Energy Conservation, Sustainability

&

Latest Trends Of Thermal Insulation In Building & Industrial Sector

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Global Warming & Green House Effect

Global warming is the increase in the average temperature of the Earth's near-surface like air and oceans …

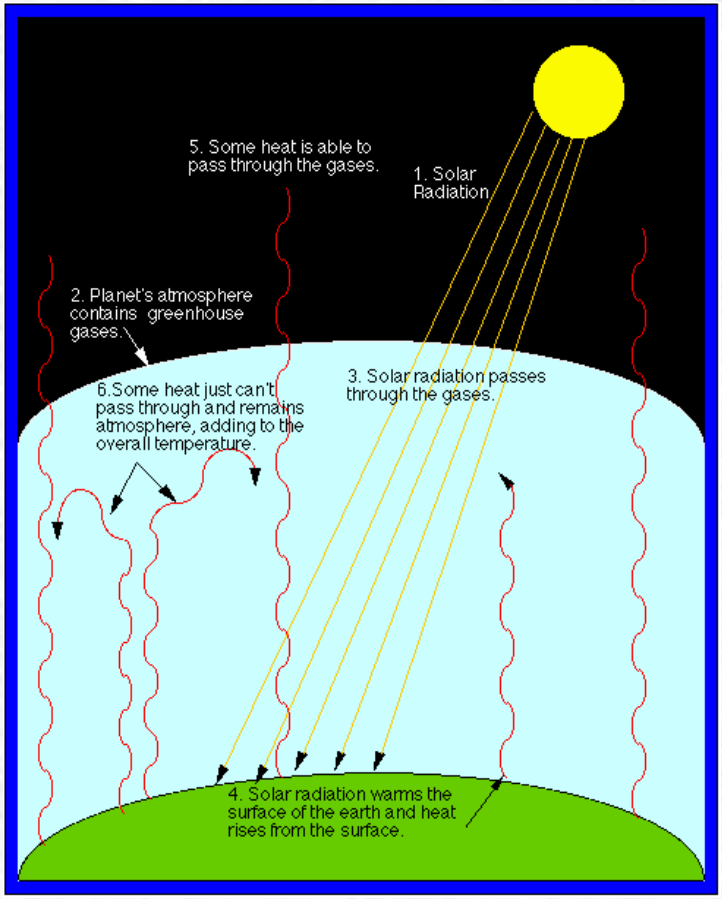
"most of the observed increase in global averaged temperature, since the mid-twentieth century is very likely due to the observed increase in ***Anthropogenic*** (man-made) greenhouse gas concentrations via an enhanced greenhouse effect.

Global Warming & Green House Effect

Greenhouse gases are the gases present in the atmosphere which reduce the loss of heat into space and therefore contribute to global temperatures through the greenhouse effect.

The Greenhouse concept… is simply that the composition of the gases that make up the atmosphere enveloping the earth is crucial to the existence of life, by acting as an insulator. This is because a precise gaseous composition allows heat which is radiated from the sun to be trapped in by the earth. Furthermore it allows the specific temperature range for life to flourish, as it allows the right amount of heat loss as well as heat retention to keep the balance of life stable.

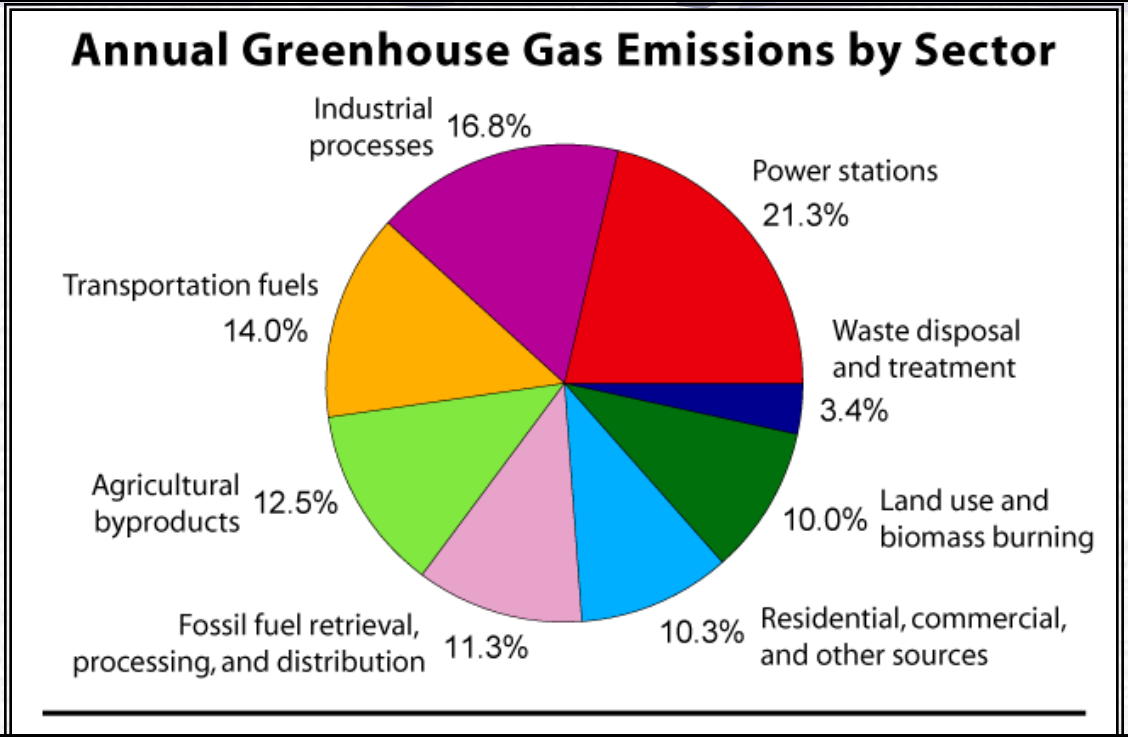
Global Warming & Green House Effect



When sunlight reaches the surface of the Earth, some of it is absorbed and warms the surface, earth surface radiates energy at much longer wavelengths than the sun does, The atmosphere absorbs these longer wavelengths more effectively than it does the shorter wavelengths from the sun. The absorption of this longwave radiant energy warms the atmosphere; the atmosphere is also warmed by transfer of sensible and latent heat from the surface. Greenhouse gases also *emit* longwave radiation both upward to space and downward to the surface. The downward part of this longwave radiation emitted by the atmosphere is the "greenhouse effect".

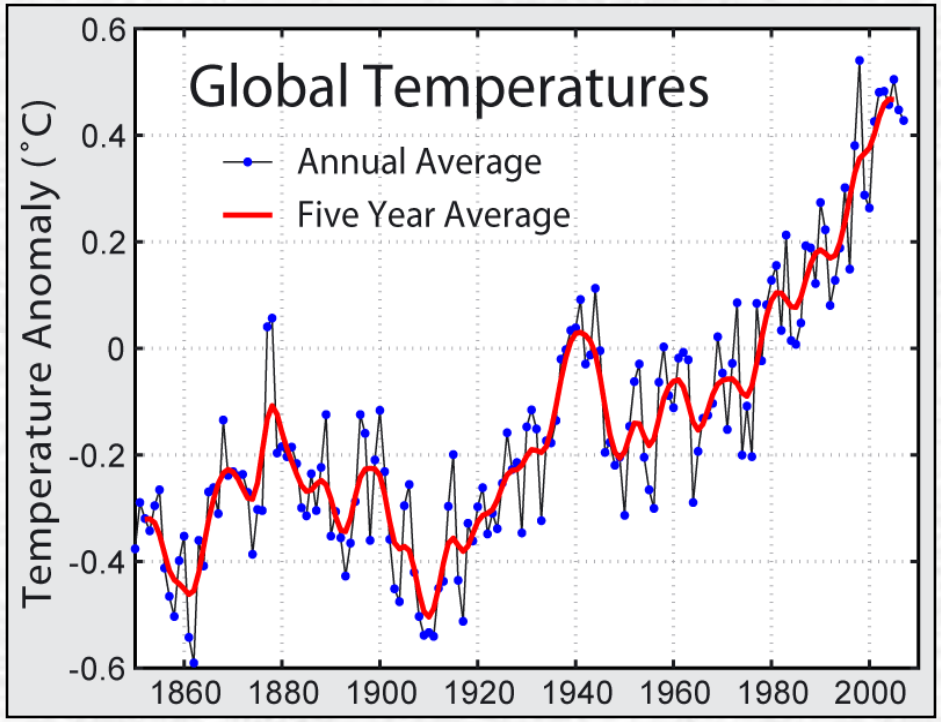
However, an excess of greenhouse gases can raise the temperature of a planet to lethal levels

Global Warming & Green House Effect

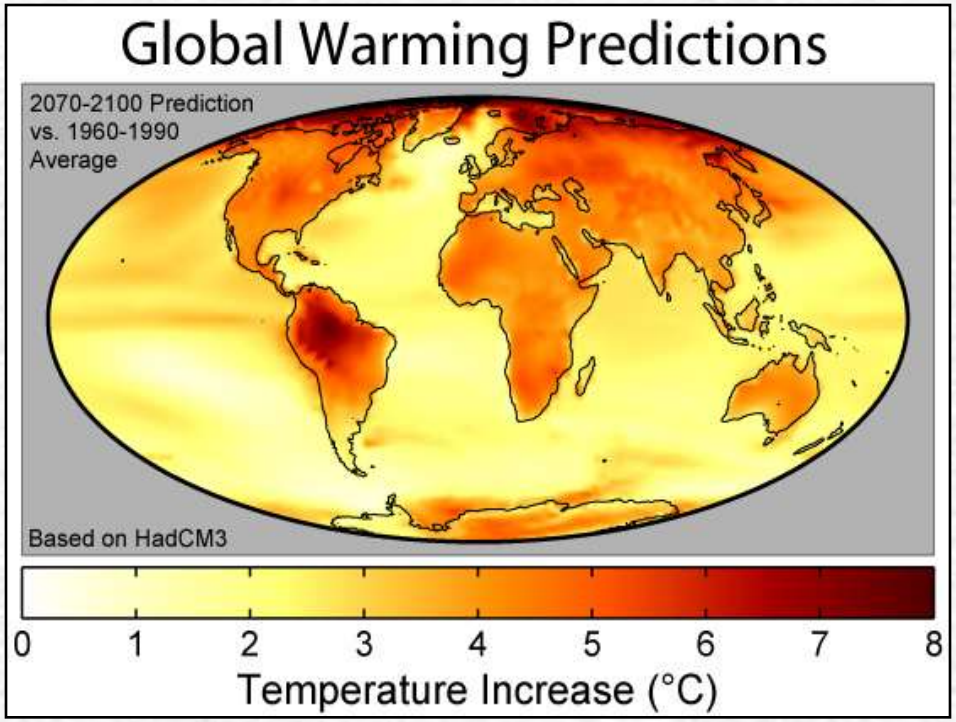


This figure shows the relative fraction of man-made greenhouse gases coming from each of eight categories of sources, as estimated by the *Emission Database for Global Atmospheric Research (Yr.2000)*, These values are intended to provide a snapshot of global annual greenhouse gas emissions in the year 2000.

Global Warming & Green House Effect

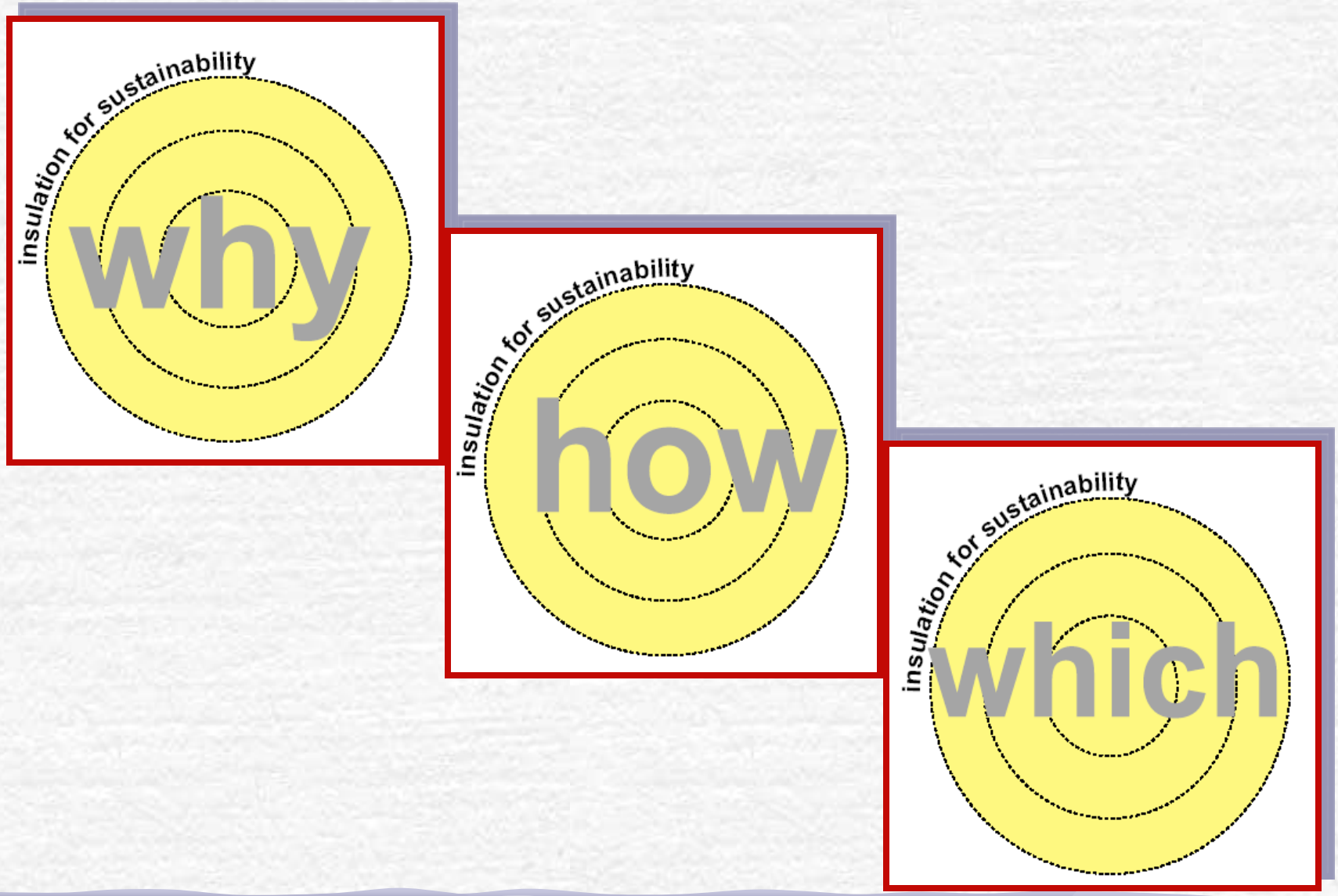


Rise in Global Temp. in last 140 yrs (from 1860 to 2000)



Prediction for Global temp. rise in next 100 yrs.

SUSTAINABILITY



SUSTAINABILITY

There are arguably three main threats to environmental sustainability:

- Global warming (climate change driven by man-made emissions of gases)
- Resource depletion (including depletion of non-renewable resources and damage to renewable resources and ecosystems)
- Ozone depletion (the last is now largely dealt with under the Montreal Protocol).

SUSTAINABILITY

Ozone depletion

Ozone is both beneficial and harmful to us. Near the ground, ozone forming as a result of chemical reactions involving traffic pollution and sunlight may cause a number of respiratory problems. However, in the stratosphere region, ozone filters out incoming ultraviolet (UV) radiation from the Sun. Without this ozone layer, life on earth would not have evolved in the way it has.

SUSTAINABILITY

Ozone depletion

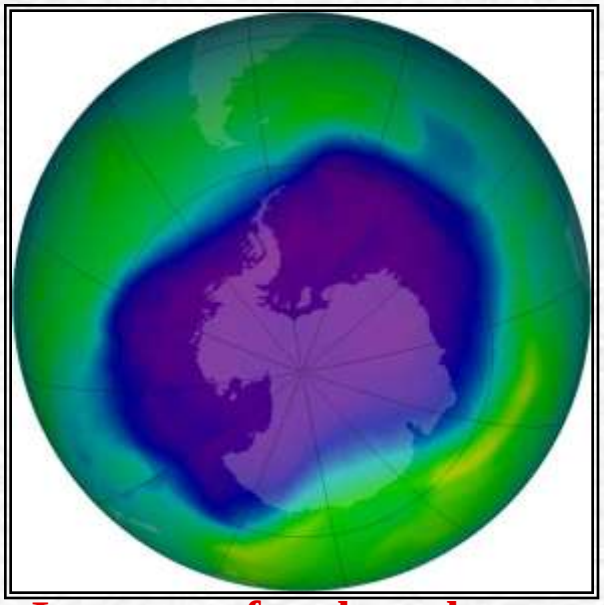
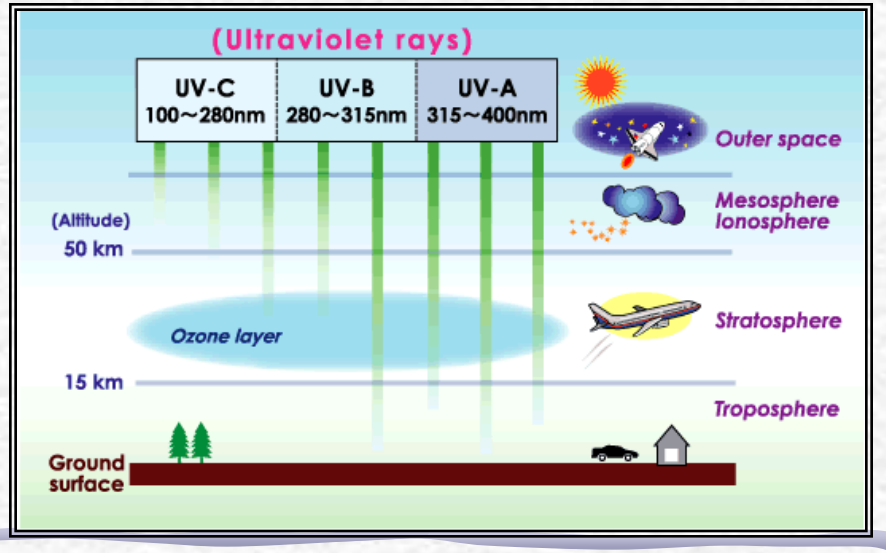


Image of the largest Antarctic ozone hole ever recorded (September 2006). area of about ten million square miles.

Like an infection that grows more and more, *ozone destruction* also increasing every day. An area of the ozone layer that is seasonally depleted of ozone is known as *" **ozone hole**"*.



SUSTAINABILITY

Resource depletion

Resource depletion is an economic term referring to the exhaustion of raw materials within a region. Use of these resources beyond their rate of replacement is considered to be *resource depletion*. Fossil Fuel is one of the most important resources among others.

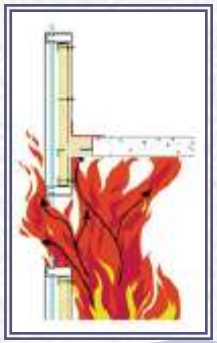
If these fossil fuels were to run out now, there would not be a suitable replacement for them that is equally as efficient at producing the same amount of energy.

SUSTAINABILITY

Energy Conservation

Energy conservation is defined largely as cost-effective ways to reduce energy consumption through existing and improved technologies as well as through sound energy use practices.

Energy efficiency technologies and practices can therefore play a significant role in reducing the threat of global climate change.



"The judicious and effective use of energy to maximize profits (minimize costs) and enhance competitive positions"

SUSTAINABILITY

One of the easiest and most effective energy efficient technologies available today is *Thermal Insulation*. Overall benefits from insulation are numerous, including thermal performance, personal comfort, sound control, condensation control, fire protection and personnel protection.

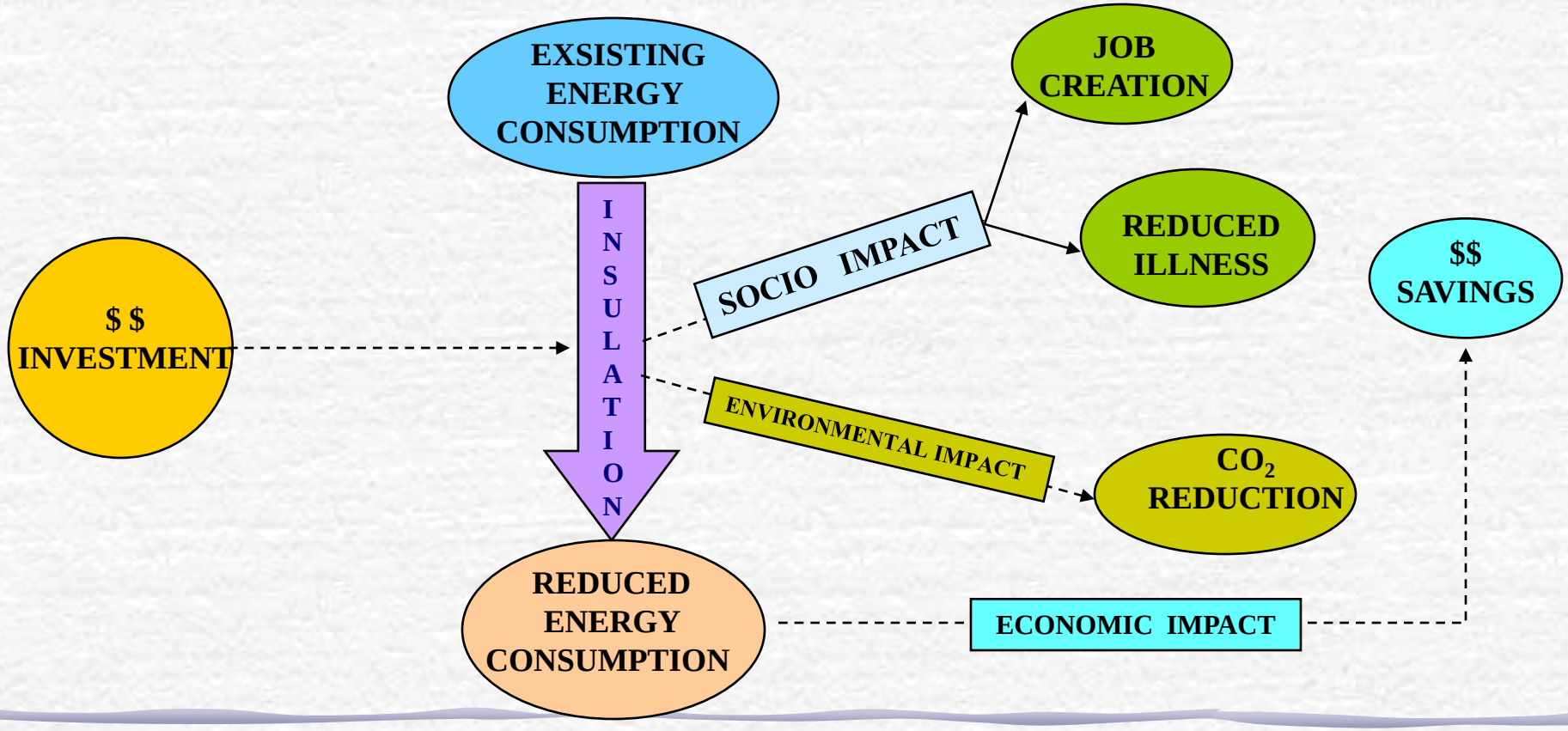
SUSTAINABILITY

The thermal insulating properties of insulation materials provide important energy and environmental benefits. Made from a variety of substances, insulation products are primarily designed to reduce the transfer of heat.

By their very nature, insulation products enable consumers to reduce more energy use and more emission of pollutants annually than it takes to manufacture them. This results in a very positive overall energy and environmental balance for thermal insulation.

SUSTAINABILITY

Insulation is a product or service, which stands up very well on its own - offering clear and straightforward energy efficiency and economic advantages and can go much further!



SUSTAINABILITY

Thermal transmission, or the transfer of heat from a warmer body to a colder body may in principal take place in the following ways:

1) **Conduction** - Transfer of heat through solid/liquid material.

2) **Convection** - The moving of heat through moving fluid or gas.

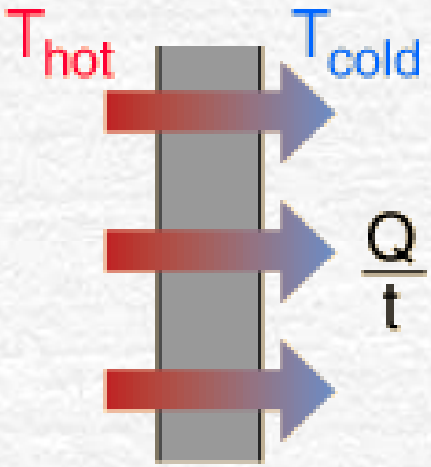
3) **Radiation** - Transfer of heat by means of electromagnetic waves.

SUSTAINABILITY

Heat Conduction

Conduction is heat transfer by means of molecular agitation within a material without any motion of the material as a whole. The higher speed particles will collide with the slower ones with a net transfer of energy to the slower ones. For heat transfer between two plane surfaces, the rate of conduction heat transfer is:

$$\frac{Q}{t} = \frac{\kappa A(T_{hot} - T_{cold})}{d}$$



Q = heat transferred in time = t

K **= thermal conductivity of the barrier**

A **= area**

T **= temperature**

d **= thickness of barrier**

SUSTAINABILITY

The exact rate of Heat Loss or Gain is very complicated to calculate on theoretical ground alone, since it shall be affected by -

- *Air movement on casing surface / Ambient wind velocity*
- *Colour / Texture of the casing (e.g. casing emissivity)*
- *Vertical and horizontal orientation of the casing*
- *Exposure to thermal radiation,(e.g. Sun light)*

SUSTAINABILITY

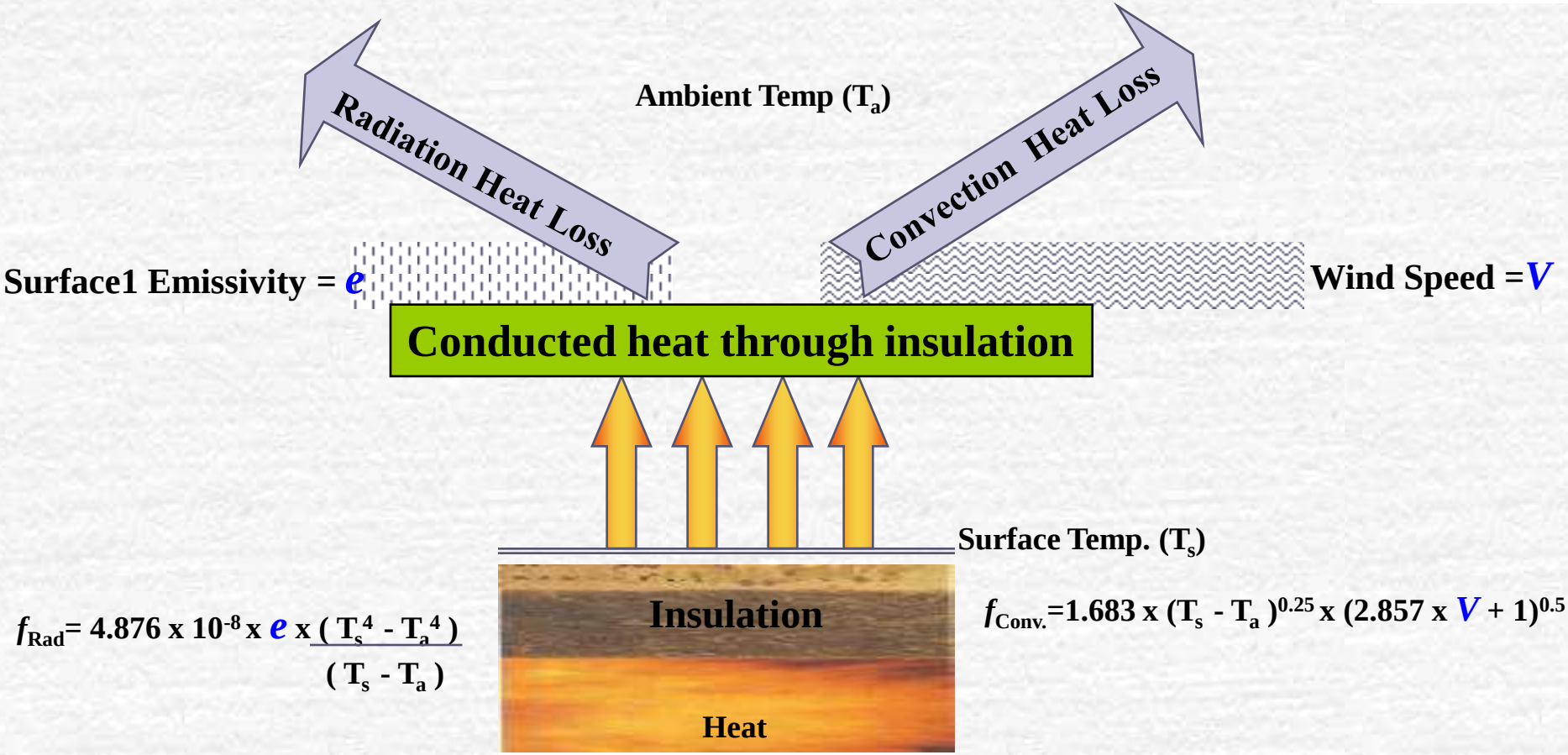
Surface Heat Transfer or film Coefficient (f)

Time rate of heat flow per unit area by convection and radiation from unit area of the surface, for unit temperature difference between the surface and the surrounding medium.

$$f = f_{Conv.} + f_{Rad.}$$

SUSTAINABILITY

Surface Heat Transfer or film Coefficient



$$f_{Rad} = 4.876 \times 10^{-8} \times e \times \frac{(T_s^4 - T_a^4)}{(T_s - T_a)}$$

$$f_{Conv.} = 1.683 \times (T_s - T_a)^{0.25} \times (2.857 \times V + 1)^{0.5}$$

SUSTAINABILITY

Energy Efficient Green Building

A Green Building is one that is environmentally responsible and a healthy place to live and work. It ensure that waste is minimised at every stage during the construction and operation of the building.

SUSTAINABILITY

Energy Efficient Green Building

Tangible Benefits

Reduce Operating Cost

Optimize Life Cycle Economic Performance

Intangible Benefits

Reduce impact on the Environment

Enhance occupant comfort

Improve Productivity of occupant

SUSTAINABILITY

Energy Efficient Green Building

- Buildings protect human being from 'Nature's' fury and 90% of time are spent within.
- The economic, health & environment impact of building is important to society.
- Buildings consume enormous amount of energy for various functions.
- Buildings are made for comfort of human being living within.

COMFORT IS THE CONCERN OF USERS NOT BUILDERS

SUSTAINABILITY

Building Energy Consumption

- Air conditioning - 57 %
- Lighting - 22%
- Ventilation Fans - 16%
- Miscellaneous - 5%

SUSTAINABILITY

STATISTICS OF TROPICAL COUNTRY

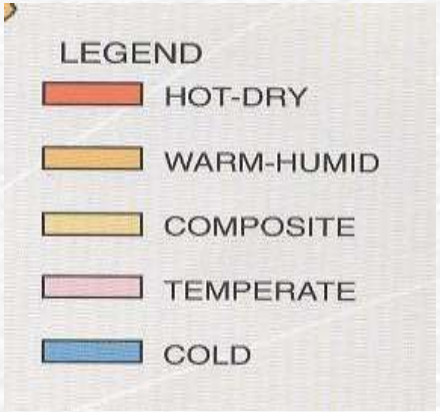
- HIGH AMBIENT MOSTLY 35 TO 45 DEGC EVEN 50 DEGC
- LOW WINTER TEMPS. 4 TO 10 DEGC EVEN MINUS TEMPS.
- HIGH HUMIDITY 60 TO 98 PERCENT

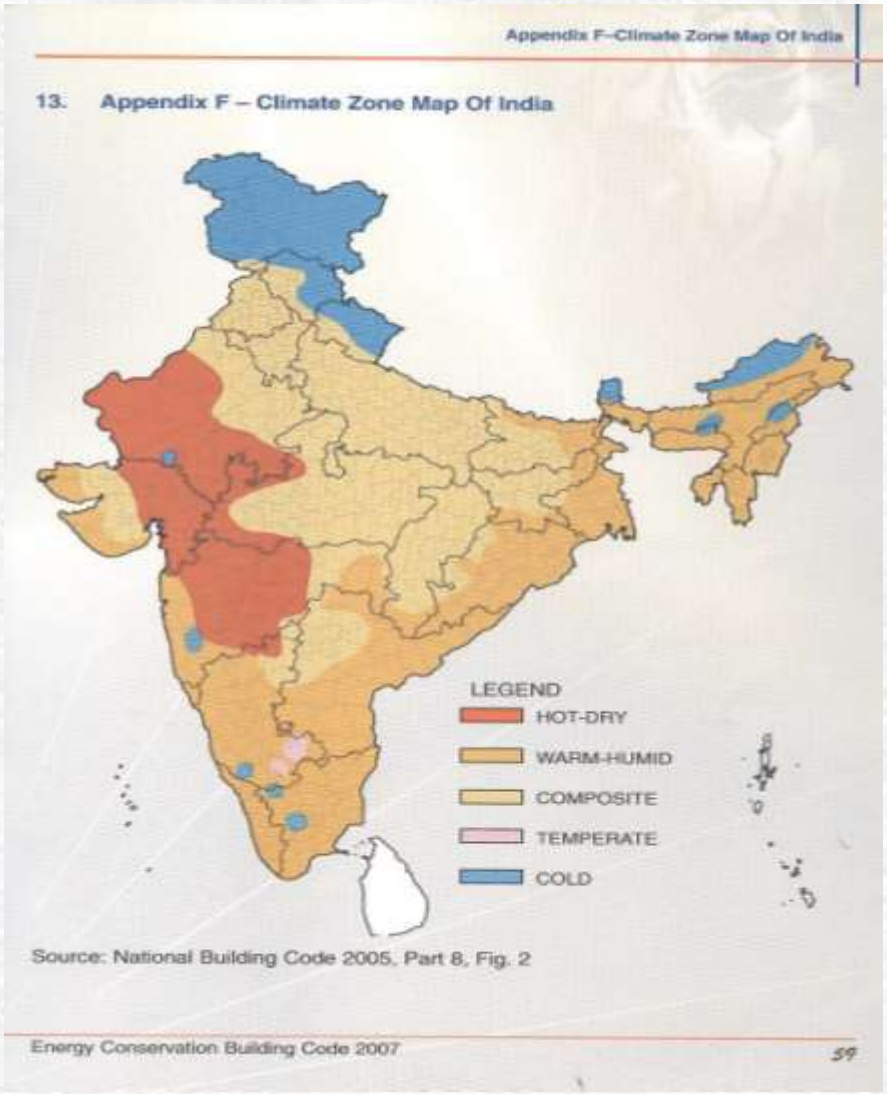
EFFECTS

MAKES LIFE MISERABLE
UN-WORKABLE OFFICE ATMOSPHERE
CONTINUOUS FLOW OF HEAT

SUSTAINABILITY

ECBC 2007





SUSTAINABILITY

ECBC 2007

ACCORDING TO ECBC			AS PER LLOYD INSULATIONS MATERIALS			
A) Roof Assembly U-factor and Insulation R-value Requirements						
Climate Zone	24- Hour use buildings Hospitals, Hotels, Call Centers etc.		Thickness of Insulation Materials			
	Maximum U-factor of the overall assembly (W/m^2-°C)	Maximum R-value of insulation alone (m^2 - °C/W)	RW (MM)	PUF/PIR (MM)	EPS (MM)	XPS (MM)
Composite	U-0.26	R-3.5	120	75	135	95
Hot and dry	U-0.26	R-3.5	120	75	135	95
Warm & Humid	U-0.26	R-3.5	120	75	135	95
Moderate	U-0.40	R-2.1	75	50	85	60
Cold	U-0.26	R-3.5	120	75	135	95

SUSTAINABILITY

ECBC 2007

ACCORDING TO ECBC			AS PER LLOYD INSULATIONS MATERIALS			
A) Roof Assembly U-factor and Insulation R-value Requirements						
Climate Zone	Daytime use buildings Other Building Types		Thickness of Insulation Materials			
	Maximum U-factor of the overall assembly (W/m^2-°C)	Maximum R-value of insulation alone (m^2 - °C/W)	RW (MM)	PUF/PIR (MM)	EPS (MM)	XPS (MM)
Composite	U-0.40	R-2.1	75	40	85	65
Hot and dry	U-0.40	R-2.1	75	40	85	65
Warm & Humid	U-0.40	R-2.1	75	40	85	65
Moderate	U-0.40	R-2.1	75	40	85	65
Cold	U-0.40	R-2.1	75	40	85	65

SUSTAINABILITY

ECBC 2007

TYPICAL ENERGY CONSERVATION CASES FOR BUILDING ROOF & WALLS as per ECBC Norms (24 Hr.)

COMPOSITE CASE STUDY

150mm RCC roof
225 mm Brick wall
For Summer Ambient Temp. = 40 deg.C.
For Winter Ambient Temp. = 4 deg.C.

Size of Building
L = Length = 33m
W=Width = 31m
H = Height = 3.5 m

CASE I = SUMMER — Considering Roof Area of 1000 m2 & Wall Area 448 m2

Insulation material	Heat gain through Roof & wall (W/m2)	Savings (W/m2)	Total Heat ingress	Cost of Energy @ Rs.5.10/KW For 300 Days ,10 Hr.	Savings (at 70% efficiency)	Equivalent TR (at 70% efficiency)	Savings in TR
	A	B	(KW)	(Rs/Year)	(Rs/Year)		
Bare RCC & Brick	99.16	-	45.120	690336	NIL	9.00	NIL
75 mm PUF/PIR insulation	6.4	92.76	9.350	143055	383096.70	1.86	7.14
120 mm Rockwool Insulation	6.4	92.76	9.350	143055	383096.70	1.86	7.14
135 mm EPS	6.4	92.76	9.350	143055	383096.70	1.86	7.14
95 mm XPS	6.4	92.76	9.350	143055	383096.70	1.86	7.14

SUSTAINABILITY

ECBC 2007

TYPICAL ENERGY CONSERVATION CASES FOR BUILDING ROOF & WALLS as per ECBC Norms (12 Hr.)

COMPOSITE CASE STUDY

150mm RCC roof
225 mm Brick wall
For Summer Ambient Temp. = 40 deg.C.
For Winter Ambient Temp. = 4 deg.C.

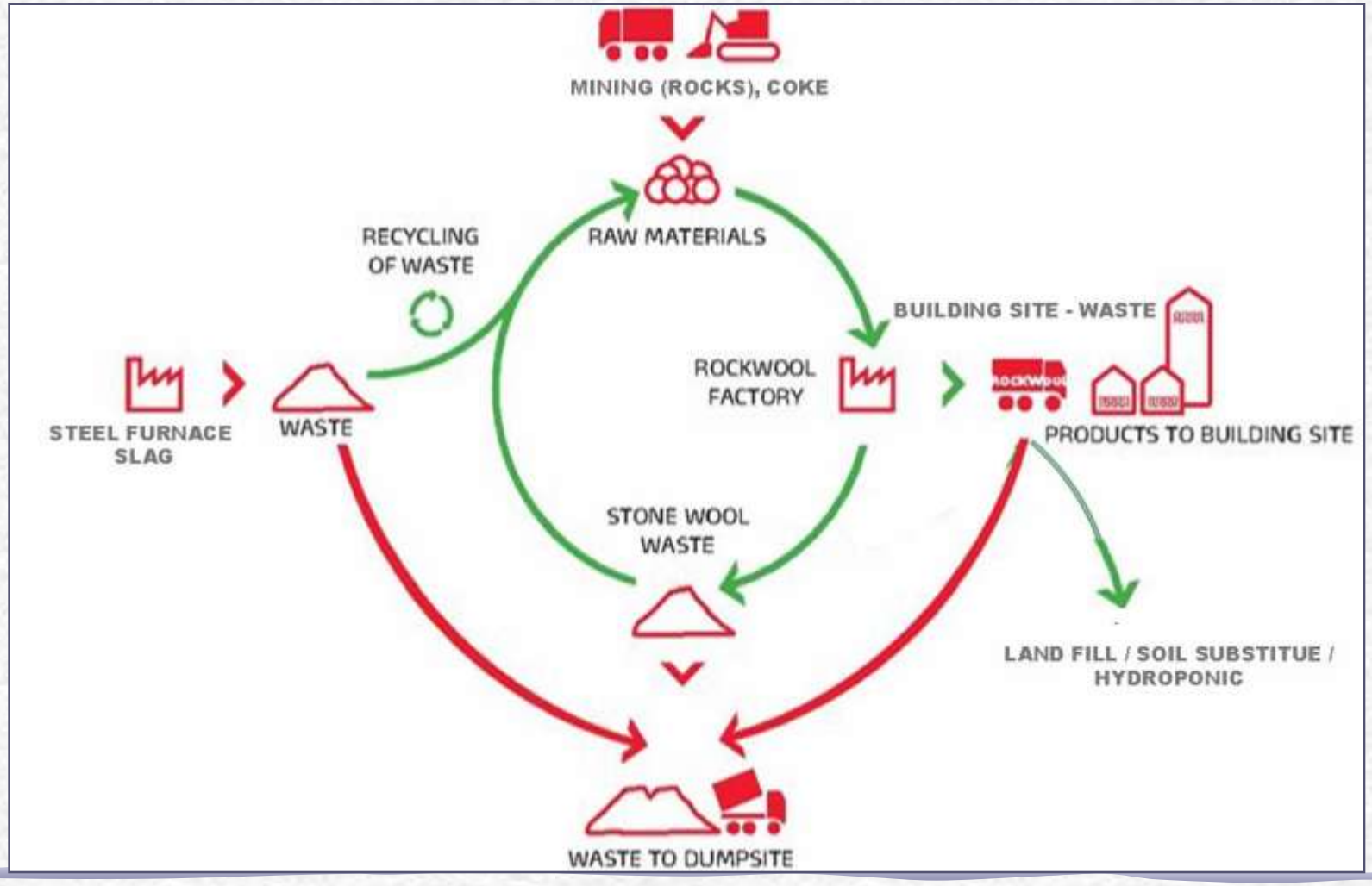
Size of Building
L = Length = 33m
W=Width = 31m
H = Height = 3.5 m

CASE I = SUMMER — Considering Roof Area of 1000 m2 & Wall Area 448 m2

Insulation material	Heat gain through Roof & wall (W/m2)	Savings (W/m2)	Total Heat ingress	Cost of Energy @ Rs.5.10/KW For 300 Days ,10 Hr.	Savings (at 70% efficiency)	Equivalent TR (at 70% efficiency)	Savings in TR
	A	B	(KW)	(Rs/Year)	(Rs/Year)		
Bare RCC & Brick	99.16	-	45.12	690336	NIL	9.00	NIL
40 mm PUF/PIR insulation	12.55	86.61	15.20	232560	320443.20	3.03	6.37
75 mm Rockwool Insulation	12.55	86.61	15.20	143055	383096.70	3.03	6.37
85 mm EPS	12.55	86.61	15.20	143055	383096.70	3.03	6.37
65 mm XPS	12.55	86.61	15.20	143055	383096.70	3.03	6.37
80 mm Nitrile Rubber	12.55	86.61	15.20	143055	383096.70	3.03	6.37

SUSTAINABILITY

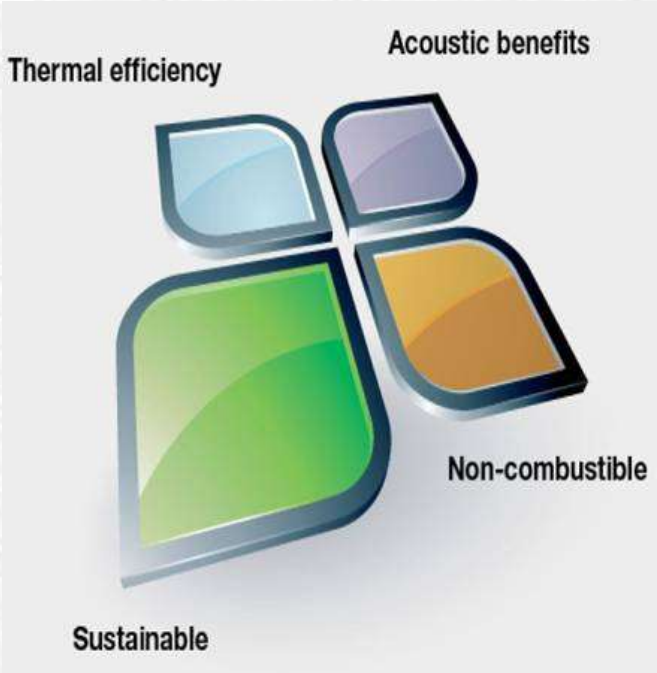
ROCKWOOL – Most Recycled Green Insulation



SUSTAINABILITY

ROCKWOOL – Most Recycled Green Insulation

THE MOST ECONOMIC YET ENERGY EFFICIENT THERMAL INSULATION MATERIAL ABUNDANT AVAILABLE IN THE COUNTRY



SUSTAINABILITY

ROCKWOOL – Most Recycled Green Insulation

Reduce – Reuse – Recycle (R-R-R)

Its use reduces energy consumption, less fossil fuel burning & reduces Co2 emission

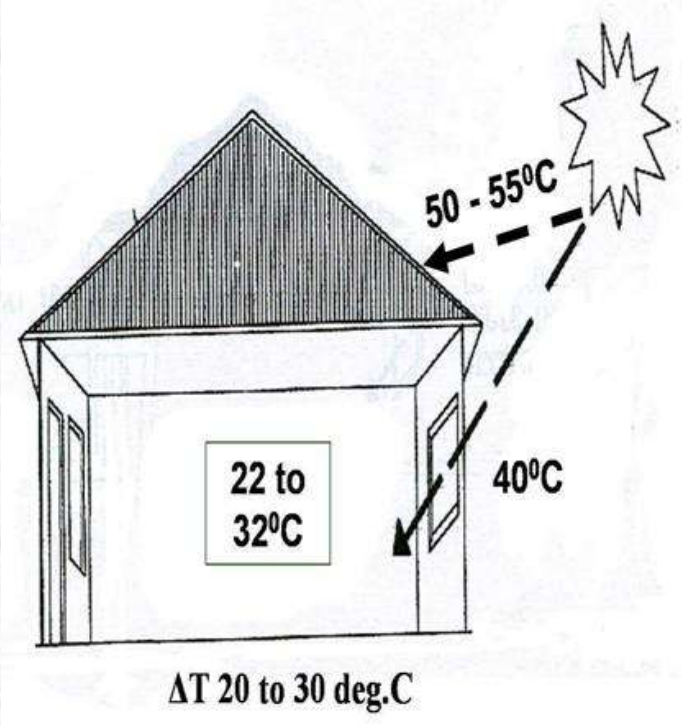
100% re-useable

97% recyclable

SUSTAINABILITY

THERMAL INSULATION

THERMAL INSULATION IS THE SYSTEM, PROVIDED TO RETARD FLOW OF HEAT OR COLD FROM ENVIRONMENT TO INSIDE OF BUILDING AND VICE-VERSA.



SUSTAINABILITY

Thermal Insulation Survey

Thermal insulation survey is a service oriented towards bringing existing shortcomings and unrealised opportunities of saving energy through extensive field data collection and possible up gradation of insulation materials for achieving higher plant efficiency.

SUSTAINABILITY

Thermal Insulation Survey : Concept

It is essential to know precisely the heat loss for the insulated surfaces in operation.

Annual heat loss in terms of money are then worked out.

A new upgraded insulation system is then designed

An economic analysis is then carried out to study the viability of the proposed system.

The investment on proposed system and simple payback are then worked out.

SUSTAINABILITY

Thermal Insulation Survey : Methodology

Following operational parameters and design data are collected from the plant authorities :

- **Cost of Fuel**
- **Calorific value of fuel**
- **Boiler / Equipment design efficiency**
- **No. of plant operating hours**
- **Pipe OD, Length and Dimension of Equipments**
- **Operating Temperature of Process fluids / Steam**

SUSTAINABILITY

Thermal Insulation Survey : *Methodology*

Following field data are collected :

Average Insulation cladding surface temperature

Corresponding ambient temperature

Corresponding air velocity

Emissivity of Insulation cladding surface

SUSTAINABILITY

Thermal Insulation Survey : *Analysis*

The data collected during plant survey are then analysed systematically and calculations are performed on present value to arrive at the quantity of energy and financial losses.

SUSTAINABILITY

Thermal Insulation Survey : *Economics*

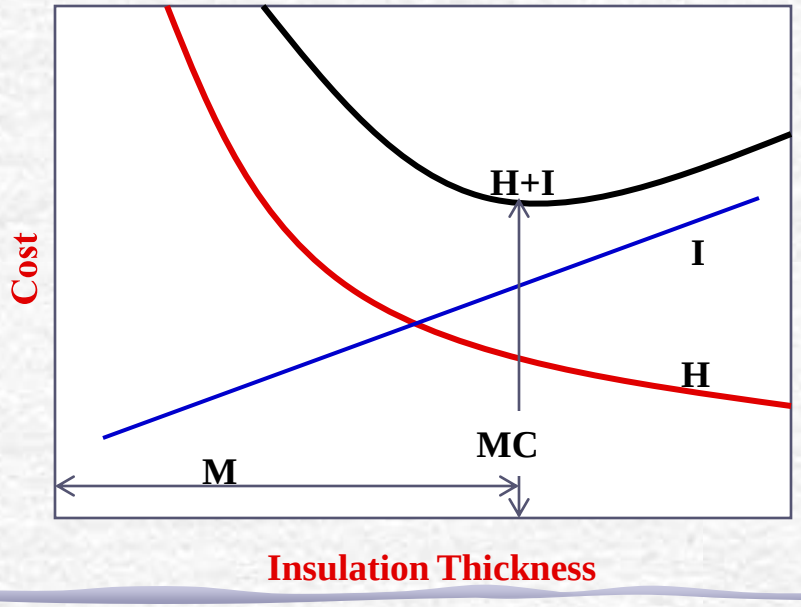
The economic benefits of insulation shall vary according to application and method of financial appraisal. One of the simplest methods of financial appraisal is the "Pay Back" analysis, where costs are compared with savings and the result is expressed in terms of "Pay Back Period".

There is a definite limiting thickness of insulation which is known as "*Economic Thickness*"

SUSTAINABILITY

Thermal Insulation Survey : *Economic Thickness*

The *Economic Thickness* of insulation is that thickness at which the costs of heat loss, plus the installed cost is at minimum.



Where :

I = Cost of Insulation

H = Cost Of Heat Loss

I+H= Total Cost

M = Economic Thickness

MC= Minimum Cost

SUSTAINABILITY

SELECTION OF INSULATION MATERIAL:

- THE MATERIALS USED FOR INSULATION SHALL CONFORM TO THE RELEVANT INDIAN STANDARDS WHEREEVER THEY EXSIST.
- INSULATION MATERIAL USED SHOULD BE SUITABLE FOR USE AT THE OPERATING TEMPERATURE AS STATED BY THE PURCHASER.
- HAND MADE MATERIALS FROM LOOSE WOOL ARE NOT PERMITTED DUE TO POOR CONSISTENCY.
- ALL INSULATION MATERIAL SHALL HAVE A PROVEN SERVICE RECORD OF SATISFACTORY PERFORMANCE UNDER INDIAN CONDITIONS IN SIMILAR PROCESS PLANT

SUSTAINABILITY

OTHER IMPORTANT ASPECTS

Water repellents

Corrosion resistant

Fire Proof / non combustible

Durability

Green insulation materials

THINK INSULATION…

SAVE ENERGY…

PROTECT ENVIORNMENT…

for a better future