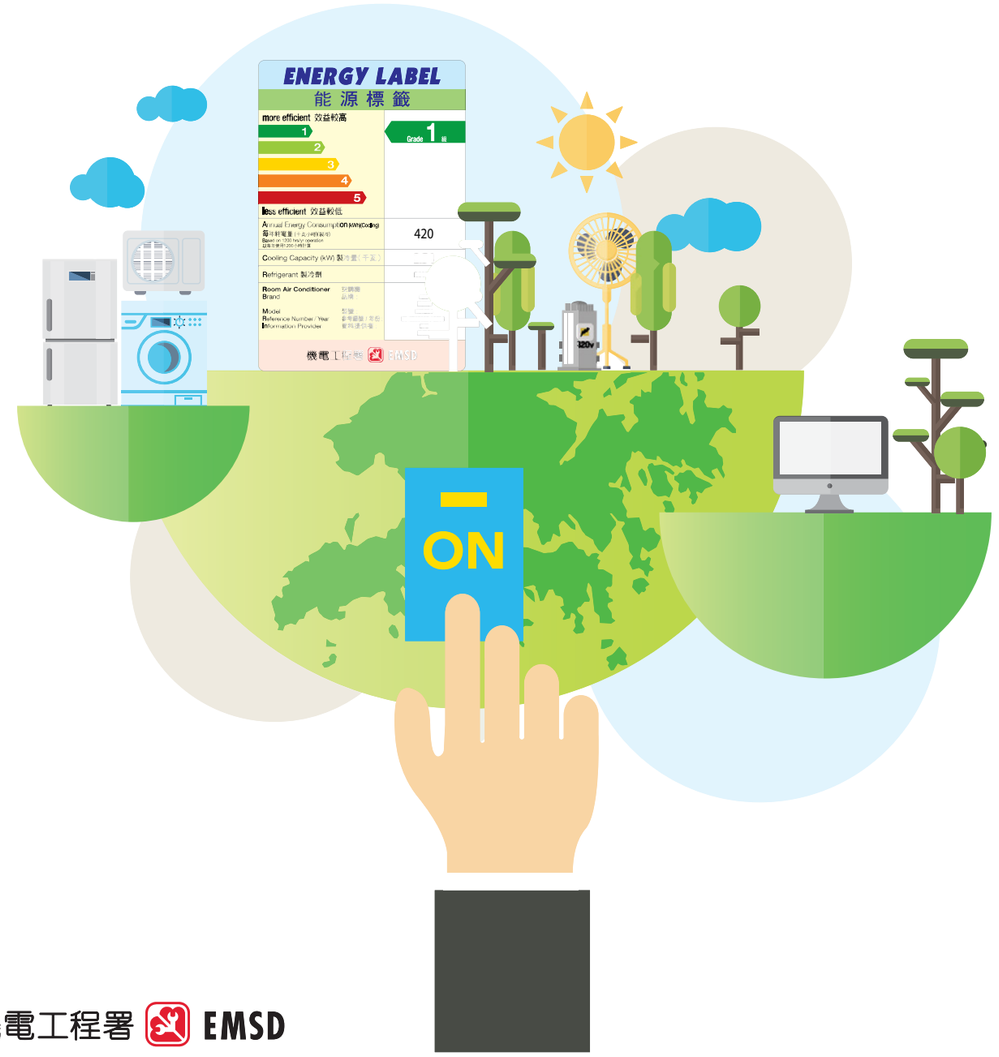
Energy Efficiency Overview



機電工程署 EMSD

Energy Efficiency Office
Electrical and Mechanical Services Department

3 Kai Shing Street, Kowloon, Hong Kong
Tel: 852 2808 3465
Fax: 852 2890 6081
Email: eepublic@emsd.gov.hk

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機電工程署 EMSD

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PREFACE

“Almost every aspect of life today is governed by energy. We need energy to run equipment and vehicles, to produce goods and support life.”

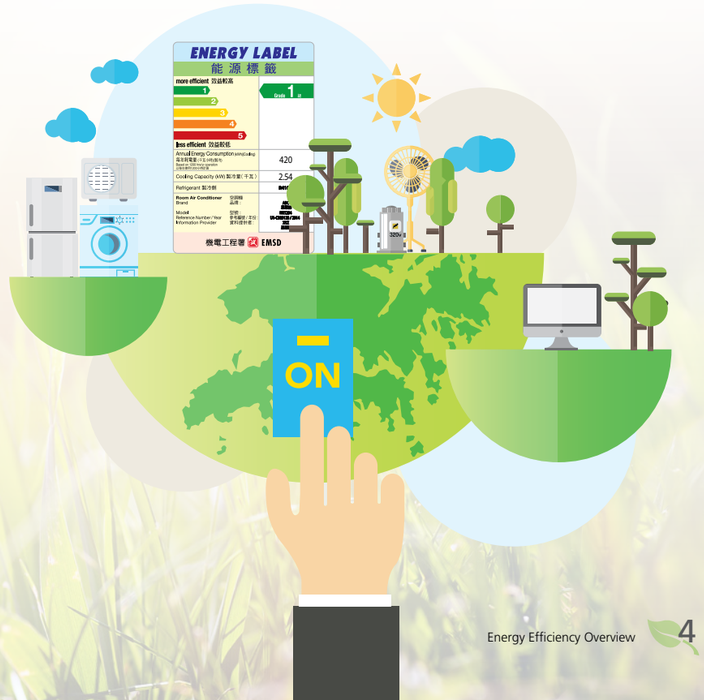
We need energy to run equipment and vehicles, to produce goods and support life. Without energy, there would be no activity, no light and no heat in the world. However, as we get used to the comfort and convenience of the modern urban environment, we are increasingly enjoying a life-style that requires high amount of energy to sustain it. Relying heavily on computers and other electronic facilities, using private cars extensively and consuming more and more animal food are just a few examples of this life-style. Unfortunately, the excessive use of fossil energy renders the world hotter and causes a wide range of irrevocable environmental problems and damage.

This education kit is designed for the Energy Technology and the Environment module under the “Liberal Studies Curriculum and Assessment Guide”, published by the Curriculum Development Council and the Hong Kong Examinations and Assessment Authority. Energy efficiency is a commendable, and indeed a necessary, topic to be introduced into the new curriculum. Aimed at Secondary Four to Six students, this kit has been designed for use in the classroom both by teachers and students. It will help them understand the key elements related to energy, hand-in-hand with its core issues. The kit also covers basic energy principles, the influences on nature and mankind, as well as the ongoing development of various energy technologies.

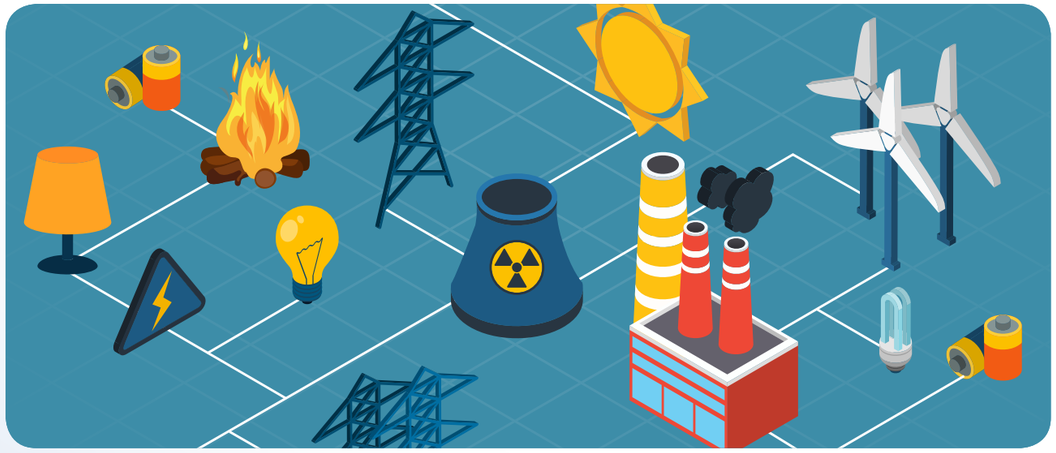
Liberal study aims to liberate students’ minds and facilitate their independent and critical thinking. This education kit therefore encompasses news extracts and a wide variety of topics, such as climate change, electric cars and energy efficient equipment.

Providing a wide range of information, this education kit is produced with a number of objectives. They include helping students to acquire knowledge of the interdependence between energy and our daily lives, develop critical thinking skills in interpreting and assessing the impact of different energy issues, and, more importantly, to arrive at and voice out individual judgment after considering and balancing the different perspectives.

We hope that this kit will help students gain a better understanding of the environmental problems facing the world today while also facilitate them to become more aware of energy efficiency and conservation issues.



1 ENERGY PRINCIPLES



What is Energy?

Energy is the ability to do work, such as baking a cake in the oven or moving cars along the road. Energy can appear in one form or another. In other words, it is transferrable and can be converted from one form to another. There are different forms of energy, including kinetic, heat, potential, chemical, etc. All forms of life, including human, extract energy from the environment and convert it to forms which can be used, e.g. from wood to heat and from fossil fuels to electricity.

Forms of Energy

According to the law for the conservation of energy, energy is neither created nor destroyed. It can only be converted. The amount of energy in the universe remains the same. When energy is used, it is being transformed from one form into other form(s) of energy.

Chemical Energy

Chemical Energy is energy stored in the bonds of atoms and molecules, holding these particles together. When these bonds break down, energy is released to the surroundings in different forms. Biomass, petroleum, natural gas and propane are examples of stored chemical energy.

Petroleum (Chemical Energy)

Mechanical Energy

Mechanical energy can be classified into two forms: kinetic energy and potential energy.

Roller Coaster (Kinetic and Potential Energies)

Nuclear Energy

Usually nuclear energy involves the energy locked in the nuclei of atoms. When two nuclei or nuclear particles collide to produce products, different from the initial particles, energy is released into the surroundings. Uranium is a typical material which generates nuclear energy.

Nuclear Energy

Thermal Energy

Thermal energy is the total internal kinetic energy in substances resulting from random movement of their atoms and molecules. The more thermal energy in a substance, the faster the atoms and molecules vibrate and move. Geothermal energy is an example of thermal energy.

Geothermal Energy

Radiant Energy

Radiant energy is electromagnetic energy that travels in electromagnetic waves. Radiant energy includes visible light, x-rays, gamma rays and radio waves. Sunlight is one type of radiant energy.

Sunlight (Radiant Energy)

Electrical Energy

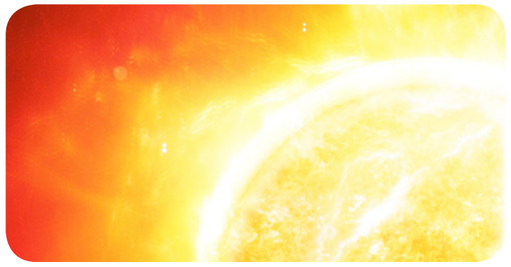
Electrical energy is the movement of electrons. Everything is made up of tiny particles called atoms. Atoms are made of even smaller particles called electrons (carrying negative charge), protons (carrying positive charge) and neutrons. Circuit electricity refers to electrons moving through a conductor. Lightning is a typical example of electrical energy in nature.

Lightning

Energy Sources

The Sun

The Sun is a major source of energy on Earth. It heats the Earth's surface and provides energy for life on Earth. Uneven heating of the Earth's surface leads to variations in air pressure. Wind is the flow of air from a high pressure region to a low pressure region. It also drives the waves in the oceans.



The Sun

Fossil Fuels

Ancient dead bodies of plants and animals were buried deep underground due to climatic and geological changes. With decomposition caused by micro-organisms, together with the great heat and pressure experienced over millions of years, this organic matter is transformed into fossil fuels, such as coal, petroleum and natural gas.

Petroleum & Natural Gas Exploitation

Nuclear Power

Nuclear power is generated from uranium, a metal which is available in various parts of the world. Using uranium as fuel, nuclear plants utilize nuclear fission reactions, heating water to make steam, to generate electricity. Nuclear fission reactions produce heat energy when neutrons smash into the nucleus of the uranium atoms.

Nuclear Power

Inside the Earth

Energy also comes from inside the Earth, mainly from the heat generated during the accretion and formation of the Earth. Some energy is also released from the radioactive decay of unstable nuclides. These are the energy sources for volcanoes, earthquakes, hot springs and the movement of tectonic plates on the Earth.

Volcanoes

Classification of Energy Sources Power

Energy sources can be classified into two types. Primary energy sources are sources which exist in nature, and secondary energy sources refer to sources converted or processed from primary sources. The availability of a primary energy source is location dependent, while that of a secondary source depends on the demand and money invested. Primary sources are transformed into secondary sources so that energy can be transmitted or used more conveniently and efficiently.

Primary sources can be further classified into renewable and non-renewable energy sources.

Non-renewable Energy	Renewable Energy
Fossil fuels and nuclear power are regarded as non-renewable energy because they will be exhausted.	Renewable energy sources are secure and inexhaustible, in the sense that there is no problem of reserves being depleted. Major types of renewable energy sources include: • Solar energy • Wind energy • Biomass energy • Hydro energy • Geothermal energy • Marine energy

Uses of Energy

Almost every aspect of our lives is associated with energy. Energy is one of the most fundamental components of our universe. Energy is the ability to do work. To human, its main function can be grouped into six main categories:

Energy Produces Light

Light is energy that travels in waves. We can see things as light enters our eyes. It is also vital to plants as no photosynthesis may take place without light.

Heat and Light Energy

Energy Produces Heat

We use heat or thermal energy for daily heating and cooking. Heat is invisible but we can feel it. Our bodies dissipate heat and our stoves and lights do, too. The sun is one of the major energy sources of heat energy.

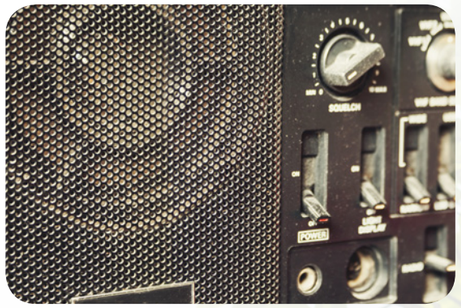
Energy Produces Motion

Motion is a change in an object's position. Everything in motion requires energy to drive. Without energy (fuel), no car may run along the highway, and even drifting clouds across the sky is not possible.

Running (Motion)

Energy Produces Sound

Energy appears as sound waves everywhere. All sounds are caused by vibrations - the back and forth motion of molecules. When a sound wave moves through air, the air molecules vibrate back and forth in the same direction as the sound. The vibrations push the air molecules close together, and then pull them apart. Sound can travel through gases, liquids and solids with different velocities. We hear sound through the air medium.



Speaker (Sound)

Energy Produces Growth

Every living thing is growing all the time. It takes energy to grow - chemical energy stored in simple sugars. To plants, energy is transformed into sugars via photosynthesis. Then the plants store it in their leaves, stems, fruits, and roots as chemical energy. When we eat the plants or animals that eat plants, we absorb the chemical energy.

Greenhouse (Plants to Grow)

Energy Powers Technology

We use energy to do work. Energy powers machinery in factories and tractors on farms, drive trains and cars, start up our computers and mobile phones to connect us to the world and exchange information, and drive technology advancement.

High Speed Rail (Energy Powers Technology)
Source: Information Services Department

Measuring Energy

Just as there are many forms of energy, there are different ways to measure these forms. Definitions of these units are shown below:

Calorie (Cal)	• Represents the amount of energy needed to raise the temperature of one gram of water by one degree Celsius. It is commonly used in the nutrition field.
Joule (J)	• Represents the amount of energy expended by a force of one newton moving an object one meter in the same direction as the force. • Known as the SI Unit (International System of Unit) of energy.
Kilowatt-hour (kWh)	• Represents the amount of energy resulting from the steady consumption of one kilowatt of power for one hour. • Used to indicate the level of electricity consumption on electricity bills.
Ton of oil equivalent (toe)	• This unit represents the energy generated by burning one metric tonne (1000 kilograms) or 7.4 barrels of oil, equivalent to the energy obtained from 1,270 cubic metres of natural gas or 1.4 metric tonnes of coal, i.e. 41.87 gigajoules (GJ), or 11.63 megawatt hours (MWh). • Bulk energy is traded in volumetric or weight units and is measured in volume or weight equivalent units.

Measuring Power

Power is the rate at which energy is used. Measurement units for power include horsepower and watts. Like units of energy, power units can be converted into one another.

Horsepower (hp)	• Measures the amount of energy required to raise coal out of a coal mine. • One horsepower is equivalent to lifting 33,000 pounds one foot in one minute.
Watt (W)	• Describes the rate at which energy is used at a specific moment. • Equivalent to one joule per second.

2 ENERGY AND ENVIRONMENT

Limited Reserve

Coal, oil and natural gas are the three essential kinds of fossil fuels that we mostly depend on for our energy needs, from home electrical appliances to fuel for our automobiles and mass transportation.

Coal Mining

Fossil fuels formed from plants and animals buried underneath the Earth's surface hundreds of millions of years ago where their remains were collectively transformed into combustible materials. However, due to the rapid social development in recent decades, consumption of these scarce natural resources is at a much faster pace than their formation.

Although only around one-fifth of the world's population resides in developed countries, their energy consumption accounts for half of the total consumption in the world. At the same time, the less developed countries often have to promote economic growth to cope with high population growth, and they are expected to consume more energy than now.

Pollution

The extraction, transportation and burning of fossil fuels result in an enormous and severe cost to the environment. The open cast mining of coal, for example, destroys the landscape and habitat, while shaft mining changes groundwater levels and produces highly acidic waste water. Accidents involving oil tankers and offshore drilling platforms spill oil into the ocean, with disastrous results to the marine ecology.

Pollution

Air Pollution

Fossil fuels are mainly hydrocarbons and their burning produces carbon dioxide. If there is inadequate oxygen available during the burning process, incomplete combustion produces carbon monoxide and particulate matter. Coal and petroleum also contain nitrogen and sulphur compounds. Their burning produces nitrogen and sulphur oxides, pollutants responsible for the forming of smog. They stimulate, or accumulate in, the respiratory system, causing various diseases.

Smog

Sulphur dioxide and nitrogen oxides cause acid rain, which has a significantly adverse effect on surface soil and water, vegetation and aquatic life. Acid rain is also corrosive to buildings made of metal and marble. Furthermore, nitrogen oxides are ozone depleting substances.

Pollutants

Clean air is essential to life and good health. Air pollution aggravates asthma, an illness with a high incidence rate for children. Air pollution also causes disease and even premature death among vulnerable populations, including children, the elderly and people with lung disease.

The two main sources of pollutants in urban areas are transportation (predominantly automobiles) and fuel combustion in stationary sources, including residential, commercial, and industrial heating and cooling and coal-burning power plants. Motor vehicles produce high levels of carbon monoxides (CO) and are major source of nitrogen oxides (NO_x), whereas fuel combustion in stationary sources is the dominant source of sulphur dioxide (SO_2).

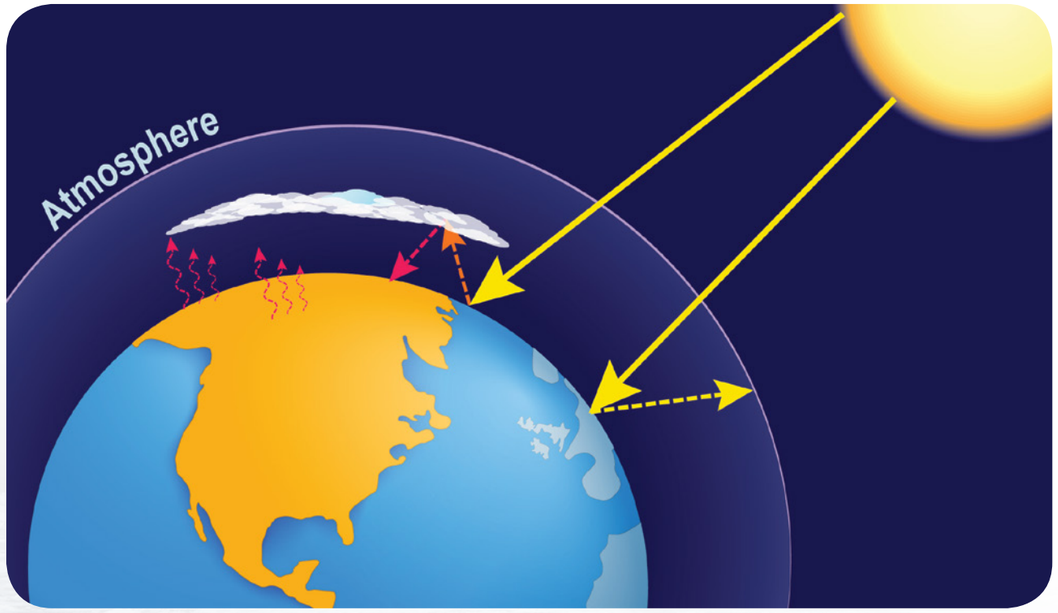
Pollutants in Urban Areas Transportation

Pollutants	Origin	Impact
Sulphur Dioxide (SO_2)	• Combustion of fuel containing sulphur, mostly coal and oil • Volcanoes and industrial processes	• Acid rain • Accelerated corrosion of buildings • Reduced visibility
Nitrogen Oxides (NO_x)	• Burning fossil fuels at electric power plants and in automobiles	• Acid rain • Lung irritation • Bronchitis and pneumonia problems • Lowered resistance to respiratory infections
Carbon Monoxide (CO)	• Incomplete combustion of fuel • Vehicular exhaust	• Odourless and colourless • Highly poisonous leading to carbon monoxide poisoning
Respirable Suspended Particulates (RSP)	• Combustion sources, such as diesel vehicle exhaust, and atmospheric oxidation of sulphur dioxide and nitrogen oxides	• Respiratory problems • Reduced visibility

Formation of Acid Rain

Global Warming

Energy from the sun drives the Earth's weather and climate, and heats up the Earth's surface. In turn, the Earth radiates energy back into space. Atmospheric greenhouse gases, in particular carbon dioxide (CO_2), trap some of the outgoing energy, retaining heat somewhat like the glass panels of a greenhouse. The energy accumulates in the atmosphere, causing global warming.



Global Warming

Causes of Global Warming

The increasing concentration of anthropogenic greenhouse gases, which results from human activities, accounts for the temperature increase of the Earth since the mid-20th century. The main source of anthropogenic greenhouse gases is the burning of fossil fuel (coal, oil, and natural gas) which occurs in power plants, transportation and industrial processes. Deforestation also indirectly contributes to the buildup of CO_2 in the atmosphere by reducing CO_2 absorbed in plants' photosynthesis.

Impact of Global Warming

Continued global warming could bring a series of damaging effects. Global warming could mean polar ice melting which would raise the sea level. Global warming also damages the ecosystems of plants and animals. As a result of habitat loss, animals may be forced to migrate to other habitats. It is assessed that about 20 to 30% of plant and animal species are exposed at increased risk of extinction if global average temperature increases more than 1.5°C. Besides, global warming could change the normal weather patterns and cause drought, flooding and other extreme weather conditions.

Drought

Flooding

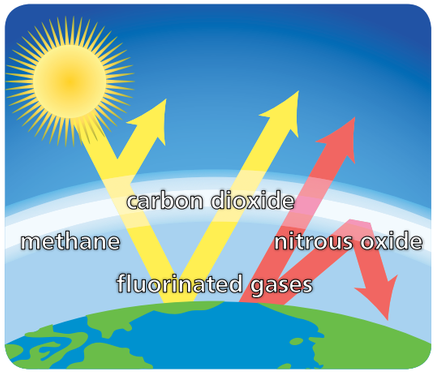
Extreme Weather

In Hong Kong, forecasts predict that the annual average temperature and sea level will keep going up with nearly no more cold winter days by the end of the century.

Greenhouse Gases

Greenhouse gases (GHG) are the gases in the atmosphere that can absorb and emit radiation and heat. This process is the fundamental cause of the greenhouse effect. In the Earth's atmosphere, the primary greenhouse gases are carbon dioxide, methane, nitrous oxide and fluorinated gases. When sunlight strikes the Earth's surface, some reflected as infrared radiation (heat). Greenhouse gases tend to absorb this infrared radiation as it is reflected back towards space, trapping the heat in the atmosphere.

What Can We Do to Reduce Greenhouse Gas Emissions?



Greenhouse Gases

- Reduce energy consumption
- Promote the use of renewable energy
- Use public transportation
- Use environmentally friendly vehicles
- Reduce solid waste (e.g. use less paper)
- Plant more trees
- Use energy efficient devices (with energy labels)
- Turn waste to energy
- Use less water

Do you know …

Climate Action Plan 2030+

Environment Bureau has published a Climate Action Plan 2030+ report in response to the Paris Agreement that came into force on 4 November 2016. Key actions are the control of greenhouse gas emissions and keep global average temperature increase well below 2°C relative to pre-industrial levels and make efforts to limit it to 1.5°C. Hong Kong will review our climate change efforts every 5 years and align the submission timelines under the Paris Agreement. An ambitious carbon intensity reduction target of 65% to 70% by 2030 using 2005 as the base has also been set, which is equivalent to 26% to 36% absolute reduction and a reduction to 3.3-3.8 tonnes on a per capita basis.

Climate Action Plan 2030+

Energy Conservation

New technology and devices are available to help us reduce our energy consumption. In the market, there are a variety of energy efficient devices which are used in our daily lives. However, no matter how advanced these inventions are, there are no magic solutions if we do not also play a role in conserving energy resources, only consuming what is required to meet our actual needs. As the Earth's non-renewable energy sources will eventually run out one day, it is important to conserve these energy resources by reducing consumption and promoting the use of renewable energy.

Promoting the Use of Renewable Energy

Energy Conservation is easy, cost effective and time-saving. Improving efficiency means doing more with less energy.

There are ten easy ways to go green at home. Try it and conserve energy, while also reducing your energy costs.

1

Turn off the electricity supply to appliances to reduce their standby power consumption.

Source: Signature Limited

2

Replace incandescent light bulbs with more efficient lamps like the light emitting diode (LED) lamps or compact fluorescent lamps.

3

Shorten shower times, install low-flow shower heads and lower the water temperature.

4

Turn off lights and appliances when not in use.

5

Buy energy saving appliances with energy labels. Energy label "Grade 1" products are most energy efficient.

6

Minimize using air conditioners. Set timers on air conditioners and maintain the room temperature between 24 and 26°C in the summer months when the air conditioner is switched on.

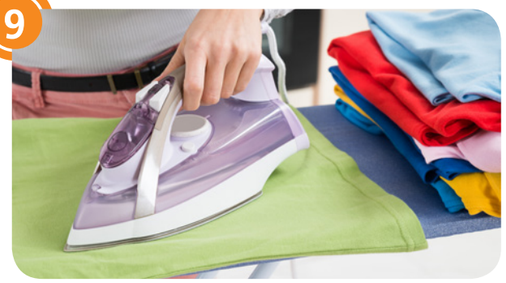
7

Use environmentally friendly cars or travel on public transportation.

8

Disconnect your mobile phone from charger once the battery is fully charged.

9



Iron all your clothes at one time to avoid reheating the iron.

10

Use a lower temperature setting or shorter programme when running your washing machine and use less detergent.

Do you know ...

"Screen Saver" on computer is actually "Energy Waster". The computer should be switched off completely when it is idle.

For air conditioning, increase the set point temperature by every 1 degree Celsius will save about 3% of electricity.

3 ENERGY USE IN HONG KONG

Energy Scene in Hong Kong

Energy is crucial to the development of modern society. For a metropolitan city like Hong Kong, energy is of fundamental importance to economic activities therein. With the scarcity of flat land within a territory of only 1,097 square km accommodating a high and ever increasing population, we need to secure energy resources to create a habitable indoor environment inside the high-rise commercial and residential buildings.

However, there are no indigenous energy resources in Hong Kong, and we have to derive energy supplies almost entirely from external sources. Energy is either imported directly (as in the case of oil products and coal products), or produced through some intermediate transformation processes using imported fuel inputs (as in the case of electricity and town gas). Besides, a small amount of energy is produced by renewable energy sources such as solar and wind energy.

The commercial and residential users combined account for more than 90% of the electricity consumption in Hong Kong. Improving energy efficiency in commercial buildings and domestic appliances should therefore be focused to better achieve reduction in greenhouse gas emissions.

Energy End-use in Different Sectors

In 1997, the Electrical and Mechanical Services Department began publishing Hong Kong Energy End-use Data every year. The data provide information on the consumption of different types of fuel and the specific purposes for which the fuels are consumed, e.g. air-conditioning, lighting, cooking, etc. The data also provide a better understanding of energy consumption patterns and usage in different sectors in Hong Kong.

Hong Kong Energy End-use Data

Transportation and LPG Consumption

As the majority of minibuses and taxies have switched to using LPG in recent years, the share of LPG has increased in the transportation sector. On the other hand, the total energy consumption and the consumption of oil and coal products by the transport sector have dropped.

LPG Taxi

4 ENERGY EFFICIENCY IN TRANSPORT

Vehicle and the Environment

Vehicle emissions are major source of roadside pollution. The gas from the exhaust contains hydrocarbon, carbon monoxide, nitrogen oxides and particulates, which are harmful to health. Promoting energy savings, the use of greener fuel and environmental friendly vehicles for both commercial and individual use are thus essential to combating air pollution problems.

Motor vehicles run primarily on petrol or diesel fuel. They generally emit a number of harmful chemicals which not only affect public health adversely, they also lower visibility. Additionally, vehicles emit large amounts of carbon dioxide (CO_2), a greenhouse gas contributing to the greenhouse effect and global warming.

Vehicle Emissions

Greener Fuel Vehicles

Due to the rise in fuel costs and worsening roadside pollution, the government has launched incentive schemes to encourage drivers to switch to more environmentally friendly fuels and vehicles.

Greener Fuel Vehicles Promotion

Alternative Fuel Vehicles

Traditionally, vehicles are equipped with conventional petrol and diesel engines (internal combustion engines, ICE). To reduce CO_2 emissions and alleviate roadside pollution, different types of alternative fuel vehicles have been introduced into Hong Kong for commercial and individual use.

LPG Filling Station
Source: The Hong Kong and China Gas Company Limited

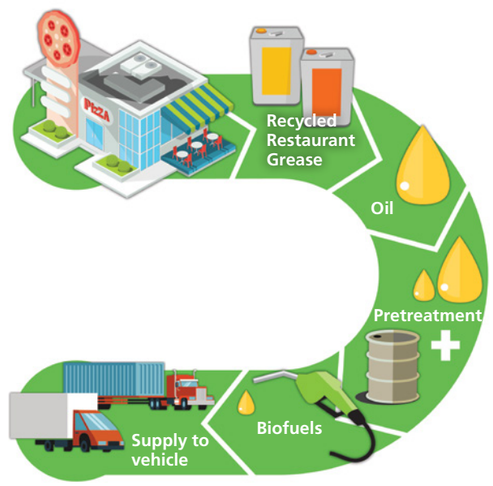
LPG

Liquefied petroleum gas (LPG) is a by-product of petroleum refining and natural gas processing. LPG is considered a cleaner fuel source as it produces fewer pollutants to the environment. It is a mix of propane and butane.

LPG is widely available and inexpensive. Since 2000, the Government has built an LPG filling network with comprehensive coverage throughout Hong Kong. As at July 2017, there were 67 LPG filling stations in Hong Kong, comprising of 12 dedicated filling stations and 55 non-dedicated filling stations.

Biodiesel

Biodiesel can be manufactured from vegetable oils or recycled restaurant grease. Since it helps cut down greenhouse gas emissions, the use of biodiesel is regarded as being environmentally friendly. With regard to exhaust emissions, its overall emission performance is roughly the same as ultra-low sulphur diesel, particularly when blended with ultra-low sulphur diesel in small concentrations. Since the biodiesel is in its early stages, there is a strong potential for further development due to the growing demand for clean alternative fuels.



Biodiesel Production Cycle

Natural Gas

In vehicles, natural gas can be stored in tanks as compressed natural gas (CNG) or as liquefied natural gas (LNG).

Compared to conventional fuels, natural gas vehicles produce lower emissions of carbon dioxide (CO_2), nitrous oxide (N_2O) and sulphur dioxide (SO_2). It is almost particulate-free and considered the cleanest fossil fuel compared to coal and oil.

Natural Gas Plant

Currently, natural gas in Hong Kong is solely used for electricity generation and has not entered the retail fuel market. To use natural gas as a vehicle fuel, high set-up costs for building of fueling stations as well as importation and storage infrastructure will be required.

Electric Vehicles

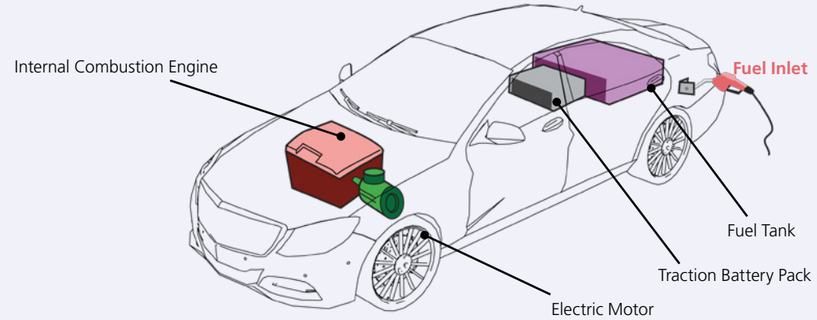
Conventional vehicles are known for their vehicular emissions. New vehicle technology can help to improve air quality by reducing pollutant emissions.

Due to the rise in oil prices, it is a global trend to develop new types of vehicles, such as hybrid electric vehicles (HEVs), Plug-in hybrids (PHEVs), battery electric vehicles (BEV)/pure electric vehicles (PEV). Electric cars benefit the environment by cutting petroleum consumption and reducing vehicular emissions worldwide for cleaner air and a greener environment.

Electric Vehicle

Hybrid Electric Vehicles (HEVs)

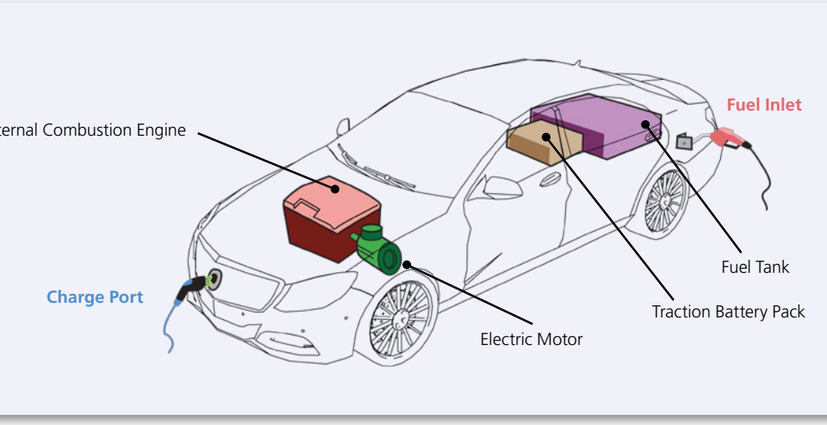
Hybrid electric vehicles (HEVs) consist of a hybrid petrol-electric model which runs on both petrol and electricity simultaneously. This type of vehicle uses 40-50% less petrol, producing fewer pollutants than cars running solely on petrol or diesel. No external battery charging is required. Generator driven by internal combustion engine is used to charge the battery.



Hybrid Electric Vehicles (HEVs)

Plug-in Hybrid Electric Vehicles (PHEVs)

A plug-in hybrid electric vehicle (PHEV) is a hybrid vehicle with rechargeable batteries. These batteries power the vehicle's movement. PHEVs looks like hybrid electric vehicles, except that there is an external plug attached to it. The external plug connects the vehicle to external power sockets (grid power) to recharge the batteries. However, vehicle battery-charging facilities are required.



Plug-in Hybrid Electric Vehicles (PHEVs)

Do you know ...

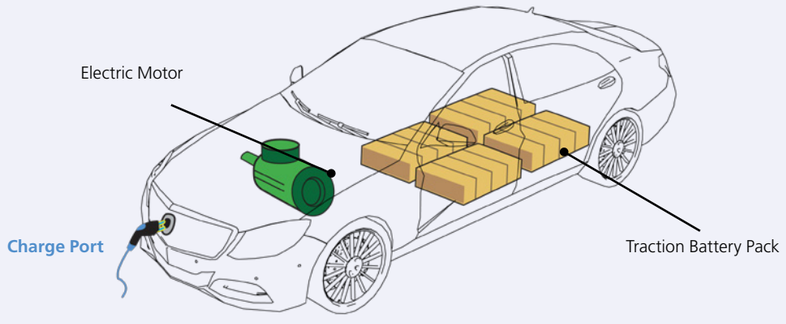
- Three new multi-standard quick charging stations for electric vehicles installed by the Hongkong Electric Company are located at the car parks of the Composite Building of the University of Hong Kong, Cityplaza and Hing Wah (1) Estate. They were officially opened on 12 May 2017. Those originally standard charging stations were also upgraded to medium or quick charging stations.

- As at the end 2018, there were about 2,166 public electric vehicle chargers of various types in Hong Kong covering all 18 districts, including about 824 medium chargers and about 498 quick chargers.

Charging Station
Source: Information Services Department

Battery Electric Vehicles (BEVs)/ Pure Electric Vehicles (PEVs)

BEVs/PEVs run completely on electric energy stored in rechargeable battery packs. They do not consume petrol or diesel at all. These vehicles provide several environmental benefits, such as better energy efficiency, zero air pollutants emitted directly from the vehicle and little noise is produced as the engine is quieter.

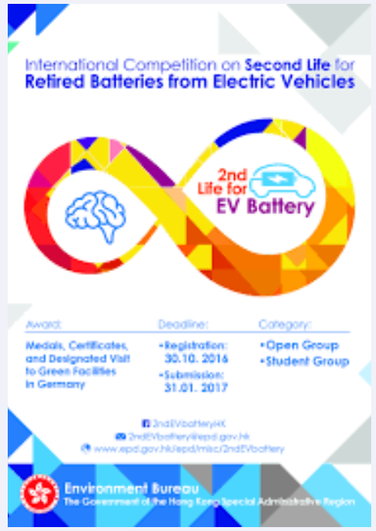


Battery Electric Vehicles (BEVs)/ Pure Electric Vehicles (PEVs)

Do you know ...

The International Competition on Second Life for Retired Batteries from Electric Vehicles was launched by the HKSAR Government in August 2016, The Competition aimed to help identify innovative and practical second-life applications for retired batteries from electric vehicles. The Competition was divided into an Open Group and a Student Group, and attracted more than 50 participating teams from eight countries or cities, namely Australia, Canada, Indonesia, Singapore, the United Kingdom, Guangzhou, Macau and Hong Kong. There were six awards in each group, namely the best originality award, the best viability award, the best value and impact award, the second runner-up award, the first runner-up award and the champion award. A list of winners and the abstracts of their entries can be obtained at the Competition website.

Source: www.epd.gov.hk/epd/misc/2ndEVbattery/en/



The International Competition on Second Life for Retired Batteries from Electric Vehicles

Do you know ...

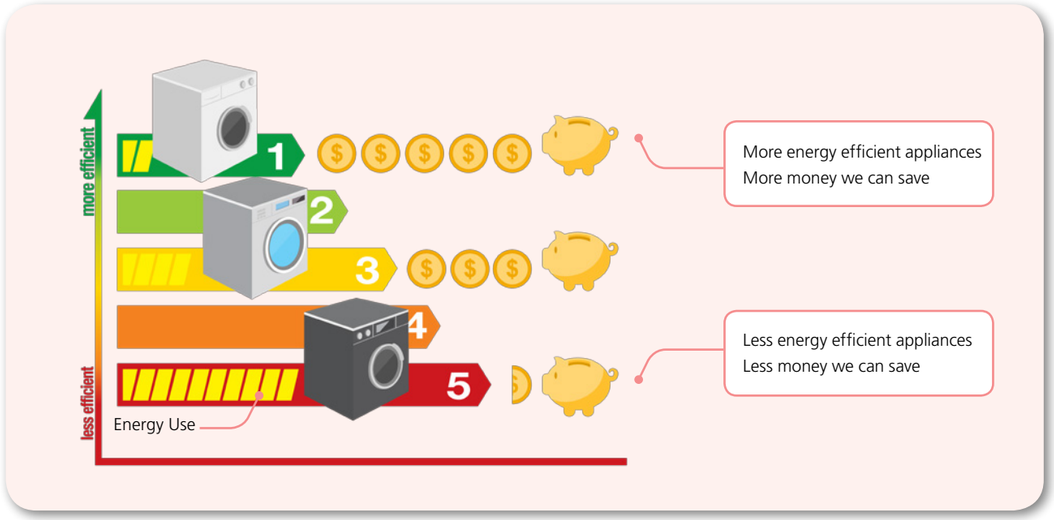
EVs in Hong Kong

As at end 2018, there were 253 electric vehicles employed by the Government and the total number of electric vehicle was 11,496 in Hong Kong.

Launch ceremony for publicity campaign on EVs and charging points
Source: Information Services Department

5 APPLIANCES

The energy labelling scheme is widely accepted as an effective tool to reduce energy demand and promote the use of energy-efficient equipment. With wider disclosure of the energy efficiency performance of the equipment, the scheme not only provides more information to consumers to help them select better products, but it also sharpens the competitiveness of manufacturers to produce more energy efficient appliances to meet growing demand.



Energy Labelling Scheme

For Individuals	For Manufacturers	For the Country
Better product choices	Business opportunities	Energy conservation
Improved consumer awareness		Reduced carbon emissions

Better Product Choices

Craftsman Working in a Factory

Reduced Carbon Emissions

Energy Efficiency Labelling Schemes

Improving energy efficiency and raising public awareness of energy conservation in Hong Kong, the Electrical & Mechanical Services Department (EMSD) introduced the Voluntary Energy Efficiency Labelling Scheme (VEELS) in 1995, followed by the Mandatory Energy Efficiency Labelling Scheme (MEELS) in 2008. Under VEELS, manufacturers, importers and agents can register their products, including household electrical appliances, office equipment, household gas appliances and petrol-driven passenger cars. The labels enable consumers to make better-informed purchasing decisions with the energy consumption and efficiency information of the products at their fingertips. Registration records are available at EMSD's website.

Voluntary Energy Efficiency Labelling Scheme (VEELS)

There are three label types under VEELS:

"Grading Type" Label

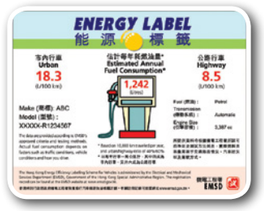
Estimates the energy consumption of the appliance and grades its energy efficiency on a scale by different grades. Grade 1 is the most efficient.

"Recognition Type" Label

Issued if a product meets the energy efficiency and performance requirements specified in the respective scheme document.

"Comparison Type" Label

This energy label provides useful fuel consumption data for comparison purposes.



The label for petrol-driven passenger cars provides fuel consumption information for the vehicle, in urban or highway driving, based on standardized test procedures. Annual consumption is also estimated and consumers can compare the efficiencies of different cars.

Mandatory Energy Efficiency Labelling Scheme (MEELS)

The MEELS was introduced under the Energy Efficiency (Labelling of Products) Ordinance (Cap. 598). Under the Ordinance, a prescribed product supplied by a manufacturer or importer should be a listed model with a reference number assigned by EMSD and it must bear an energy label that complies with specified requirements. The manufacturer/supplier must therefore ensure that the prescribed product supplied is a listed model and that it bears an energy label which classifies the energy performance of a product type. A record of listed models can be found on EMSD's thematic website Energy Label Net at www.emsd.gov.hk/energylabel .

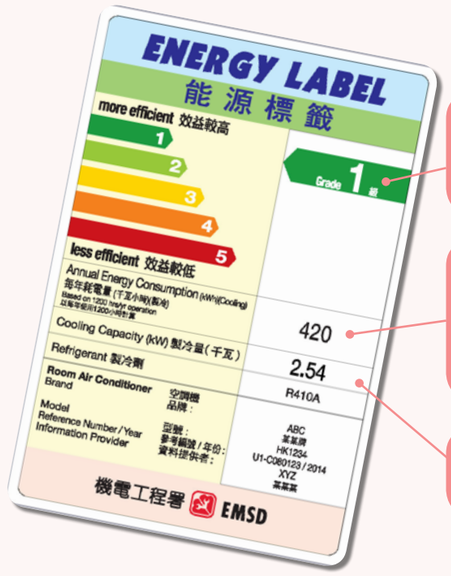
The MEELS is implemented in phases. Currently, the MEELS covers eight types of prescribed products, namely room air conditioners, refrigerating appliances, compact fluorescent lamps, washing machines, dehumidifiers, televisions, storage type electric water heaters and induction cookers. All these eight types of prescribed products are required to bear energy labels to inform consumers of their energy efficiency performance.

To further encourage suppliers to provide more energy efficient products for consumers, the scope of MEELS and the energy efficiency grading standards of products are regularly reviewed to cover more products and hence increase the penetration rate and energy efficiency of products bearing energy labels. For details, please refer to the thematic website Energy Label Net.

Do you know …

How the Energy Efficiency Grades are Defined

The energy efficiency grades range from 1 to 5. Grade 1 products are the most energy efficient and Grade 5 products are the least efficient. For example, a Grade 1 split type room air conditioner saves about 61% energy more than a Grade 5 split type room air conditioner.



Grade 1 products are most efficient (green) and Grade 5 products are least efficient (red).

Annual electricity consumption. Use this number to estimate how much money you could save by choosing different models.

Cooling capacity (kW) of the model at full load.

Do you know …

Compliance Monitoring

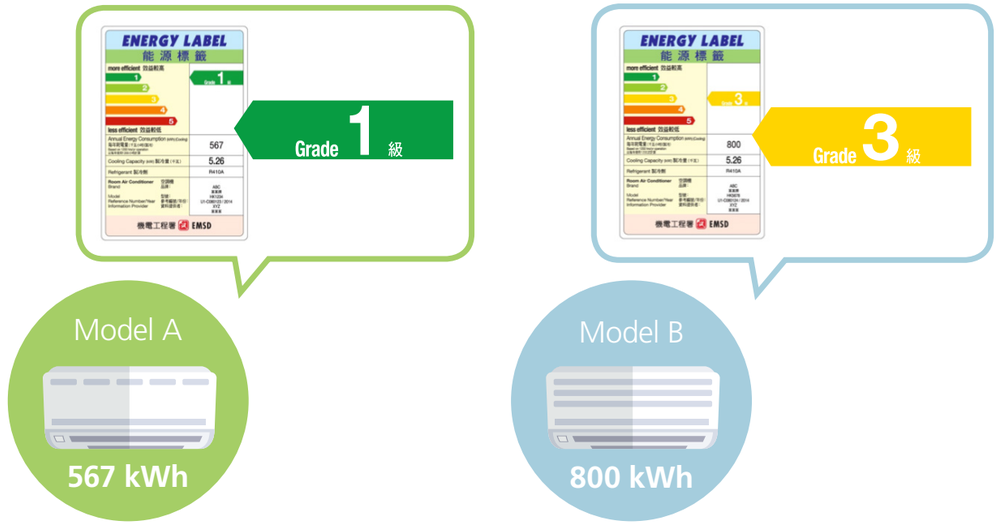
EMSD regularly selects samples of listed models for compliance monitoring. Testing is carried out by independent accredited laboratories to check that the products conform to the energy efficiency information submitted to EMSD. Under MEELS, if a listed model does not conform to the information submitted, its reference number will be removed from the record of listed models and the model will not be allowed to be supplied in Hong Kong.

EMSD
Source: Electrical and Mechanical Services Department

Do you know …

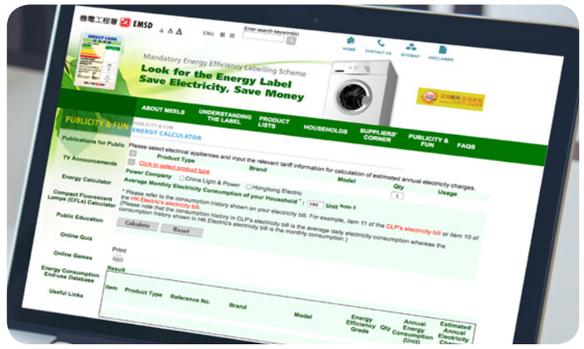
How Much Can You Save?

In the energy labels of below, Models A and B air conditioners have almost the same cooling capacity but are classified as Grade 1 and Grade 3 respectively.



(Assuming 1200 hrs/yr operation) Model A consumes less energy per year – 567 kWh for Model A and 800 kWh for Model B .
Supposing each kWh of electricity costs $1.2, let's see how much you can save by choosing Model A:
(800 kWh – 567 kWh) × $1.2 = $279.6 per annum.

For public convenience, EMSD developed the "Energy Calculator" on the Energy Label Net for calculation of estimated annual electricity charges for electrical appliances.



Energy Calculator on Energy Label Net

6 ENERGY EFFICIENT EQUIPMENT

Lighting

Lighting is the second largest component of electricity usage in Hong Kong. Traditional incandescent light bulbs have a very low luminous efficiency, i.e. most of the power is not output as light. There are several energy-efficient lamps available in the market which achieve a much higher luminous efficiency.

Do you know ...

CFL and fluorescent lamps: Handle with care

Despite their enhanced energy efficiencies, common CFL and fluorescent lamp contain a small amount of mercury (around 4 milligrams for CFLs), which is harmful to human beings and the environment. Their disposal must therefore be handled properly.

There is a Chemical Waste Treatment Centre in Hong Kong where mercury-containing waste is handled. The lamp bulbs are sent there to separate and recycle the mercury. The resulting lamp items are then treated before being sent to the landfills for disposal.

Source: Hong Kong Waste Reduction Website

CFL Collection Box
Source: Information Services Department

Compact fluorescent lamps (CFLs) are compactly-designed fluorescent tubes with their ballast and gas-filled tubes assembled together. Thus, they can replace light bulbs.

T5 fluorescent lamps refer to tubes 5/8 inches in diameter. T5 fluorescent lamps using electronic ballasts that offer high frequency output not only help improve energy efficiency, but also extend the life span of the products. Their lengths are designed to fit into modular ceilings.

Mirrors or nano-technology reflectors can be added to existing lighting to increase illumination levels. Daylight can also be introduced to building interiors with light tubes coated with highly reflective materials.

Light-emitting diodes (LEDs) provide a semi-conductor light source. The luminous efficacy of LED lighting is comparable to the T5 fluorescent tubes. They have longer life span, contain no mercury and operate at a very low (safety) voltage. They light up quickly and frequent switching does not reduce their life cycle.

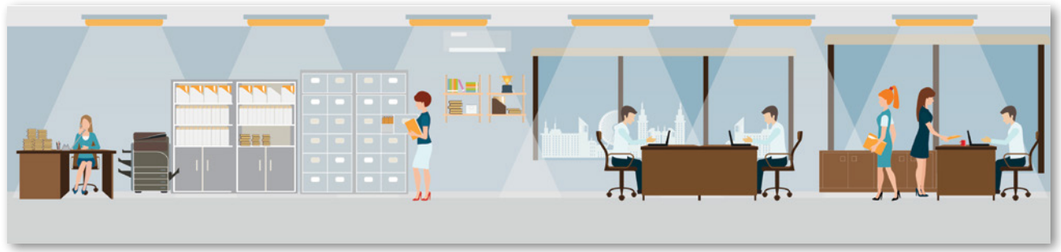
Do you know ...

LED lighting has higher luminous efficacy than compact fluorescent lamp (CFL). As a comparison on products of energy label grade 1, LED lamps can give 40% illumination output higher than that of compact fluorescent lamps.

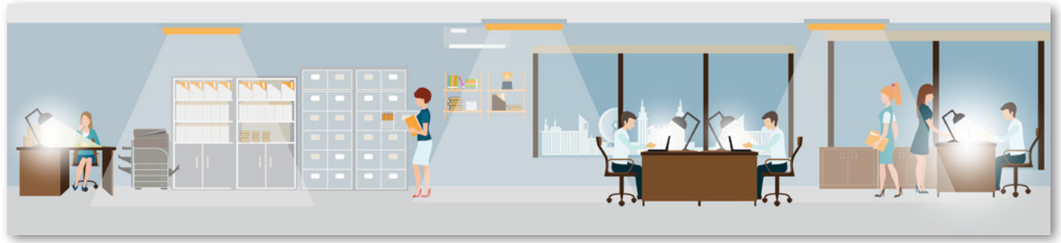
LED lighting has been used in government venues such as corridors, canteens, conference rooms, classrooms, assembly halls, parks, swimming pools, fountains, etc

LED Light in School Hall
Source: Electrical and Mechanical Services Department

Task lighting design provides enough task illumination while keeping other areas at lower illumination to save energy. It also enables the users to have some control over the amount and distribution of light on the task by dimming or switching off the light source. Thus, the application of it can reduce the lighting power density and hence the energy consumption.



Without Task Lighting Design



Task Lighting Design

Air Conditioning

The largest component of electricity consumption in Hong Kong is taken up by air conditioning. There are two major types of air conditioning systems – air-cooled and water-cooled systems. Air-cooled systems, including the most commonly found single unit systems installed at windows or through walls, eject heat into the atmosphere. Water-cooled air conditioning systems eject heat by evaporation through cooling towers, or by seawater discharged into the sea.

Air Cooled Chiller
Source: Electrical and Mechanical Services Department

Cooling Tower
Source: Electrical and Mechanical Services Department

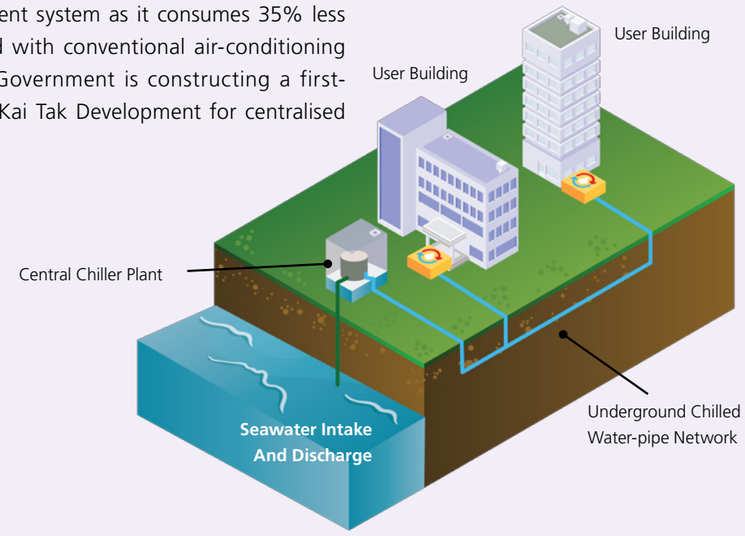
Water Cooled Chiller
Source: Electrical and Mechanical Services Department

Split Type Condenser

Do you know ...

District Cooling System

District cooling system (DCS) is a centralised cooling system which provides chilled water to the air-conditioning systems of multiple user buildings for cooling purpose. DCS is an energy efficient system as it consumes 35% less electricity as compared with conventional air-conditioning systems. The HKSAR Government is constructing a first-of-its-kind DCS at the Kai Tak Development for centralised air-conditioning.



District Cooling System

Water-cooled air conditioning systems can achieve greater environmental, economic and financial benefits than air-cooled systems. Therefore, the government launched a scheme to encourage the wider use of fresh water in cooling towers for energy efficient air conditioning systems (Fresh Water Cooling Towers Scheme) for non-domestic buildings in 2000. The scheme also monitors the water demand and the health and environmental issues arising from water-cooled air conditioning systems.

Cooling Seasonal Performance Factor (CSPF)

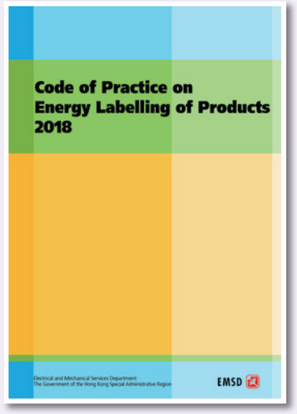
CSPF of a room air conditioner is the ratio of the total annual amount of heat that the room air conditioner can remove from the indoor air when operated for cooling in active mode to the total annual amount of energy consumed by the room air conditioner during the same period. This is a measure of the efficiency of the room air conditioner. Higher CSPF indicates a room air conditioner with higher energy efficiency.

Do you know ...

How to Know The Cooling Seasonal Performance Factor (CSPF) of A Room Air Conditioner

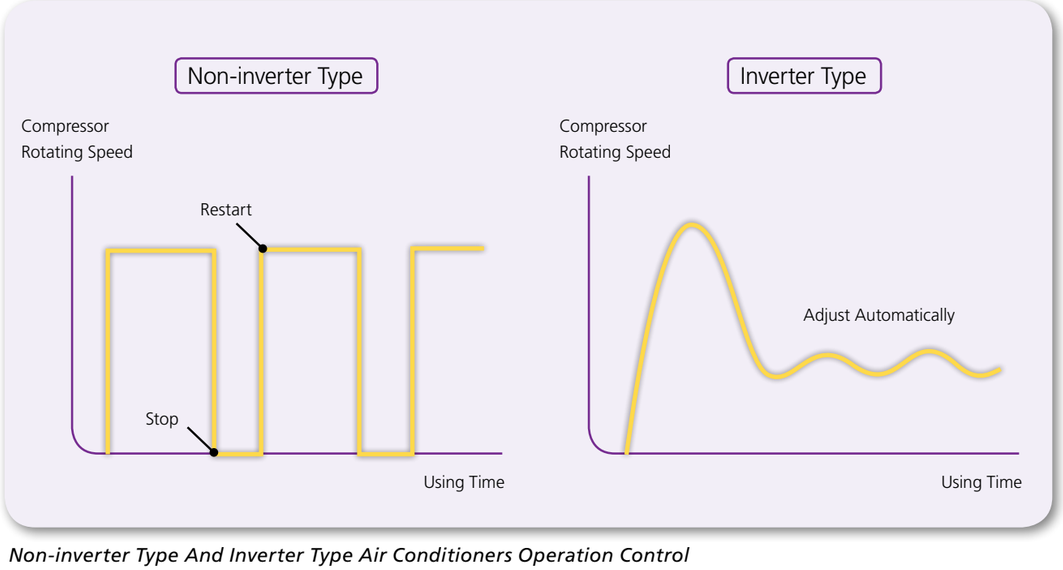
The CSPF of a room air conditioner listed under the Mandatory Energy Efficiency Labelling Scheme is published on the Energy Label Net.

Source: Energy Label Net



Inverter Type Air Conditioners

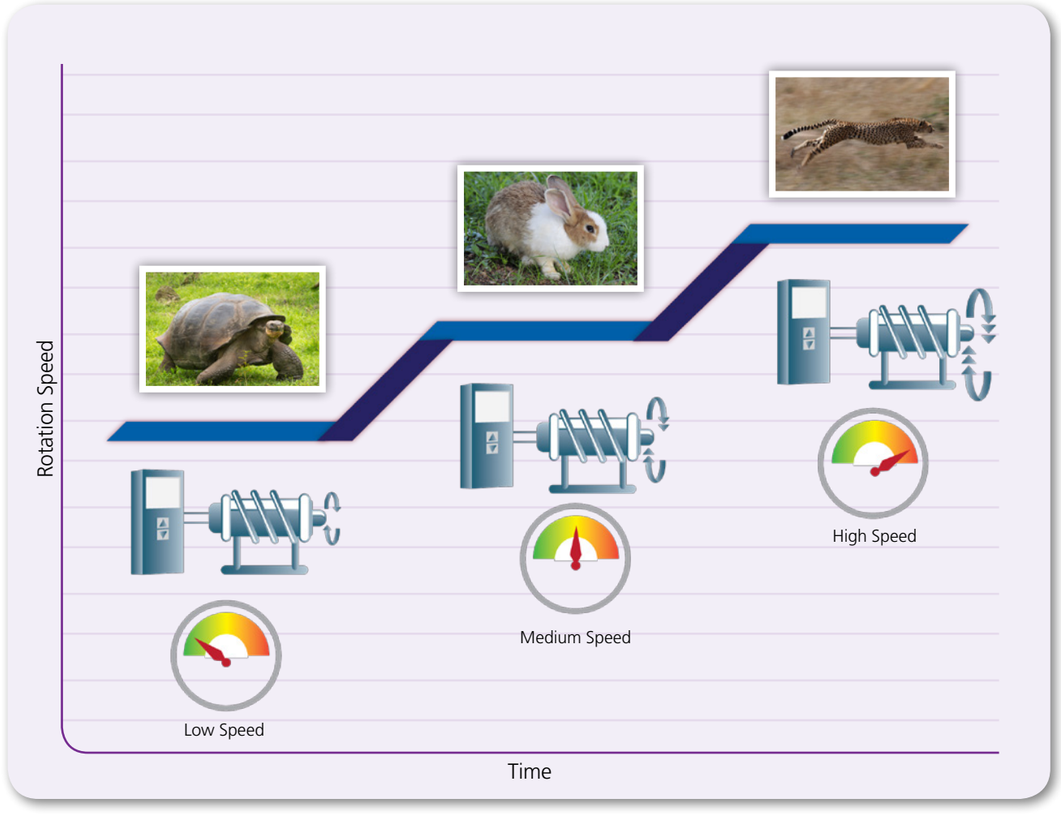
An inverter type unit can adjust the compressor rotating speed automatically. It operates with high rotating speed right after the start-up and then operates in a relatively low speed level to save energy. Compared with the non-inverter type unit, the inverter unit type saves 40% electricity on average.



Non-inverter Type And Inverter Type Air Conditioners Operation Control

Variable Compressor Speed Drives

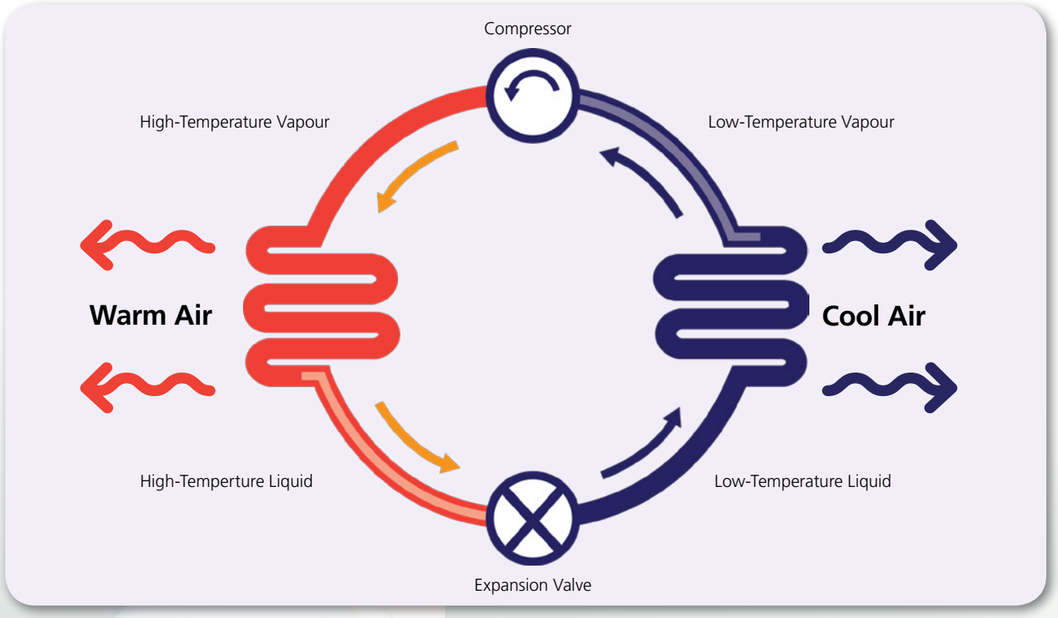
The compressor and fan in air conditioners are designed to work under their maximum load. Conventionally, they work under full power when switched on, regardless of the actual demand required. Variable speed drives (VSDs) in air conditioning can reduce the fan speed for the fresh air or cool air supplied according to the CO_2 level, temperature or pressure. A 20% reduction in the motor speed can cut the energy used by half.



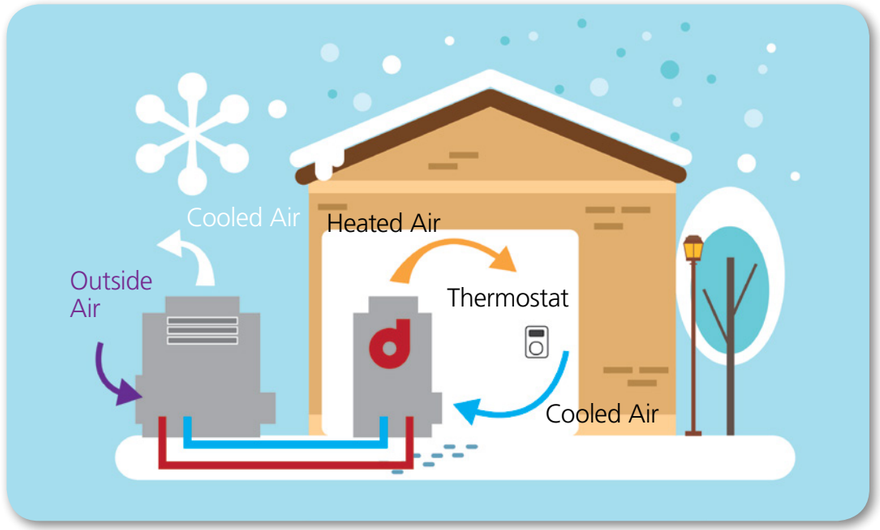
Variable Speed Drives

Heat Pump

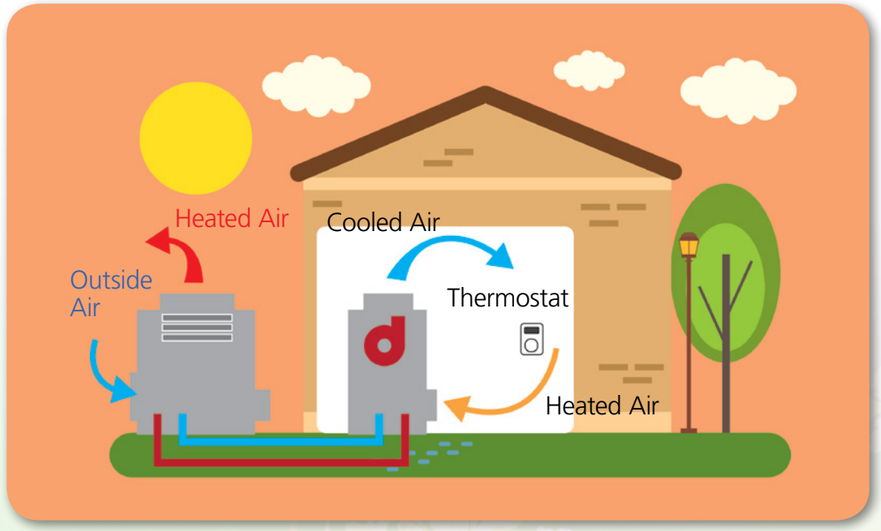
A heat pump extracts heat from a relatively cool medium and transfers it to a relatively hot medium to make the cool medium cooler and the hot medium hotter. For one unit of electrical energy supplied to the heat pump, more than one unit of heating as well as cooling energy can be produced. It is much more efficient than other heating processes which normally produce less than one unit of heating energy. The efficiency of heat pump will be superb in applications where both heating and cooling are required simultaneously. Heating energy and cooling energy from the heat pump could be fully utilised.



Heat Pump



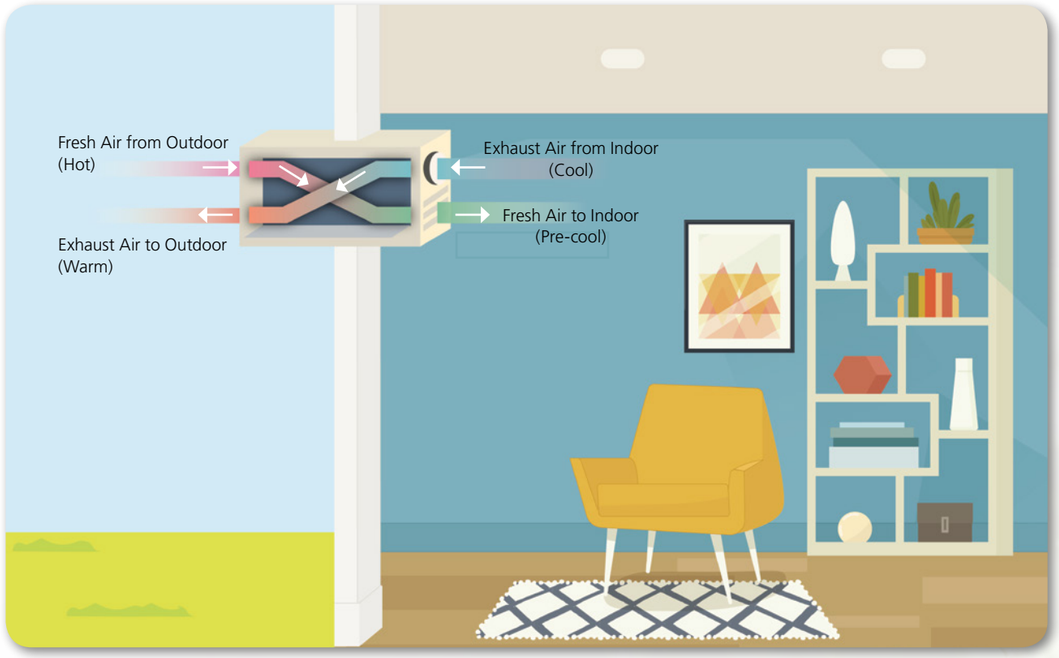
Winter Mode Operation



Summer Mode Operation

Heat Recovery Ventilation

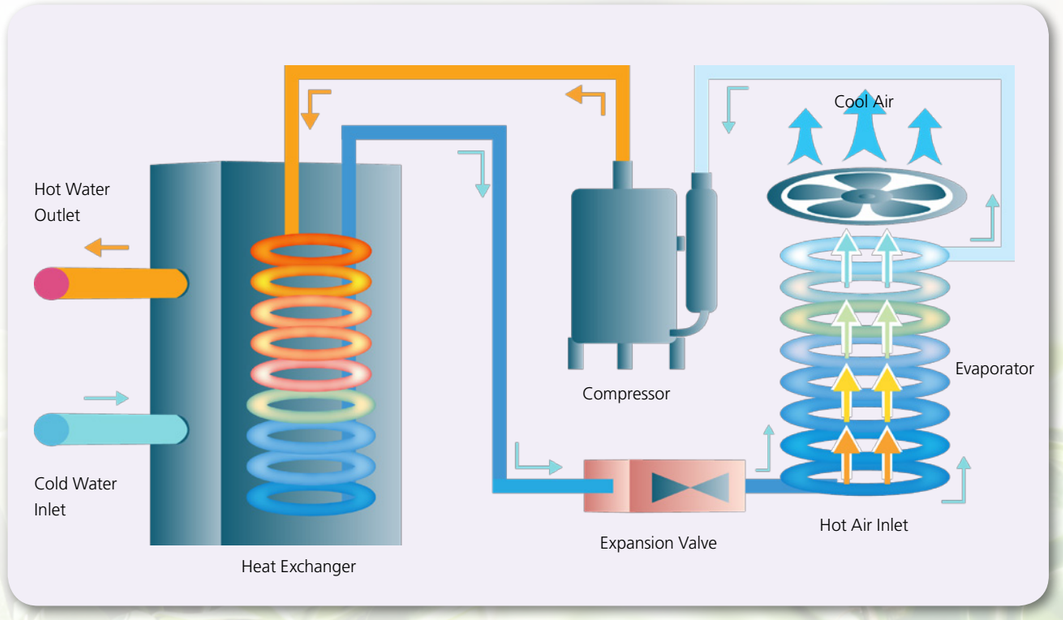
Heat recovery ventilation (HRV) is an energy recovery system. In an air-conditioned space, a source of fresh air is needed to maintain the indoor air quality. Keeping a window open introduces heat and water vapour into the building and the energy efficiency of the air-conditioning system drops. HRV technology offers an optimal solution for fresh air treatment. It makes use of the cool exhaust air inside the building to pre-cool the incoming fresh air through a heat exchanger, reducing energy loss and the cooling load.



Heat Recovery Ventilation

Heat Pump Water Heaters

Electric or gas water heaters produce heat by electricity or burning of gas. The heat produced is limited by the energy input and the efficiency of the heat exchange. Heat pump water heaters can provide air-cooling and hot water simultaneously. It extracts and makes use of the free or waste heat from the air to heat water. New heat pump design can achieve a coefficient of performance larger than 5. This means that the heat transferred to the water is more than five times the energy input into the pump. They can also provide water output with temperature of up to 90 degrees Celsius.

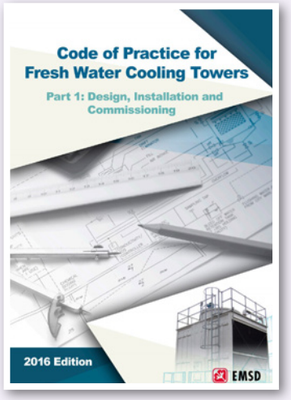


Heat Pump Water Heater

Do you know …

Prevention of Legionnaires' Disease –
Regulatory Control of Fresh Water Cooling Towers

Fresh water cooling towers (FWCTs) could be sources of spreading Legionella if they are not properly designed, installed, operated and maintained. To address the concern of the risk of causing Legionnaires' Disease, EMSD has published the Code of Practice for Fresh Water Cooling Towers to provide guidelines for reference by owners and relevant stakeholders. The Code of Practice for Prevention of Legionnaires' Disease issued by Prevention of Legionnaires' Disease Committee, Hong Kong is also available to serve similar purpose. EMSD takes about 800 water samples from FWCTs for testing each year. If the water quality of FWCTs cannot satisfy the relevant standard, EMSD will regulate improperly maintained or contaminated FWCTs under the Public Health and Municipal Services Ordinance (Cap 132).



Code of Practice for Water Cooling Towers

Code of Practice for Prevention of Legionnaires' Disease

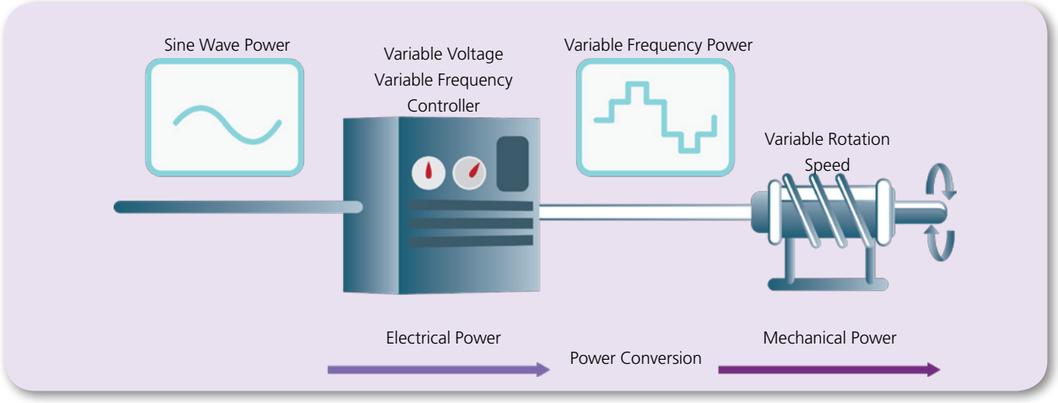
Lifts & Escalators

The motors of lifts and escalators do not need a full power supply when the loading is low. An energy optimizer (also known as performance controller or power factor controller) reduces losses in the alternating current (AC) motors. It provides suitable power to the lift, adapting to the range of loading conditions. Its soft starting reduces the starting current and mechanical wear and tear. This applies to any AC motor with steady speeds and variable loads, such as lifts, escalators and moving walkways.

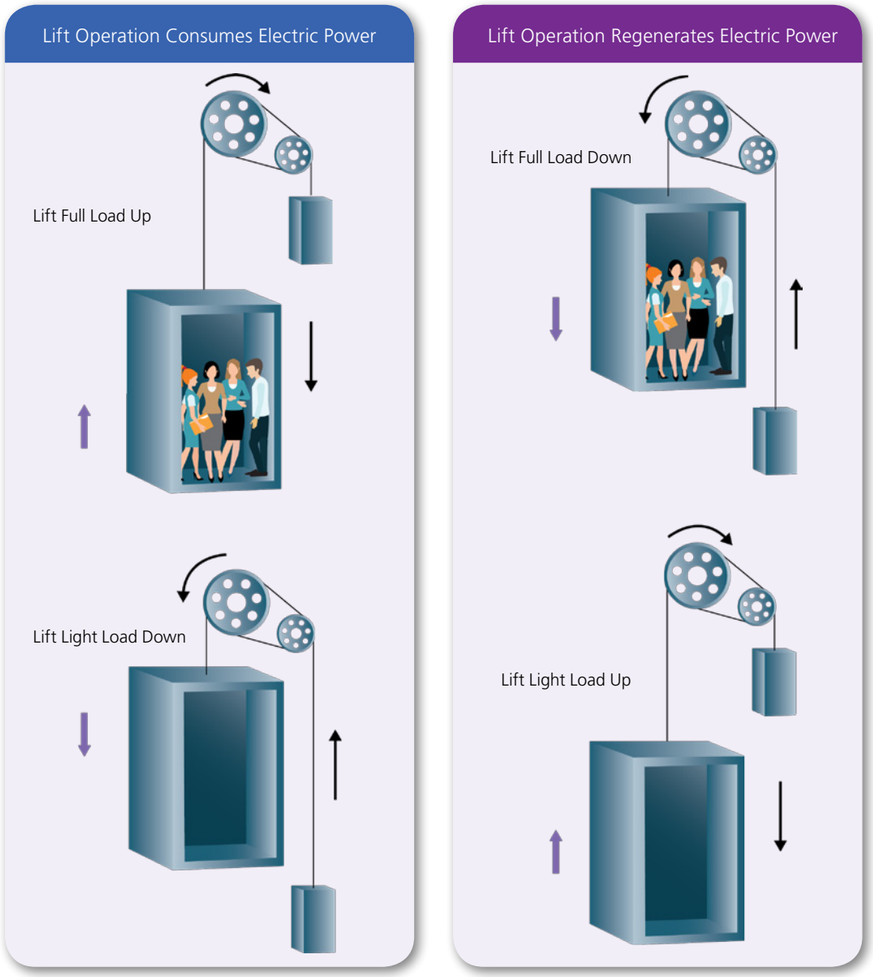
Lift

Escalators

Motors change the speed of lifts when starting and stopping. Variable Voltage Variable Frequency (VVVF) drives control the speed of the motor by varying the voltage and frequency of the electricity supplied. It makes the change in speed simpler and smoother and uses much less energy when compared to AC drivers. It also reduces the maintenance costs. VVVF control can be integrated with automatic controls in escalators to vary speeds according to passenger flow, thus saving energy when the escalator is idle.



Variable Voltage Variable Frequency



Lift with Regenerative Function

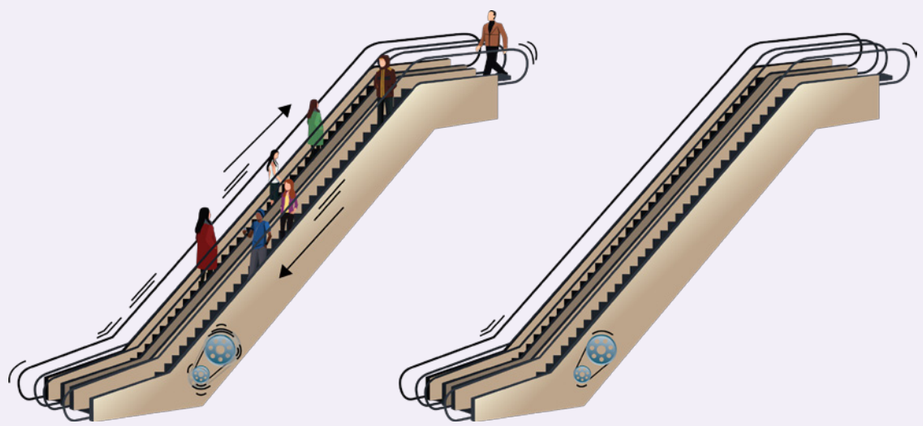
A lift with regenerative function recovers braking energy from lift operation and feed-in power to electrical supply network. When it travels downwards with heavy load or upwards with light load, the traction machine will act as a power generator and the lift will be running at "regenerative mode". It converts the energy generated from the lift motor driven by gravity into electricity for other uses and the regenerated electricity can then be captured to feed directly into the power grid for immediate consumption by communal facilities. When compared to conventional lifts, regenerative lifts are 20 to 30% more energy efficient.

Lifts can be positioned at pre-programmed levels at specific times to match peak demand, while shutting down in off-peak hours. Steps and motors of escalators can also be made of lighter, non-metallic materials to reduce weight and thus lower electricity consumption.

Do you know ...

Service-on-demand (SOD) escalators stop or slow down when passengers are not present.

Service-on-demand (SOD) Escalators



Operation
(When Passengers Present)

Slow / Stop
(When No Passengers)

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