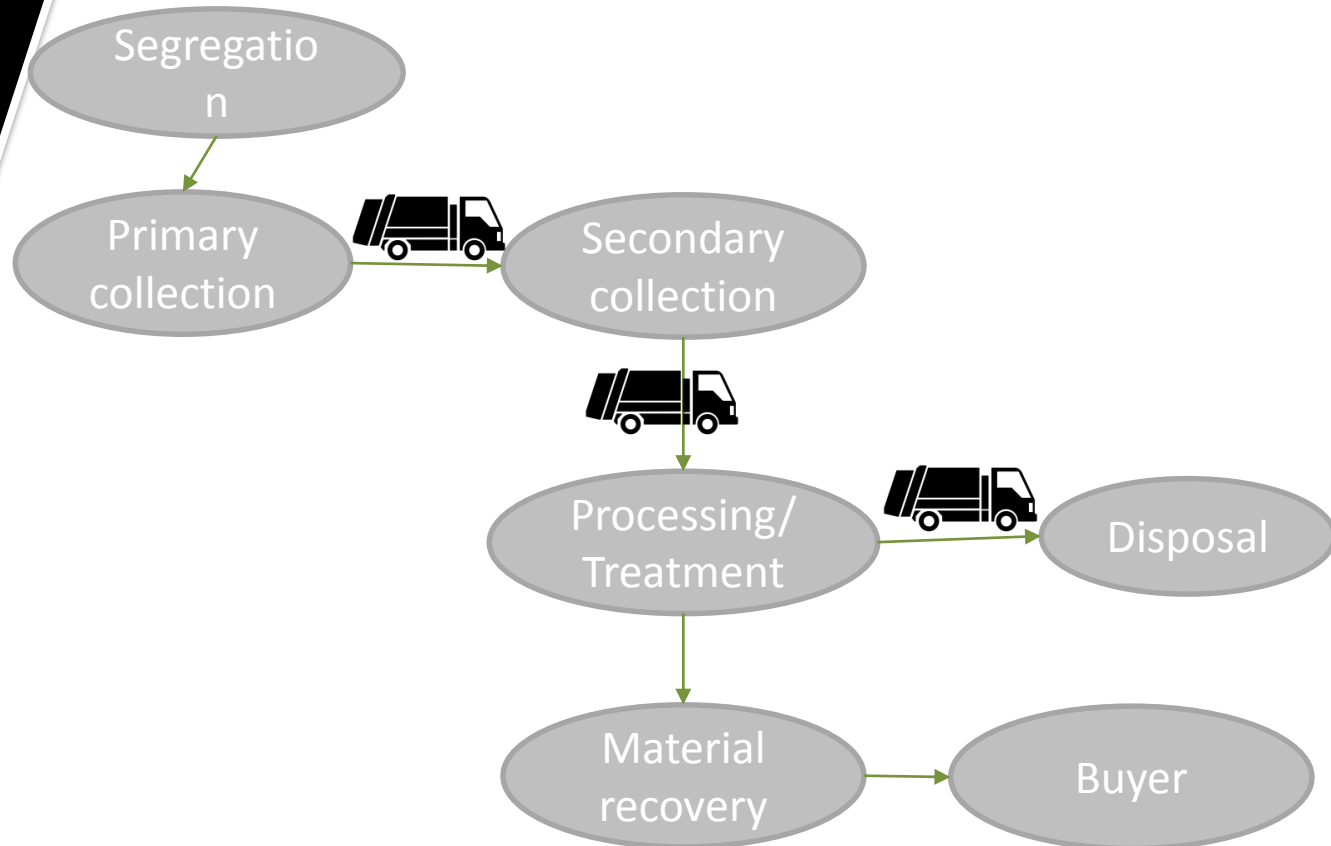


AAETI

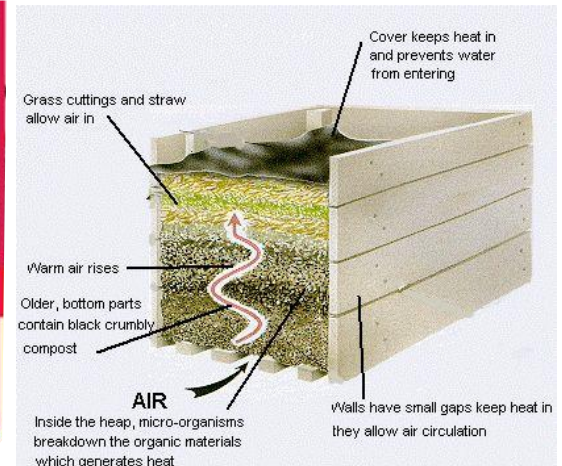
SOLID WASTE

Operations and
Maintenance

Waste Management



Organic Waste



AAETI

SOLID WASTE

Passive Techniques

Organic Waste

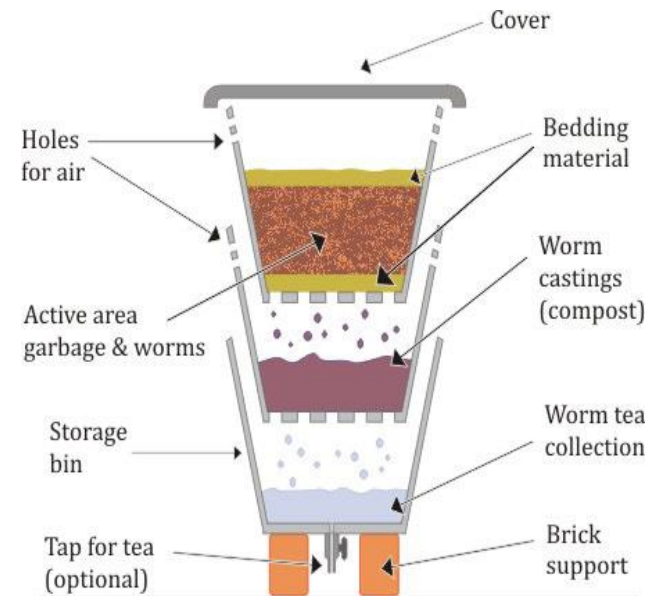


Mandatory to compost in site with built area above 20,000 sqm

Mechanised Composting



Vermi Composting



Pit Composting






AAETI

SOLID WASTE

Consumption

Plastic Waste



 Safest Choice  Use with Caution  Avoid



AAETI

SOLID WASTE

Conservation

Initiatives, Communication



Initiatives : Policies, Action plans, Sustainability Framework, Reduction commitments, Fines, segregation, plastic free campus, recycling, upcycling, composting.

Wet waste-
kitchen/
horticulture



In situ composting/
biogas plant

Plastic waste
recyclable



Stored and given to a
authorised vendor/ dealer
at regular intervals

Plastic waste
non-recyclable



Stored and given to a
authorised vendor/ dealer
at regular intervals/
options to eliminate

Paper/
cardboard



Stored and given to a
authorised vendor/ dealer
at regular intervals

Metal/ glass



Stored and given to a
authorised vendor/ dealer
at regular intervals

Any other
waste- textile
rubber, markers,
hazardous
waste



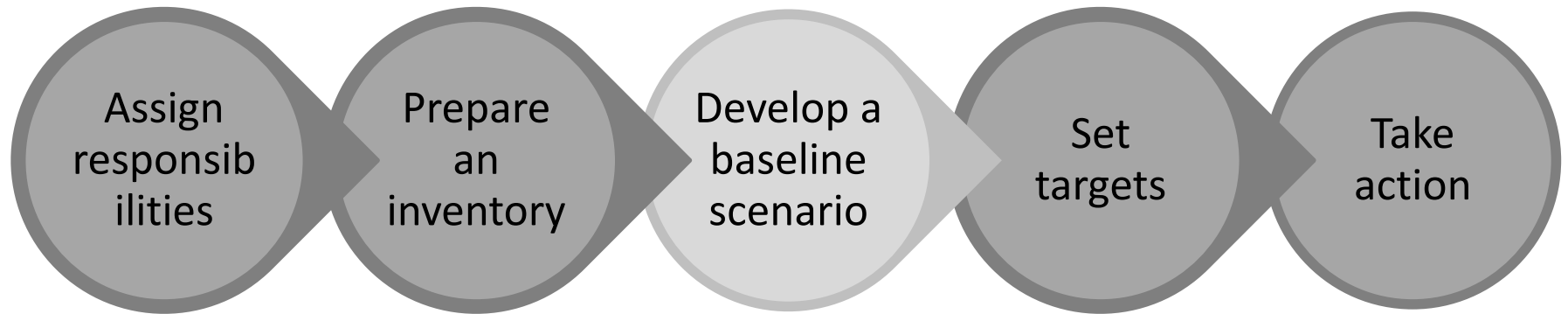
Stored and given to a
authorised vendor/ dealer
at regular intervals

Sanitary waste



Sent to the common bio-
medical waste treatment
facility (CBMWTF)

PROCESS



Green strategy

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

Green strategy – Xavier's Bbsr

Level	Policy	Organising	Commitment	Performance measurement	Communicating	Investment
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Green strategy – RMVCC

Level	Policy	Organising	Commitment	Performance measurement	Communicating	Investment
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PROCESS

