AAETI

Sustainable Buildings and Habitat Programme

March 5, 2019

Green Sense: Educational Campus Inventory

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What is Green Sense?

Sensitivity towards environment that is addressed in our decisions, practices and general lifestyle

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What is a Green Campus?

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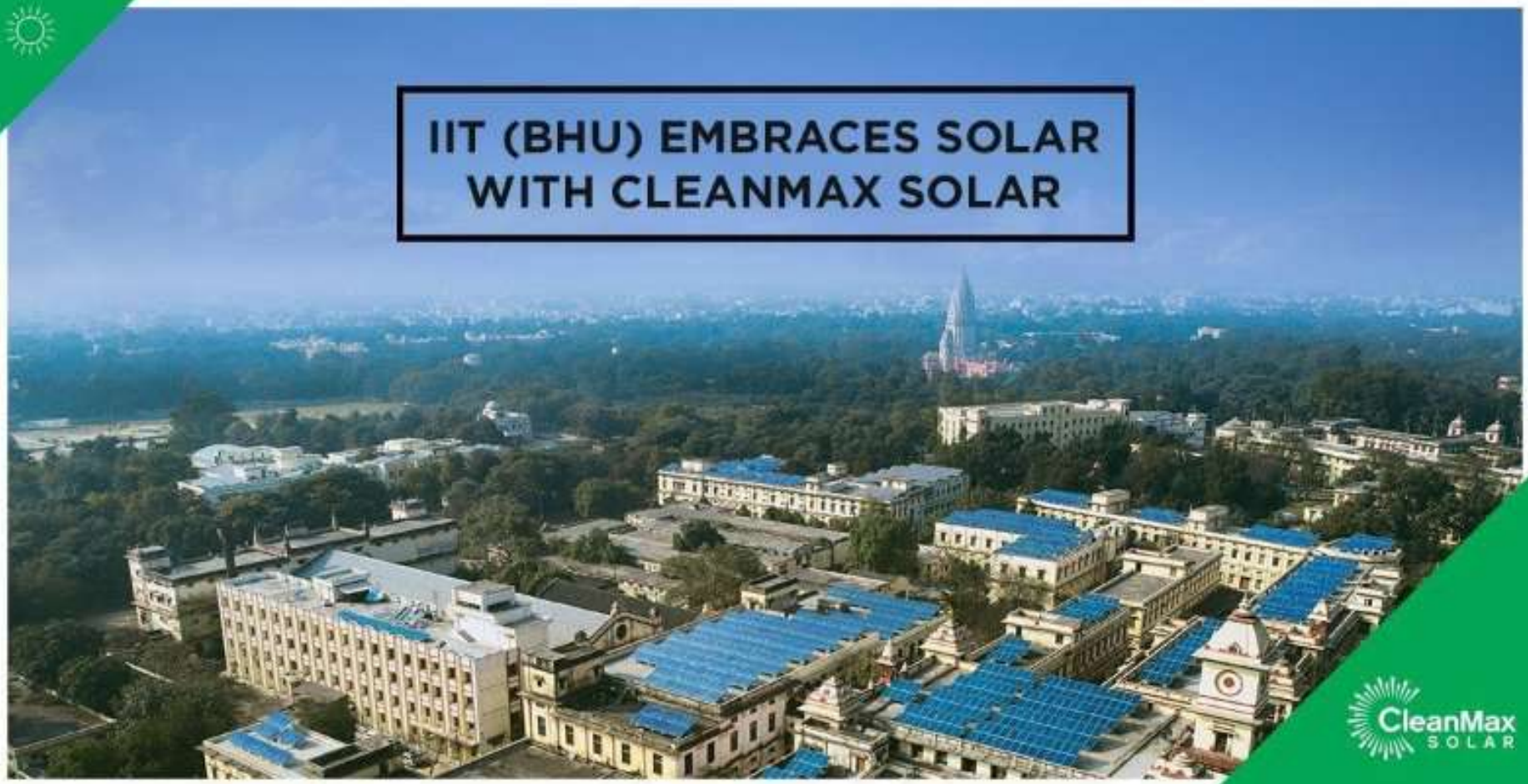
Environmental

2015 SUSTAINABILITY



Princeton University

@TigersGoGreen

CSI

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What is a Green Campus?

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IDEOLOGY

Environment

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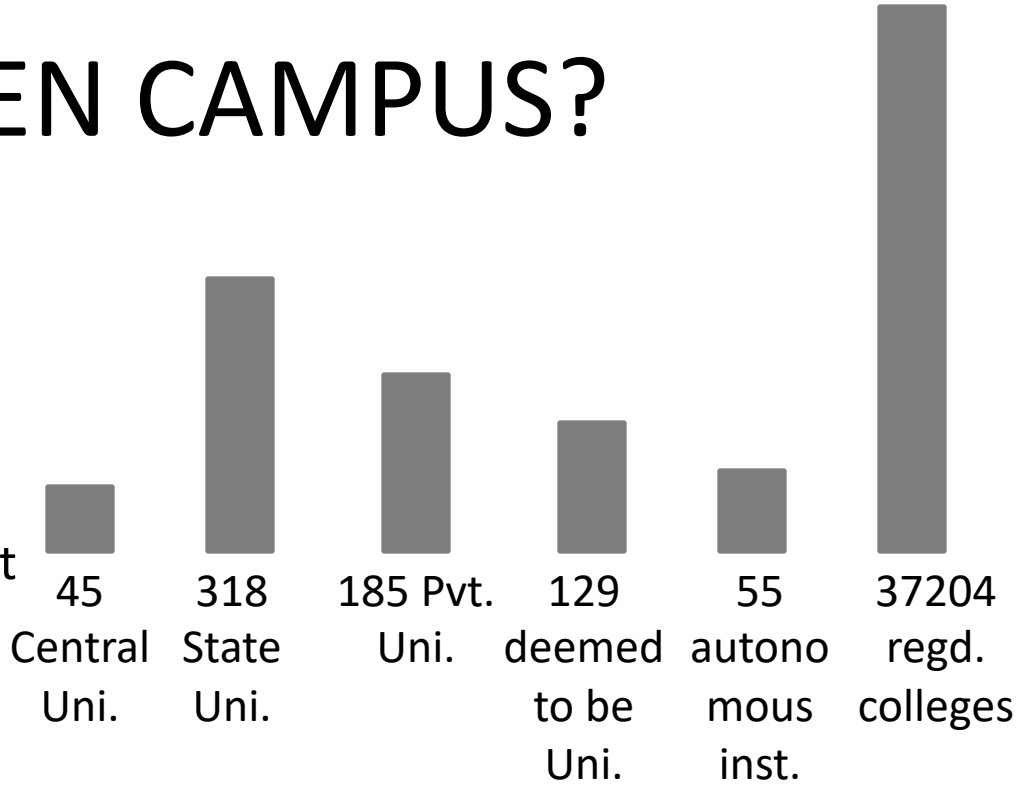
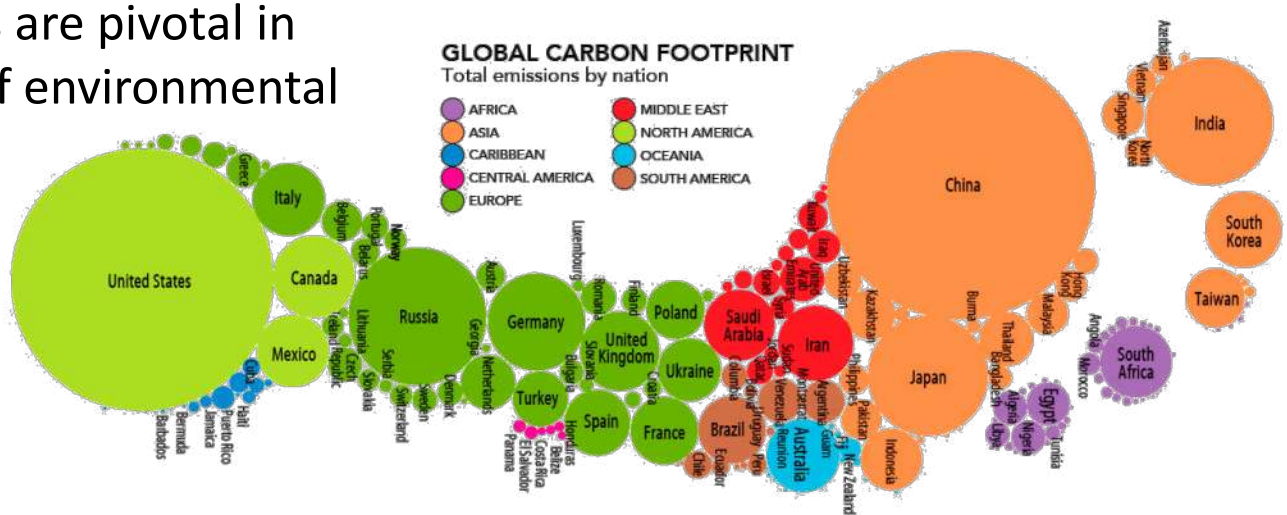
WHY GREEN CAMPUS?

- 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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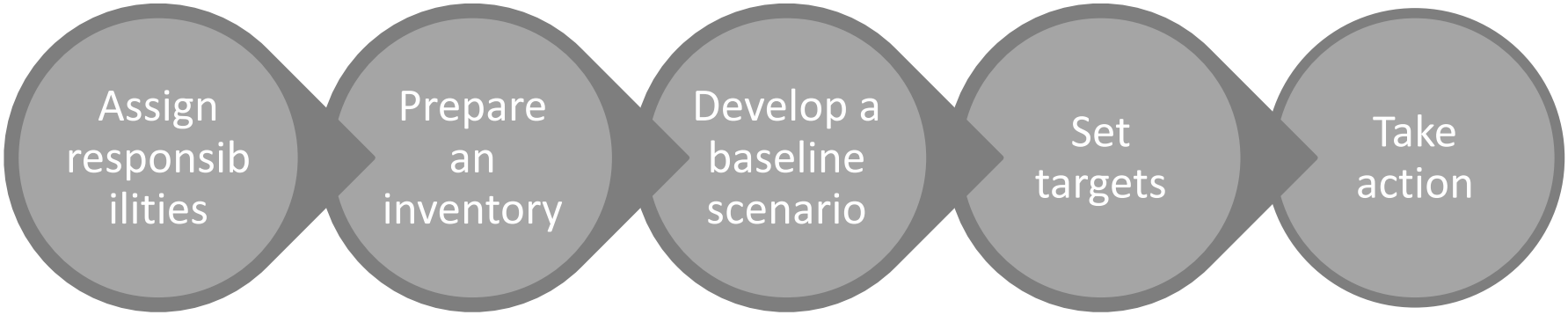
PROCESS



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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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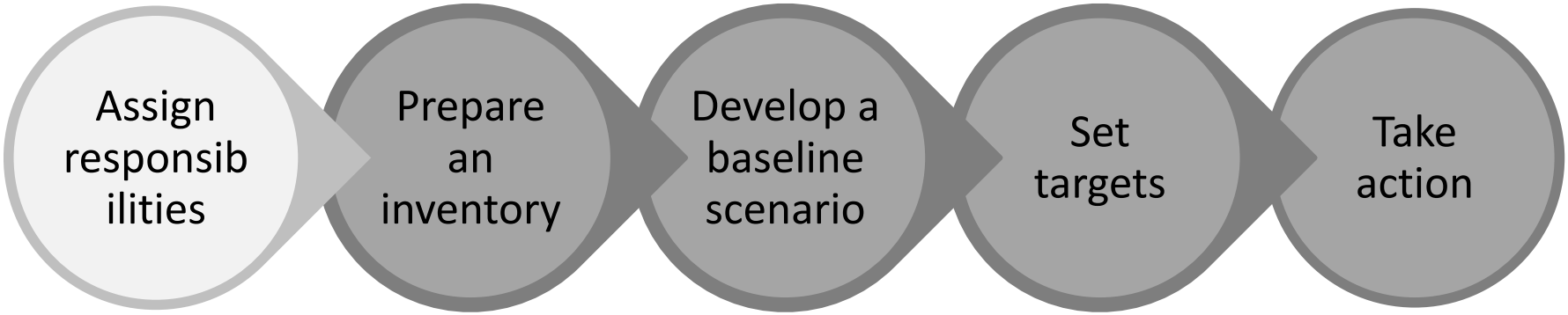
PROCESS



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ASSIGN RESPONSIBILITIES

Green Mandate

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

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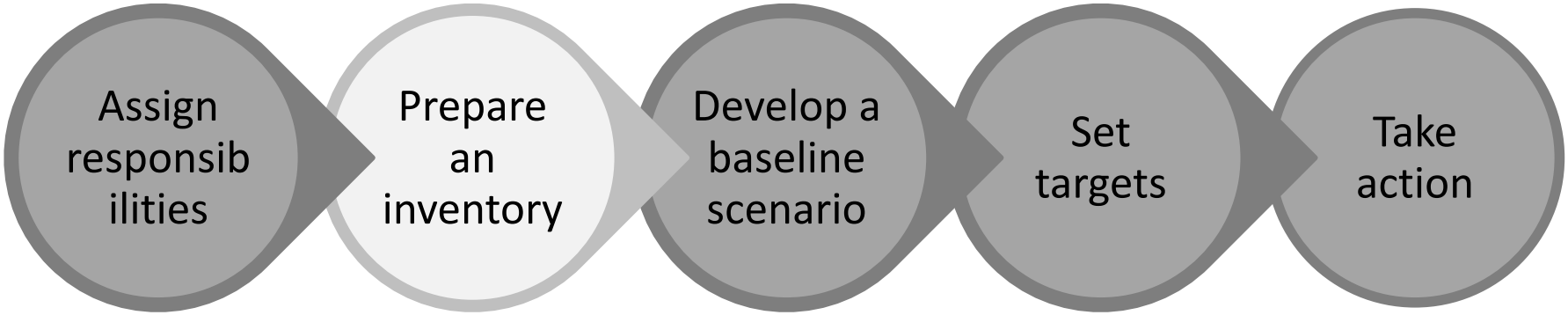
PROCESS



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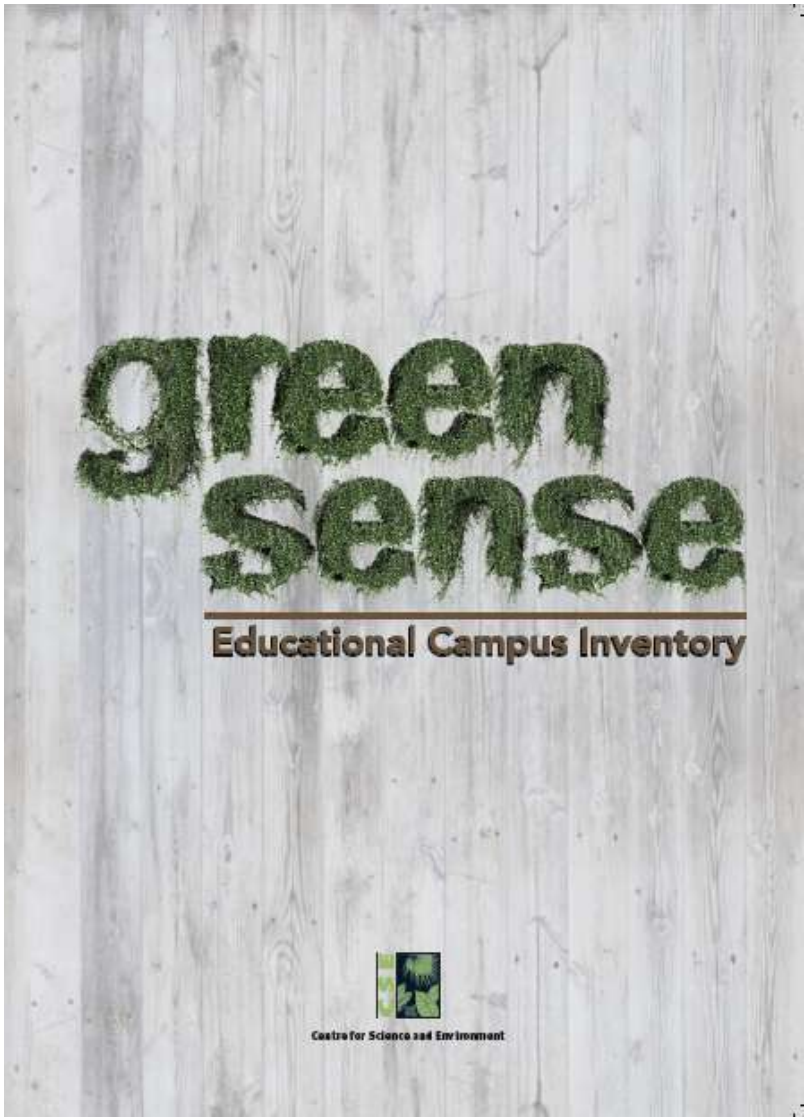
INVENTORY



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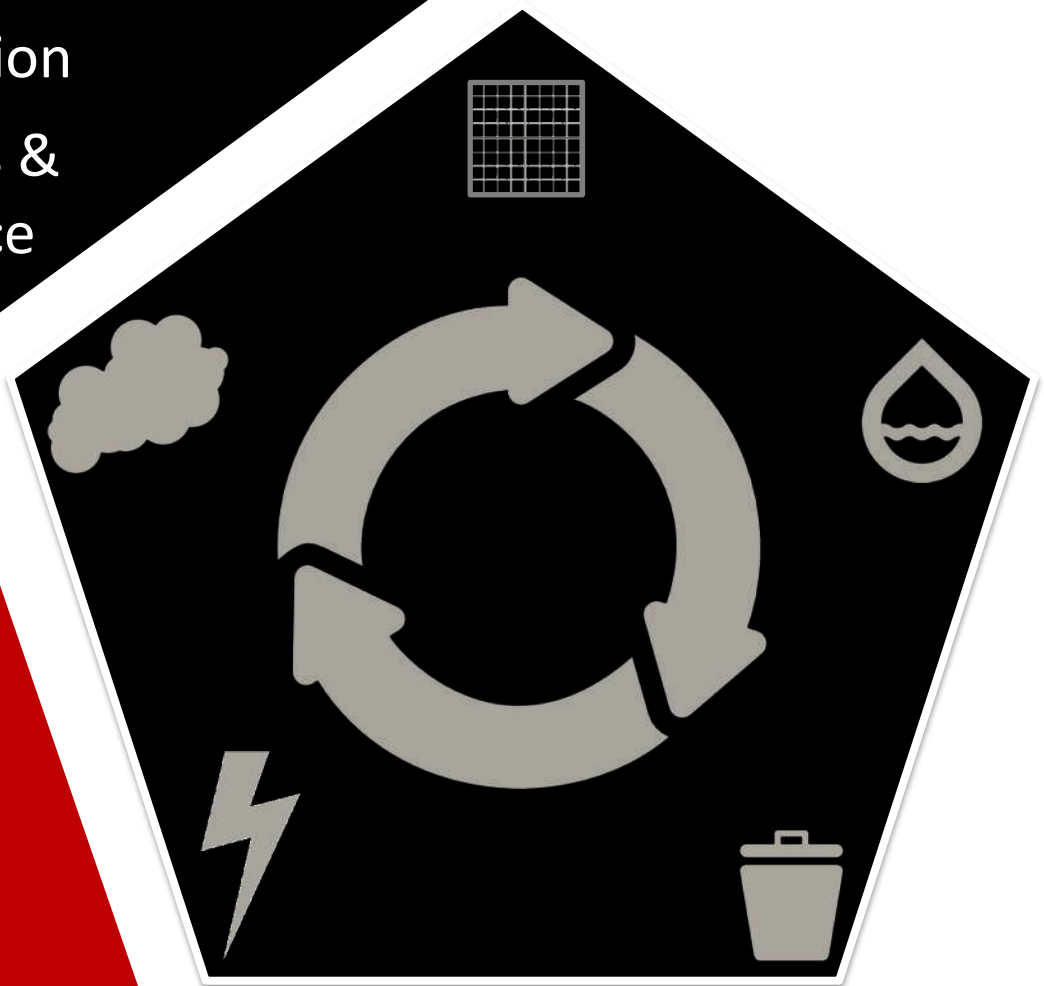
5 THEMES

- Consumption
- Conservation
- Operations & Maintenance



Land

Energy

Water

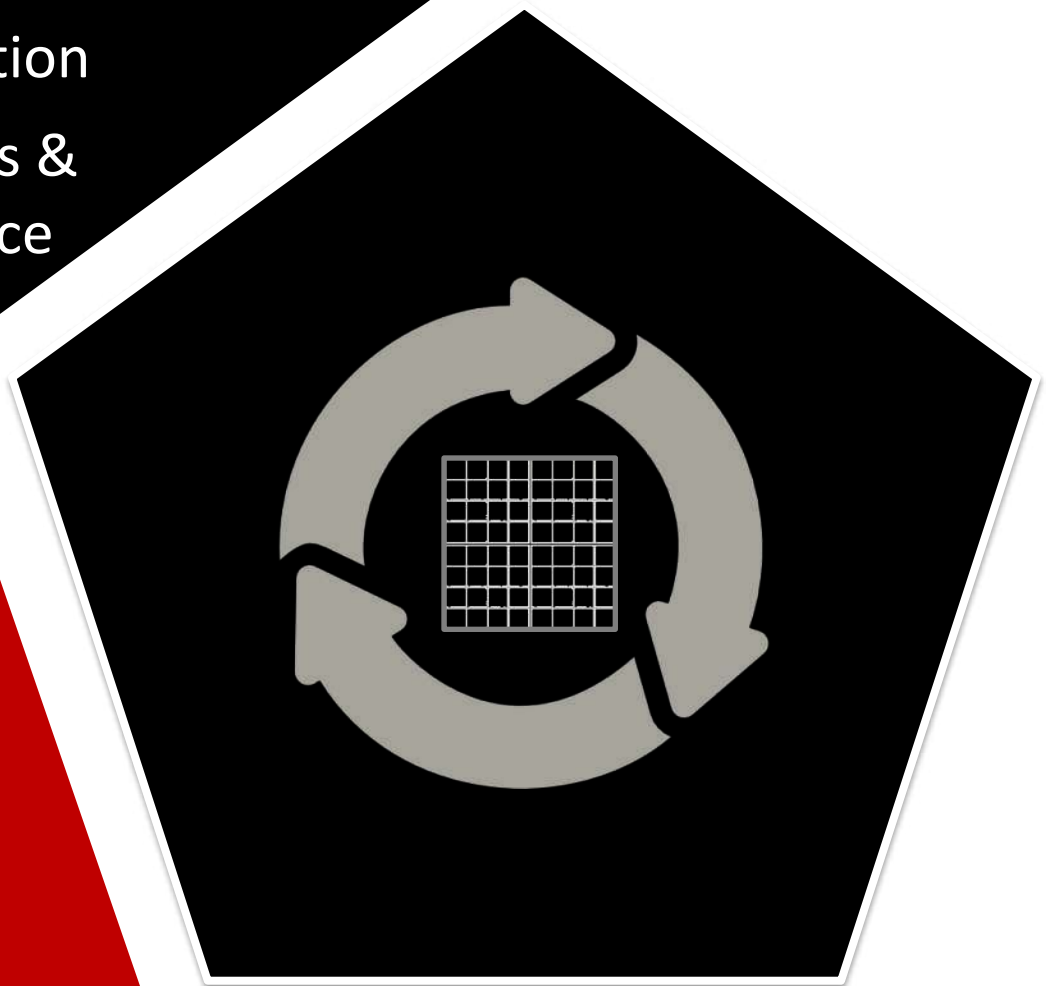
Air

Waste

AAETI

LAND

- Consumption
- Conservation
- Operations & Maintenance



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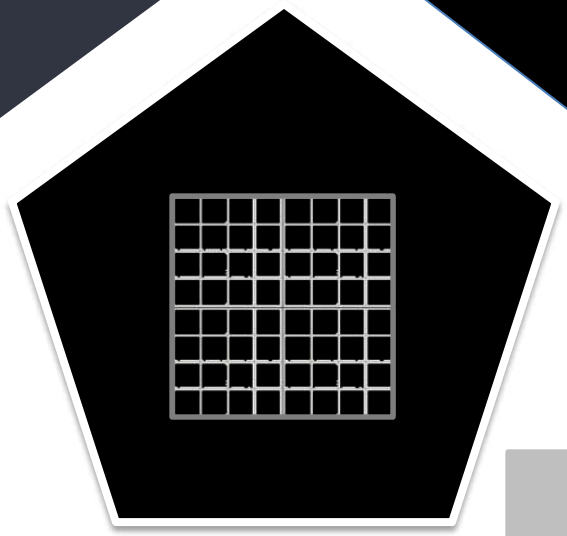
LAND

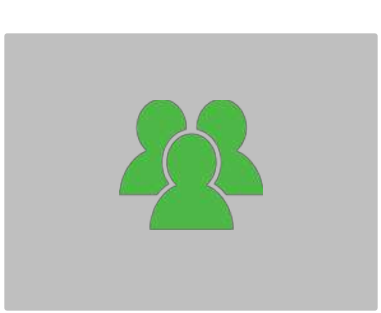
Consumption

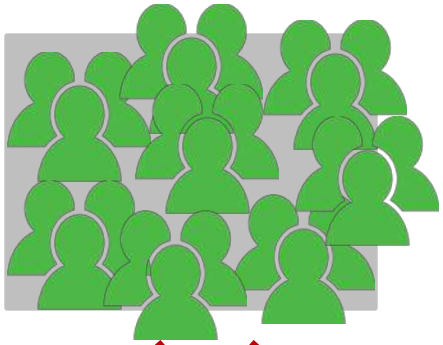
Land use, people and occupancy

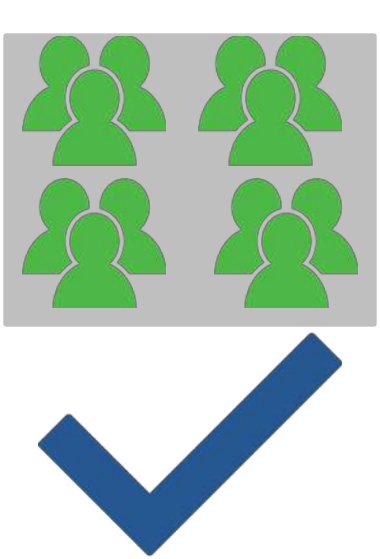


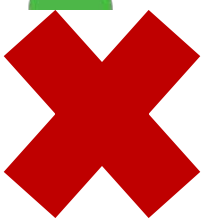
CARRYING CAPACITY

OPTIMIZATION









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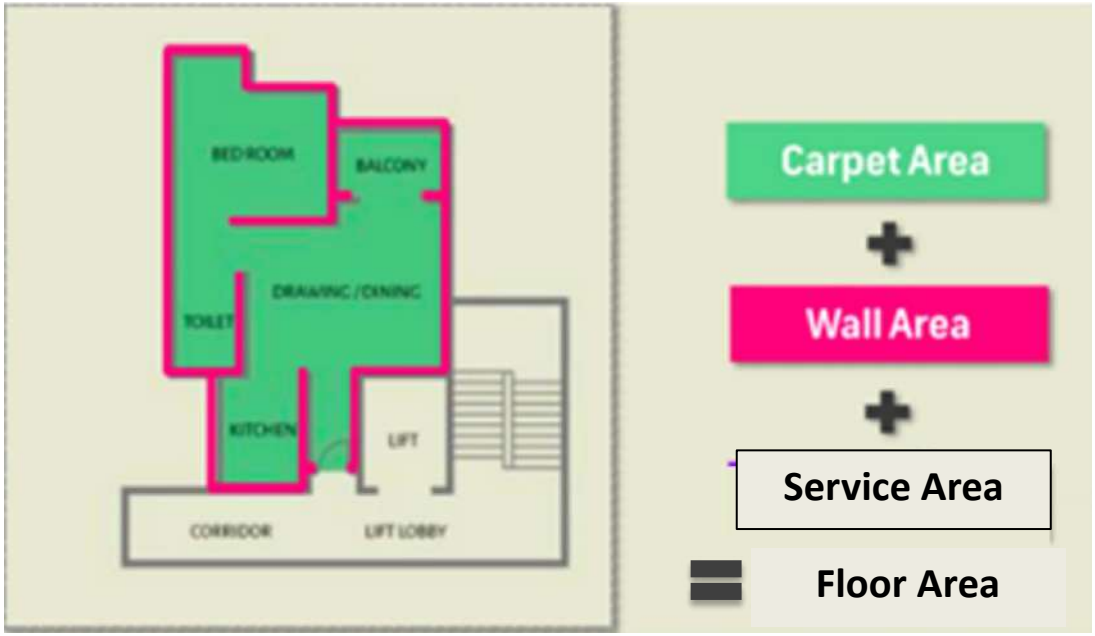
LAND

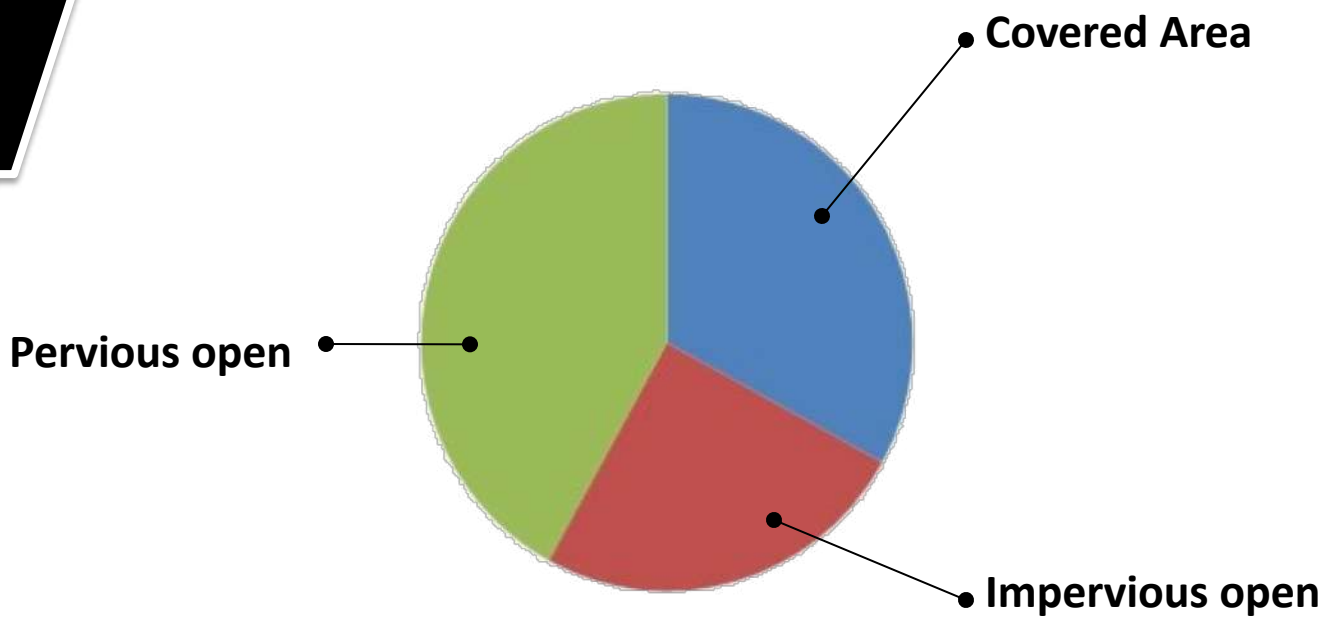
Consumption

Building area elements



AAETI LAND Consumption

Covered Area, Pervious open, Impervious open



AAETI

LAND

Consumption

Covered Area

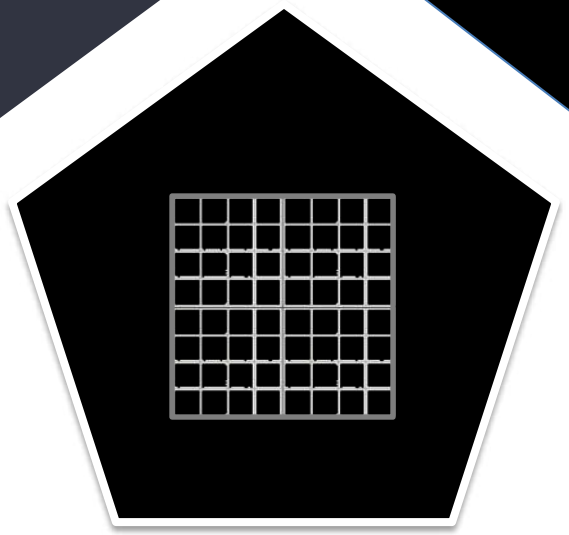
Covered Area

AAETI

LAND

Consumption

Impervious Open



Impervious

Open

AAETI

LAND

Consumption

Pervious Open

Pervious Open

AAETI

LAND

Consumption

Surfaces

Landscaped and green finish

Water body/
swimming pool

Polyurethane coating
(Terrace)

Plain Concrete

Propylene tile

Acrylic layering

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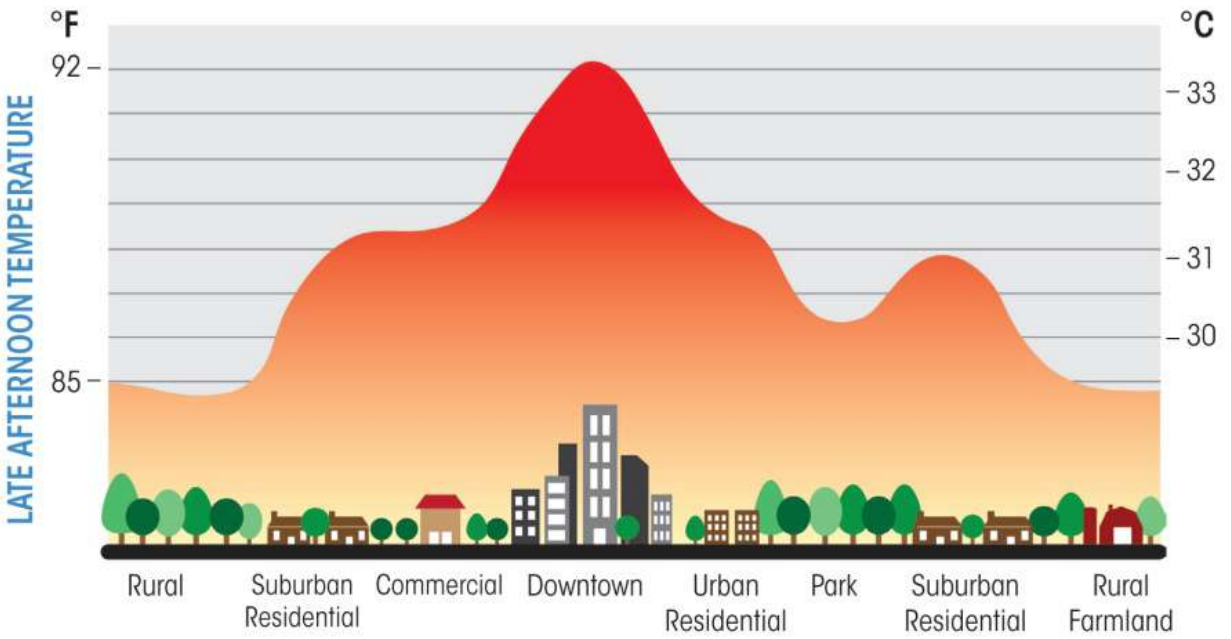
LAND

Consumption

Heat Island Effect



CSE

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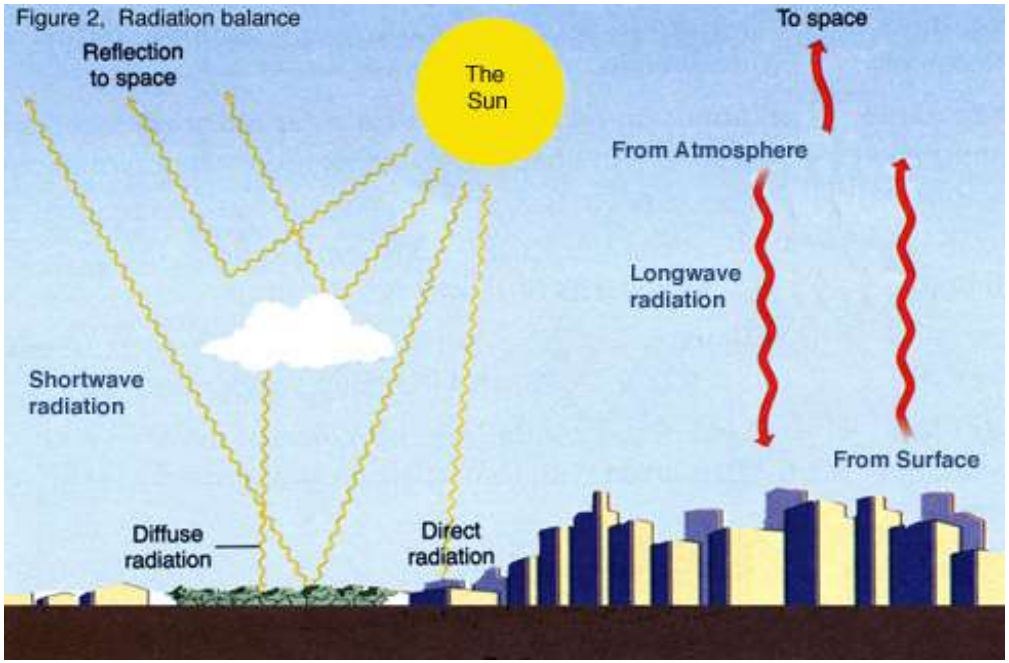
LAND

Consumption

Heat Island Effect

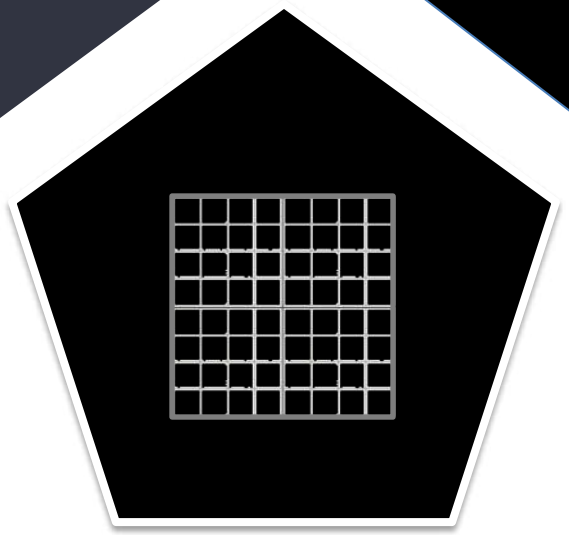


AAETI

LAND

Conservation

Pervious Open



Impervious Open

Pervious Open

Land Exercise

- **Pervious Open**
- **Impervious Open**
- **Covered**

- **Heat Island Effect**

- **Landscaping**

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ENERGY

- Consumption
- Conservation
- Operations & Maintenance

CSE

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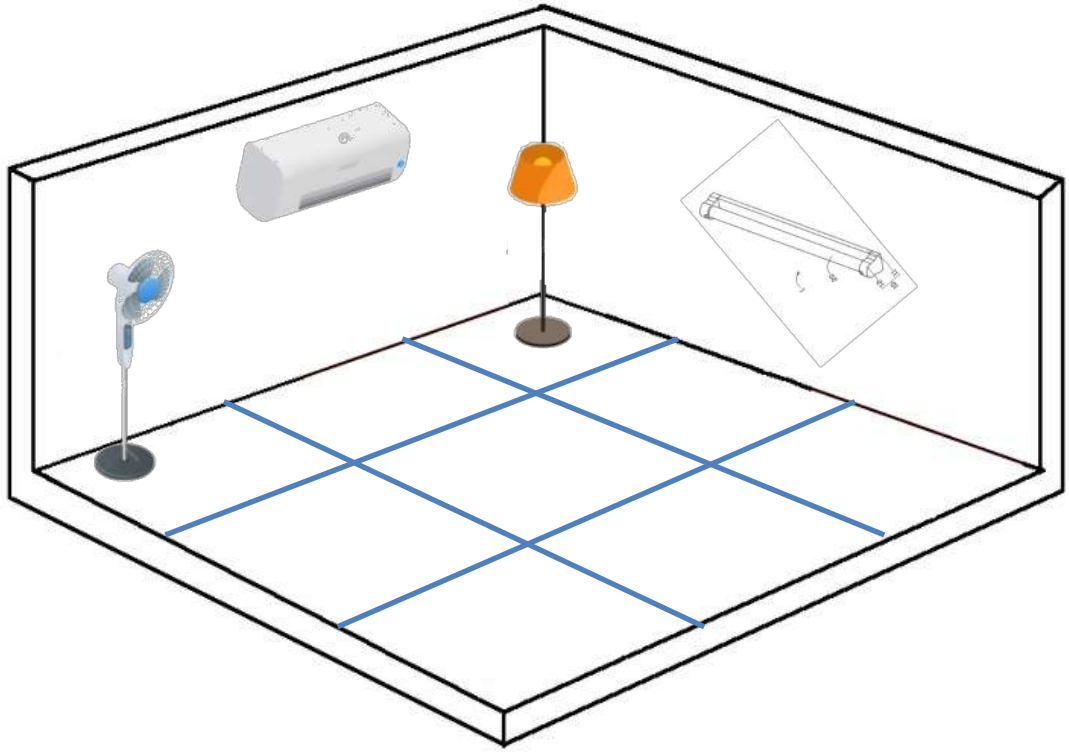
ENERGY

Consumption

EPI – Energy Performance Index



AAETI

ENERGY

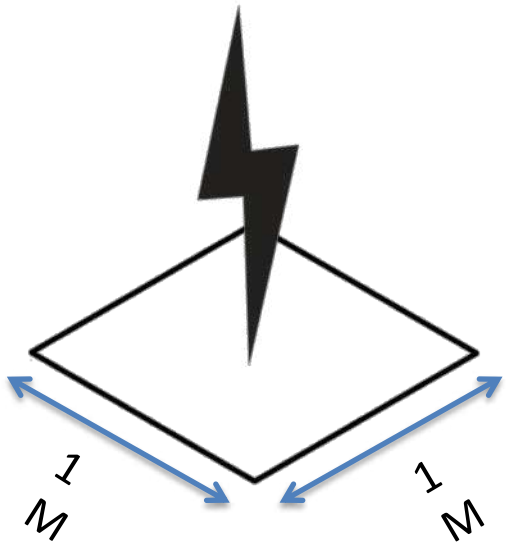
Consumption

EPI – Energy Performance Index

AAETI ENERGY Consumption

EPI – Energy Performance Index

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



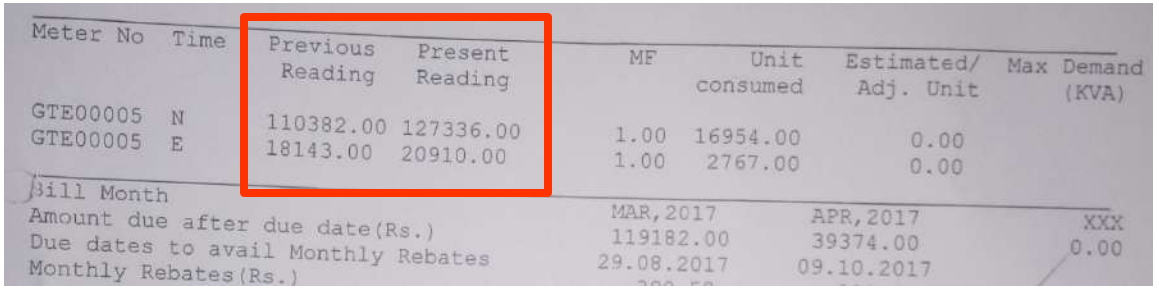
AAETI = 62.7 KWh/sq.m./yr.

AAETI

ENERGY

Consumption - Monitoring

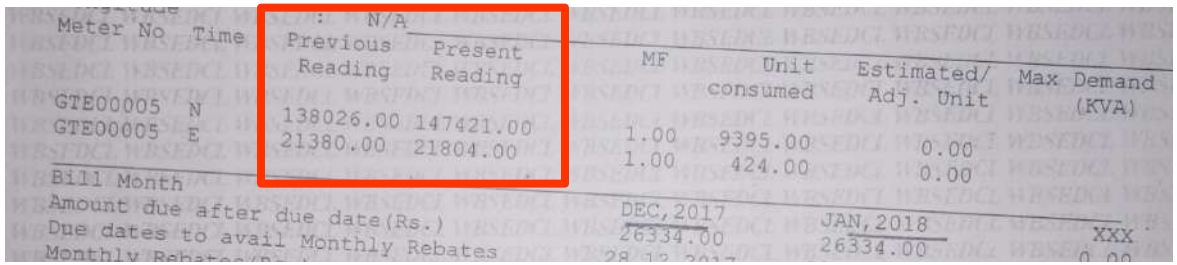
EPI – Energy Performance Index



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.)			

$$\text{EPI} = \frac{54267\ \text{KWh}}{2160\ \text{Sqm}} = 26\ \text{KWh/Sq m/yr.}$$



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	0.00
Due dates to avail Monthly Rebates			
Monthly Rebates(Rs.)			

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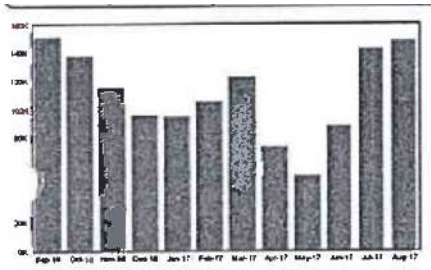
AAETI ENERGY

Consumption – Passive Techniques

Renewable Penetration

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

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	: 533.60
Units Billed	: 140,600.00
Meter Status	: Normal / OK
Bill Basis	: Actual

Previous Consumptions

Month	Units
Aug 2017	148000.00
Jul 2017	142800.00
Jun 2017	88400.00
May 2017	53800.00
Apr 2017	72800.00
Mar 2017	122640.00

Meter Change Details

FR Status
FR KWH
FR KVAH
FR MD
FR Tod1
IR KWH
IR KVAH
IR Tod1

Slab Calculation

Connection Details

Connected Load	720.00 KW
Category	SPP
Tariff Type	HT/SPP/>=110
Supply Type	11.00 HV
Meter Make	3ph Static TV+ MU
Meter Serial No.	CSD30240
SD Amount	2749118.00

Solar Penetration

AAETI current solar penetration

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

AAETI after 2nd Phase

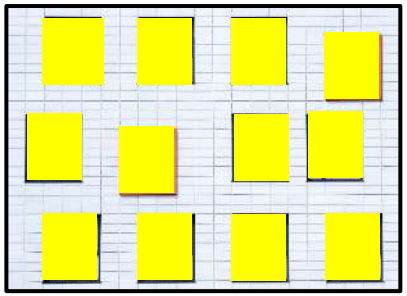
Net Zero Energy Building

AAETI

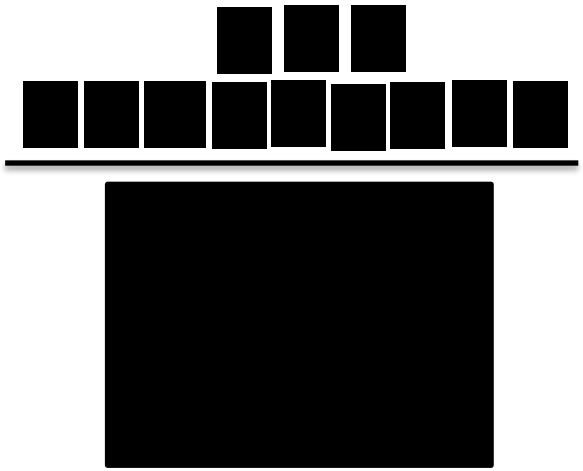
ENERGY

Consumption – Passive Technique

Window Wall Ratio



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



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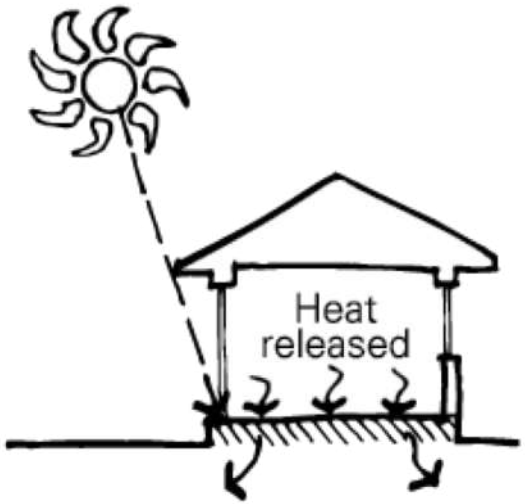
ENERGY

Consumption – Passive Technique

Natural Ventilation

OR



Night Purge

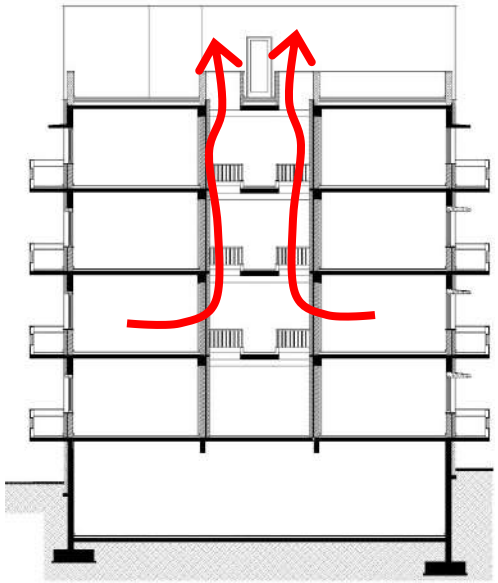
AAETI

ENERGY

Consumption – Passive Technique

Natural Ventilation

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



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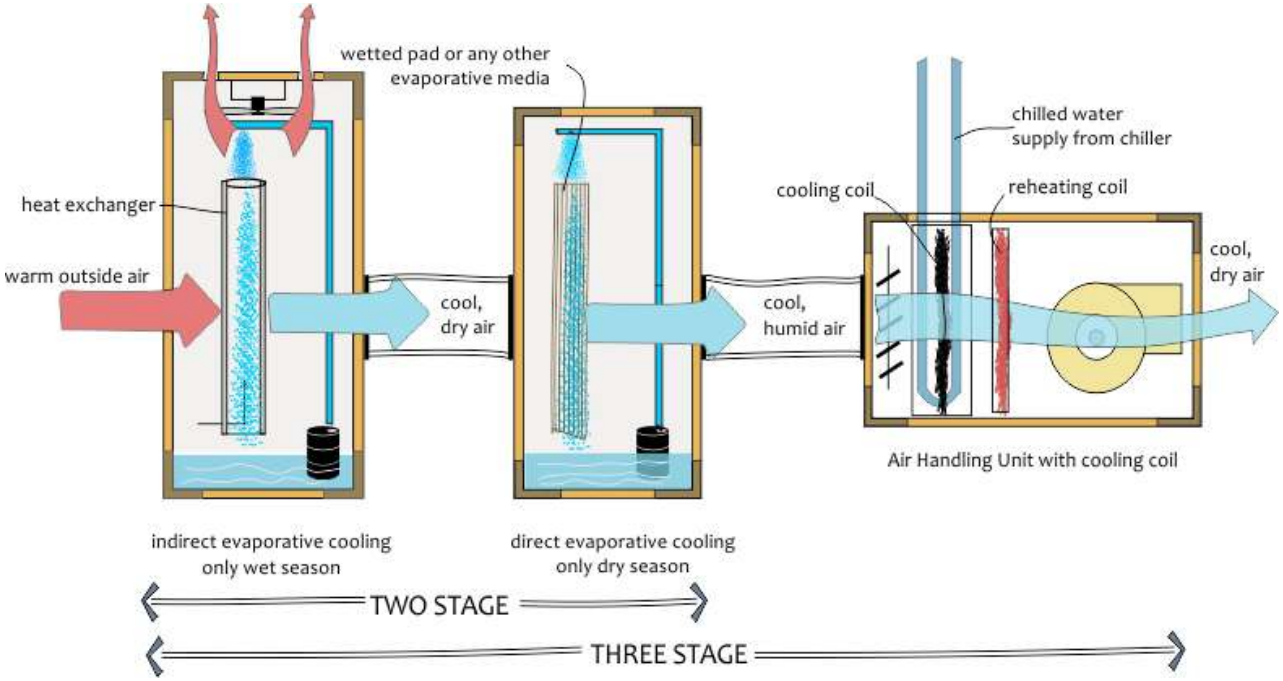
AAETI ENERGY Operation and Maintenance

Response time, Procurement, Retrofit, Controls, Temperature setting

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



Retrofit: 3 stage cooling at AAETI

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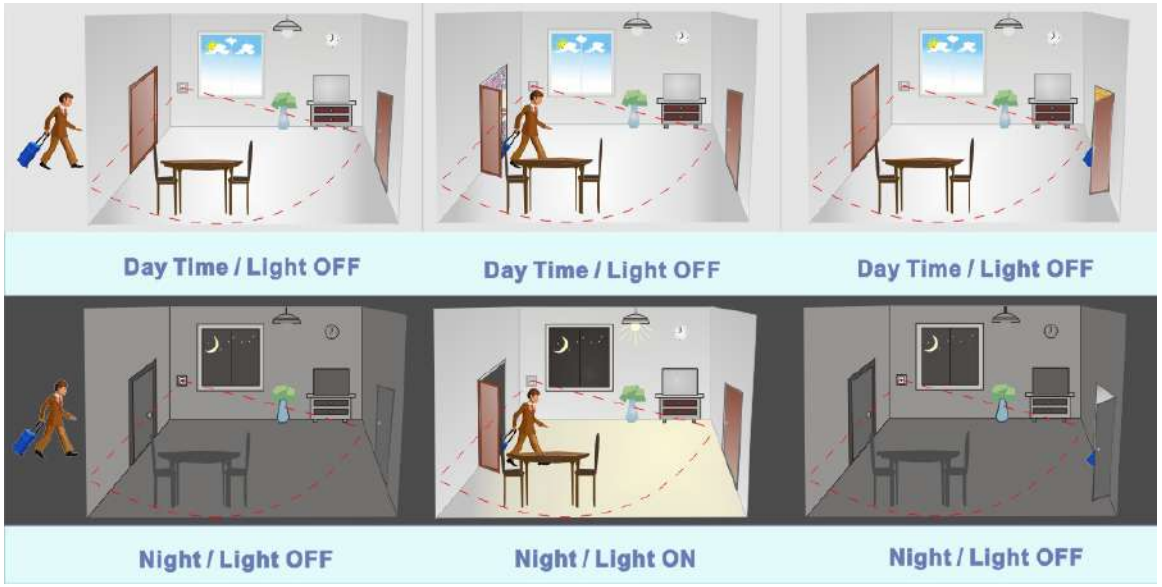
ENERGY

Operation and Maintenance

Response time, Procurement, Retrofit, Controls, Temperature setting

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



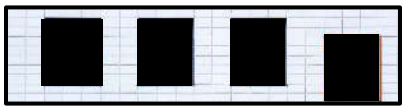
AAETI ENERGY Conservation

Initiatives, Communication

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

Energy exercise

- **Passive Design features**



- **Window Wall Ratio**

- **Energy efficient fixtures**

- **Materials:**

1. Colour
2. Properties

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AAETI

WATER

- Consumption
- Conservation
- Operations & Maintenance

CSE

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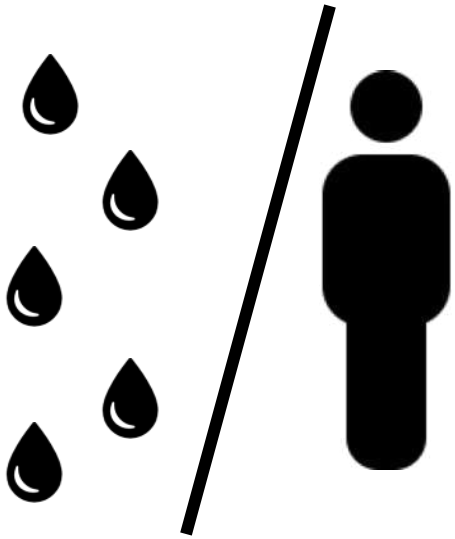
WATER

Consumption - Monitoring

Per Capita Water Consumption

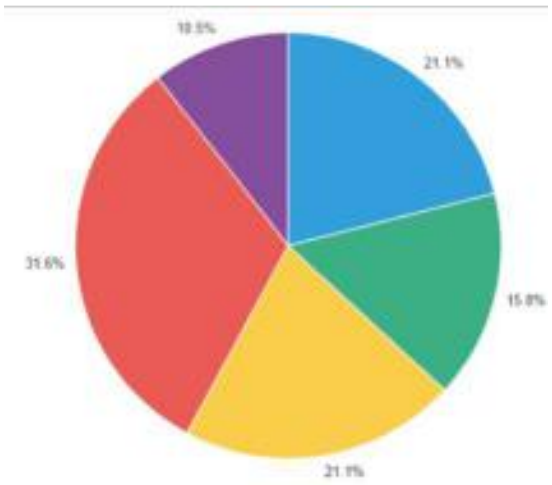
$$\text{Per Capita Water Consumption} = \frac{\text{Total Water Consumed}}{\text{Number of People}}$$



Water Source Indicator

Sources of Water

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



AAETI

WATER

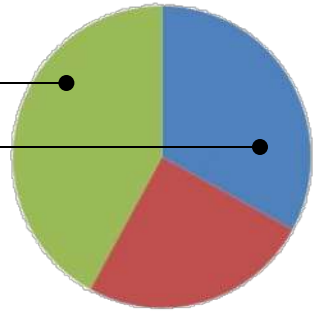
Consumption – Passive Techniques

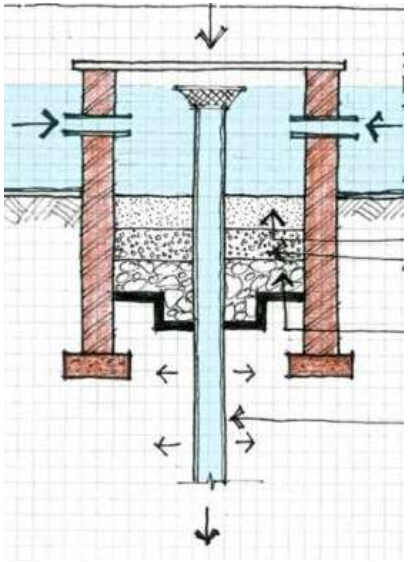
Harvesting Rain Water

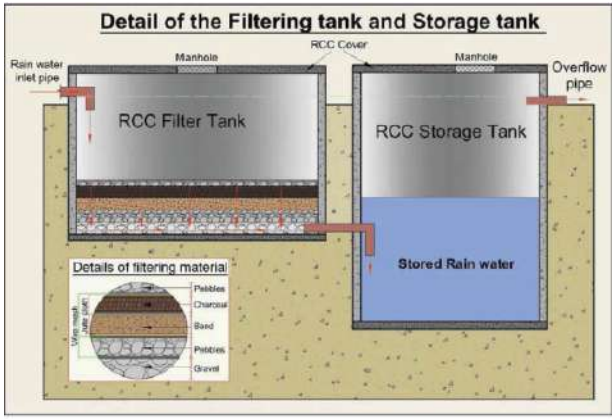
Do you harvest rain water ?

- Recharge Wells
- Storage Tanks

Capacities (Kilo Litres)







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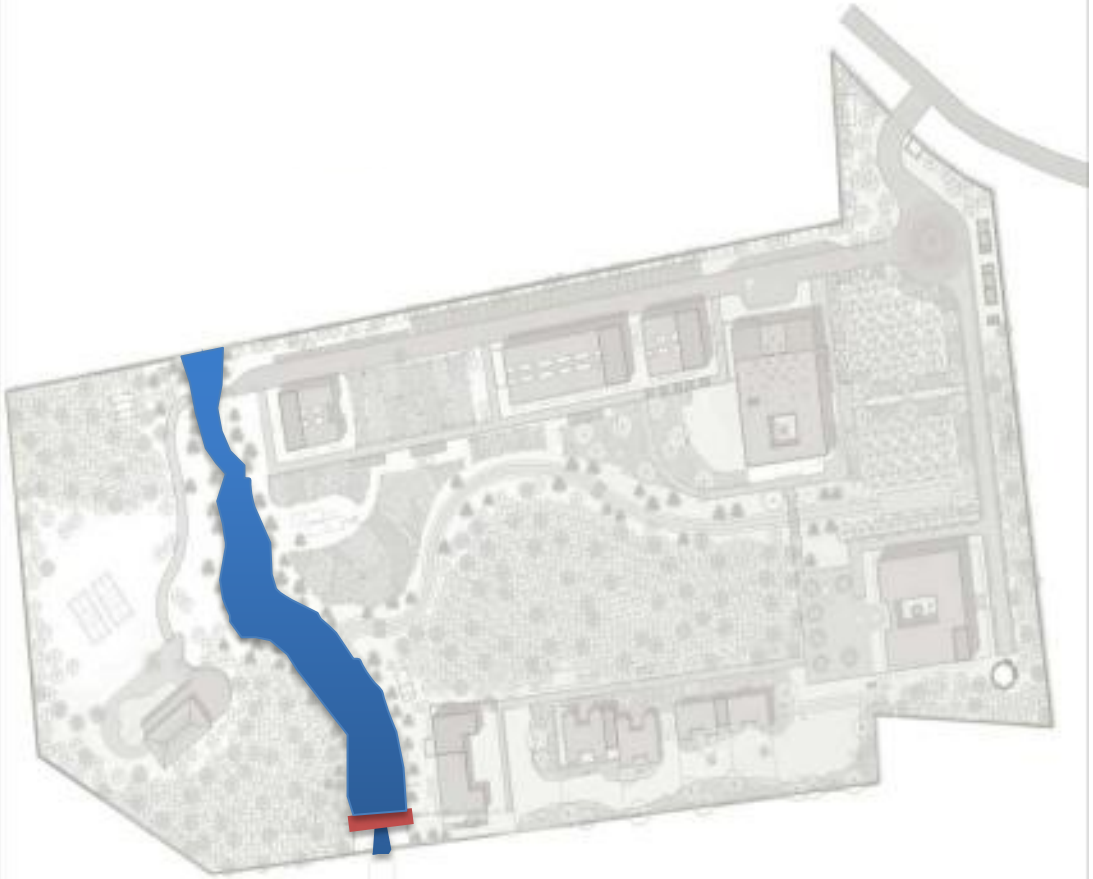
WATER

Consumption – Passive Techniques

Harvesting Rain Water



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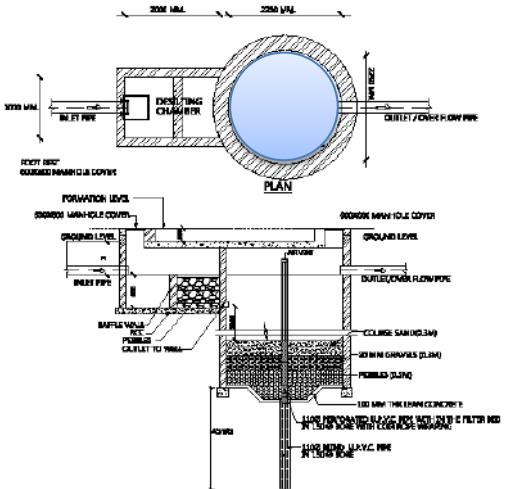
WATER

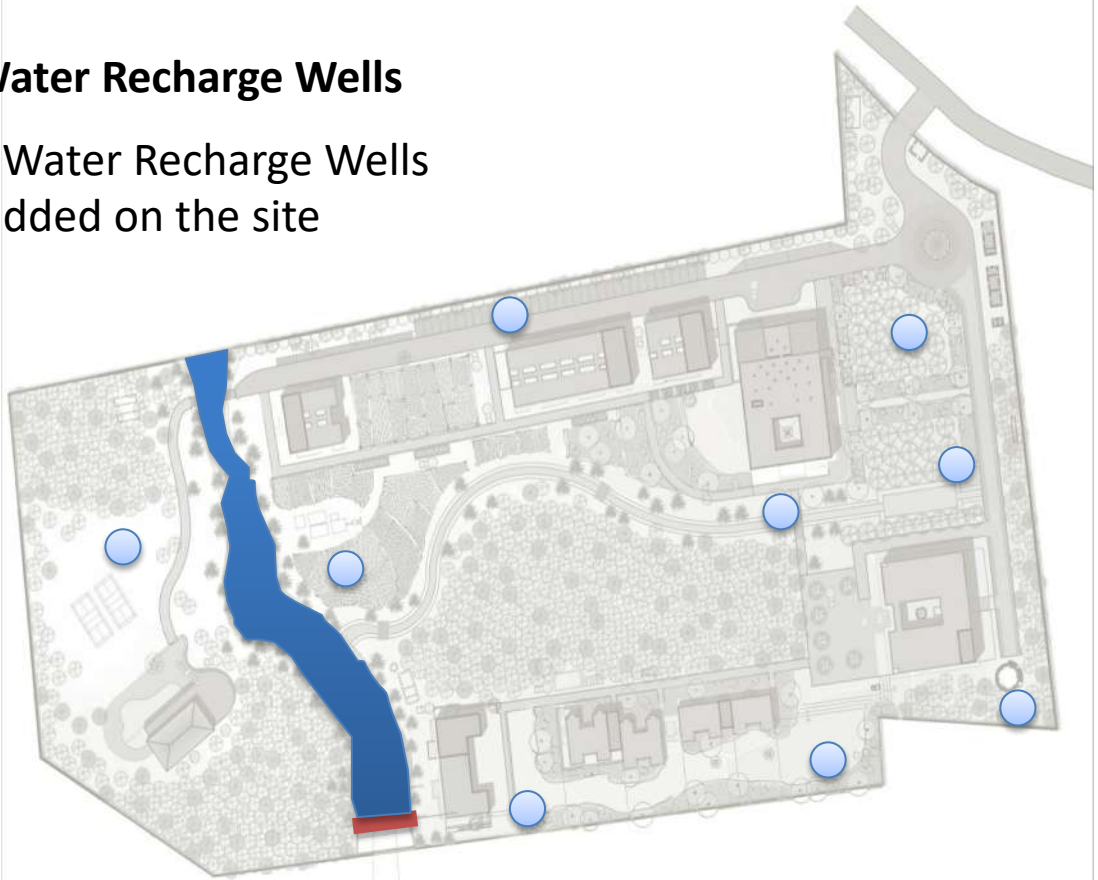
Consumption – Passive Techniques

Harvesting Rain Water

Rain Water Recharge Wells

9 Rain Water Recharge Wells were added on the site





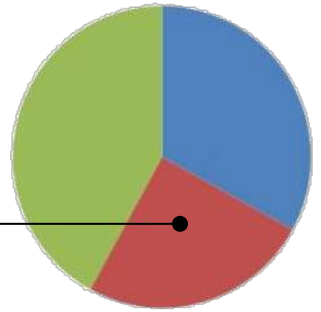
AAETI WATER Consumption – Passive Techniques

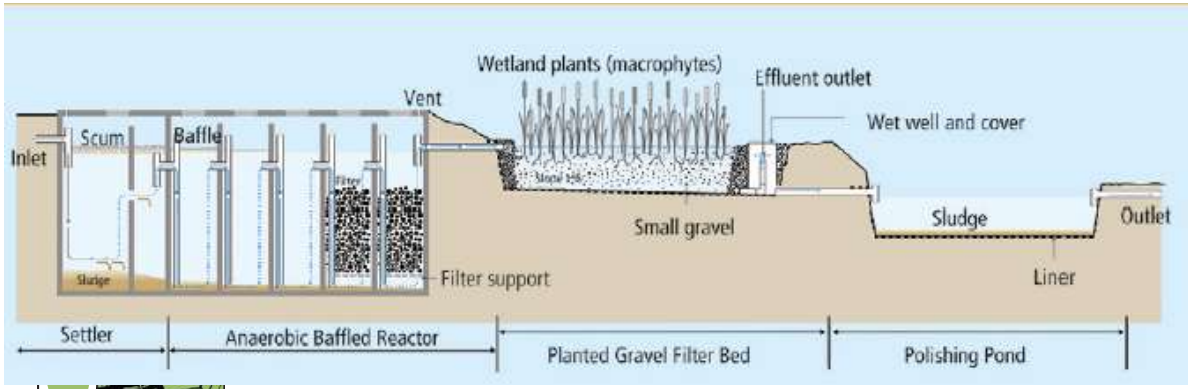
Waste Water Recycling

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

- Waste Water Recycling

Capacities (Kilo Litres)



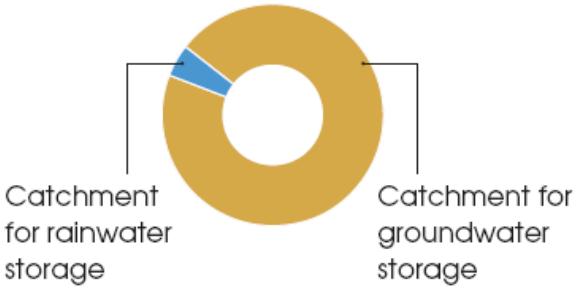


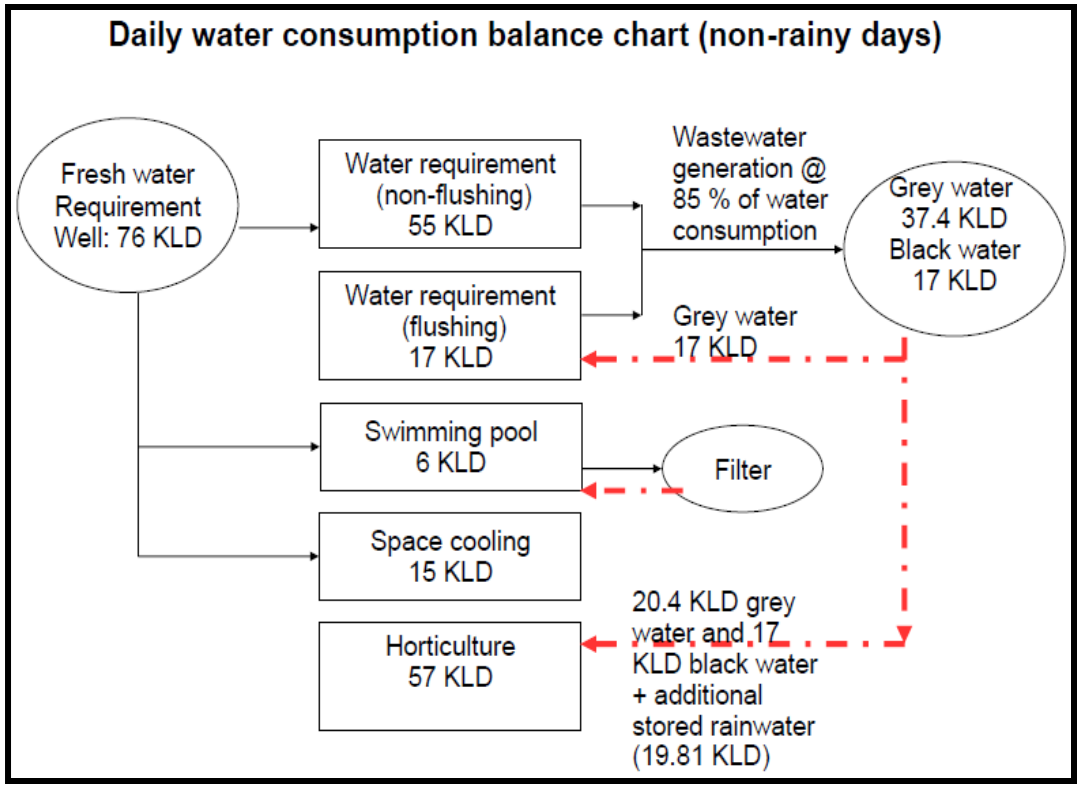
AAETI WATER Consumption – Passive Techniques

AAETI water balance

Pervious area helps greatly!

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





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

Water exercise

- **Runoff reduction**

- **Water efficient fixtures**

- **Waste Water Recycling**

1. Technology 1
2. Technology 2
3. Technology 3 etc.

AAETI

AAETI

AIR

- Consumption
- Conservation
- Operations & Maintenance

Factors affecting air quality

Source of Fuel Consumption

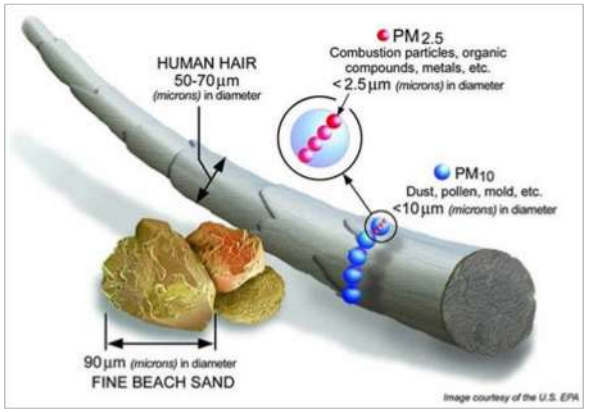
- Vehicles
- DG Sets
- Kitchen
- Heating

Pollutants

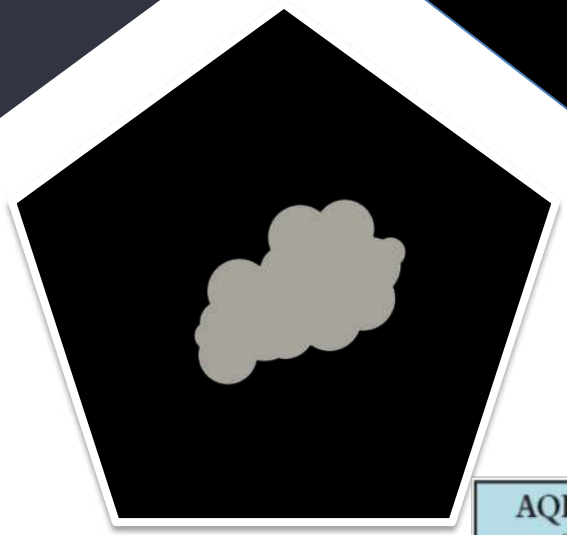
- (Toxic) Dust
- Waste burning
- Construction and demolition

Major Pollutants:

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

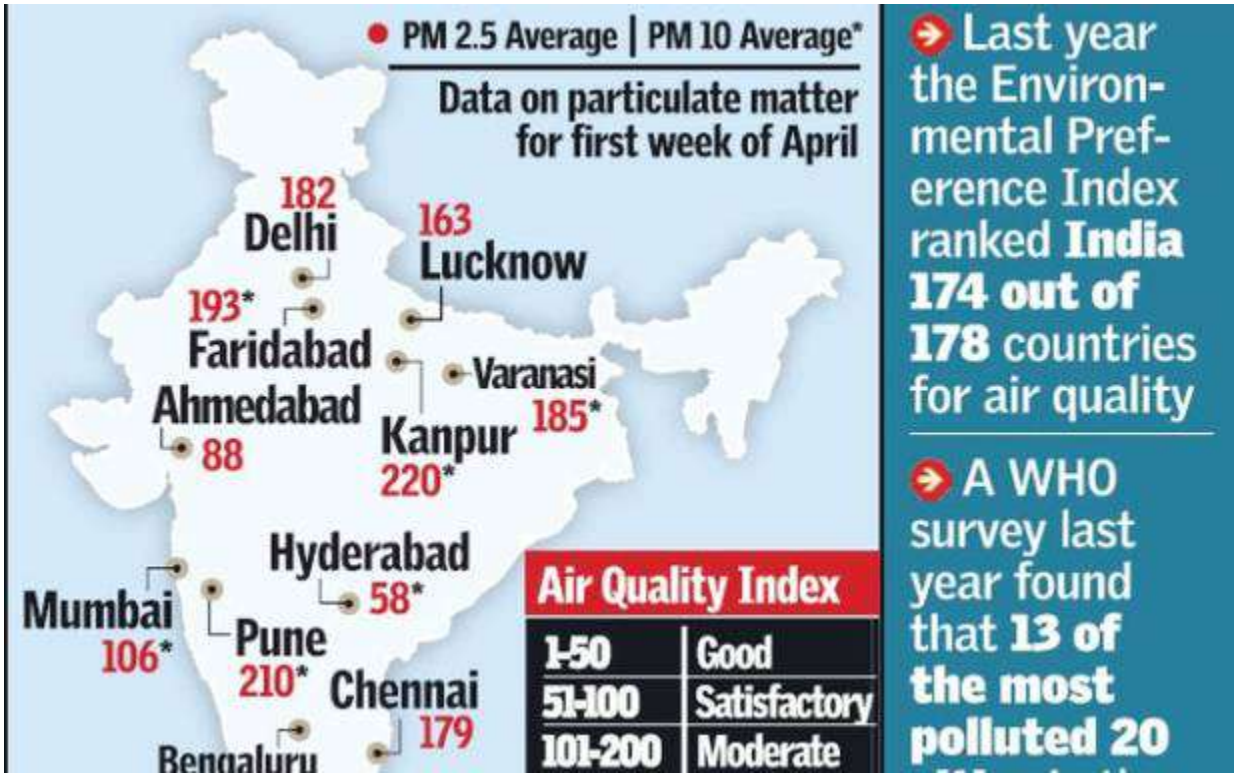


Air quality index



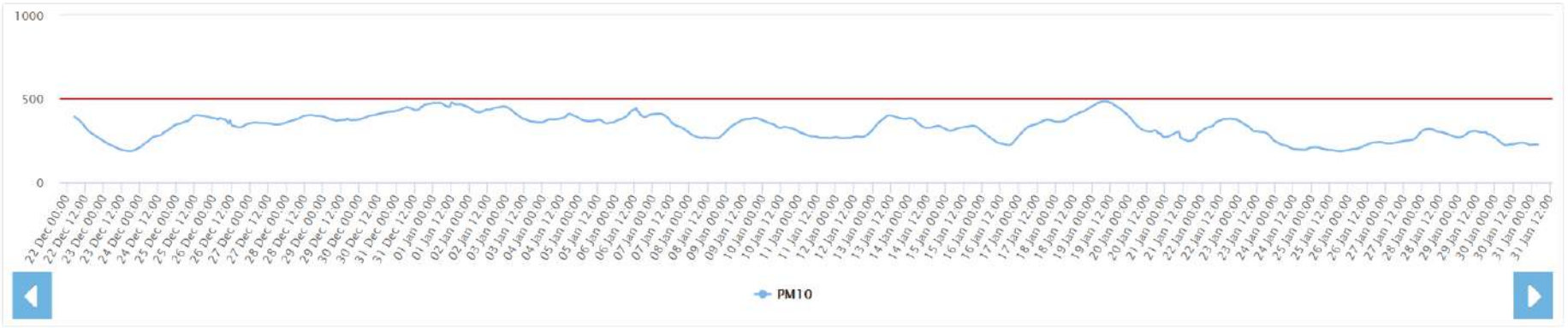
AQI Category (Range)	PM_{10} 24-hr	$PM_{2.5}$ 24-hr	NO_2 24-hr	O_3 8-hr	CO 8-hr (mg/m^3)	SO_2 24-hr	NH_3 24-hr	Pb 24-hr
Good (0-50)	0-50	0-30	0-40	0-50	0-1.0	0-40	0-200	0-0.5
Satisfactory (51-100)	51-100	31-60	41-80	51-100	1.1-2.0	41-80	201-400	0.5 –1.0
Moderately polluted (101-200)	101-250	61-90	81-180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

Air quality index



AAETI AIR Consumption - Monitoring

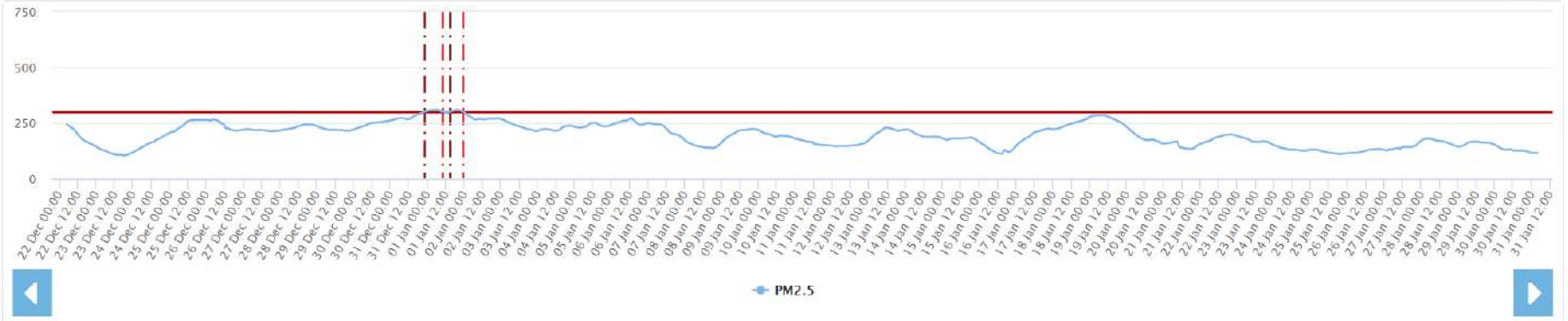
Air quality index



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



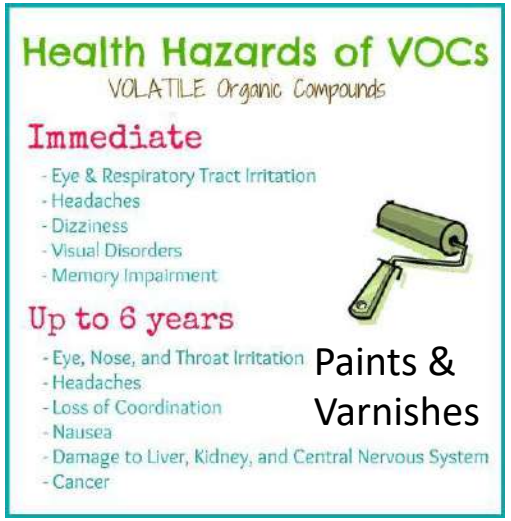
AAETI

AIR

Consumption

Indoor air quality

Housekeeping and pest control activities



Paints & Varnishes

CSE

Indoor court surfaces

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.

CSE

AAETI

WASTE

- Consumption
- Conservation
- Operations & Maintenance

CSE

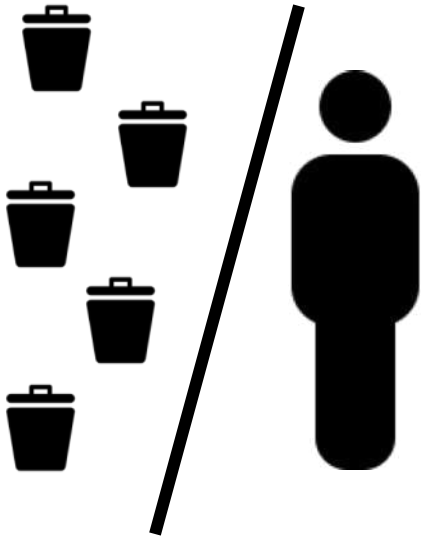
AAETI

SOLID WASTE

Consumption

Waste Generation

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



CSE

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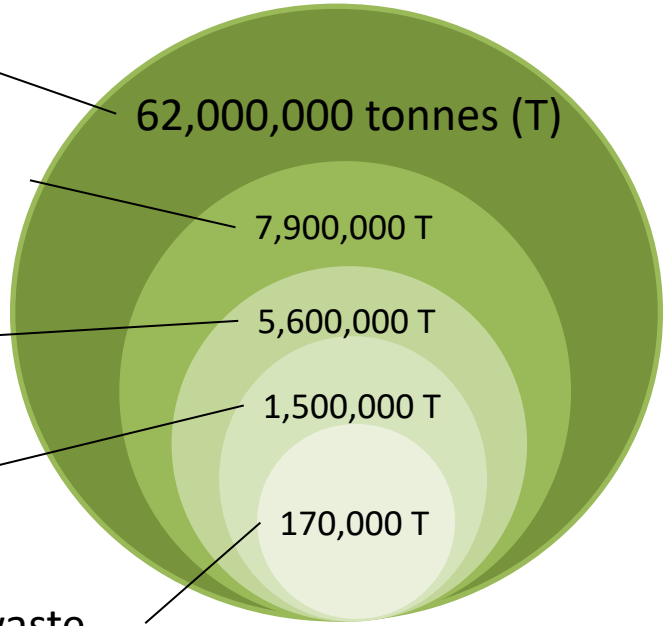
SOLID WASTE

Consumption

Waste Generation

Total municipal solid waste (MSW) in 2014



CSE

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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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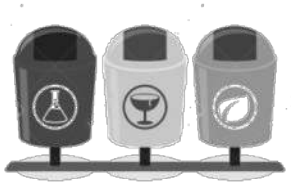
SOLID WASTE

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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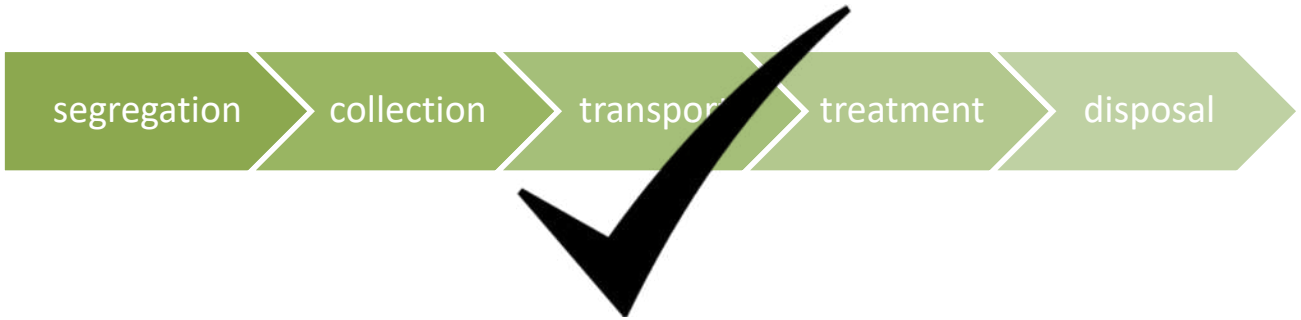
SOLID WASTE

Operations and Maintenance

Waste Management



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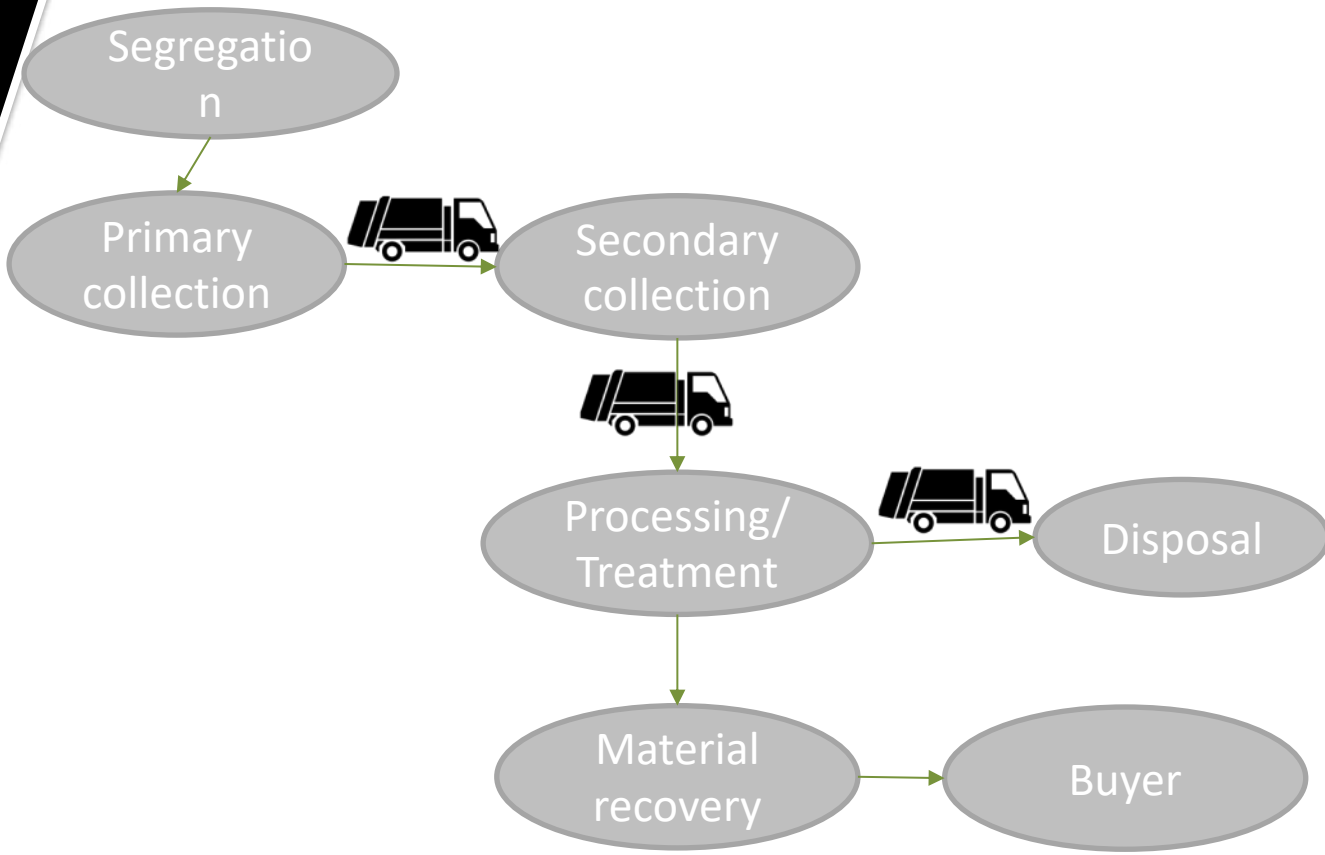
SOLID WASTE

Operations and Maintenance

Waste Management



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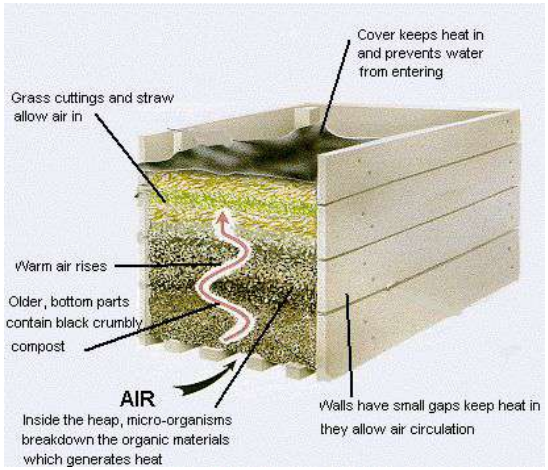
SOLID WASTE

Passive Techniques

Organic Waste



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SOLID WASTE

Passive Techniques

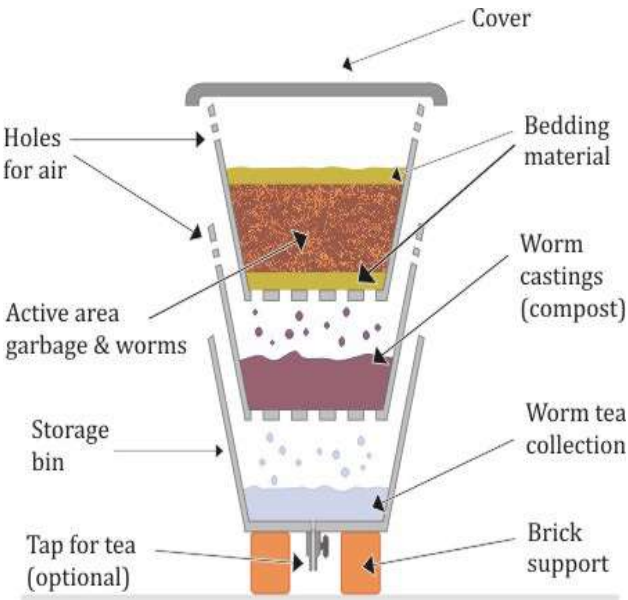
Organic Waste

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

Pit Composting

Mechanised Composting

Vermi Composting



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SOLID WASTE

Consumption

Plastic Waste

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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)

Waste exercise

- **Waste Segregation**

- **Construction and Demolition waste reduction**

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CSE

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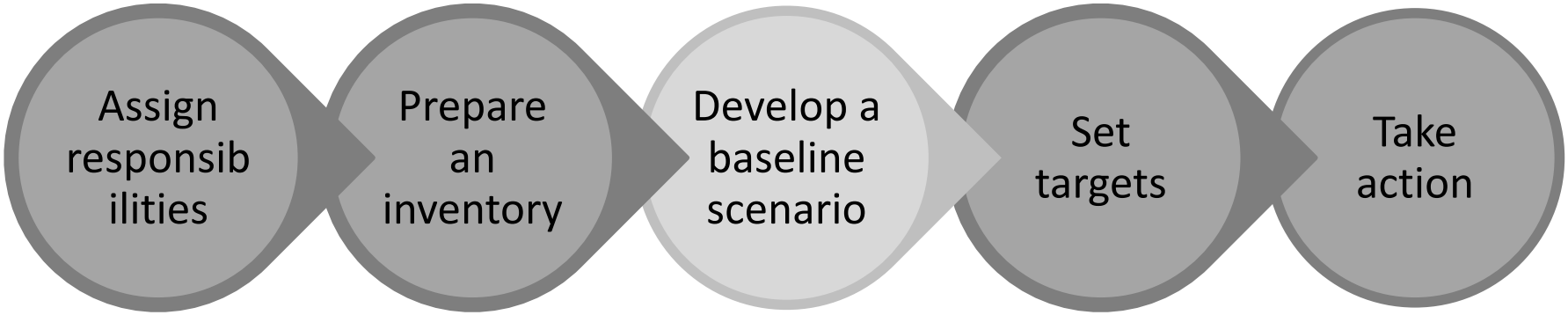
PROCESS



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