AAETI

Anil Agarwal Environment Training Institute

Green Sense : Educational Campus Inventory

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January 31 – February 2, 2018
Sustainable Buildings and Habitat Programme

Green Sense : Educational Campus Inventory

CSE

SHAKTI SUSTAINABLE ENERGY FOUNDATION

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What is Green Sense?

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

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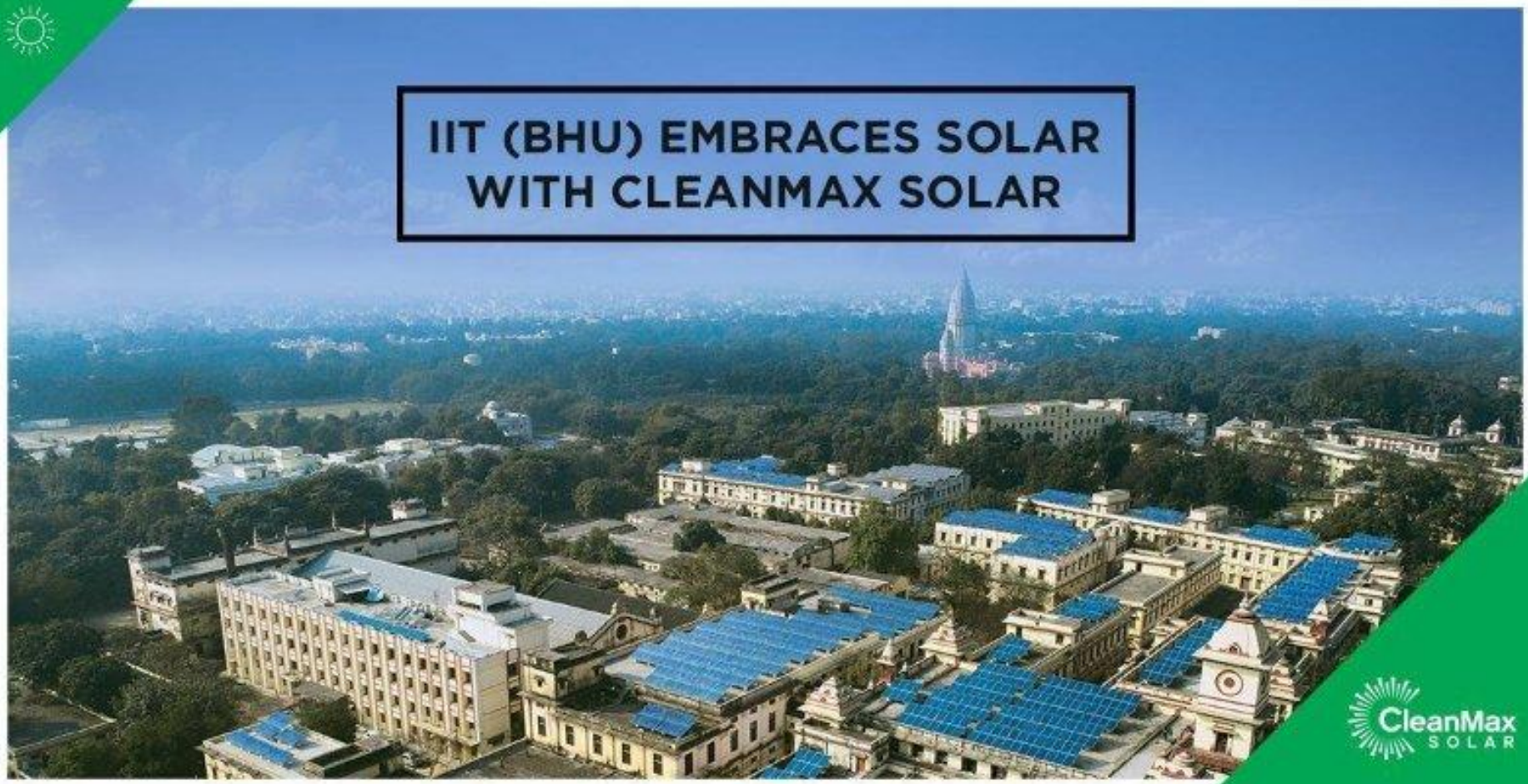
Environmental

2015 SUSTAINABILITY



Princeton University

@TigersGoGreen

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What is a Green Campus?

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IDEOLOGY

Environment

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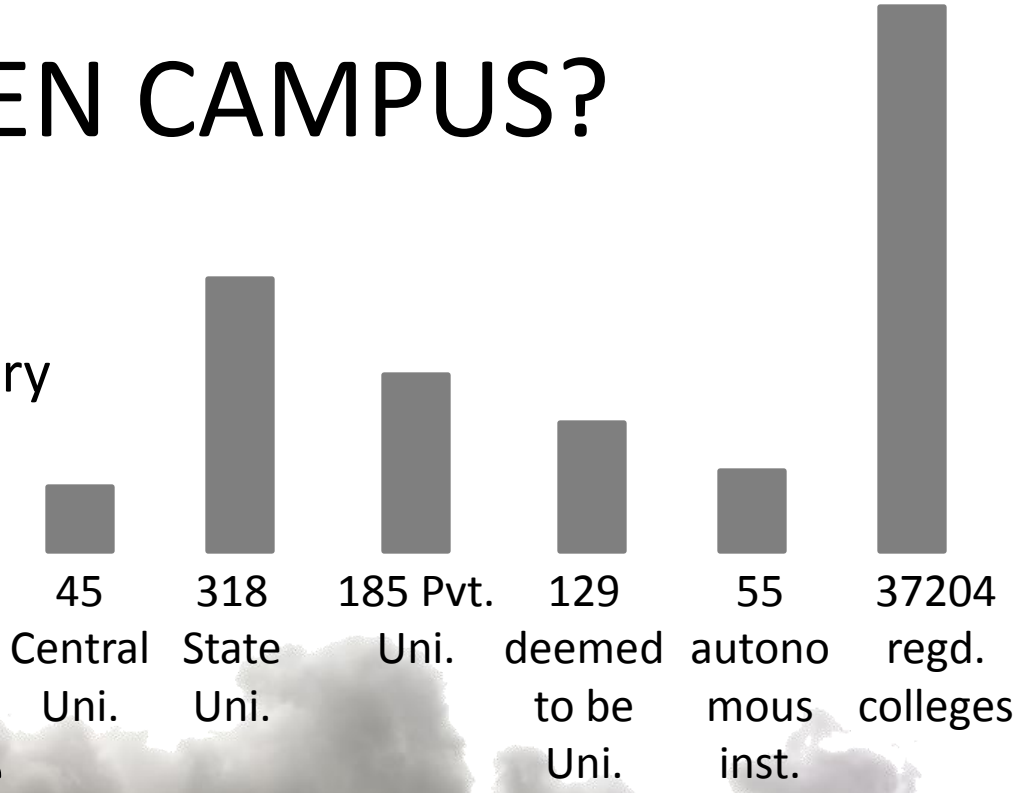
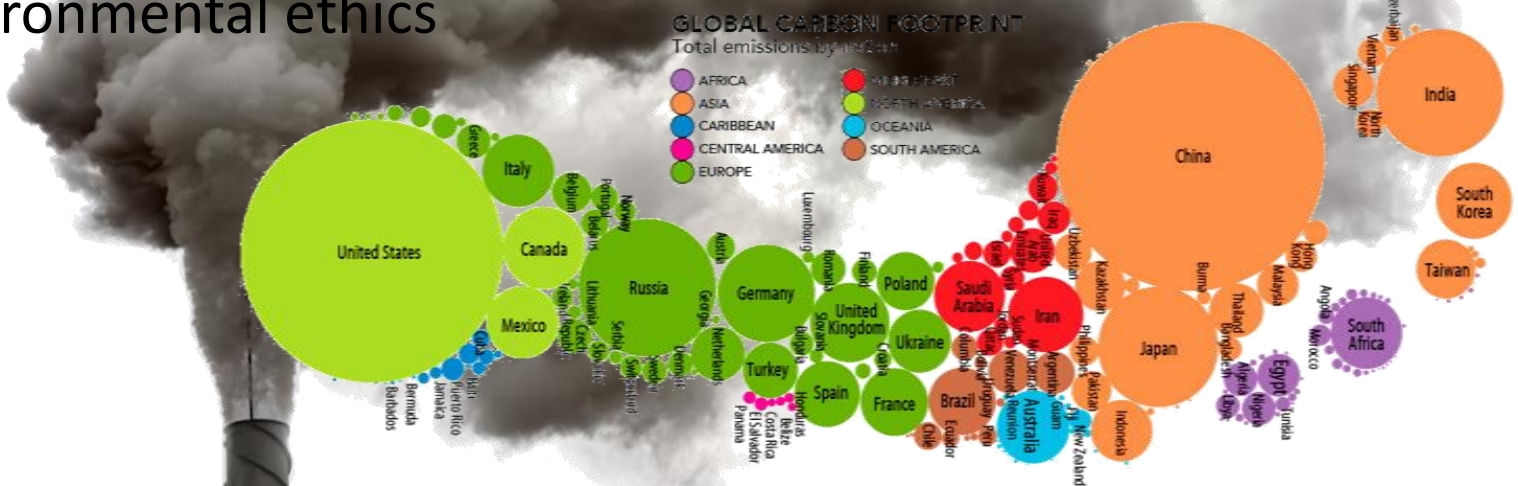
WHY GREEN CAMPUS?

- Estimated 231 Million Tons Equivalent CO_2 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



Graphic not to scale; Source: MHRD 2013



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SUSTAINABLE DEVELOPMENT GOALS

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CAMPUS AND SDG'S

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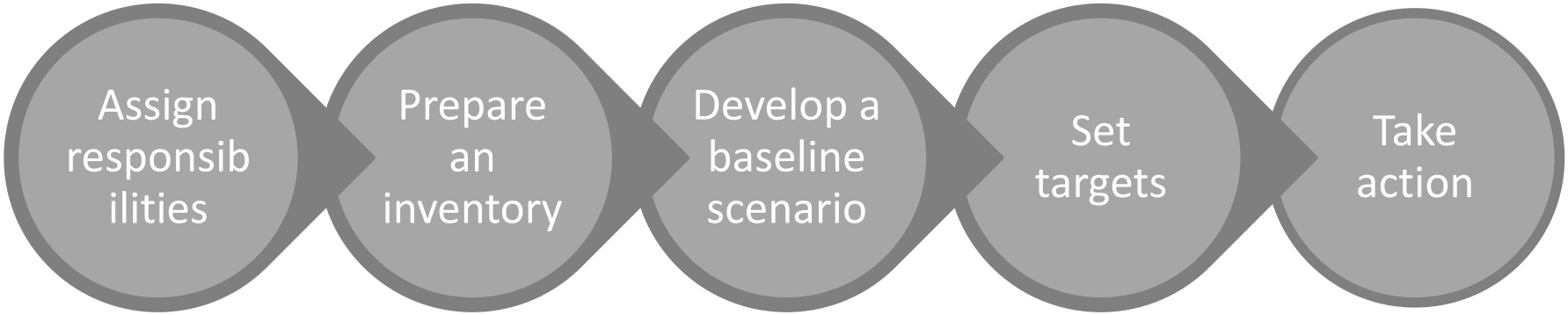
PROCESS



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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

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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

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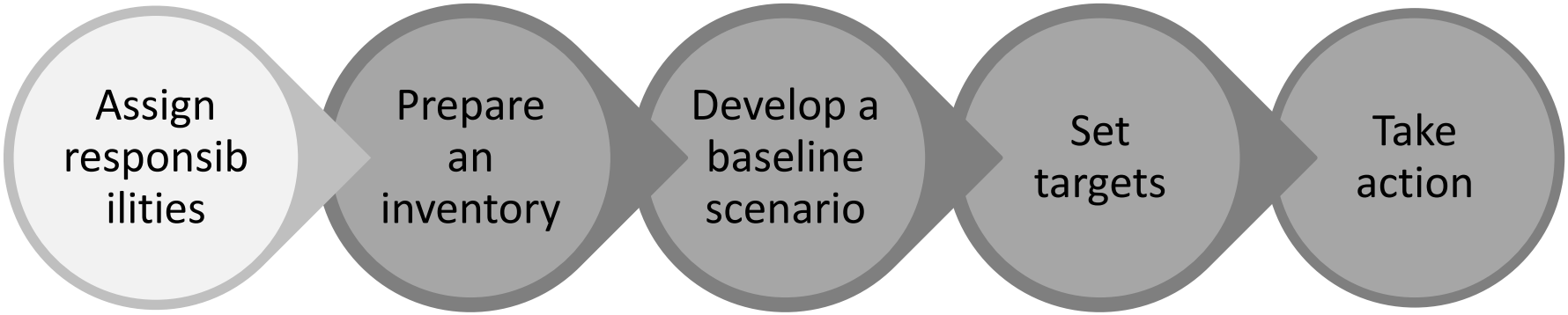
PROCESS



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ASSIGN RESPONSIBILITIES

Green Mandate

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

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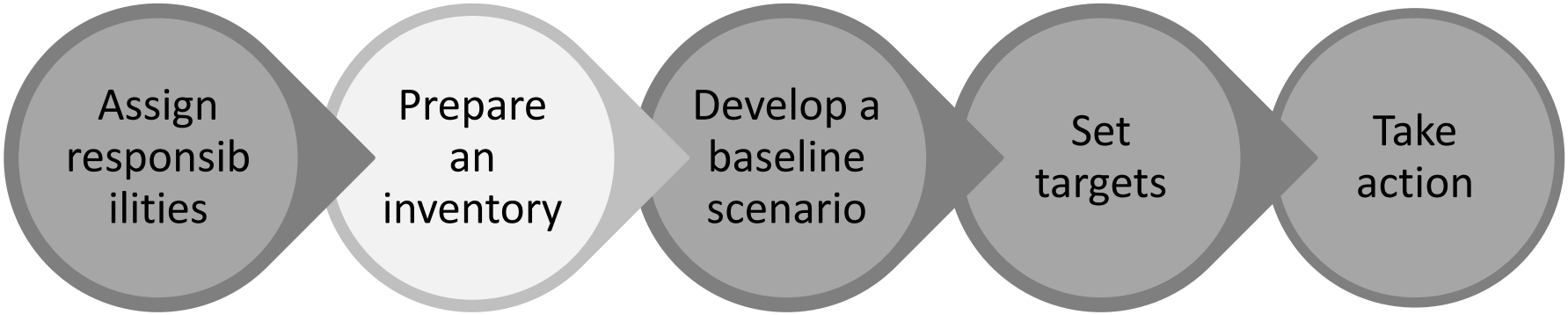
PROCESS



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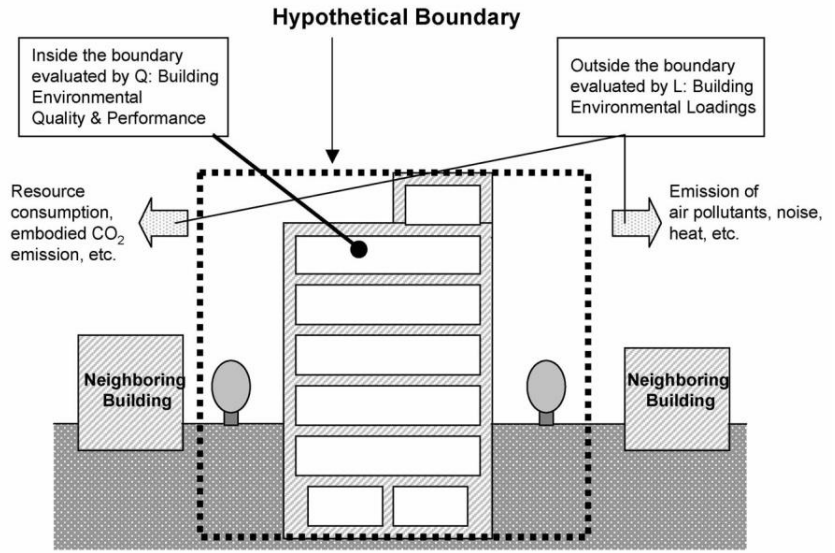
INVENTORY

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			
	NEGLIGIBLE	MARGINAL	CRITICAL	CATASTROPHIC
Frequent				High
Probable				
Occasional		Medium		
Remote				
Improbable	Low			

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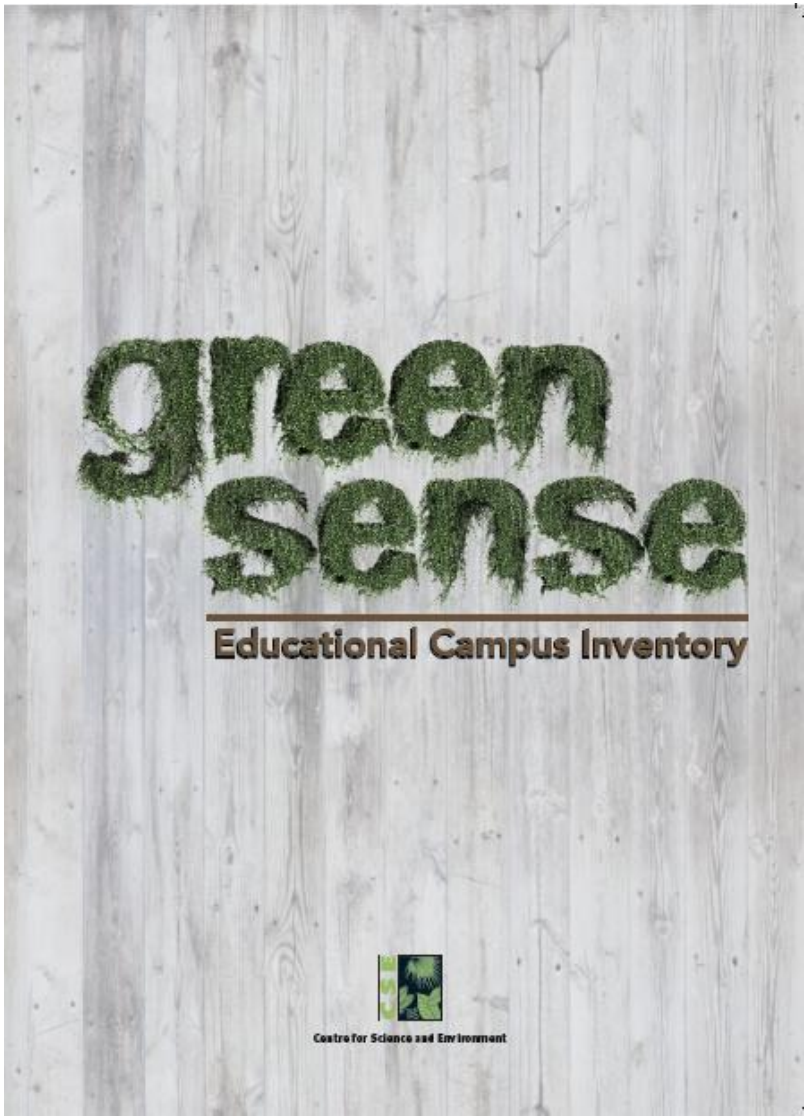
INVENTORY



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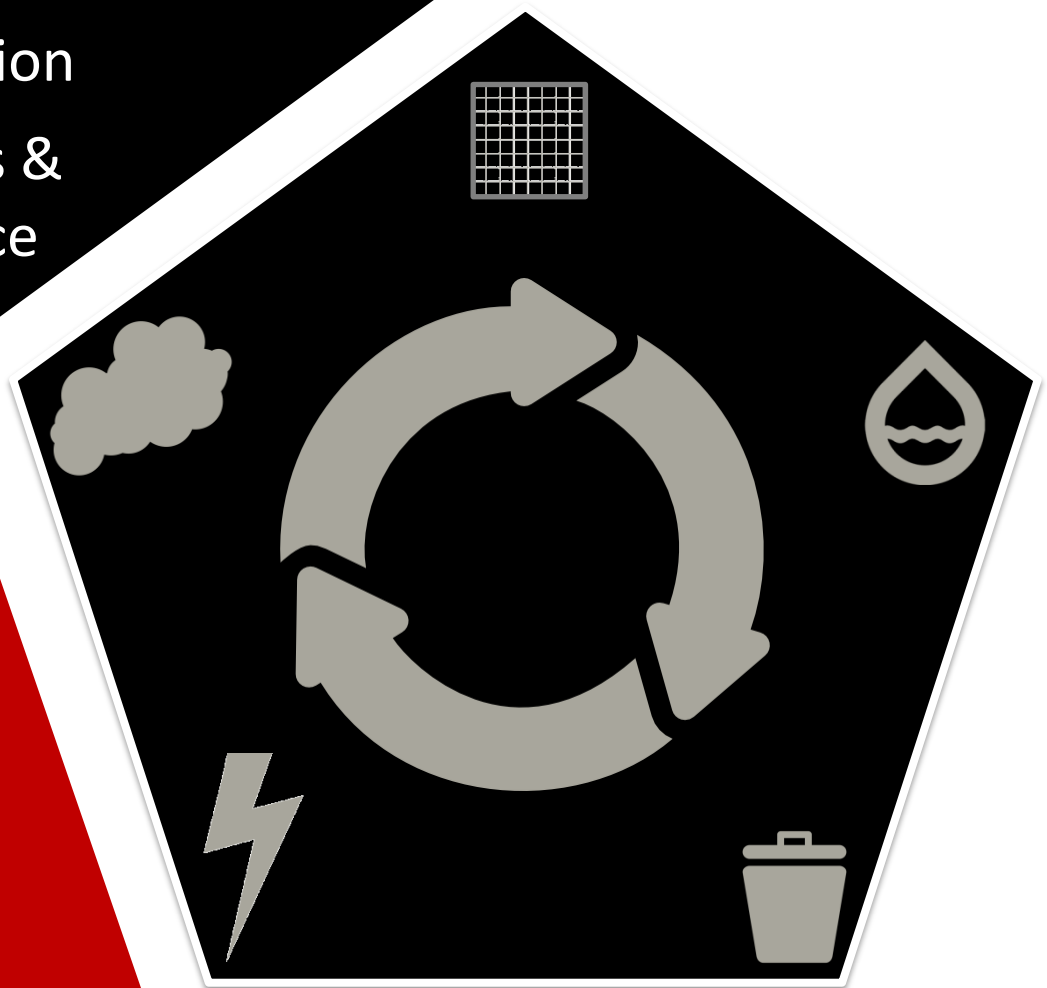
5 THEMES

- Consumption
- Conservation
- Operations & Maintenance



Land

Energy

Water

Air

Waste

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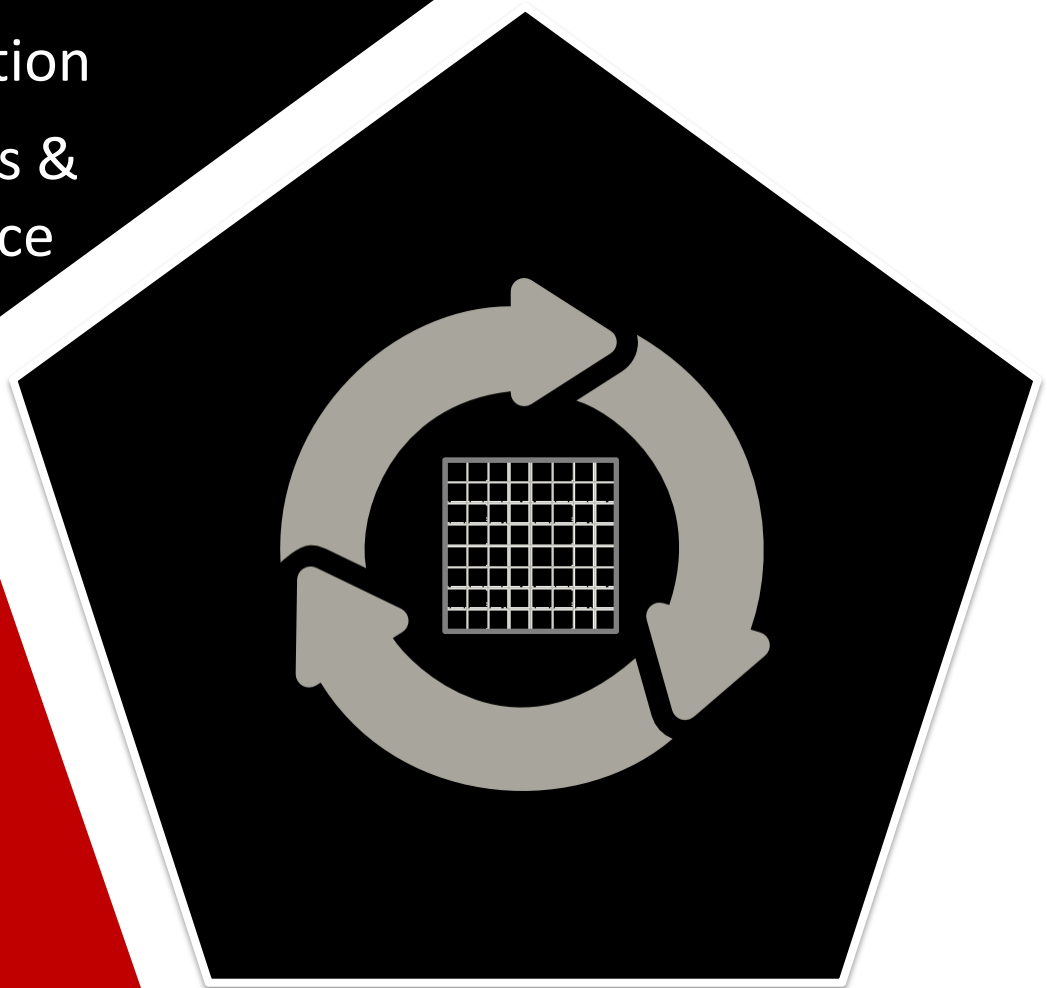
LAND

- Consumption
- Conservation
- Operations & Maintenance



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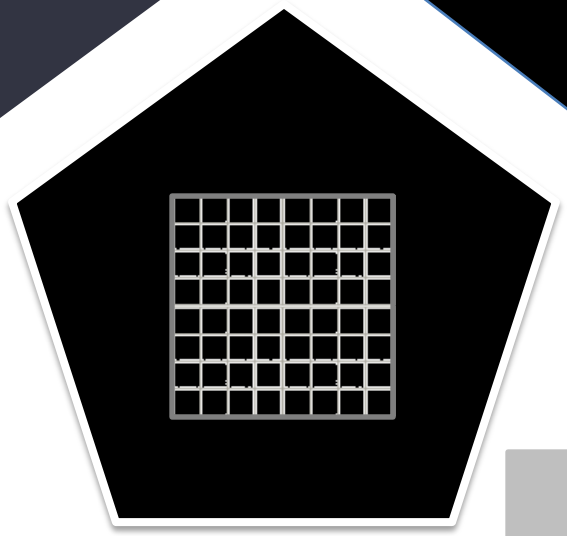
LAND

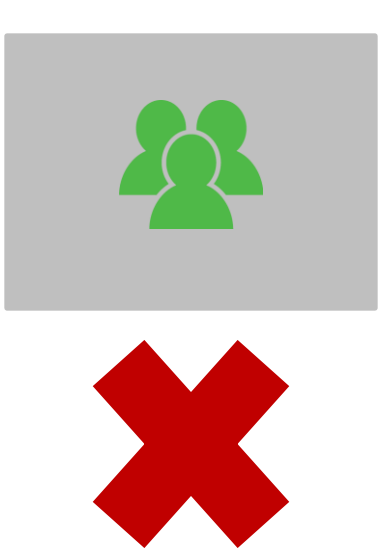
Consumption

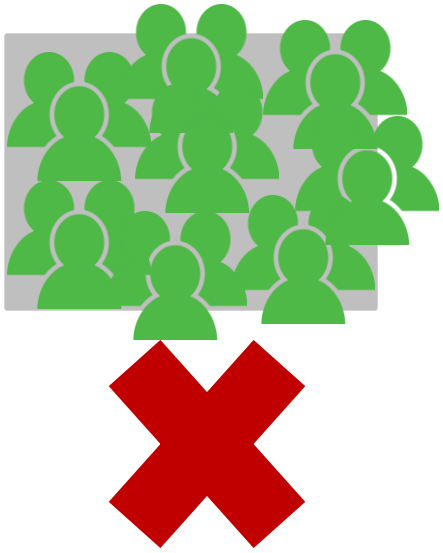
Land use, people and occupancy

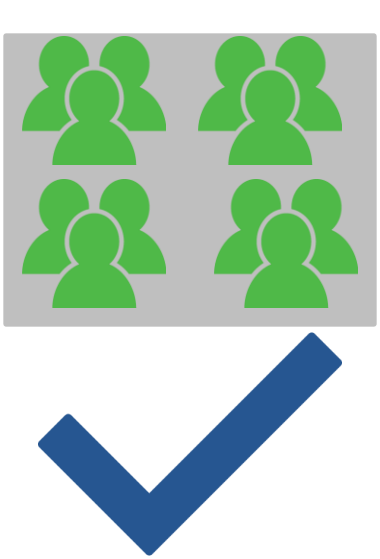


CARRYING CAPACITY

OPTIMIZATION







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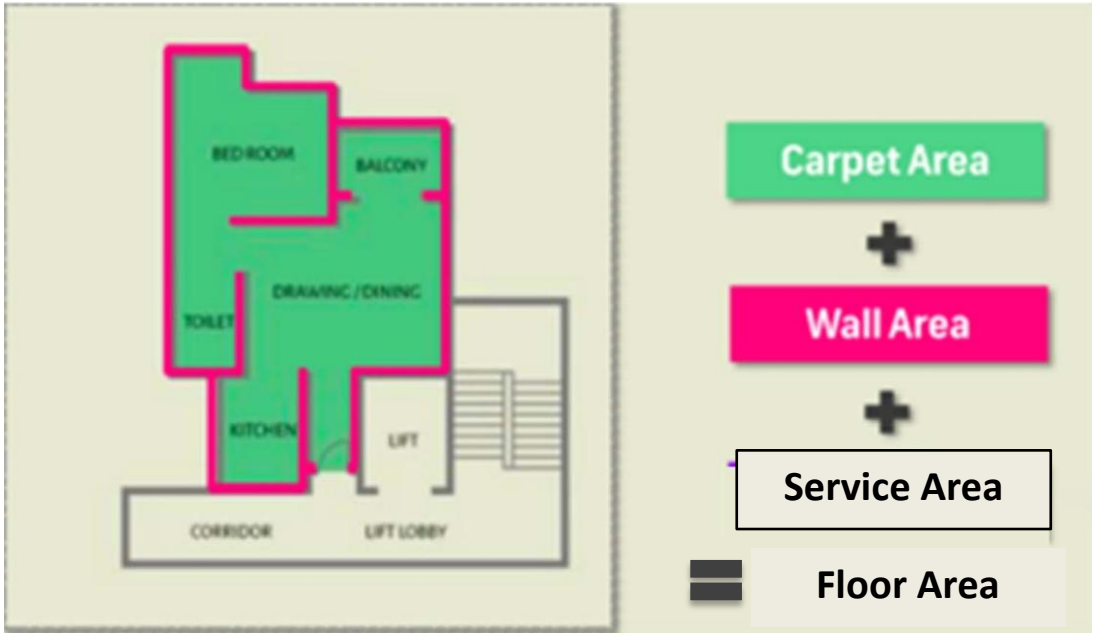
LAND

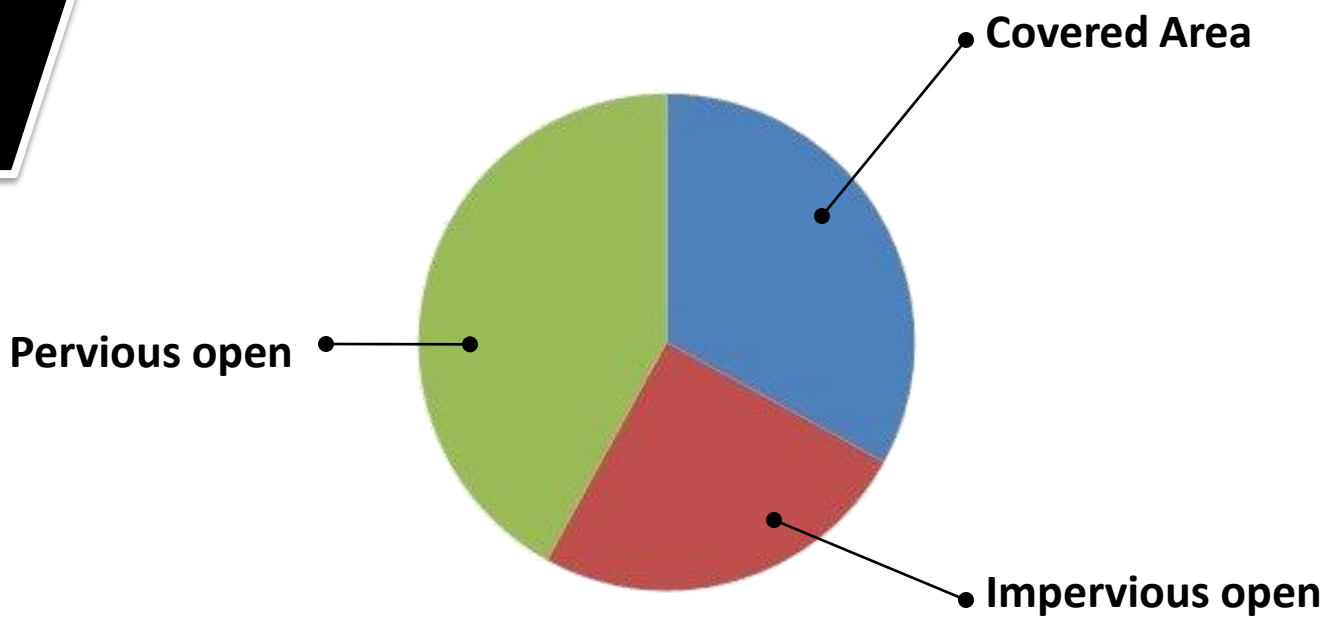
Consumption

Building area elements



AAETI LAND Consumption

Covered Area, Pervious open, Impervious open



Covered Area

Covered Area

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LAND

Consumption

Impervious Open

Impervious

Open

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LAND

Consumption

Pervious Open

Pervious

Open

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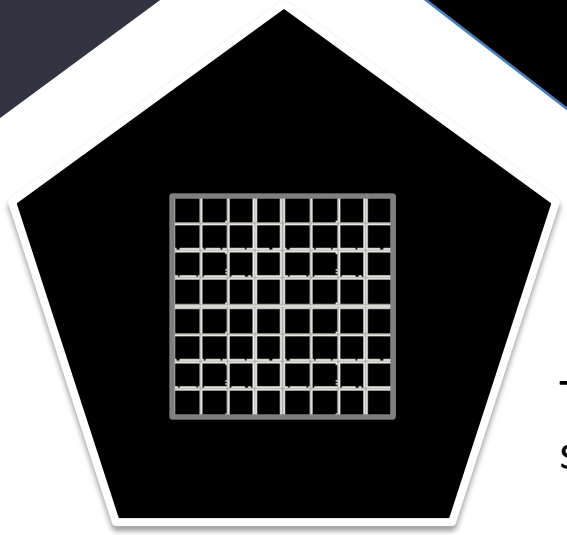
LAND

Consumption

Surfaces



Terrace surfaces

Landscaped and green finish

Reflective/heat-resistant tiles

Polyurethane coating

Outdoor court surfaces

Cement concrete

Propylene tile

Acrylic layering

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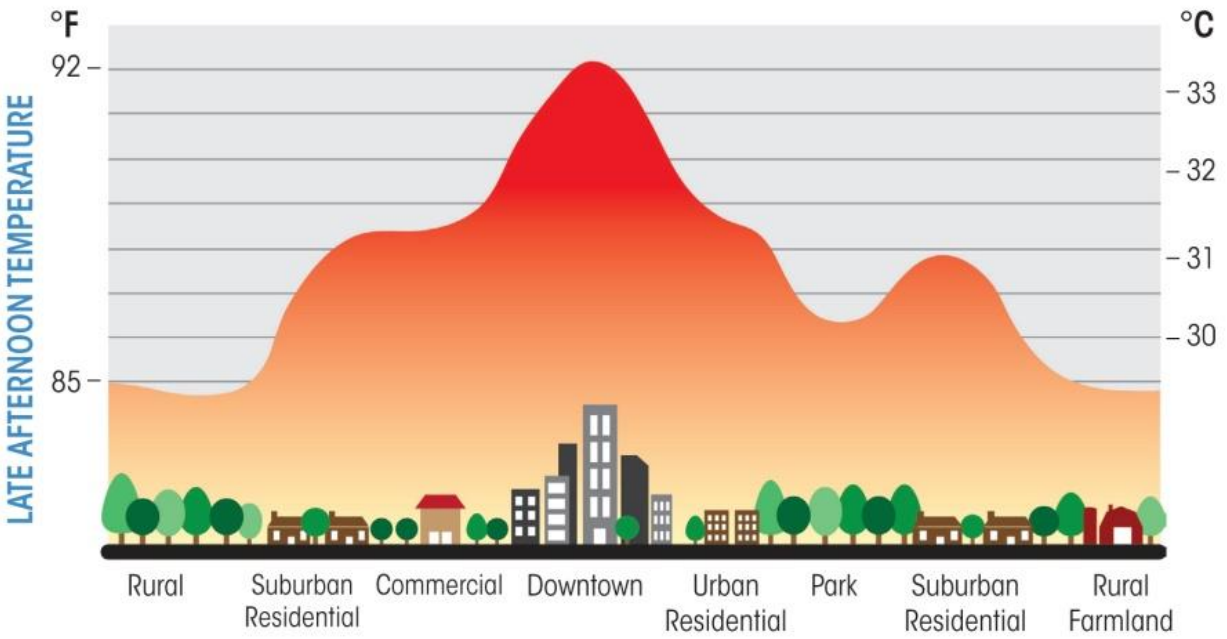
LAND

Consumption

Heat Island Effect



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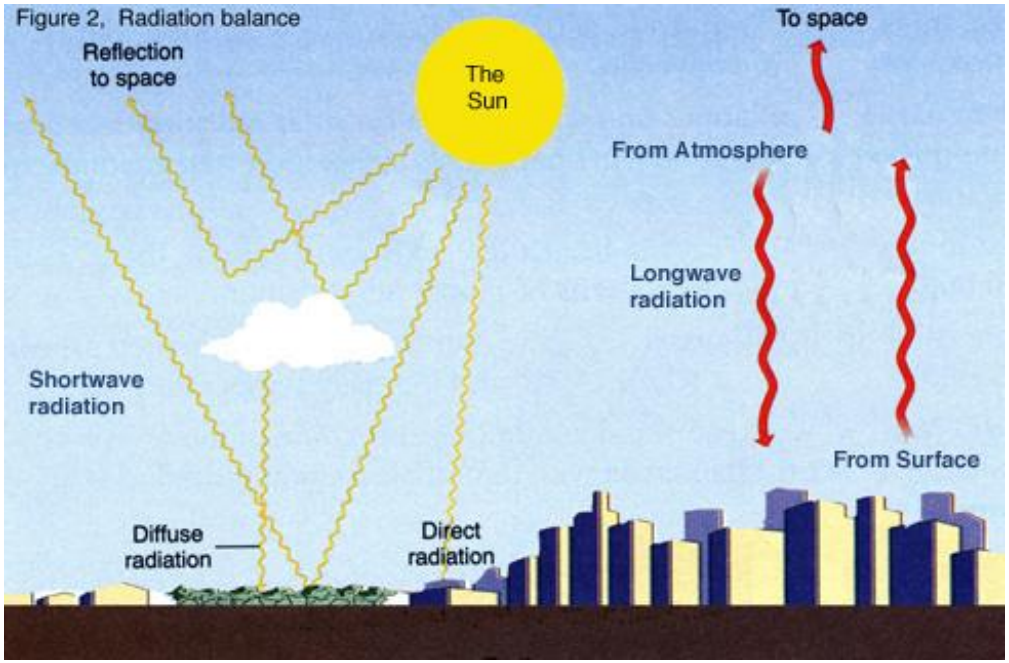
Consumption

Heat Island Effect



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LAND

Conservation

Heat Island Effect

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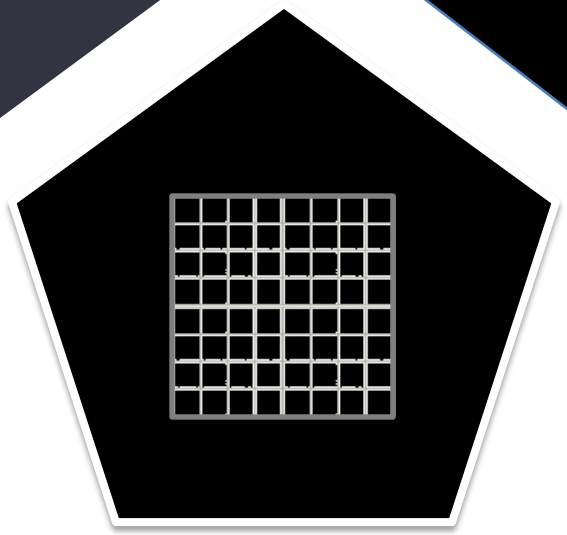
LAND

Conservation

Pervious Open



Impervious Open

Pervious Open

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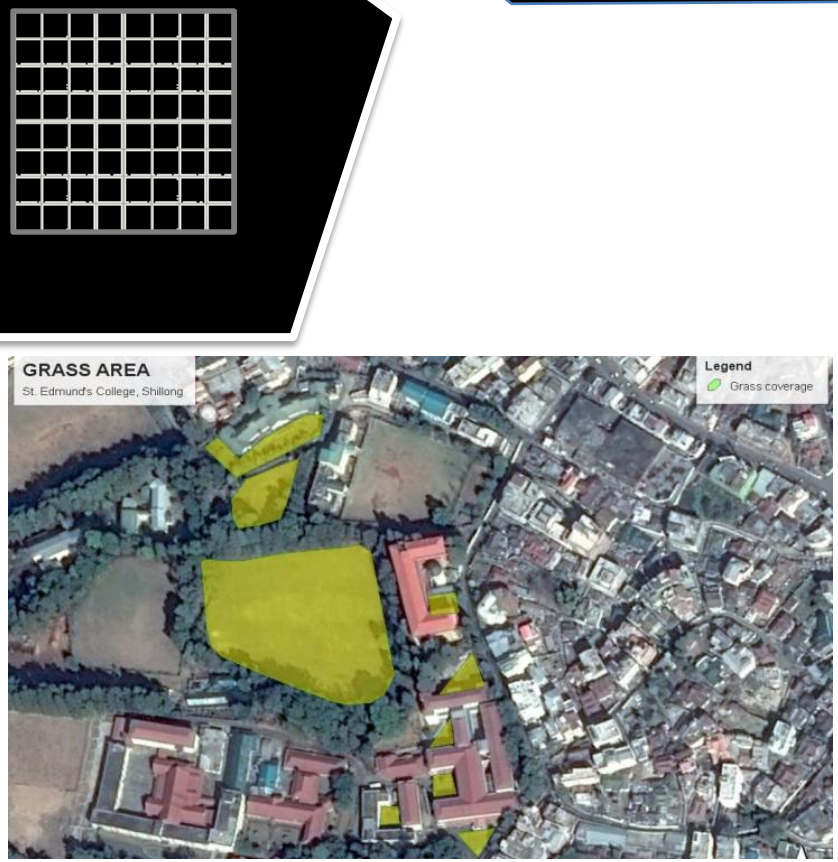
LAND

Conservation

Green area mapping: Shared cases



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ENERGY

- Consumption
- Conservation
- Operations & Maintenance

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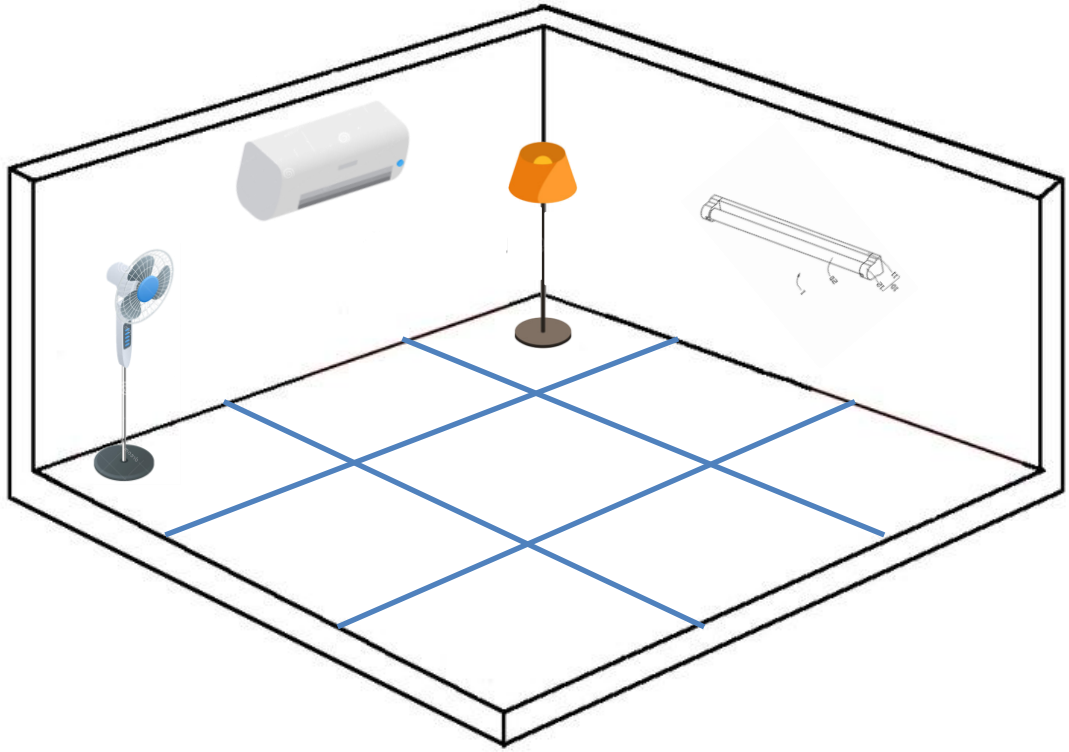
ENERGY

Consumption

EPI – Energy Performance Index



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ENERGY

Consumption

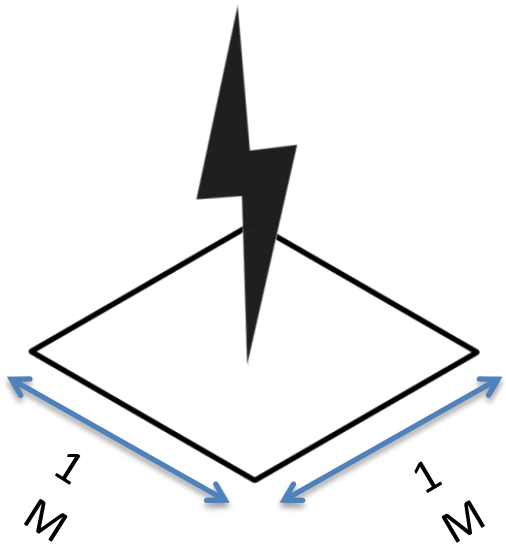
EPI – Energy Performance Index

AAETI ENERGY Consumption

EPI – Energy Performance Index

Energy
Performance =
Index

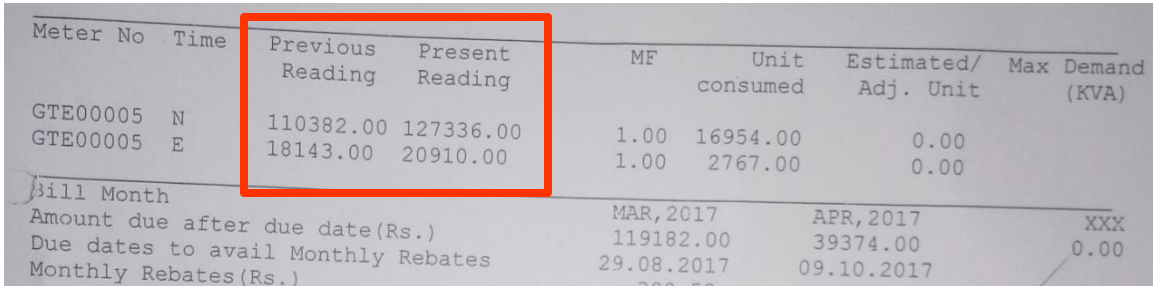
$$\frac{\text{Energy Consumed Annually (KWh)}}{\text{Built Up Area (sq.m.)}}$$



AAETI = 62.7 KWh/sq.m./yr.

AAETI ENERGY Consumption - Monitoring

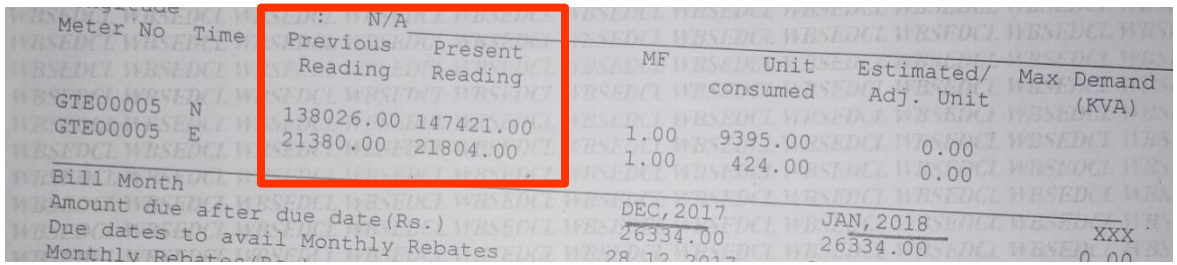
EPI – Energy Performance Index



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.)			

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



Meter No	Time	: N/A 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	
Due dates to avail Monthly Rebates			

AAETI ENERGY

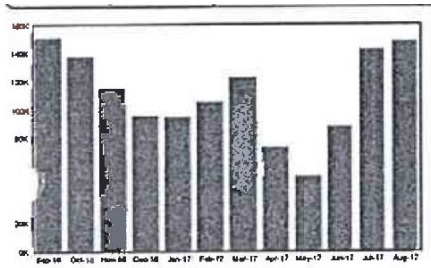
Consumption – Passive Techniques

Renewable Penetration

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

Xavier's Bhubaneswar

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



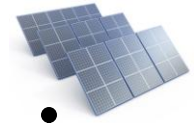
Consumption Pattern (12 months)

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		
Aug 2017	148000.00	FR KWH		
Jul 2017	142800.00	FR KVAH	Connected Load	720.00 KW
Jun 2017	88400.00	FR MD	Category	SPP
May 2017	53800.00	FR Tod1	Tariff Type	HT/SPP/>=110
Apr 2017	72800.00	IR KWH	Supply Type	11.00 HV
Mar 2017	122640.00	IR KVAH	Meter Make	3ph Static TV+ MU
		IR Tod1	Meter Serial No.	CSD30240
Slab Calculation			SD Amount	2749118.00

Solar Penetration

AAETI current solar penetration



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

AAETI after 2nd Phase

Net Zero Energy Building

Window Wall Ratio

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

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ENERGY

Consumption – Passive Technique

Window Wall Ratio

Xavier's
Bhubaneswar – 35%

RMVCC Kolkata – 50%

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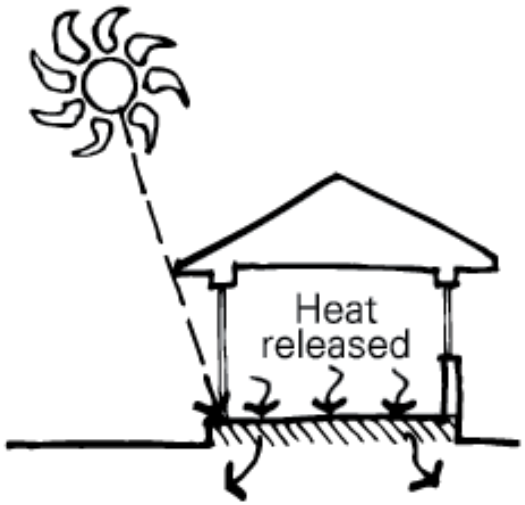
ENERGY

Consumption – Passive Technique

Natural Ventilation

OR



Night Purge

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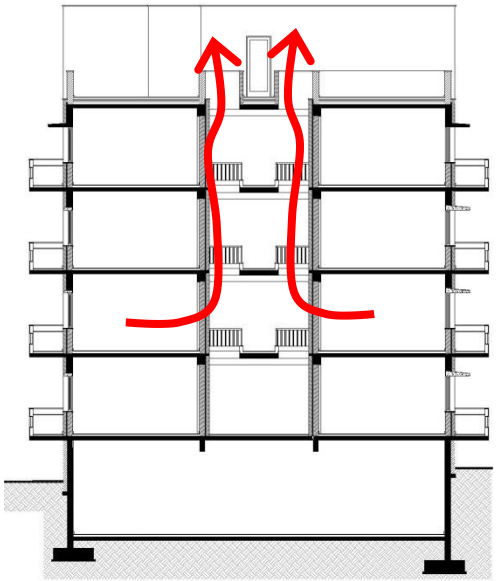
ENERGY

Consumption – Passive Technique

Natural Ventilation

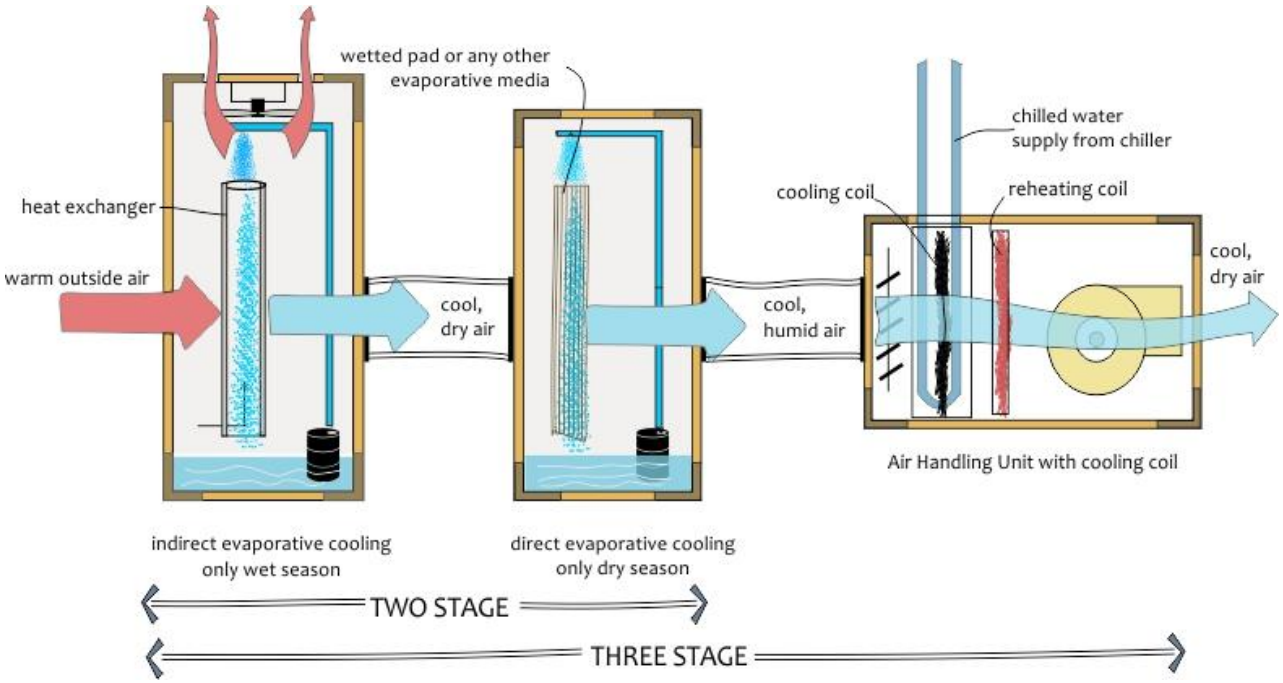
Light shelves in corridors allow natural light to filter in and allow hot air to escape



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

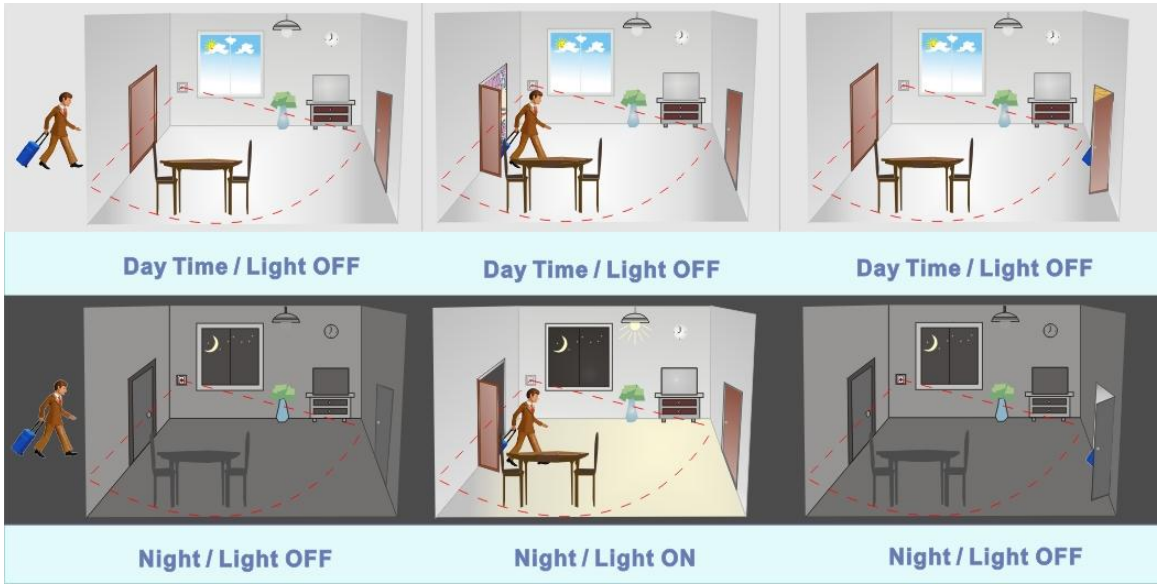
ENERGY

Operation and Maintenance

Response time, Procurement, Retrofit, Controls, Temperature setting

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

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

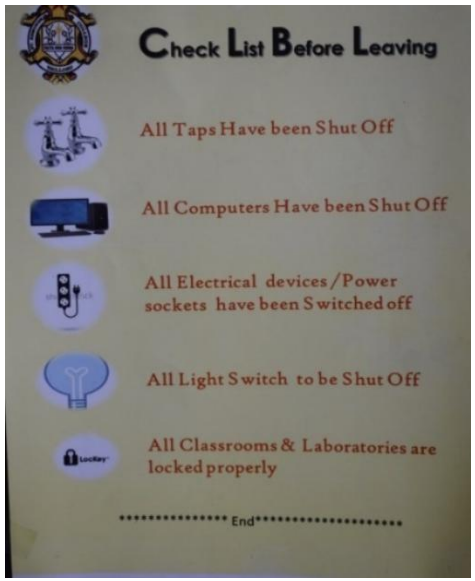


AAETI ENERGY Conservation

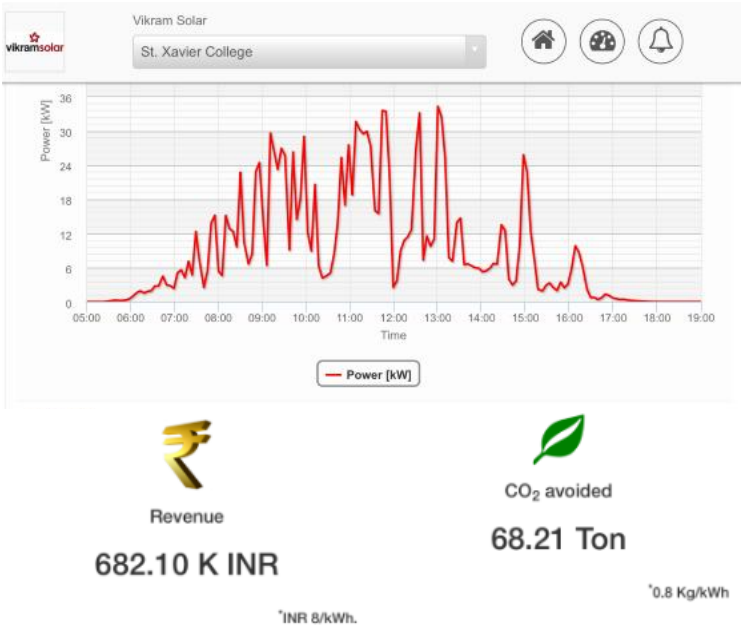
Initiatives, Communication

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

St. Edmund's



St. Xavier's Kolkata



AAETI

WATER

- Consumption
- Conservation
- Operations & Maintenance

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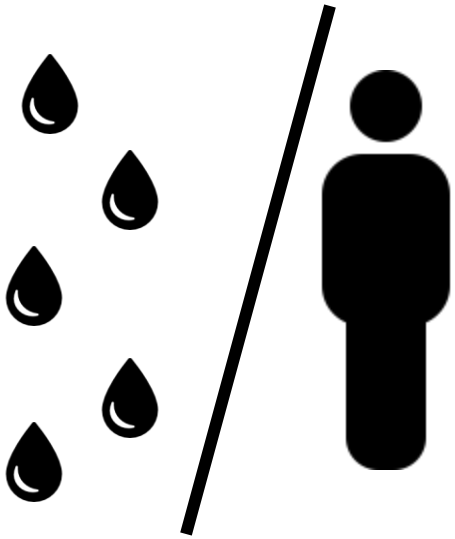
WATER

Consumption - Monitoring

Per Capita Water Consumption

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



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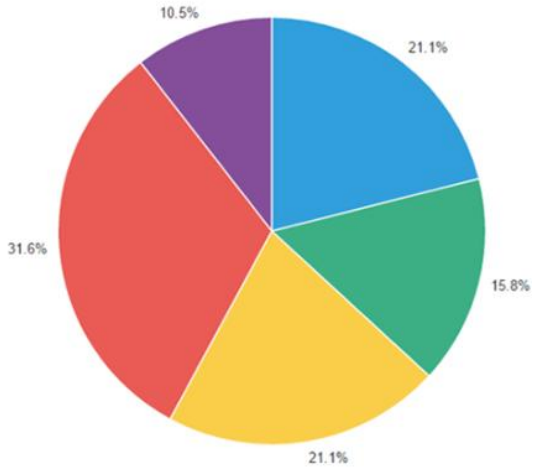
Water Source Indicator

Sources of Water

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



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WATER

Consumption – Passive Techniques

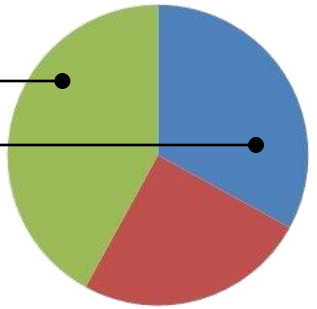
Harvesting Rain Water

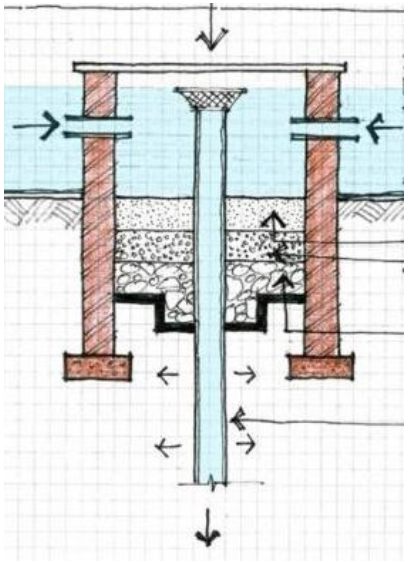
Sources of Water

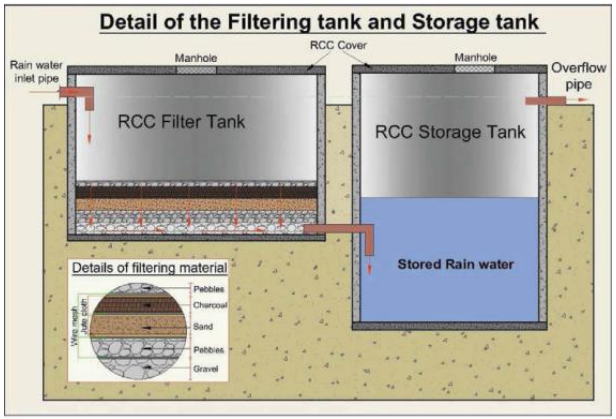
Do you harvest rain water ?

- Recharge Wells
- Storage Tanks

Capacities (Kilo Litres)







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WATER

Consumption – Passive Techniques

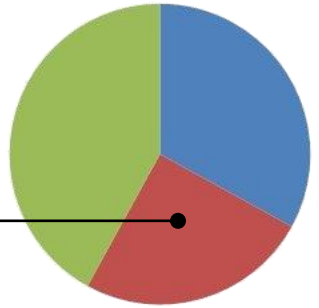
Waste Water Recycling

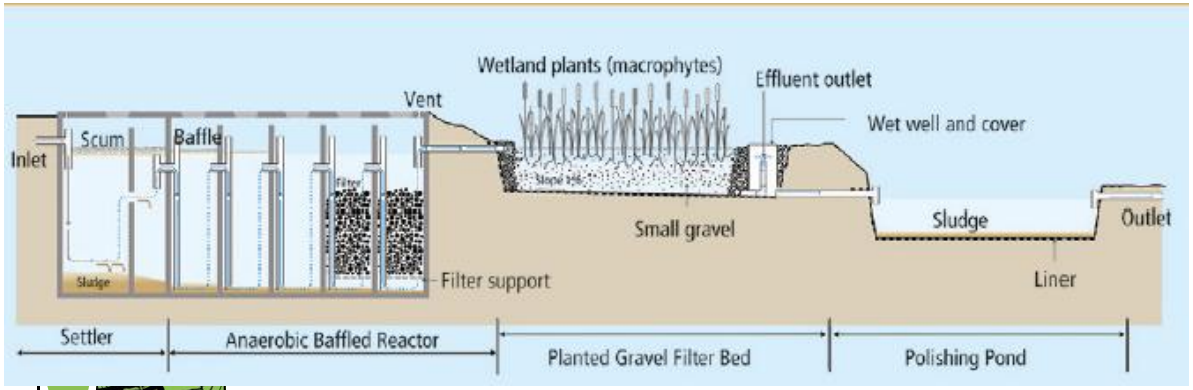
Sources of Water

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

- Waste Water Recycling

Capacities (Kilo Litres)





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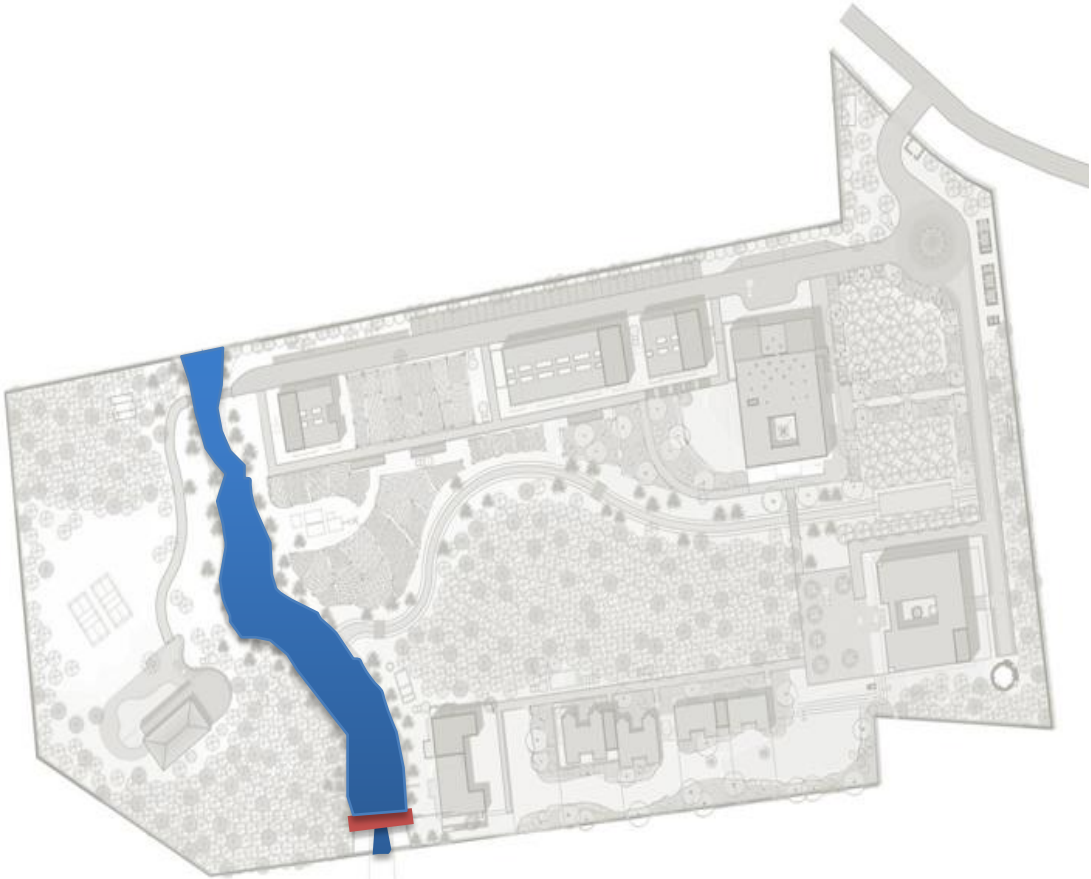
WATER

Consumption – Passive Techniques

Harvesting Rain Water



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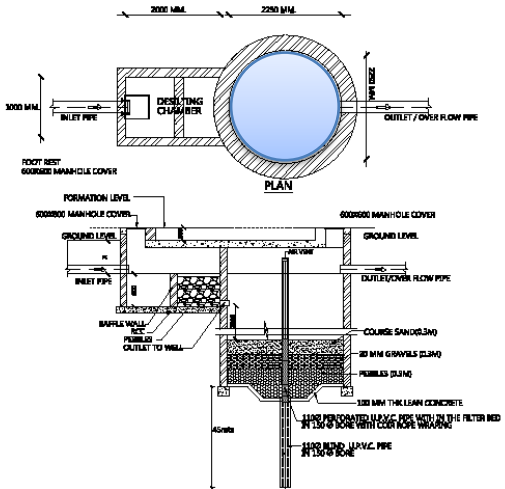
WATER

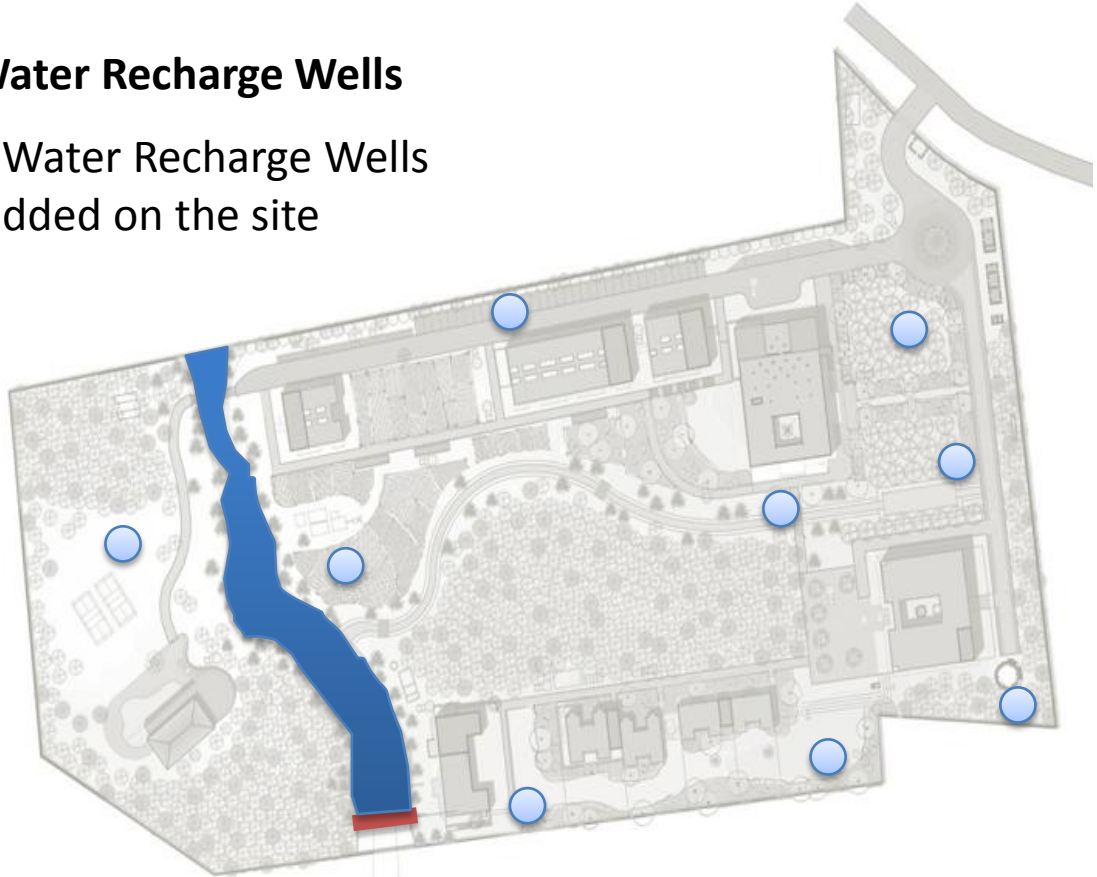
Consumption – Passive Techniques

Harvesting Rain Water

Rain Water Recharge Wells

9 Rain Water Recharge Wells were added on the site





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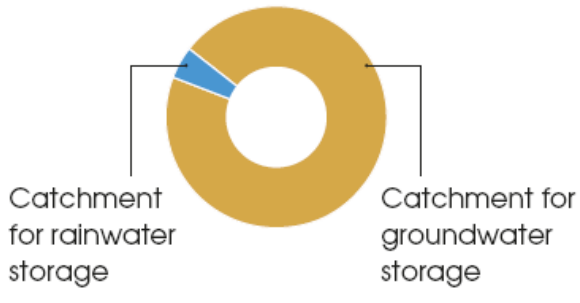
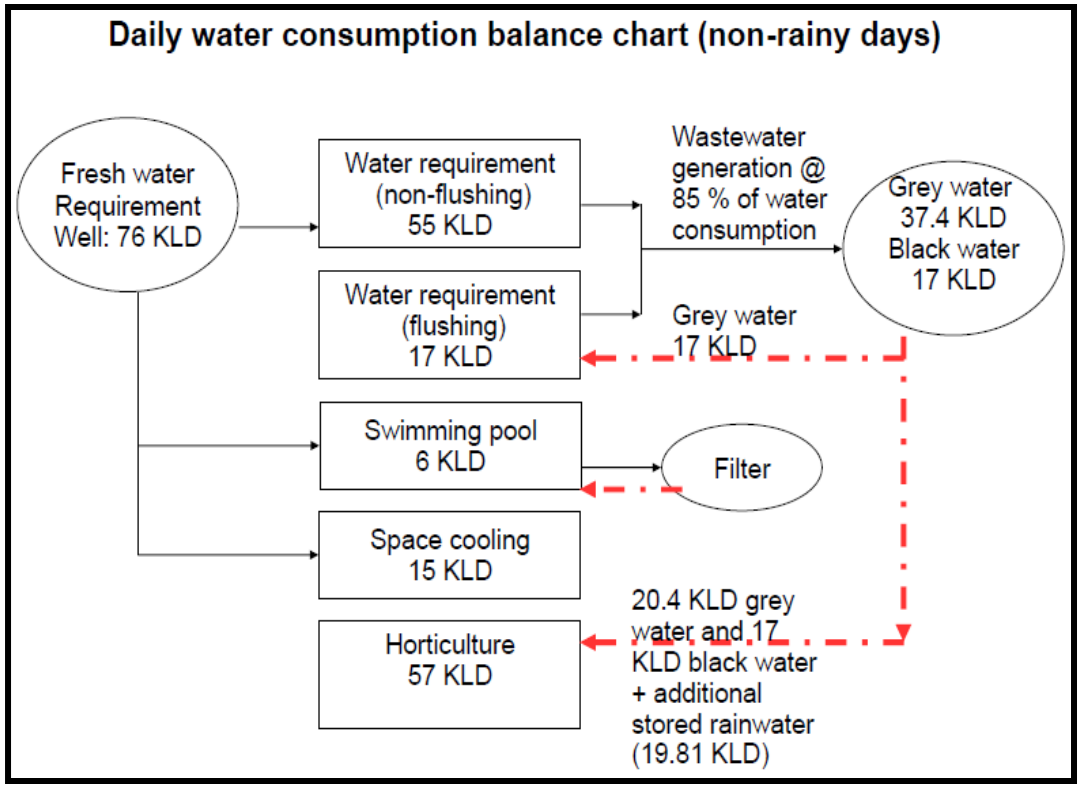
AAETI WATER Consumption – Passive Techniques

AAETI water balance

Pervious area helps greatly!





AAETI WATER Operation and Maintenance

Response time, Procurement, Retrofit, Controls

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%

Smart Meter

AAETI

AIR

- Consumption
- Conservation
- Operations & Maintenance

Factors affecting air quality

Source of Fuel Consumption

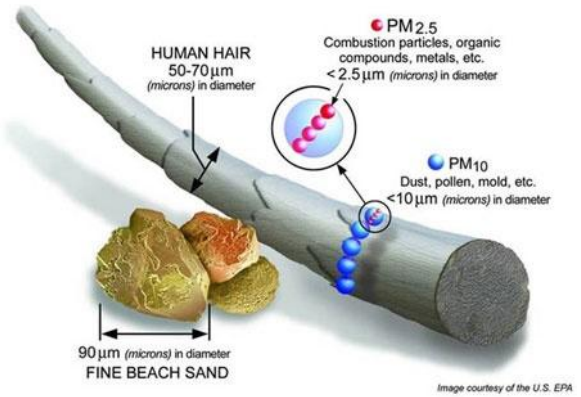
- Vehicles
- DG Sets
- Kitchen
- Heating

Pollutants

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

Major Pollutants:

- $PM_{2.5}$
- PM_{10}
- SO_2
- NO_x
- CO
- O_3
- NH_3
- Pb



Air quality index

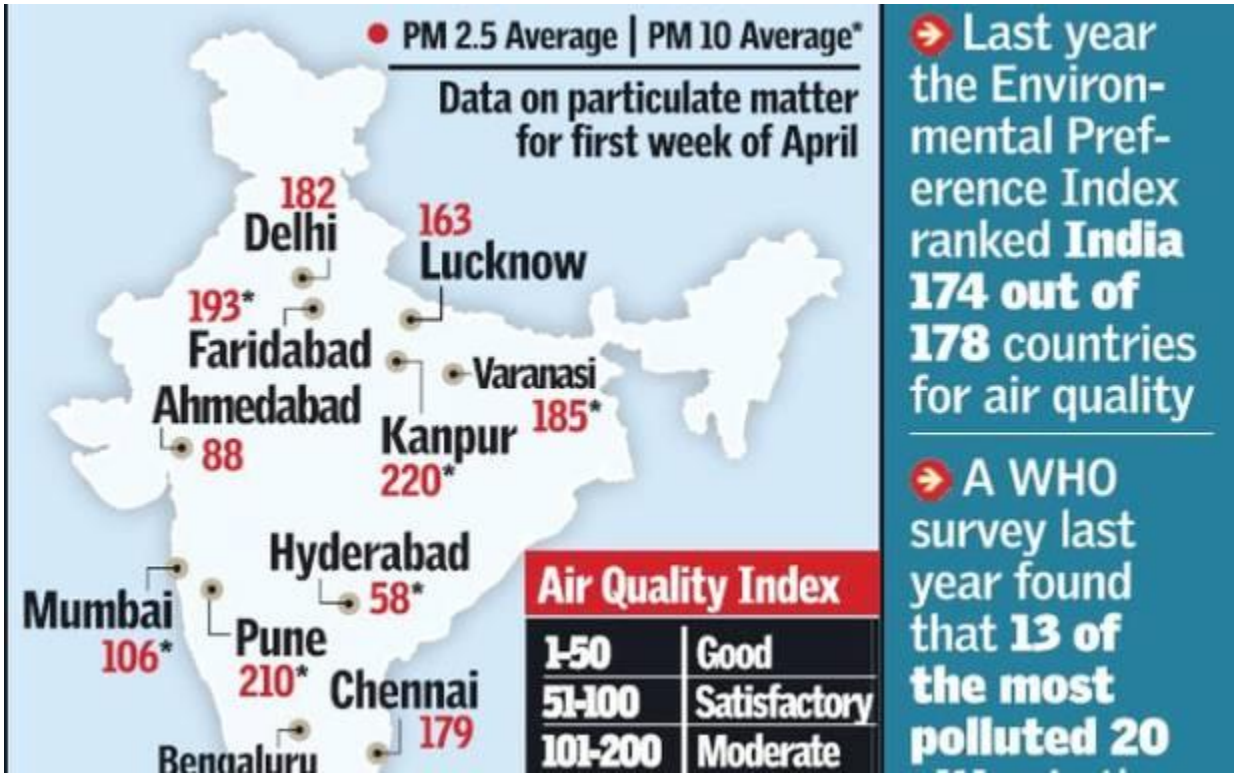
AQI Category (Range)	PM_{10} 24-hr	$PM_{2.5}$ 24-hr	NO_2 24-hr	O_3 8-hr	CO 8-hr (mg/m^3)	SO_2 24-hr	NH_3 24-hr	Pb 24-hr
Good (0-50)	0-50	0-30	0-40	0-50	0-1.0	0-40	0-200	0-0.5
Satisfactory (51-100)	51-100	31-60	41-80	51-100	1.1-2.0	41-80	201-400	0.5 –1.0
Moderately polluted (101-200)	101-250	61-90	81-180	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+

AAETI

AIR

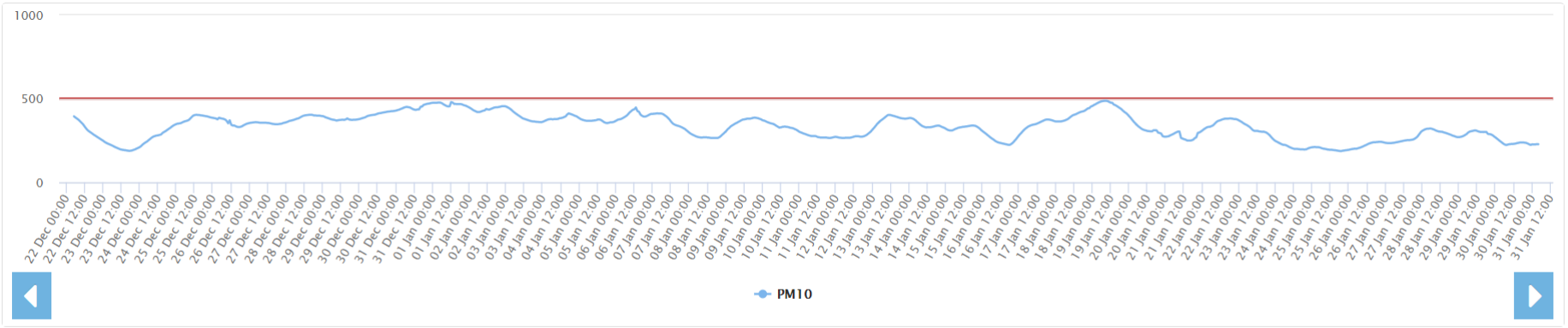
Consumption - Monitoring

Air quality index



AAETI AIR Consumption - Monitoring

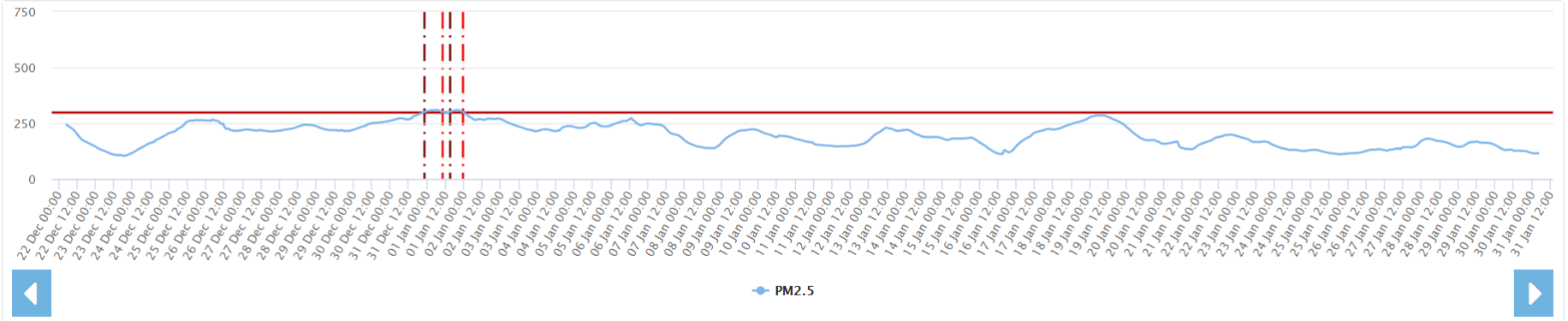
Air quality index



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 ug/m3)

PM2.5 vs Time From: 22-12-2017 04:00 To: 31-01-2018 04:00

0 Hours

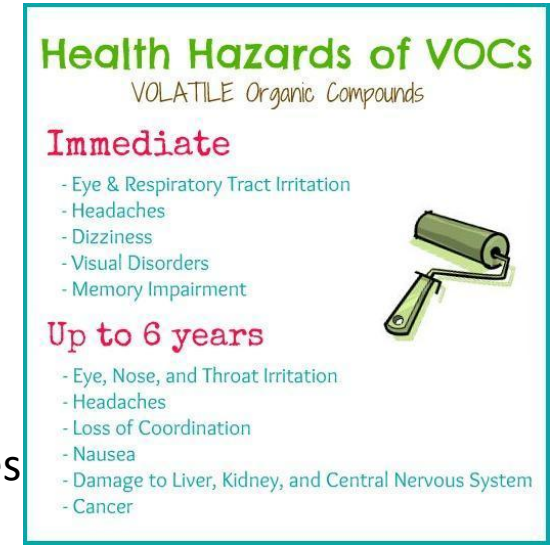


AAETI AIR Consumption

Indoor air quality

Housekeeping and pest control activities

Paints & Varnishes



CSE

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, 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

CSE

AAETI

WASTE

- Consumption
- Conservation
- Operations & Maintenance

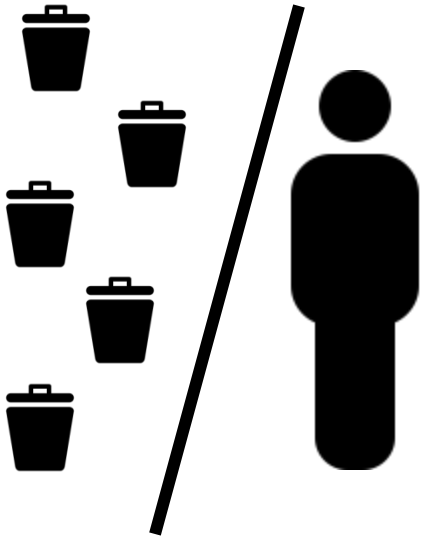
AAETI

SOLID WASTE

Consumption

Waste Generation

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



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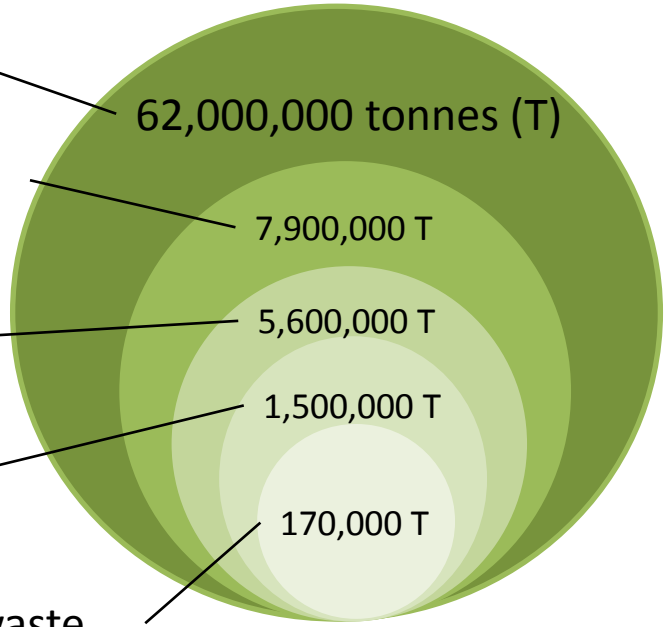
SOLID WASTE

Consumption

Waste Generation

Total municipal solid waste (MSW) in 2014



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SOLID WASTE

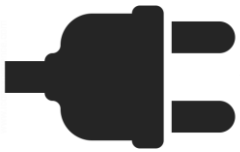
Consumption

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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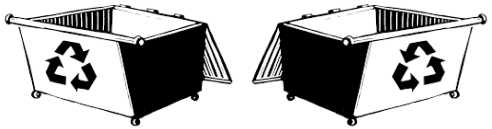
SOLID WASTE

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?

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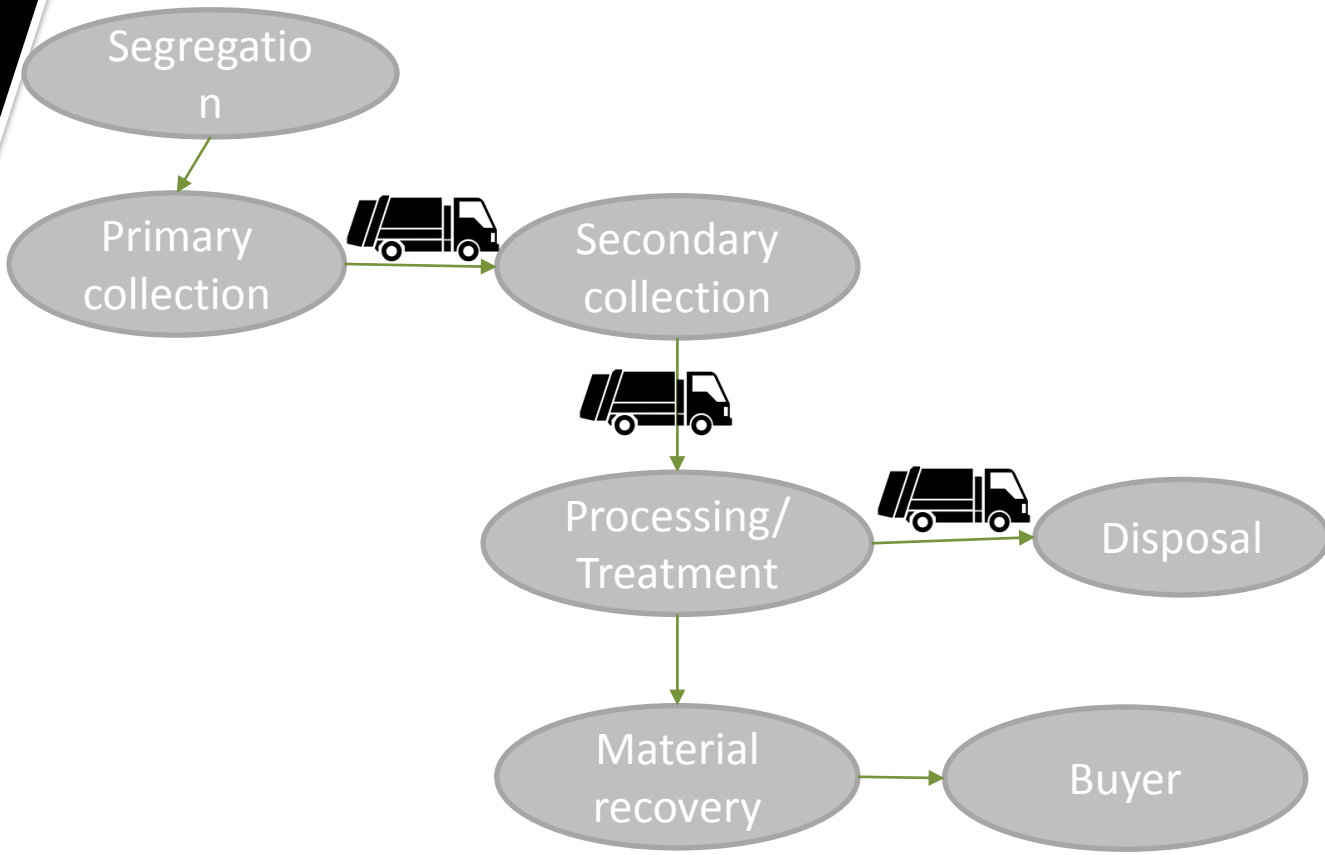
SOLID WASTE

Operations and Maintenance

Waste Management



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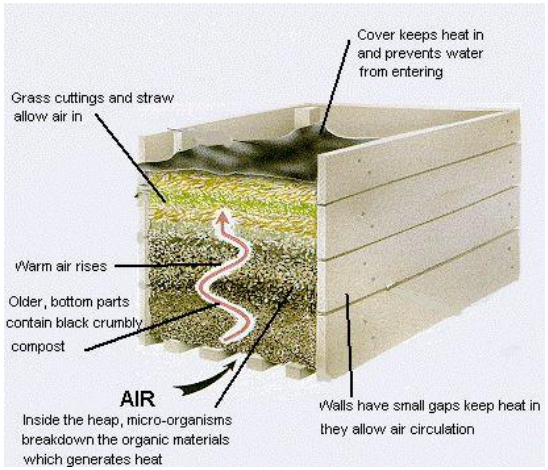
SOLID WASTE

Passive Techniques

Organic Waste



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SOLID WASTE

Passive Techniques

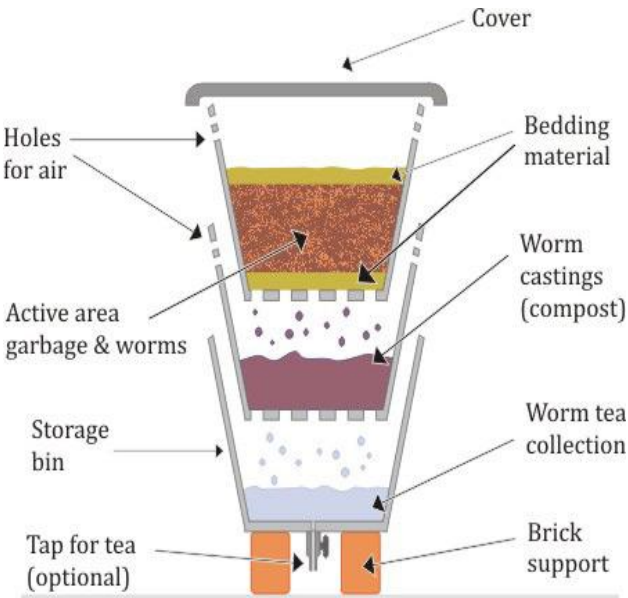
Organic Waste

Pit Composting

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

Mechanised Composting

Vermi Composting



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SOLID WASTE

Consumption

Plastic Waste

CSE

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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	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 bio-medical waste treatment facility (CBMWTF)

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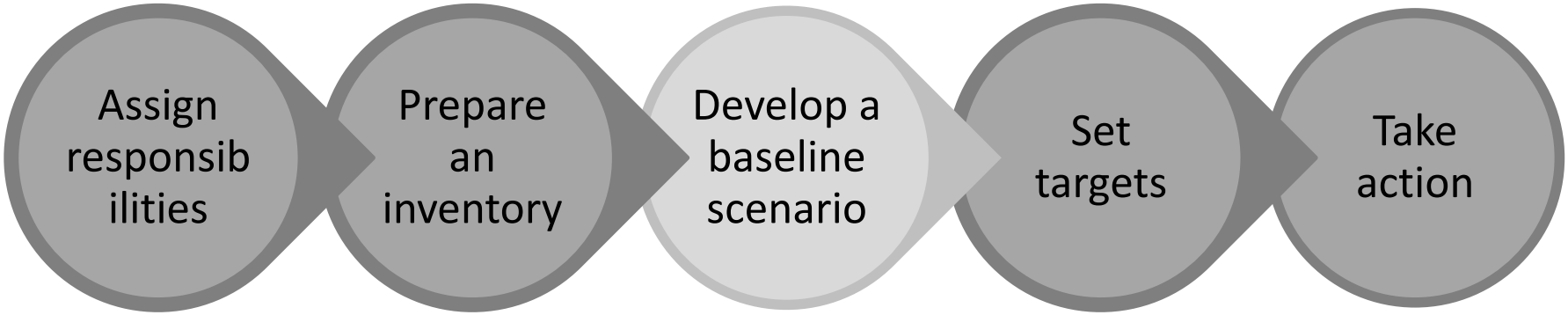
PROCESS



CSE

AAETI

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

AAETI

Green strategy – Xavier's Bbsr

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
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AAETI

Green strategy – RMVCC

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
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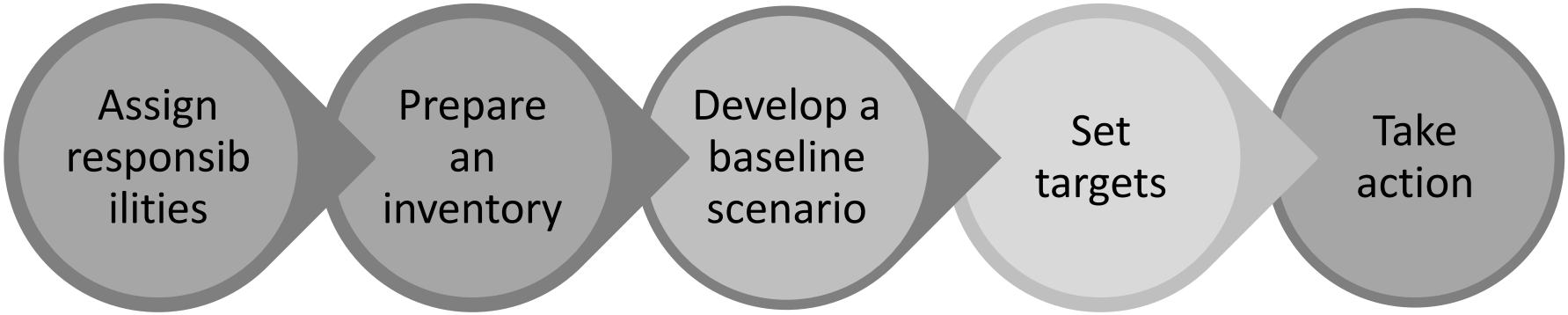
AAETI

PROCESS



CSE