
Energy Utilization in Buildings and its Approach on Energy Savings

11 February 2010

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Agenda

- Concept of sustainability
- Buildings in Hong Kong
- Energy consumption and its characteristics
- Energy and carbon audits
- Energy Efficient Technologies & Applications
- Use of natural energy in building
- Concept of life cycle assessment
- Technologies advancement



Concept of Sustainability

Concept of Sustainability

"one that meets the needs of the present without compromising the ability of future generations to meet their own needs"

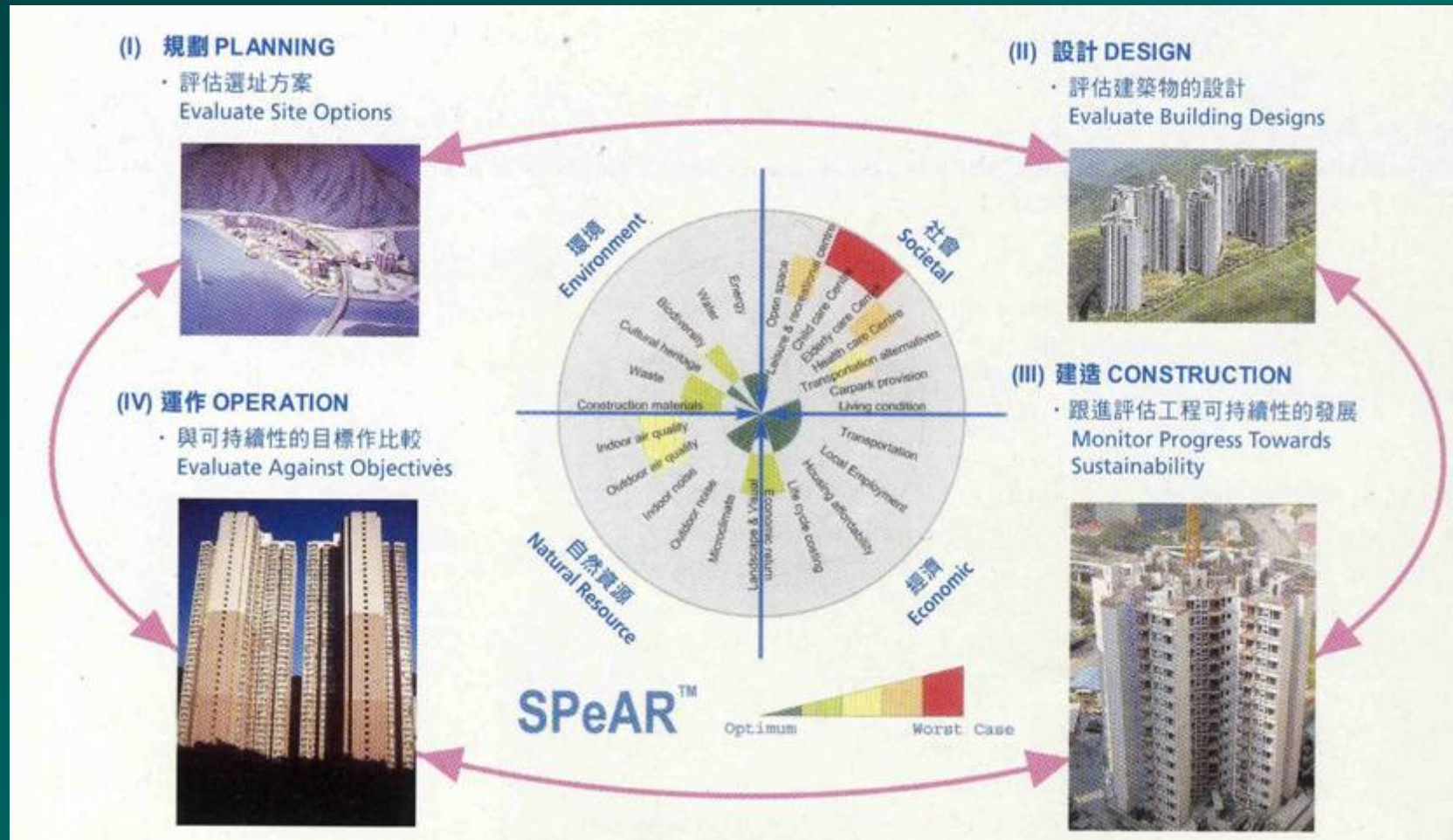
(World Commission on Environment and Development, 1987)



Balance in this generation & future generations !!!!!

Concept of Sustainability

Sustainability Assessment



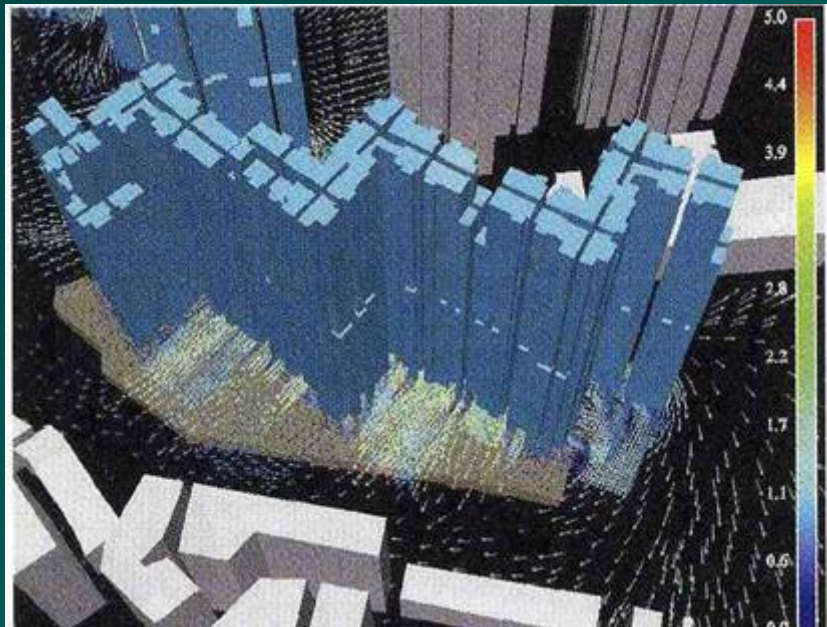
Concept of Sustainability

SPeAR (Sustainable Project Appraisal Routine)

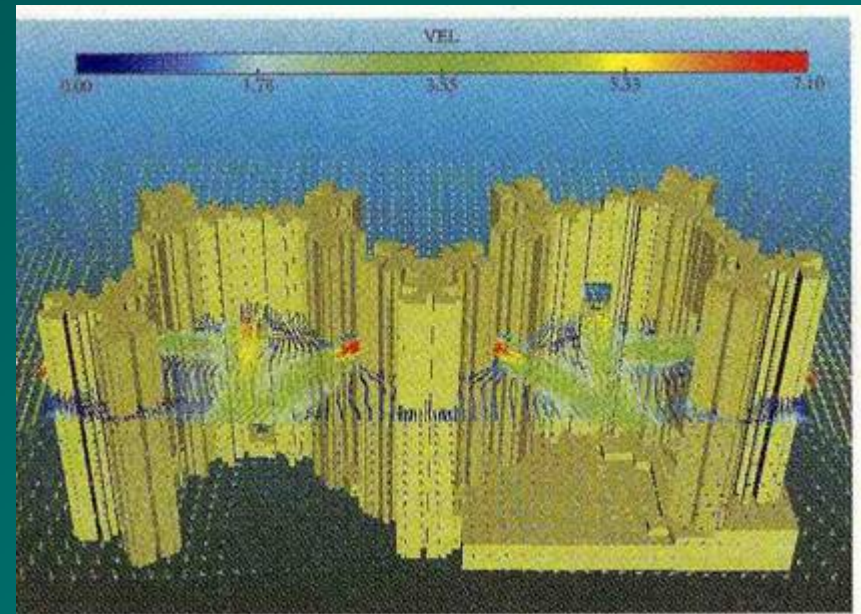


Concept of Sustainability

Outdoor Environment



Low level opening enhance pedestrian wind comfort



Massing Opening to enhance wind penetration

Concept of Sustainability

Indoor Environment



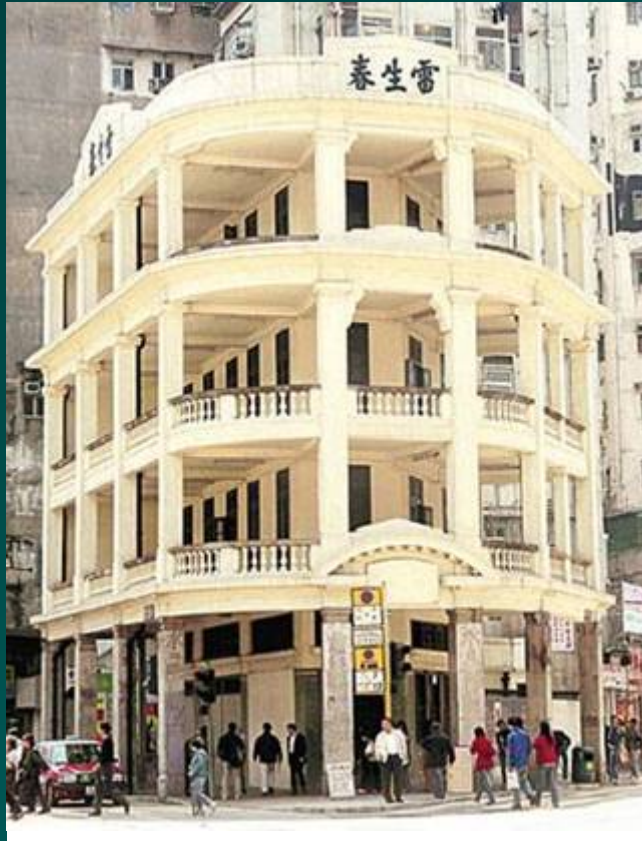
Cross ventilation design enhances air circulation



Natural daylight enhances visual comfort

Buildings in Hong Kong

Building in Hong Kong



雷生春 Lui Seng Chun



Hong Kong Inte'l Airport



IFC

From oldest to most modern buildings in Hong Kong. Are they all sustainable?

Building in Hong Kong

Construction Stage

- Pre-fabrication of Building Module
- New Construction Technology minimizes in-site temporary works and timber use and eliminate scaffolding
- Off-site construction reduces environmental impact



Building in Hong Kong

Energy Efficient

- Apply energy efficient technologies that can be applied in various kinds of building services installations
- Execute Building Management System to optimize energy uses



EMSD Headquarter

Building in Hong Kong

Renewable Energy

- Most efficient solar energy application – Solar Thermal
- Architectural Design
- Semi-transparent



Building in Hong Kong

Green Roof, Green Wall

- Most efficient solar energy application – Solar Thermal
- Architectural Design
- Semi-transparent

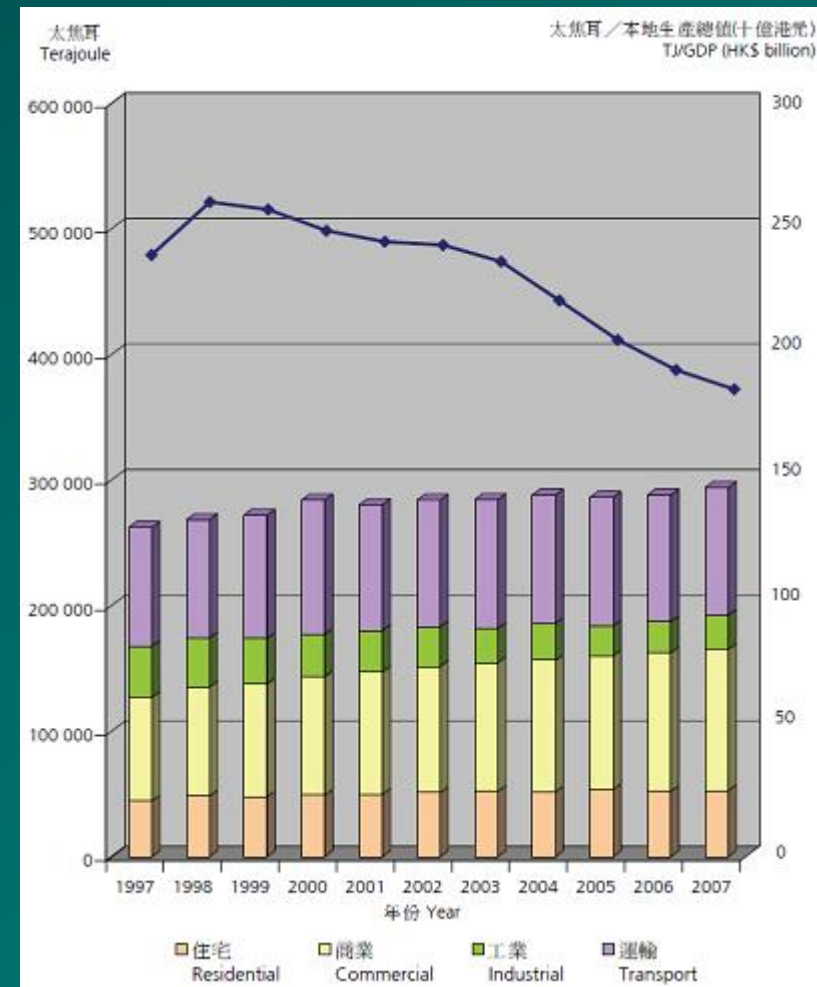


Energy consumption and its Characteristics

Energy consumption and its characteristics

Energy end-use Per GDP in Hong Kong

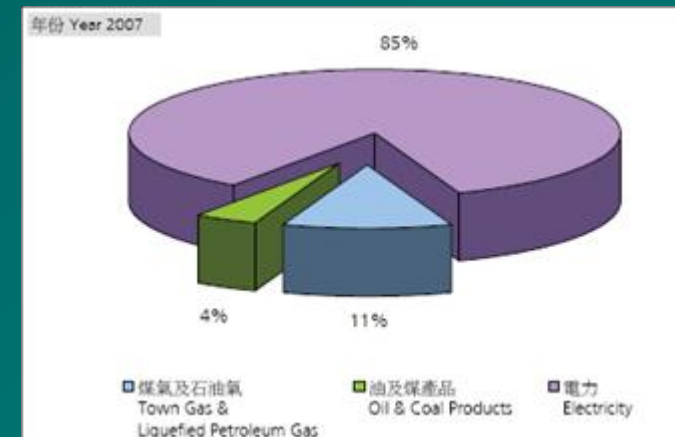
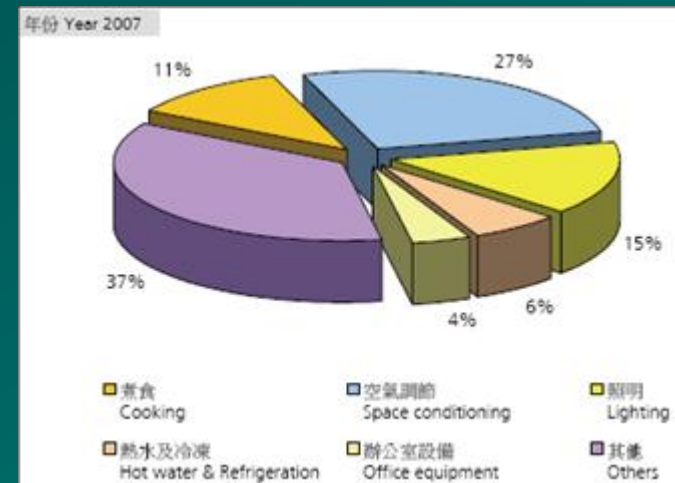
- Energy end-use per GDP for last ten years was decreasing
- Energy use for Commercial Buildings were increasing
- Energy use for Industrial Buildings were decreasing due to the reform of Hong Kong economic structure



Energy consumption and its characteristics

Commercial Buildings Energy end-use

- Air-conditioning & Lighting consume around 50% of energy for entire building
- Electricity account for 85% of energy use while oil, coal, LPG and town gas record 15%.
- Electricity consumption increase steadily for last ten years. Energy efficient in this section is key focus

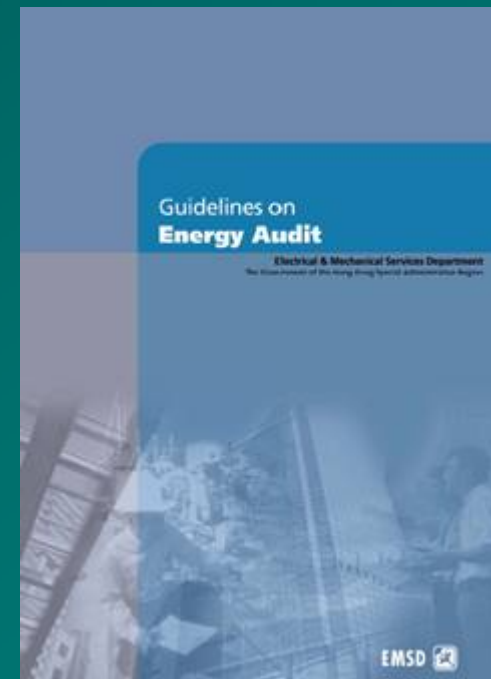


Energy and Carbon Audits

Energy and Carbon Audits

What is Energy Audits ?

- Energy Audit is an examination of an energy consuming equipment / system to ensure that energy is being used efficiently. It looks for Energy Management Opportunities (EMO) for improvements
 - Walk through energy audit
 - Detailed energy audit
- Energy Efficiency Assessment
- Mandatory Building Energy Code Compliance Check



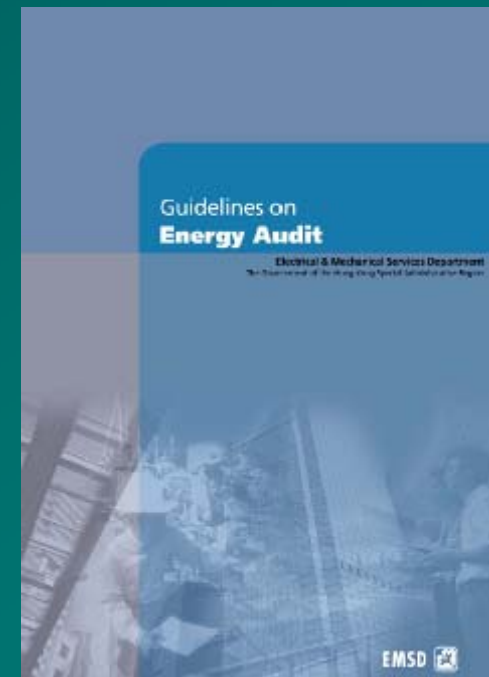
Energy and Carbon Audits

What is Energy Audits ?

Steps for Energy Efficiency Assessment

- 🌐 Gathering Information and Data
- 🌐 Review the Operating Performance of the Equipment
- 🌐 Energy Management Opportunities
- 🌐 Report Preparation

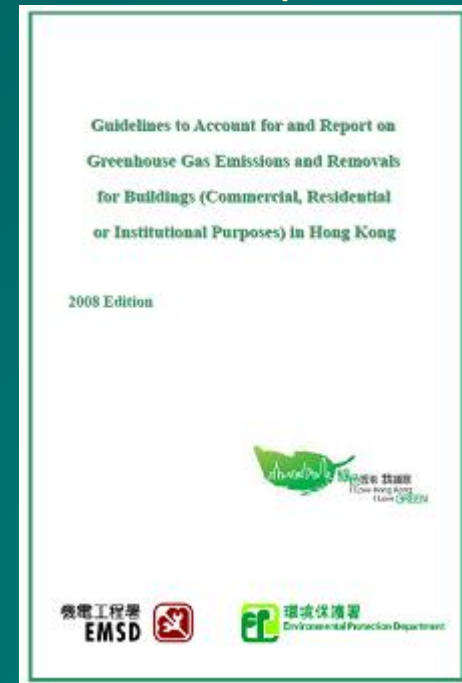
'don't waste when not in use'
'do more with less'



Energy and Carbon Audits

What is Carbon Audits ?

- Carbon Audit refers to the quantification of the GHG directly and indirectly emitted by a corporation
- Companies will need to be able to measure their GHG footprint if they are to manage GHG emissions
- Carbon Audit provides an indicator for a company to derive a pragmatic approach to reduce GHG emissions and allows evaluation of the effectiveness of measures and policies introduced



Carbon Audits

Guidelines and Protocol for Carbon Audits

- Although measurement of GHG emissions is becoming an accepted part of business accounting practice, and environmental reporting is increasing generally, there is no accepted standard measurement protocol for GHG emissions
- Reference can be made to some commonly used protocol:
 - The Greenhouse Gas Protocol (**GHG Protocol**) - jointly convened in 1998 by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI)
 - **General Reporting Protocol** of the Climate Registry - The Registry is the premier voluntary GHG registry in North America.
 - **IPCC Guidelines** – published by the Task Force on National Greenhouse Gas Inventories The Intergovernmental Panel on Climate Change

Carbon Audits

Guidelines and Protocol for Carbon Audits (Cont'd)

- Guidelines are also developed by governments according to their own country-specific methodologies, substituting national data for the generic international data provided
- **Guidelines to Account for and Report on Greenhouse Gas Emissions and Removals for Building (Commercial, Residential or Institutional Purposes) in Hong Kong** – published by the Environmental Protection Department and the Electrical and Mechanical Services Department

Carbon Audits

Reporting a Company's Carbon Footprint

- The carbon footprint will comprise those emissions that the company is directly responsible for from fuel generation usage to fuel usage from transport and emissions from other process.
- The wider footprint of the group will be related to its waste and recycling policy, which has a direct link to emissions, but not included in the core footprint. Most companies will also be able to create carbon emissions or savings from its interaction with its supply chain.

Carbon Audits

Carbon Audit Procedure

- Set the Boundaries
- Scope of Emissions/Removals
- Collect Data and Information
- Apply Emission Conversion Factors
- Calculate Carbon Footprint
- Prepare Report
- Post Audit

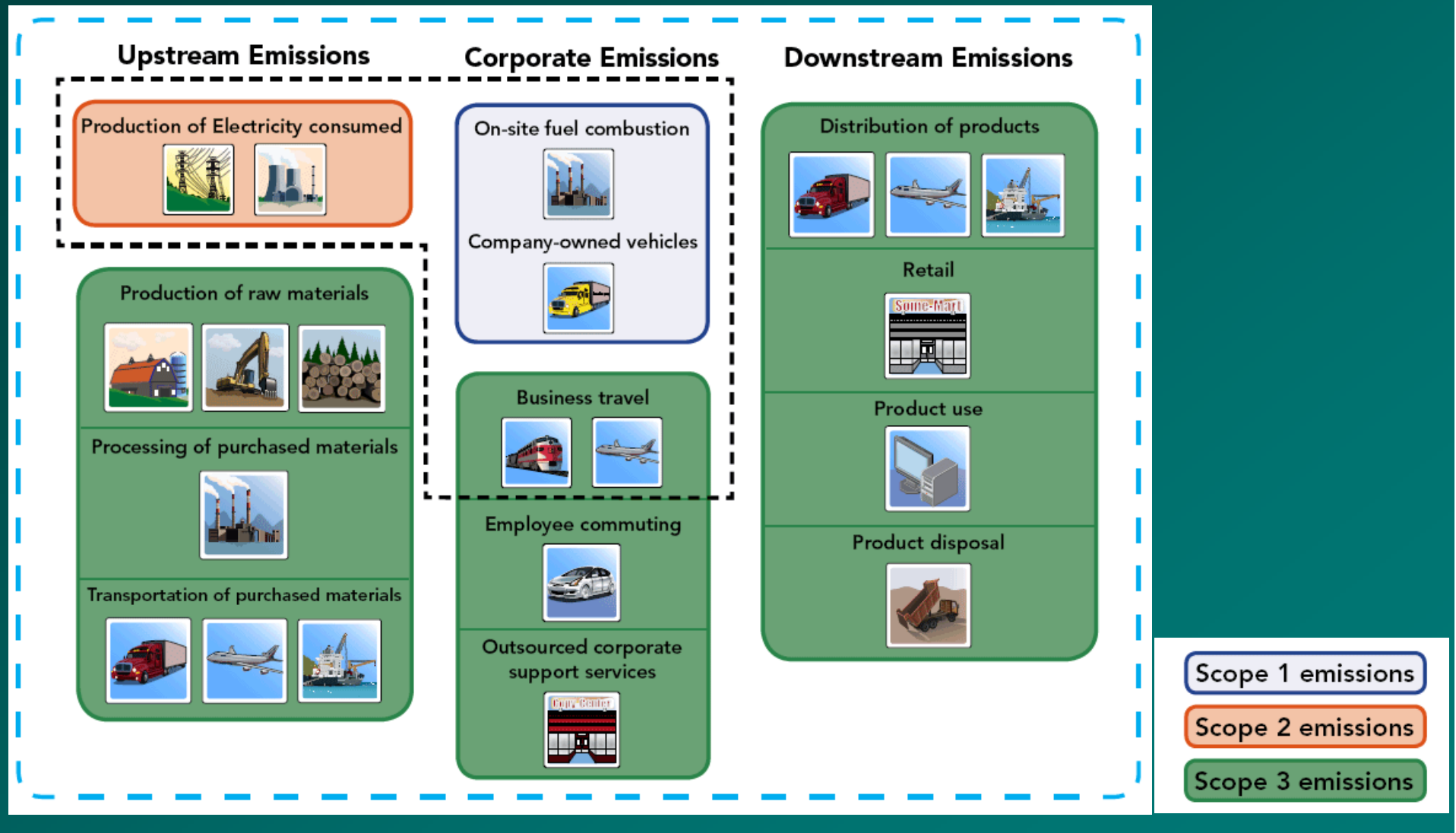
Carbon Audits

Scope of Emissions (direct and indirect) and removals

- 🌍 **Scope 1** - covers direct emissions from sources and removals from sinks within the boundary of an organization such as fuel combustion and manufacturing processes.
- 🌍 **Scope 2** - covers indirect emissions from the consumption of purchased electricity, steam or heat produced by another organization. Scope 2 emissions result from the combustion of fuel to generate the electricity, steam or heat and do not include emissions associated with the production of fuel.
- 🌍 **Scope 3 (Optional for reporting purposes)** - includes all other indirect emissions that are a consequence of an organization's activities but are not from sources owned or controlled by the organization. Whilst being optional Scope 3 offers the greatest transparency in its inventory and creates a larger scope of potential influence.

Carbon Audits

Carbon Audit Protocol



Carbon Audits

Scope 1 Direct Emissions and removals

Stationary sources –

- Combustion of fuel in boilers or furnaces that are owned by the reporting organization
- Generation of electricity, steam, or heat in equipment that is owned by the reporting organization

Mobile sources –

- Business travel in vehicles that are owned by the reporting company, such as company cars or corporate jets.
- Employee commuting in company-owned vehicles, such as a van pool or company car

Process-related emissions – industrial production processes that transform materials chemically or physically

Fugitive emission - GHG released from equipment and systems e.g. HFCs and PFCs emission during the use of refrigeration equipment

Removals – Assimilation of CO₂ into biomass e.g. planting of tree

Carbon Audits

Scope 2 Indirect Emissions

- 🌐 Generation of purchased electricity, steam, or heat
- 🌐 Generation of purchased gas

Carbon Audits

Scope 3 Indirect Emissions

- Business travel in non-company-owned vehicles such as rental cars, employee cars, trains, and commercial planes
- Combustion of fuel in boilers or furnaces not owned by the reporting organization
- Employee commuting in vehicles not owned by the reporting organization, such as light rail, train, buses, and employee cars
- Production or manufacture of materials and resources used by an office organization, such as furniture, paper, equipment, toner cartridges, etc.
- Electricity used for fresh water processing and sewage processing by the public services entities
- Incineration of office waste or decomposition in a landfill when the facilities are not owned by the reporting organization
- Any outsourced activities such as shipping, courier services, cleaning and printing services

Energy Efficient Technologies & Applications

Energy Efficient Technologies & Applications

Currently Available New Technologies

- Energy Label
- Lighting
- MVAC
- Lifts and escalators
- Water Heating & Waste Heat Recovery



Technologies Advancement

Energy Label

Recognition Type

- CFL
- Photocopiers
- Multifunction device
- Electric rice cooker
- Dehumidifier
- Laser printer
- TV set
- LCD Domestic gas instantaneous
- Electronic ballast
- Computer
- Fax

Grading Type

- Room cooler
- Refrigerator
- Washing Machine
- Electric storage water heater
- Electric clothe dryer



Recognition Type



Grading Type

Energy Efficient Technologies & Applications

Lighting

- CFL (save 80%)



- Electronic Ballast & T5 Fluorescent Tube (save ~20-30%)

Lifts and escalators



- High reflectance nano reflector to increase light output from fluorescent lamp

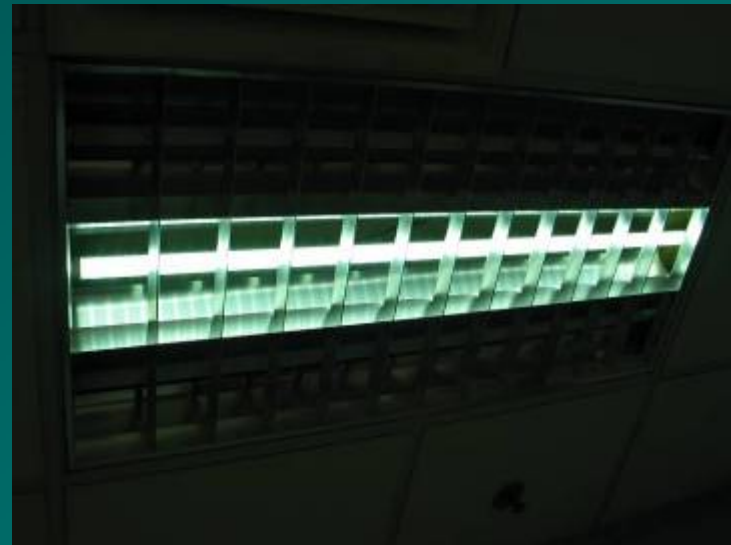


Energy Efficient Technologies & Applications

Lighting

Points to Note

- Origin of chips
- Use proper drivers
- Heat rejection required
- Use reflector / diffuser
- Light intensity decline
- Use of Day Light (Passive Design)
- Light Quality vs Energy Efficiency
- Lighting Design



Energy Efficient Technologies & Applications

Mechanical Ventilation & Air Conditioning



Automatic tube cleaning
(save 10-15%)



Water cooled chiller
(save ~30%)

Energy Efficient Technologies & Applications

Mechanical Ventilation & Air Conditioning



VSD for Fan & Pump (save ~30%)



**Heat Recovery Ventilator
(reclaim ~40% energy)**



Energy Efficient Technologies & Applications

Lift

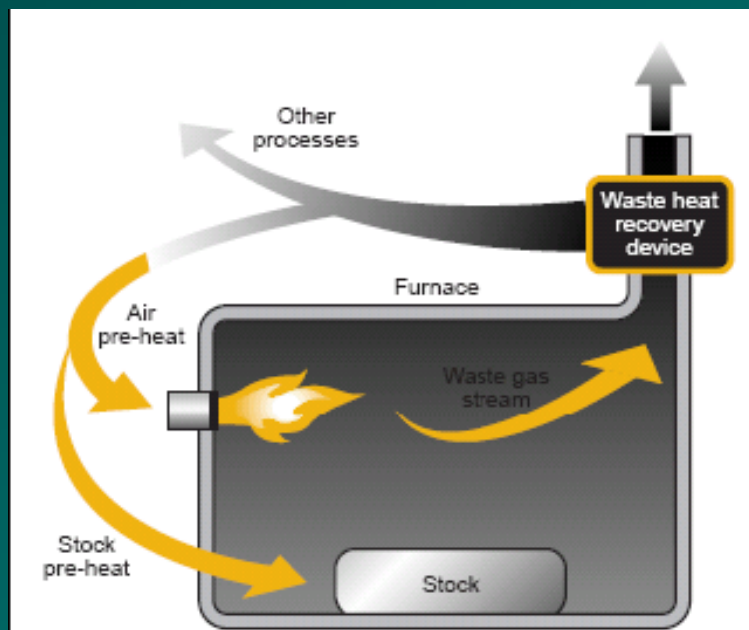
- Safety First
- Choice of lift
 - Material
 - Motor
 - BS inside
- Lift management system – run on demand
- Double deck lift – point to point travel
- Maintenance Strategy



Energy Efficient Technologies & Applications

Water Heating & Waste Heat Recovery

- **Boiler Economizer**
- **Waste Heat Recovery Device**
- **Flue heat recovery gain ~5% efficiency**



Use of Natural Energy in Building

Use of natural energy in building

Building Energy Management – Green Roof, Green Wall



Use of natural energy in building

Renewable Energy System - Solar

- Most efficient solar energy application – Solar Thermal
- Architectural Design
- Semi-transparent



Use of natural energy in building

Renewable Energy System - Wind

- 🌐 Wind Turbine convert the wind's kinetic energy into mechanical or electrical energy
- 🌐 Visual & ecological impact



Concept of Life Cycle Assessment

Concept of Life Cycle Assessment

Life Cycle

- Raw Material Acquisition
- Product Manufacturing and Transportation
- Construction and Fitting out
- Operation and Maintenance
- Renovation and Demolition
- Grave



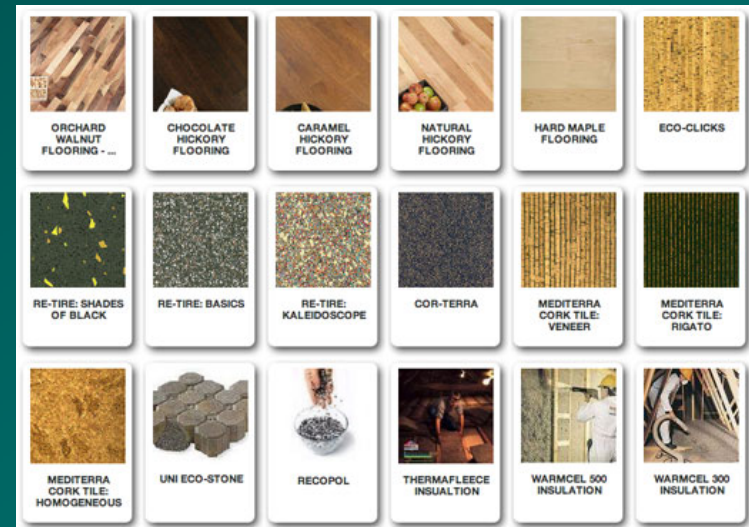
生命週期評估及成本概念
Concept of Life Cycle Assessment and Costing

Concept of Life Cycle Assessment

Life Cycle

Embodied Energy

- Measures the amount of energy needed to produce building materials
- Reduce recurrent energy use



Technologies Advancement

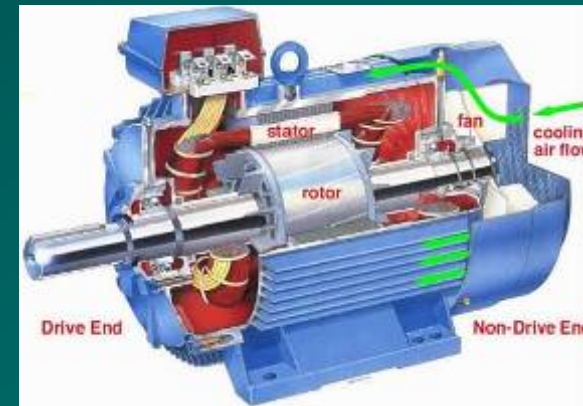
Technologies Advancement

- High Efficiency Motors
- Oil Free Magnetic Bearing Compressor
- Heat Pumps
- LED
- Induction Cooking

Technologies Advancement

High Efficiency Motors

- Efficiency Class Designations
- Higher the nos mean better efficiency
(i.e. EFF 3 > EFF 2 > EFF 1)



Points to note

- Increase use of Copper
- Improve stator design
- Reduce air gap between stator & rotor
- Improve overall design to reduce windage loss

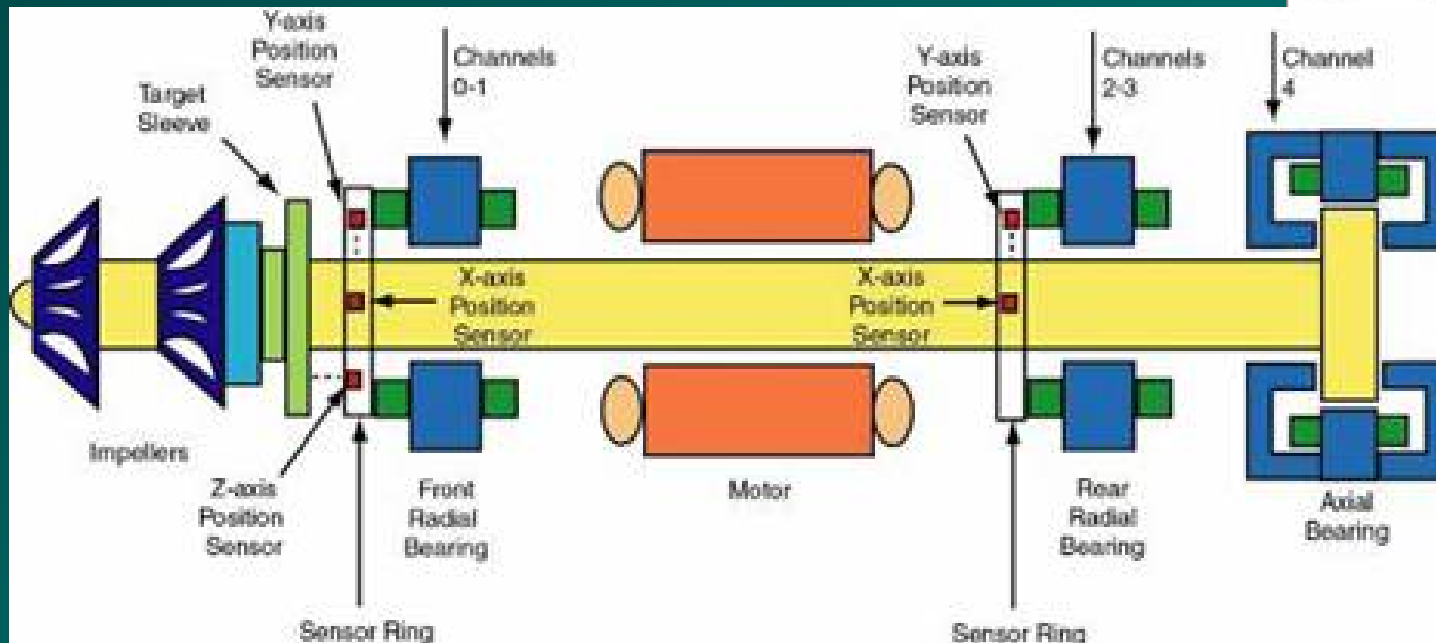
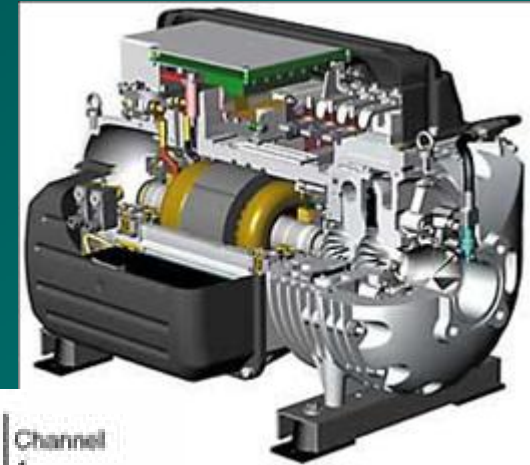


Technologies Advancement

MVAC – Oil Free Magnetic Bearing Compressor

Points to Note

- VSD – Harmonics
- Parts availability



Energy Efficient Technologies & Applications

MVAC – Oil Free Magnetic Bearing Compressor

- First case in HK
- EMSD
- Government House
- High energy efficiency
- High COP
- Expensive
- Bulky

Energy Saving Technology

Oil-free Centrifugal Compressor Chillers

EMSD has installed two oil-free centrifugal compressor chillers, the first introduced into Hong Kong, at the Government House and EMSD Headquarters, to enhance energy efficiency of central air-conditioning systems and reduce associated environmental pollution. These chillers use the latest magnetic bearing technology which reduces energy loss and damage to the bearing and also increases the speed and efficiency of the compressor, achieving a higher energy efficiency but lower noise level during operation than conventional chillers.



Eliminate oil contamination and minimize friction

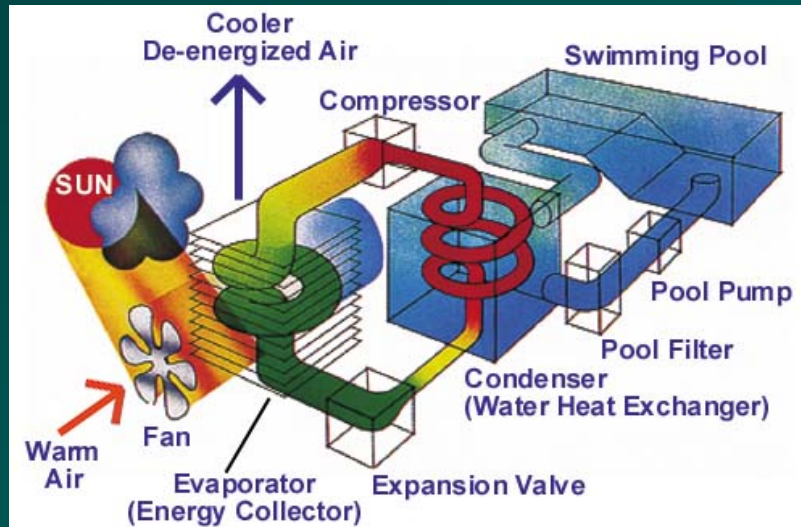
Hong Kong's first Oil-free Centrifugal Compressor Chiller installed at Government House.

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Hong Kong's first Oil-free Centrifugal Compressor Chiller installed at Government House.

Technologies Advancement

Heat Pump – Swimming Pool



Heat Pump Water Heater (COP ~3, save >60%)

Energy Efficient Technologies & Applications

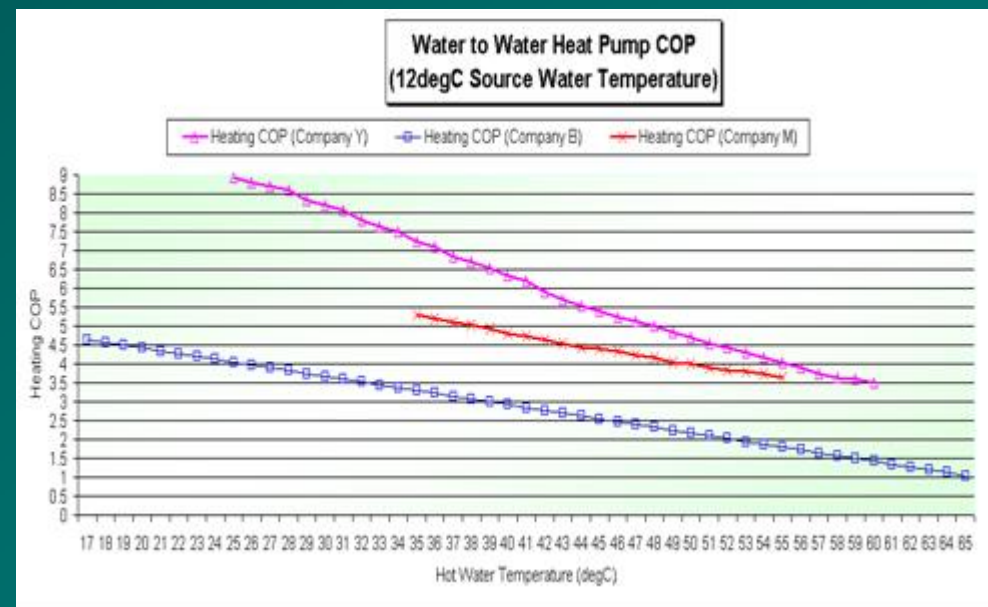
Heat Pump – Water Source

- Mixed refrigerant (HTR01)
 - Non-toxic, non-ozone depleting
- Water Source
- High COP > 5
- High temperature 85°C



Point to Note

- Available heat sink source
- Waste heat source condition



Energy Efficient Technologies & Applications

Heat Pump – CO₂ Heat Pump (Air Source)

- CO₂ refrigerant (R744)
 - Global Warming Potential (GWP) = 1.0 [*GWP of HFC-134a = 1300*]
 - Non-toxic, non-ozone depleting & natural material
- High COP
- High output temperature

Point to Note

- Water pressure problem
- Expensive
- Low Water Flow



Technologies Advancement

LED

LED lamp to replace incandescent light



LED Lamp & Exit Sign (save 80%)



Interior decorative lighting



Technologies Advancement

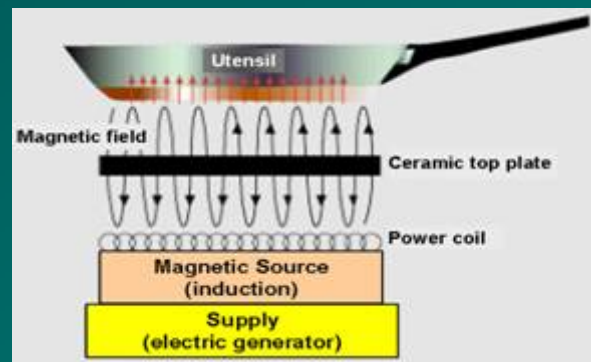
LED

- **Direct replacement fluorescent tubes by LED lamp fluorescent tube**



Technologies Advancement

Induction Cooking



Induction Cooking
(save ~60-80%)