Energy Conservation in Building Sector

Santosh Mestry

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RELIANCE Energy
Anil Dhirubhai Ambani Group

Energy Conservation in Building sector

Flow of Presentation

- *Company & Plant Profile*
- *3E- Environment, Energy, Economy*
- *Energy Scenario*
- *Energy Conservation in Building*
- *Case Studies*
- *Challenges & Barriers*
- *Green Building Example*
- *Green Building Benefits*
- *Conclusion*

1. Company & Plant Profile

Company Profile

Generation

Generates 940 MW of electricity through Power Stations across Maharashtra Andhra Pradesh, Kerala, Karnataka and Goa

Distribution

Distributes over 36 billion units of electricity to 30 million consumers

EPC

Leading player in India in the engineering, procurement and construction segment of the power sector

RELIANCE Infrastructure
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Infrastructure

- Road Projects: Largest developer of road projects for NHAI totaling 467 kms
- Metro project: First and only private sector builder and operator in Mumbai and Delhi covering 34 kms

Transmission

- Parbati and Koldam Hydroelectric project
- Project under Western Region System Strenghtening Scheme II in Maharashtra and Gujarat

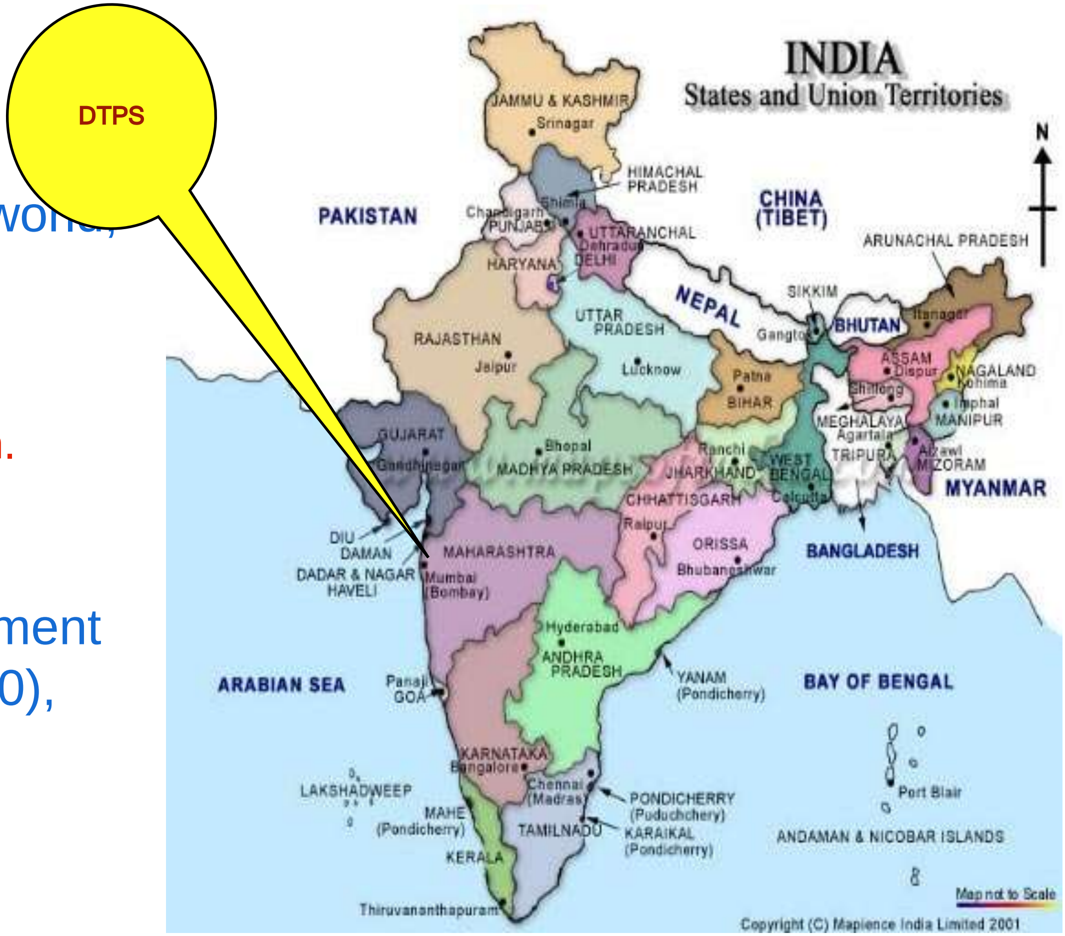
Plant Profile

- 2 x 250 MW Thermal Plant, Supplies Electricity to Mumbai.

- Amongst top performers in the world, on all operational parameters:
  - lowest heat-rate.
  - highest capacity utilisation.
  - least secondary fuel consumption.
  - highest plant availability.

- Certified for Integrated Management System (ISO9001, 14000, 18000), SA 8000, ISMS 27000.

- Energy efficiency at core.



Dahanu Thermal Power Plant (DTPS)

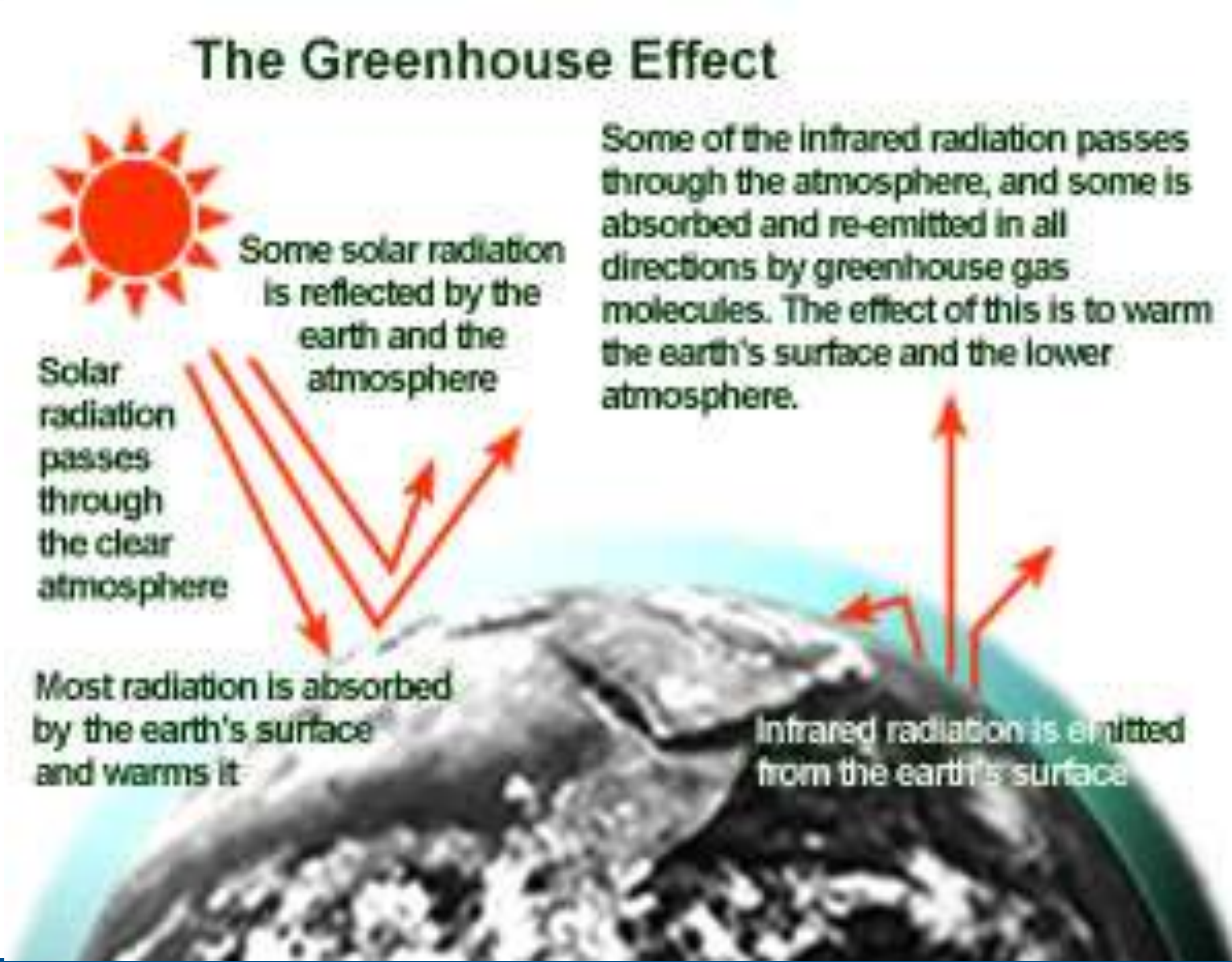
2. 3E- Environment, Energy, Economy

3 E- Environment, Energy , Economy

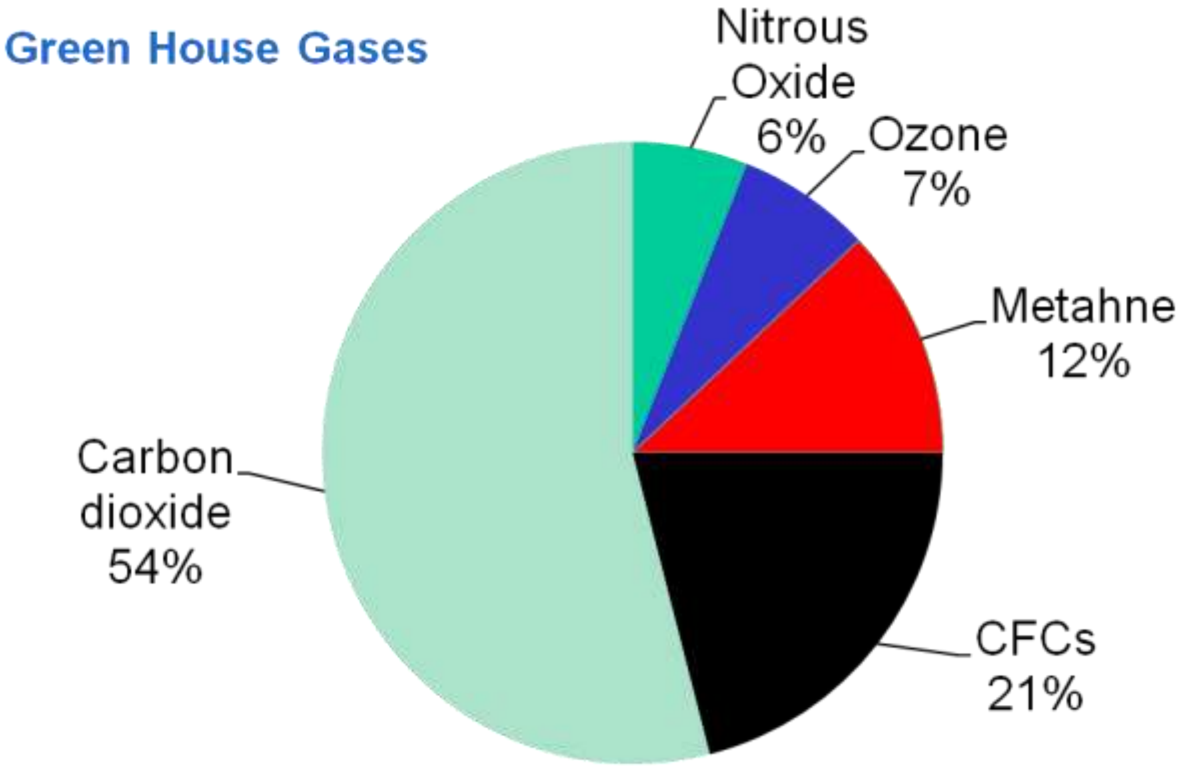
Environment Energy Economy

Resource flow

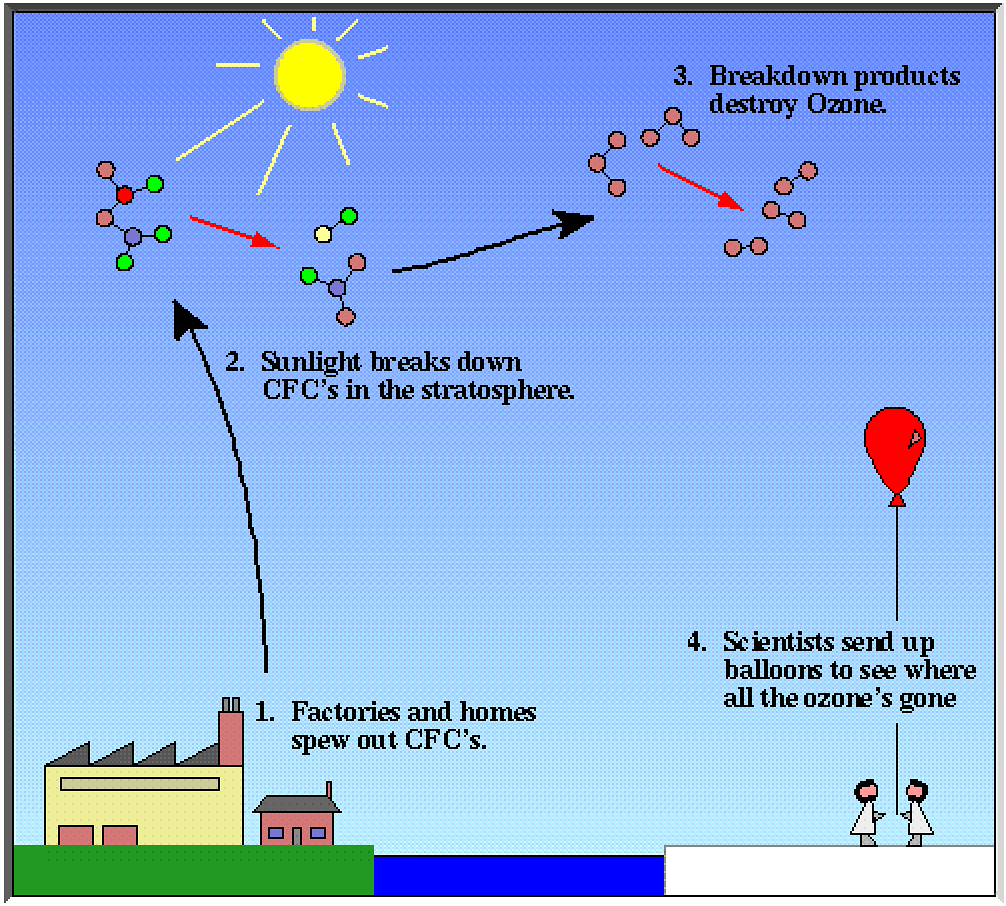
- Environmental Degradation:
  - Depletion of Natural resources due to production of energy
  - Increase in Pollution level due to consumption of Energy.
    - Global Warming
    - Climate Change


The Greenhouse Effect
Some of the infrared radiation passes through the atmosphere, and some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the earth's surface and the lower atmosphere.
Some solar radiation is reflected by the earth and the atmosphere
Solar radiation passes through the clear atmosphere
Most radiation is absorbed by the earth's surface and warms it
Infrared radiation is emitted from the earth's surface

Green House Gases (GHG)



Ozone Depletion



GHG Emission

What do humans do that increases atmospheric CO_2?

Figure 1.15
CO_2 sources

Mainly, we burn fossil fuels - coal, oil, and gas.

→ *80% of the CO_2 increase*

Secondarily, we cut down forests (particularly in the tropics)

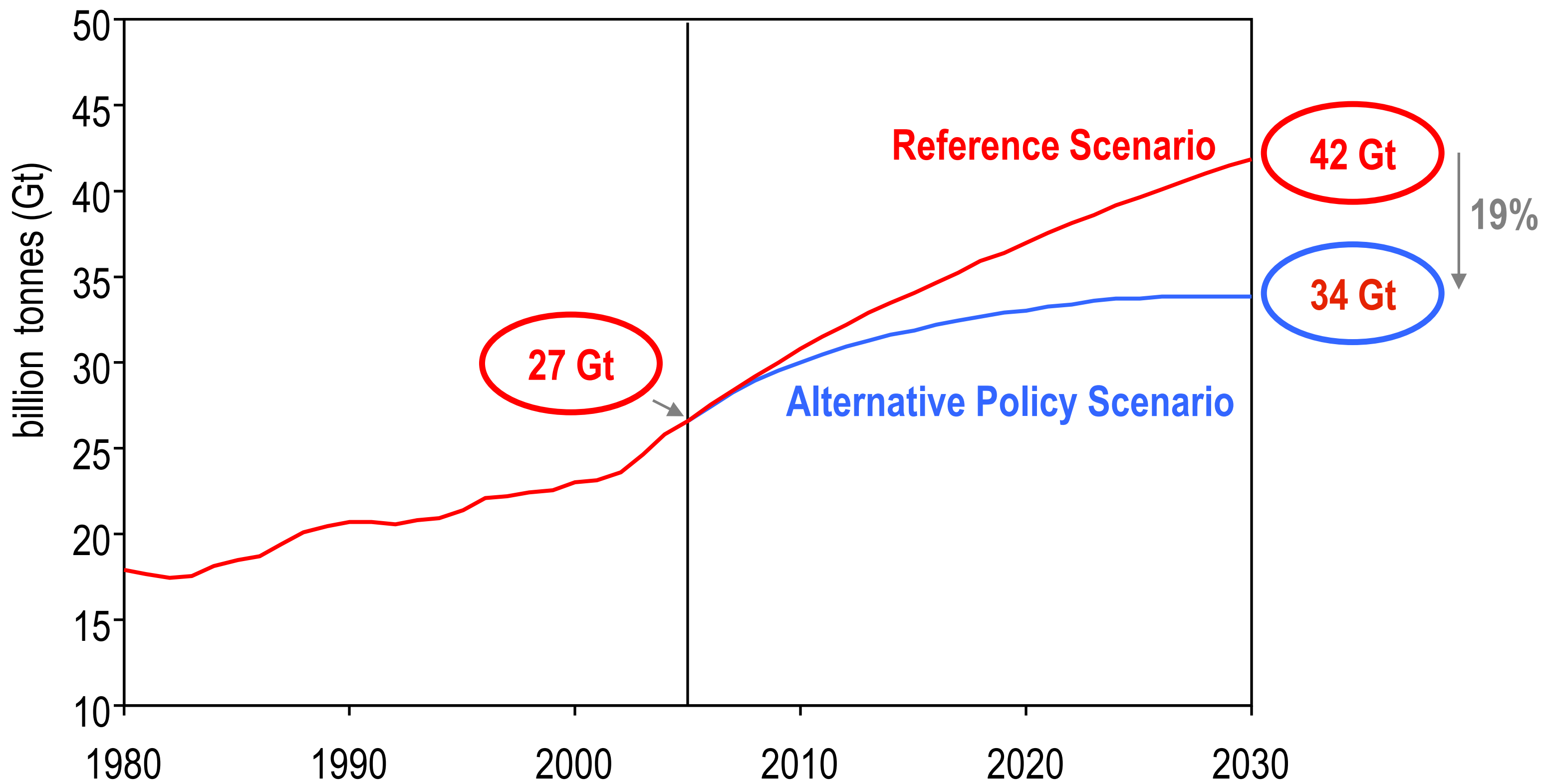
→ *20% of the CO_2 increase*

World's Top Five CO_2 Emitters

	2005		2015		2030	
	Gt	*rank*	*Gt*	*rank*	*Gt*	*rank*
US	5.8	1	6.4	2	6.9	2
China	5.1	2	8.6	1	11.4	1
Russia	1.5	3	1.8	4	2.0	4
Japan	1.2	4	1.3	5	1.2	5
India	**1.1**	**5**	**1.8**	**3**	**3.3**	**3**

India becomes the world's third-largest energy-related emitter of CO_2 by 2015

Global Energy-Related CO_2 Emissions



Global emissions will increase by 57% in the Reference Scenario, but they level off in the Alternative Policy Scenario

Acid Rain

- Caused by release of SOX and NOX , which then mixes with water vapour to form acids.
- Effects:
  - Acidification of lakes, streams and soils.
  - Release of metals, washing away of nutrients.
  - Killing wild life.
  - Decay of buildings.
  - Health problems.

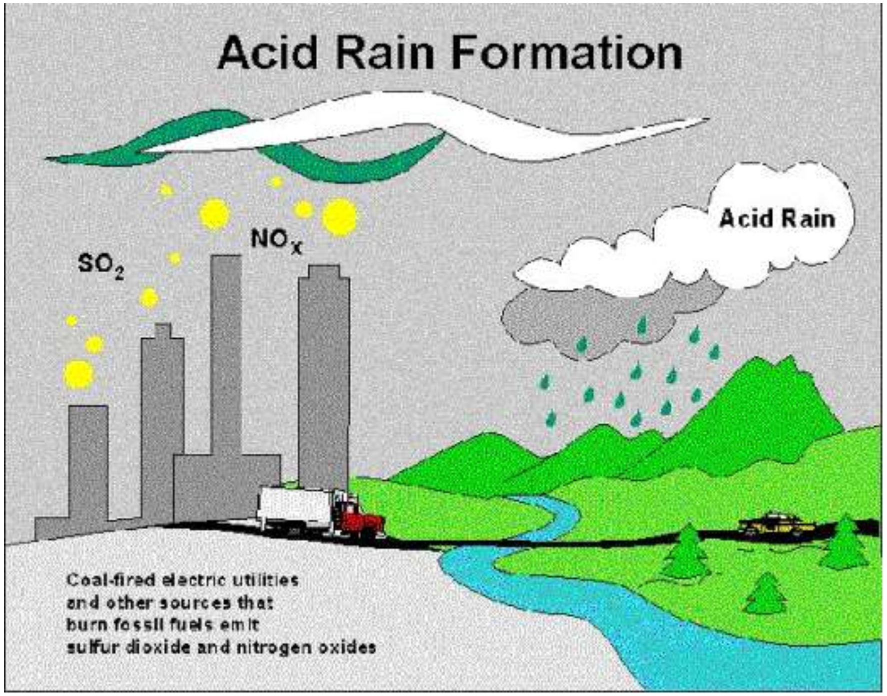
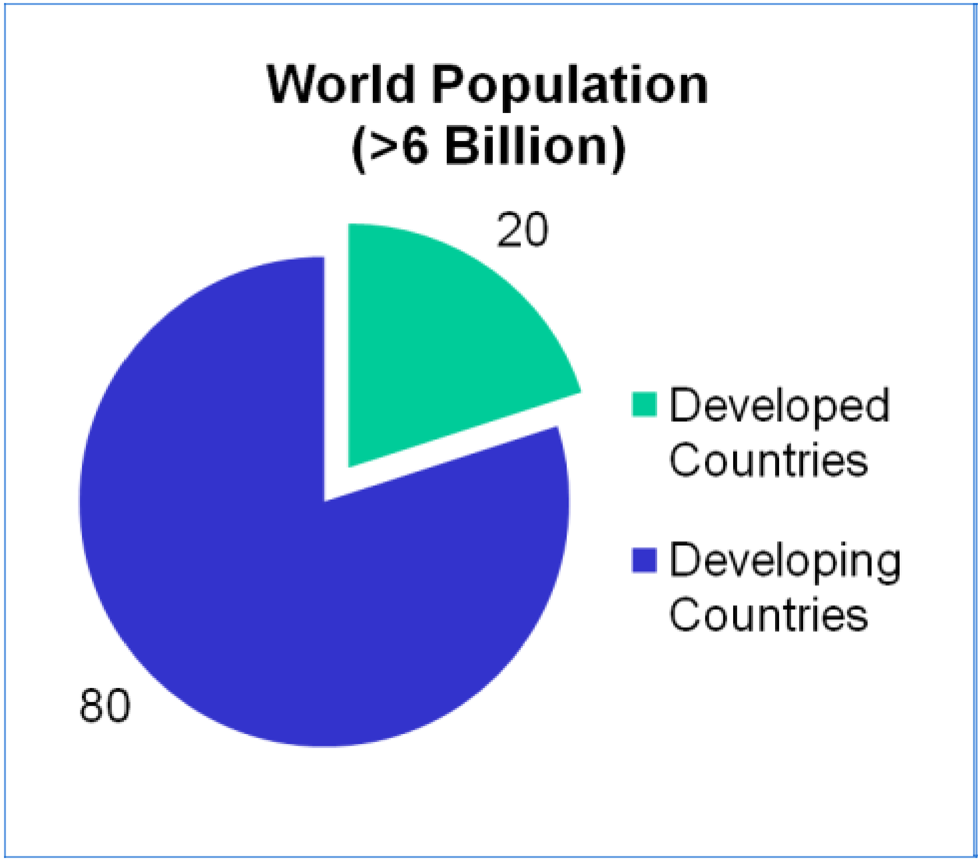
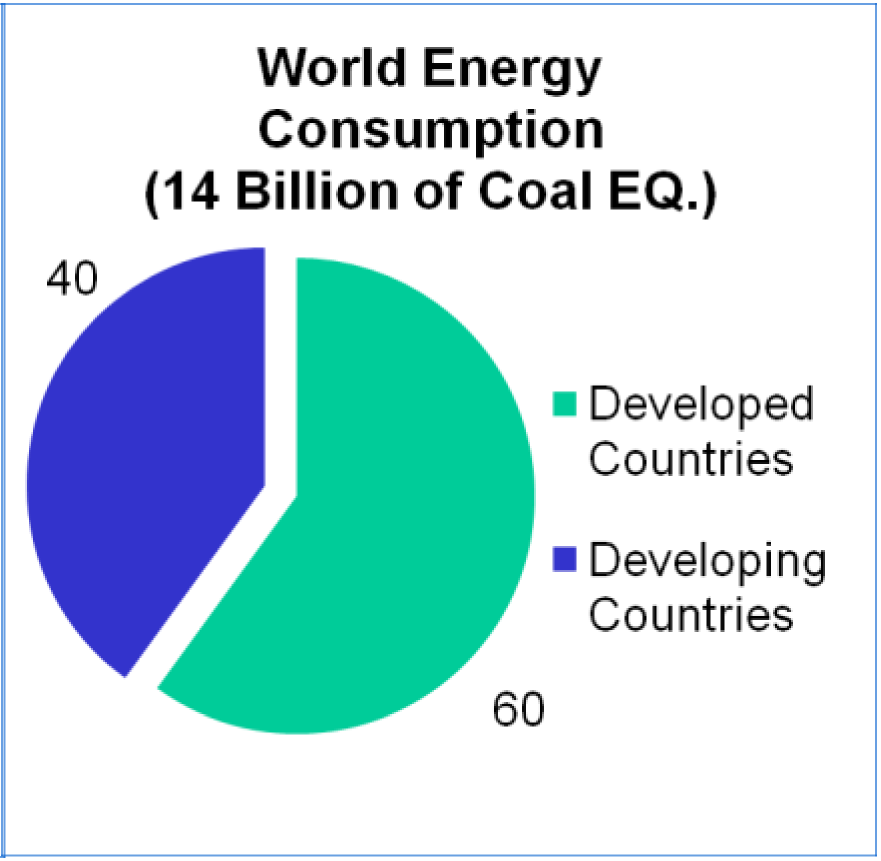


Figure 1.16

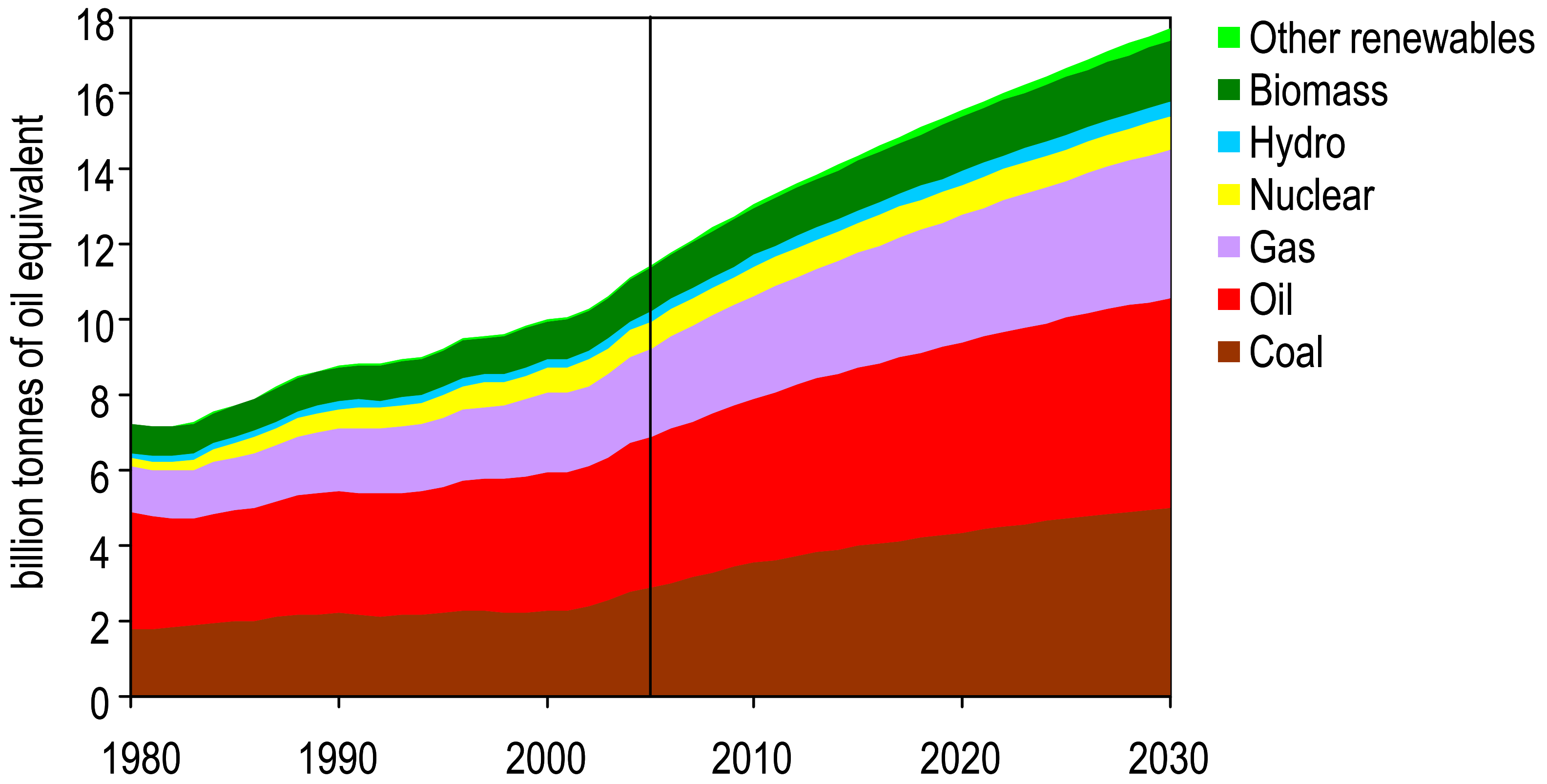
3. Energy Scenario

World Energy Distribution & Usage





World Primary Energy Demand



Global demand grows by more than half over the next quarter of a century, with coal use rising most in absolute terms

Global Energy Reserve

- Global coal reserves 9,84,453 million tones.
- 1047.7 thousand million barrels of oil.
- 155.78 trillion cubic meters of gas.
- World oil and gas reserves are estimated to last 45 years and 65 years respectively.
- Coal is likely to last a little over 200 years.

Energy Scenario Of India

- Peak demand shortage of 14% and energy deficit of 8.4%.
- To maintain GDP growth rate at 8% to 10%, target of 215,804 MW of power generation set by GOI.

India's perspective plan for power for zero deficit power by 2011/12 (Source Tenth and Eleventh Five-Year Plan projections)					
	Thermal (Coal) (MW)	Gas / LNG/ Diesel (MW)	Nuclear (MW)	Hydro (MW)	Total (MW)
Installed capacity as on March 2001	61,157	Gas: 10,153 Diesel: 864	2720	25,116	100,010
Additional capacity (2001-2012)	53,333	20,408	9380	32,673	115,794
Total capacity as on March 2012	114,490 (53.0%)	31,425 (14.6%)	12,100 (5.6%)	57,789 (26.8%)	215,804

Energy Intensity

- 6% increase in GDP would contribute to 9% increase in energy demand.
- Energy intensity is energy consumption per unit of GDP.
- High energy intensity points to energy wastages in economy which can be minimized through efficient use of energy.
- India's energy intensity is 3.7 times of Japan, 1.55 times of USA, 1.47 times of Asia and 1.5 times the world average.
- Ratio for developed countries < 1.

Energy Security

- Energy demand growth rate projected at 4.6% through 2010.
- India has to import 75% of oil and 22% of coal to meet requirement.
- We are vulnerable to external price shocks and supply fluctuations.
- Need to reduce dependence on middle east and diversify supplies .
- Building stock piles.
- Increased capacity of fuel switching.
- Demand restraint.
- Development of natural gas field and renewable energy sources.
- However, best measure is persistent energy conservation.

Sustainable Development

- Economic security and prosperity
- Social development and advancement
- Environmental sustainability

Power Sector Reform

- Energy Conservation (EC) Act 2001
- Electricity Act 2003
- National Electricity Policy Feb 2005
- Tariff Policy Jan 2006
- Ultra mega Power project (UMPP)
- Renewable Energy Policy

EC Act 2001

- Supply Side Management:
  - Efficient Production of Energy
    - Use of efficient boiler,
    - Efficient Turbo generator
    - Integrated energy system
    - Renewable energy sources
    - Clean Coal technology

- Demand Side Management:
  - Efficient Consumption of Energy
    - Use of energy efficient equipment
    - Energy conservation measure
    - Distributed generation
    - Power quality improvement

- Background of high Energy saving & its benefit.
- Bridge the gap between Demand & Supply.
- Reduce Environmental degradation.
- Legal policy framework & arrangement to overcome barrier.

List of Energy Intensive Industries and other establishments specified as designated consumers.

- Aluminium
- Fertilizers
- Iron and Steel
- Cement
- Pulp and paper
- Chlor Akali
- Sugar
- Textile
- Chemicals
- Railways
- Port Trust
- Transport Sector (industries and services)
- Petrochemicals, Gas Crackers, Naphtha Crackers and Petroleum Refineries
- Thermal Power Stations, hydel power stations, electricity transmission companies and distribution companies
- **Commercial buildings or establishments**

4. Energy Conservation in Building

Building

- A roof construction having wall for which energy is used to condition the indoor climate.

- EC Act-2001

  Any structure or part of structure having connected load of 500 Kw or contract demand of 600 KVA & above & intended to be used for commercial purpose.

- Green building

  Environmentally sustainable building, designed, constructed and operated to minimize the total environmental impacts.

Building

- Responsible for @ 40%of global energy use and up to 30% of global GHG emissions.

- Greatest potential for delivering greenhouse gas (GHG) emissions cuts, at the least cost, using available and mature technologies.

- Can deliver significant cost savings improvements in energy and resource use. It can also create jobs and improve local economies.

Building

- Type of building by purpose of Occupancy
  - Residential
  - Commercial
    - Offices, Business Premises
    - Hotels or Hospitality Building
    - Shopping Mall
    - Cold storage
  - Industrial
  - Education
  - Entertainment
    - Theatres, Sport stadium

Building

- Electrical Energy Usage in Building
  - HVAC (Heating , Ventilation & Air Conditioning)
  - Lighting (Illumination)
  - Water Supply, Waste water, Service water, rain water, water heating
  - Cleaning, Washing, Disposal of Waste
  - Appliances & Equipment
  - Communication/ Entertainment Media
  - Movement of Material & People – Lift, Escalator

Steps & Effort required for Green building.

- Education & Training for building industry professional
  - Problem of climate change & environmental degradation
- Brainstorming for stakeholders of building sector
  - New technology adoption, engineering & planning
- Adoption of Renewable energy resources.
  - Solar Thermal for water heating & cooking , Solar Photovoltaic(PV) for lighting , Wind power, Hybrid, Biomass

Savings for average household – Rs.6000 per year

Steps & Effort required for Green building.

- Use of energy efficient appliances
  - BEE rated energy star label

- Use of Low energy material & method of construction
  - Autoclave aerated concrete block Instead of conventional bricks, Fly ash cement, recycled aluminum & steel, Recycled tiles, waterless urinals etc.
  - Avoid Glass & Steel.

- Optimize HVAC & Lighting performance

- Installation of Building automation system / Energy Monitoring system

Steps & Effort required for Green building.

- Adoption of 3R (Reduce, Recycle, Reuse) Approach
  - Minimisation, Reuse, Recycle, Vermin composting
  - Energy recovery- Biogas Plant
  - India Generating potential from municipal & urban wastes- 15000 MW

Portable Biogas unit developed
ARKA technologies Pune

Steps & Effort required for Green building.

- Water Management

  Rain water harvesting, Use of shower & water efficient fitting, Reduce capacity of WC flush, Use of correct size pump. Electronic flush system, Level control for pump, Drip irrigation for landscaping, ‘Grey water’ for toilet flushing

- Regular Energy Audit

  - To identify, quantify & prioritize improvement opportunities.
  - Useful for development of design guidelines for new construction & new equipments.
  - Preventive & predictive maintenance to address the gaps identified in audit.

HVAC: Good Practices

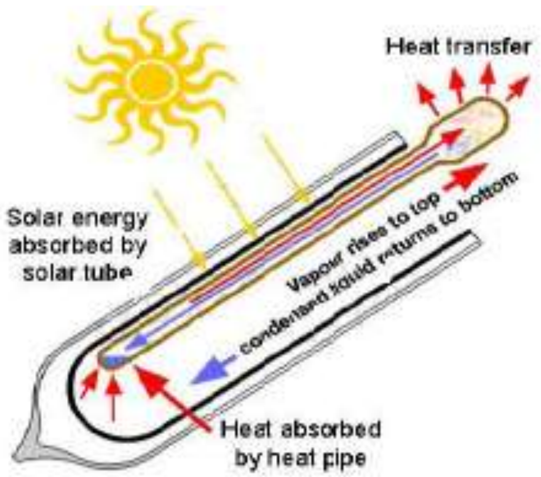
- Optimizing the chilled water temperature set point.
- Use of evaporative cooling in dry areas.
- Use of thermal storage for load shifting.
- Optimize air conditioning volumes by technique such as false ceiling.
- Heat Load minimization
  - Roof cooling, roof painting, efficient lighting, Pre cooling of fresh air by air to air heat exchanger, Variable volume air system, Optimal thermosetting of temperature of air conditional spaces , sun film application.
- Regular Maintenance
- Process Heat load minimization by:
  - Flow Optimization
  - Avoid heat gain, loss of chilled water, idle flow.
- Adoption of VAM where economics permits non CFC solution.

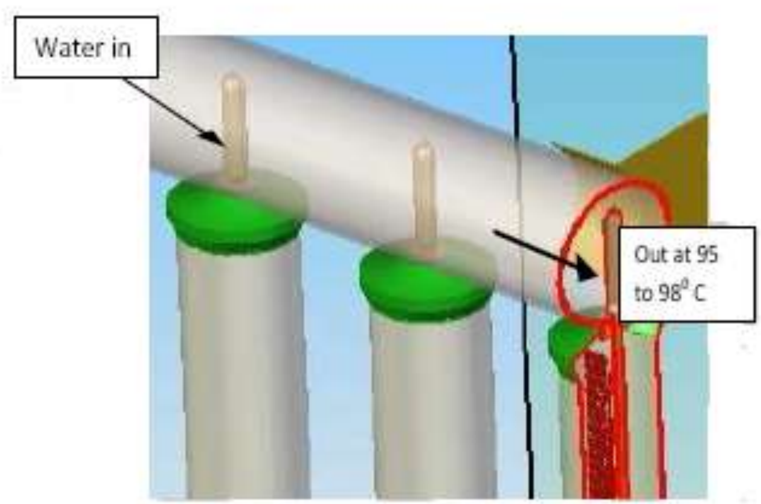
HVAC: Good Practices

- Cold Insulation for cold lines & vessel using ETI.
  - Chilled water pipe insulation (Provide 2 to 3 inch thickness).
  - Duct insulation (Provide 1 to 2 inch thickness).
  - Suction line refrigerant pipe insulation (Provide 2 to3 inch thickness).
- Installation of Variable speed drives for air handling unit, cooling tower fan, & chilled water pump motor.
- Use of polybutene-1(PB-1) material in HVAC piping.

HVAC: Good Practices

- Installation of Solar Thermal Air Conditioner (STAC)
  - Use of evacuated tube heat pipe solar collector.
  - Vapor absorption machine (VAM) to generate the cooling effect.





Lighting

- Accounts @ 19% of global electricity consumption.
- Visible consumable part.
- Energy Efficient Light
  - Right amount of light
  - Installed at right location
  - Available at right time
- "Save Energy & not Light"
  - Do not compromise lighting level.
- " Light for the people & not for Empty Space".

Lighting

- Selection Factors
  - Lamp
    - Efficacy, Life, ,CRI, Heat & UV radiation, Dimension.
  - Control gear
    - Harmonics, Re striking time, Size, Power factor.
  - Luminaries
    - Size, Aesthetics, Environmental Protection, Construction.
  - Lighting design
    - Cost , Comfort , Efficiency.
  - Control system
    - Dimmer, Motion & Occupancy sensor, Photo sensor, Timer
  - Maintenance
  - Day light
  - Economy

Lighting: Best Practices

- Installation of Energy efficient equipment

    - Fluorescent lamp in place of conventional FTL(T12) Use of T8 & T5 having highly sophisticated Tri-phosphor fluorescent technology.
    - Compact fluorescent lamp (CFL) in place of incandescent lamp.
    - Metal halide lamp in place of mercury/sodium vapour lamp.
    - HPSV lamp for application where colour rendering is not critical.
    - LED panel indicator panel lamp in place of filament lamp.
    - “ Exclusive “ transformer for lighting.
    - Servo stabilizer for lighting feeder.
    - High frequency (HF) electronic ballasts in place of conventional ballasts.

- Use of appropriate control.

- Optimum usage of day lighting.

Lighting: Best Practices

- Minimize the hidden phantom (ghost) load
    - Cell phone charger
    - Power answering M/C
    - S/By operation of TV & music system
    - Inkjet printer

5. Case Studies

1.Installation of Turbo Wind Ventilators

DTPS replaced old TG roof electric exhauster with hybrid wind ventilator (ec0600).

Old-Electric Exhauster	New- Hybrid Wind Ventilator(eCO600)
	

1.Turbo Wind Ventilators : Test Data

Design Data	
Old electric Exhauster	New-Hybrid Wind Ventilator(eCO600)
Motor Watts: 3700 Watts Flow: 6000 M3/hr Make: DOCTAIRE	Motor Watts: 116 Watts Current : 0.47 Amp Voltage : 200 – 277 Volts Flow: 2000 to 3000 M3/hr (Motor not in service) Flow: 4000 M3/hr (Motor is in service) Make: M/s Sudha Ventilating Systems Pvt. Ltd,AhmadNagar
Test Data	
Old electric Exhauster	New-Hybrid Wind Ventilator(eCO600)
Motor Watts: 3700 Watts Current : 6.1 amp Voltage : 410 volt Flow: 6000 M3/hr	Motor: Watts: 93 Watts Current : 0.47 amp Voltage : 210 volt Flow: 3324 M3/hr (Motor not in service) Flow: 6183 M3/hr (Motor is in service)

1.Turbo Wind Ventilators: Cost Economics

- Total nos. of ventilator = 20
- Power consumption of old electrical exhauster = 3.7 KW / exhauster
- Total power consumption by 20 exhauster = 20 * 3.7= 74 KW**---(A)**
- Power consumption by Turbo wind ventilator = 0.093 Kw / ventilator
- Total power consumption by 20 ventilator = 20 * 0.093 = 1.860 KW **----(B)**
- Expected saving for 20 ventilator = A – B = 74 – 1.860 = 72.14 kWh
- Expected saving per day = 72.14 * 24 = 1731 Kw / day
- Financial saving per day (Rs.) = 1731 * 3.5 = 6059 /Day
  = 1, 81,770 /month **----(C)**
  = **21.81 Lacs/Year**
- Cost of one ventilator = 74,700 Rs/ventilator
- Total cost of all 20 ventilators = 74700 * 20 = 14, 94,000 Rs **----(D)**
- Pay back period = D/C = 1494000/181770 = 8.22 months = **9 months**

1.Installed Turbo Wind Ventilators at stores.

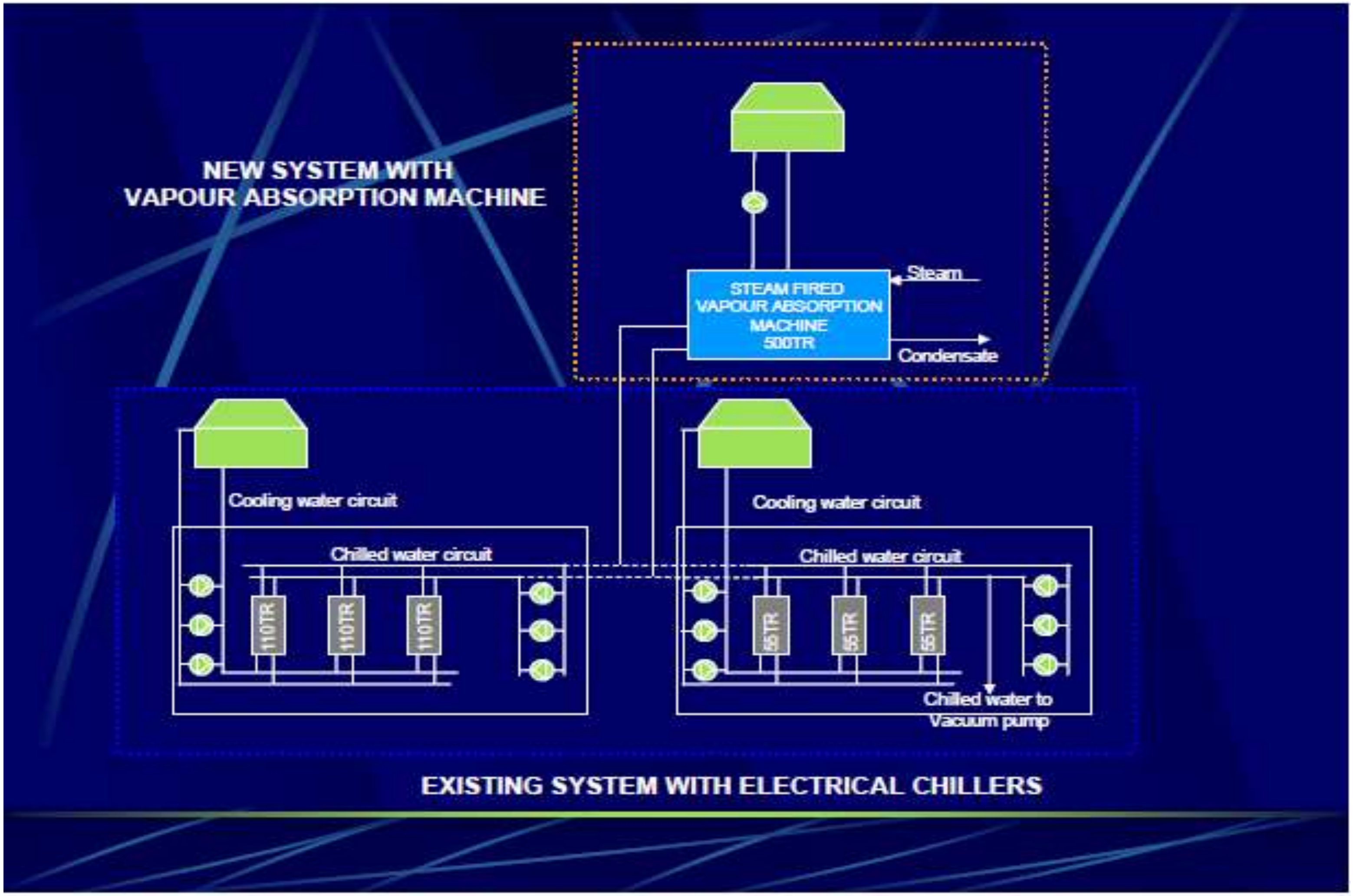
1.Turbo Wind Ventilators: Benefits

- 97% saving in electricity consumption
- Noise free operation
- Eco-friendly
- Hybrid operation i.e. with and without power

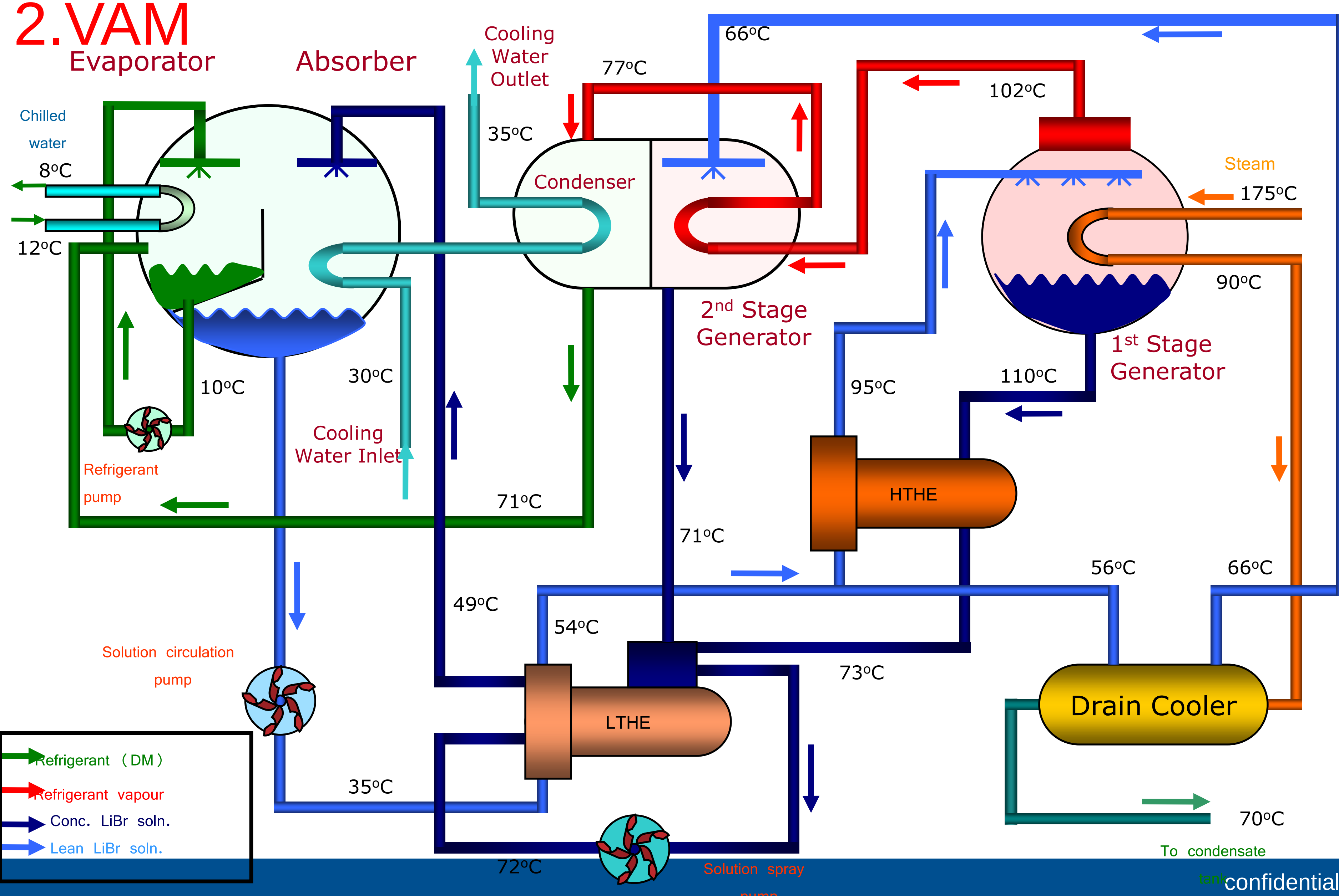
2.Installation of VAM

- Reliability
- Ease of O&M
- Compactness
- **Legislative Requirement**
  MoEF Notification
  The OZONE Depleting Substances
  (Regulation & control) Rules, 2000

2.Installation of VAM



2.VAM


Evaporator
Absorber
Cooling Water Outlet
Chilled water
8°C
12°C
10°C
30°C
35°C
77°C
66°C
102°C
Condenser
2nd Stage Generator
1st Stage Generator
Steam
175°C
90°C
95°C
110°C
Refrigerant pump
Cooling Water Inlet
71°C
71°C
HTHE
56°C
66°C
49°C
54°C
73°C
Solution circulation pump
LTHE
Drain Cooler
35°C
72°C
70°C
Solution spray pump
To condensate tank
Refrigerant（DM）
Refrigerant vapour
Conc. LiBr soln.
Lean LiBr soln.

2.VAM: Cost Economics

Steam Fired VAM			Reciprocating Chiller		
CAPACITY	500	TR	CAPACITY	500	TR
TYPE OF ENERGY	STEAM		TYPE OF ENERGY	ELECTRICITY	
SPECIFIC STEAM CONSUMPTION	4	Kg/hr-TR	SPECIFIC ELECT CONSUMPTION	0.9	KW/TR
TOTAL STEAM/ HR	2000	Kg/ hr	TOTAL ELECT/ DAY	450	KW
DAILY OPERATION	22	HRS	DAILY OPERATION	22	HRS
TOTAL STEAM CONSUMPTION PER DAY	44000	Kg	TOTAL ELECRTICITY CONSUMPTION PER DAY	9900	KWH
COST OF STEAM	0.35	Rs/Kg	COST OF ENERGY	3.5	Rs/KW
TOTAL COST OF ENERGY/ DAY	15400	Rs.	TOTAL COST OF ENERGY/ DAY	34650	Rs.
POWER REQUIRED BY M/C PER DAY	127	kW			
COST OF POWER REQUIRED BY M/C PER DAY @3.5 Rs/unit	444	Rs			
TOTALOPERATING COST PER DAY	15844	Rs	TOTALOPERATING COST PER DAY	34650	Rs.
TOTAL COST OF OPERATION PER YEAR	5782885	Rs.	TOTAL COST OF OPERATION PER YEAR	12647250	Rs.
MAIINTAINANCE COST	25000	Rs.	MAIINTAINANCE COST	50000	Rs.
TOTAL OPEATIONAL COST	5807885	Rs.	TOTAL OPEATIONAL COST	12697250	Rs.
ANNUAL SAVINGS	**68,89,365**	Rs.			

2. VAM : Benefits

- Reduce dependence on scarce & expansive electricity.
- Eliminate the need of generator back up for cooling
- Efficient part load performance with automatic capacity control.
- Eco- friendly, CFC free Machine
- Low Maintenance
- Noiseless & vibration free operation.
- Free hot water generation from steam condensate.

3.Fly Ash Utilization

- Use of fine fly ash as a cement admixture.
- Manufacturing Ash cured bricks (in house).
- Pond ash issued to local clay brick manufacturers.
- Ash used as land fill/Agri Initiatives.

3.Fly Ash Utilization

- **Statutory Requirement for Ash Utilization**

  MoEF:

  notification No. 763 (O) Dt. 14/09/1999:

  To achieve 100% Ash utilisation in phased manner (15 years), mandatory for all thermal power stations

3.Ash Generation (MT / Day) at Dahanu TPS (typical)

- **Total Ash Generated**
  1690 (6500*0.26= 1690)
  (100%)
  - **Bottom Ash**
    338
    (20%)
  - **Fly Ash**
    1352
    (80%)
    - **Field-1** 1082 (80%)
    - **Field-2** 216 (80%)
    - **Field-3** 43 (80%)
    - **Field-4** 8.6 (80%)
    - **Field-5** 1.73 (80%)
    - **Field-6** 0.67 (80%)

3.Ash Disposal System

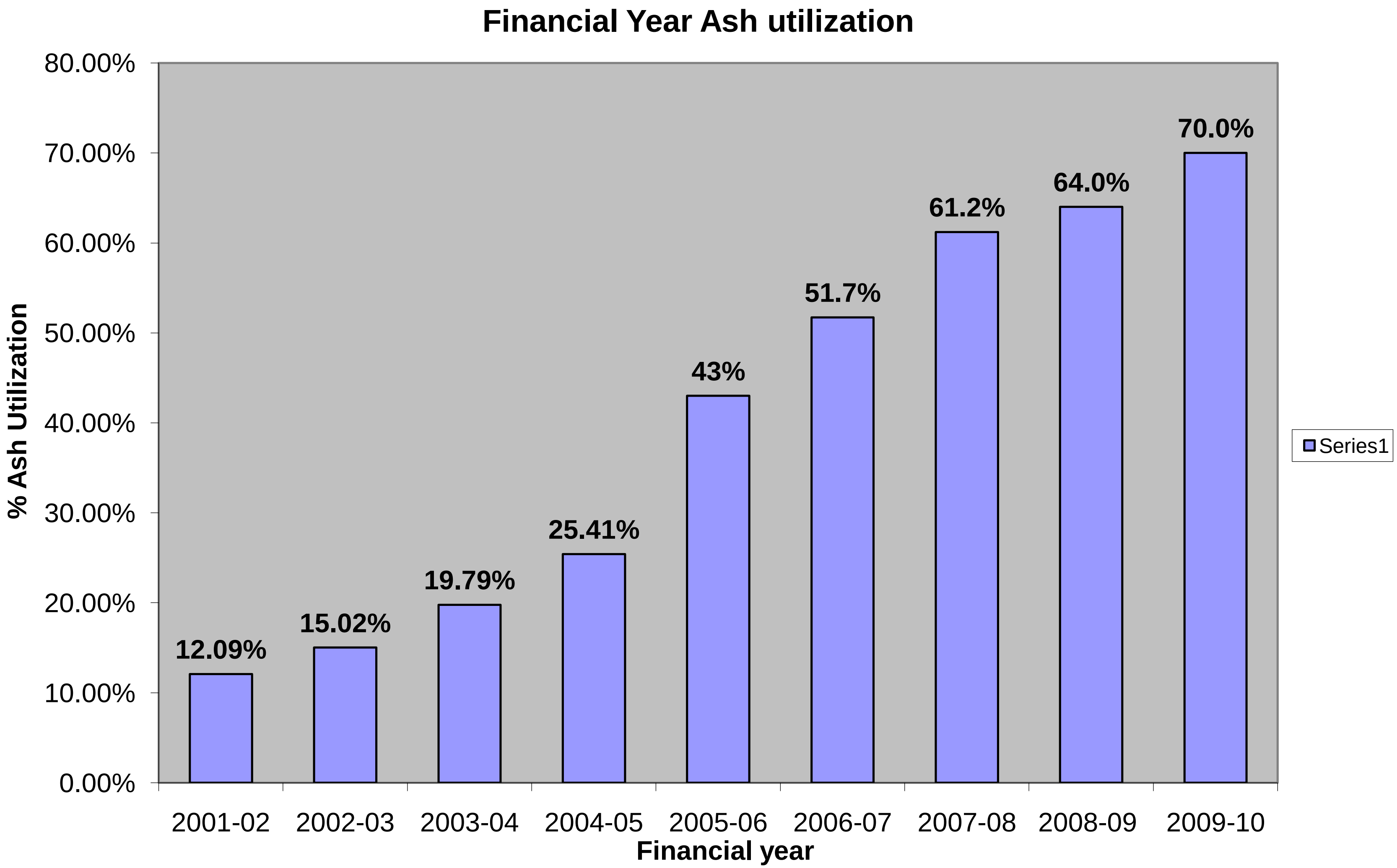
- **Wet Ash handling :**
  - Ash is collected at bottom of the Boiler, in Economiser, Air Pre-heater, Duct and Hoppers.
  - Ash disposed as low concentration slurry into Ash ponds located at 2 km.
  - Ash pond area – 370 hectares.

- **Dry Ash handling :**
  - Dry Ash collected in ESP hoppers.
  - Transported to Silos as dense phase.
  - Composite (1st Field) Ash Classification in Coarse & Fine.
  - Bulker loading and bagging system.

3.Fly Ash Utilization: Benefits

- Reduction in water consumption .
- Reduce chances of water pollution .
- Increase life of available ash ponds .
- Use of fine fly ash in cement manufacturing reduces:
  - Consumption of lime stone
  - Emissions from the calcination process
  - CO_2 emission

3.Fly Ash Utilization



3.Fly Ash Utilization

Land before Chikoo plantation

Use of Ash in Soil Reclamation

Rain water harvesting pond

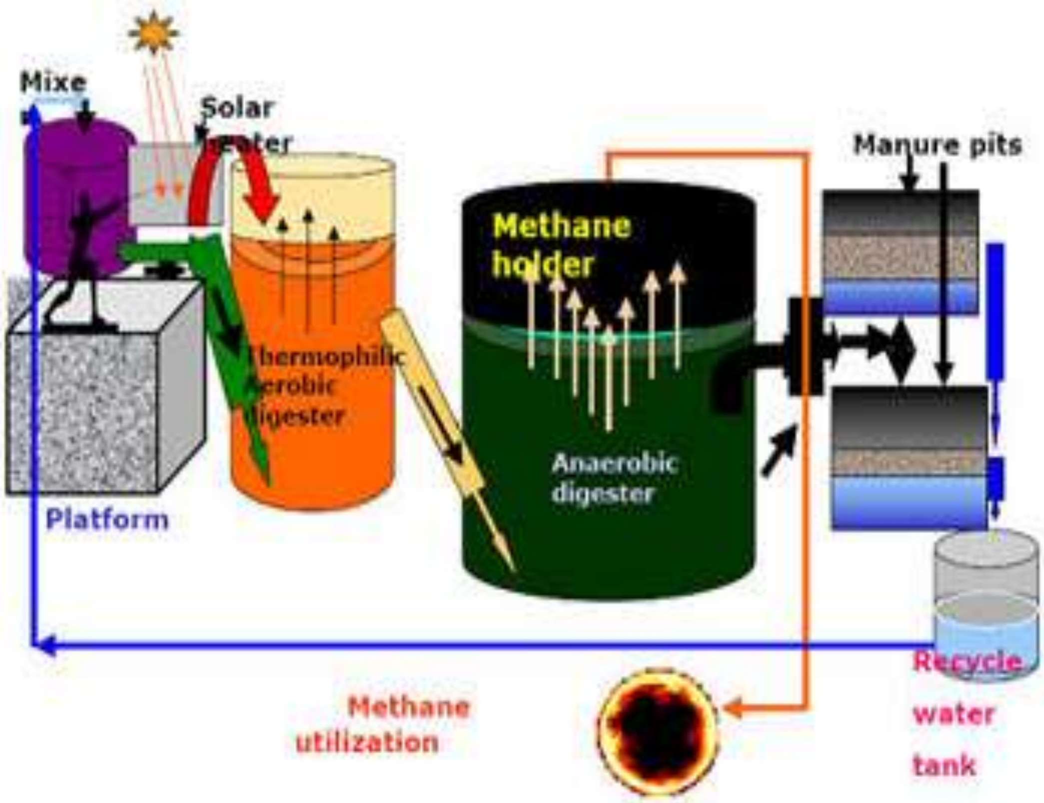
Chikoo Plantation with Drip Irrigation

3.Fly Ash Utilization

Use of Ash Bricks in CSR Projects

4.Installation of Biogas Plant

- It is the Nisargruna technology developed by BARC.
- Capacity: 300Kg/day
- Best way to Dispose Kitchen Waste
- Cooking Gas is Output
- Organic Manure is Byproduct



4.Biogas Plant : Cost Economics

Generation of Biogas per day	20m3/day
Equivalent to LPG Kg/day	9.5 Kg/day
Equivalent to LPG cylinder	20 Cylinder/month(each 14 Kg)
Cost of LPG per Kg	Rs. 47
Saving Per month through Biogas	Approx. Rs. 13000
Generation of manure per month	450 Kg/month
Minimum cost of Manure per Kg	Rs 6/ Kg
Saving per month through manure	Approx. Rs 2700

4.Biogas Plant : Benefits

- Decentralized processing of biodegradable waste.
- Reduction in transportation cost.
- Maintenance of biogeochemical cycle
- Benefit in carbon credit.
- Benefit in health sector.

6. Challenges & Barriers

Challenges & Barriers

- To maintain balance between economic growth & sustainabilty is difficult.
- Expansive green technology.
- Waste management.
- Regulatory uncertainty.
- Absence financial incentives for builder.

7. Green Building Example
Suzlon global headquarter ‘One Earth’

Suzlon global headquarter 'One Earth'

- Project Name : Suzlon One Earth Corporate Campus
- Site Location : Pune, Maharashtra, India
- Site Area : 45,393 square feet (10.4 acre)
- Built up Area : 8,16,171 square feet
- Award : LEED Platinum award
- Years (Started – Completed) : 2006-09

One Earth

One Earth

‘One Earth’- Features

- Use of low energy materials
- Renewable energy-based exterior lighting
- Daylight & occupancy sensor
- Efficient ventilation system
- Storm & rain water management system

8. Green Building Benefits

Benefits of Green Building

- Environmental Benefits
  - Enhance & Protect Ecosystem & biodiversity
  - Improve air & water quality
  - Reduce solid waste
  - Conserve Natural resources
- Economic Benefit
  - Reduce operating cost
  - Enhance asset value & profit
  - Improve employee productivity & satisfaction
  - Optimize lifecycle economic performance
- Health &Community benefit
  - Improve thermal, air & acoustic environment
  - Enhance Occupant control & health
  - Contribute to overall quality of life

Conclusion

- Sustainable development by Adoption of Green Technology-
  - Pollution Management technology
  - Clean Technology
  - Resource Management technology
- Power for all by 2012
  - Adoption of ECBC code
- Sustainable development
  - Heart of planning policy
- Product lifecycle approach

- Balance between growth and sustainability.

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Thank you