



Energy Efficiency and Conservation for Buildings

建築物能源效益及節約指南

機電工程署
EMSD





Foreword 前言

Energy is crucial to the development of modern society. For a metropolitan city like Hong Kong, energy is of fundamental importance to all of the economic activities therein.

With the scarcity of flat land within an area of about 1,100 square km yet accommodating a high and ever increasing population, we need enormous energy resources to create a habitable indoor environment inside those high-rise commercial and residential buildings. We also need a great deal of energy resources to light up our night sky so as to sustain the intense human activities right into the mid-night.

We also need a lot of energy resources to drive our infrastructure machinery - our water supply, drainage systems and transportation networks. Of course we need energy to provide mobility for everyone of us - railway, trams, cars, aeroplanes, etc.

However, there are no indigenous energy resources in Hong Kong, we have to rely totally on imported fuels and we know that fossil fuels are already exhausting.

Import dependence on exhaustible fossil fuel, local environmental problems and concern for the global environment are the driving factors influencing our policies. We seek to ensure that the energy needs of the community are met reliably, efficiently, safely and at reasonable prices. Concurrent with such goal, the efficient use and conservation of energy, as well as the minimisation of the environmental impact due to energy


能源對現代社會的發展十分重要。香港是一個國際大都會，所有經濟活動都需要能源。

這片土地只有約 1,100 平方公里，但人口密集且不斷增加，因此，我們需要大量能源，以便在商業或住宅樓宇內創造理想的室內環境。包括空調及照明等，令各類活動得以持續進行。

在基建方面，我們的供水和排水系統及交通網絡都需要大量能源來運作。當然，能源亦為我們帶來交通上的方便，鐵路、電車、汽車、飛機等交通工具已成為我們生活中不可缺少的一部分。

香港本土沒有能源資源，故我們必須完全依靠輸入的化石燃料來產生能源，而化石燃料的蘊藏量已日漸減少。

我們需要輸入化石燃料，但使用化石燃料卻為本港和全球帶來環境問題，這一切都是影響著我們的政策。我們正尋求方法，確保能源供應穩定，價格合理，並能以安全有效的方式滿足社區對能源的需求。此外，我們應推廣能源效益及節約能源，以減低生產及使用能源對環境所造成的影響。我們繼續密切留意全球能源的供求情況，務求能在經濟發展、社會需求和保護環境之間取得平衡。



production and use should be promoted. We are always on the watch for the changing global energy supply and demand situation and seek for a balance among achieving economic development, satisfying the need of the society and protecting our precious environment.

To coordinate the development on energy efficiency and conservation for buildings in Hong Kong, this Booklet aims to help the community to understand and administer this complex issue. The Booklet is based on current practices on energy efficient design in building services installations as well as on other aspects affecting energy efficiency and conservation where these exist and insofar as their provisions are applicable to Hong Kong.

This Booklet provides comprehensive guidelines on energy efficiency and conservation. It also covers a wide range of issues, including key persons in building energy efficiency and conservation, suggestions on building energy efficiency and conservation and other sources of information. It is designed to enable developers/architects/building managers/building services engineers/end-users to successfully conserve the energy used in buildings in Hong Kong, for the health and well-being of us all.

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Enquiries

Please feel free to contact the following office for any enquiries on energy efficiency and conservation matters: Electrical and Mechanical Services Department (Energy Efficiency Office)

查詢

如對能源效益及節約能源有任何查詢，請與機電工程署 (能源效益事務處) 聯絡。

本小冊子旨在協助各界認識和管理建築物之能源效益及節約，並按照現時本港常見的節能建築物設計以及其他影響能源效益及節約的因素來撰寫。

本小冊子為能源效益及節約提供較全面的指引，並涉及廣泛題目，包括與建築物能源效益及節約有關的重要專業人士、建築物之能源效益及節約方面的建議，以及相關的資料。透過本小冊子，我們希望發展商、建築師、物業管理經理、屋宇裝備工程師和建築物用戶能夠在其建築物內積極節約能源，使香港成為一個更健康和生活更舒適的城市。

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Introduction

引言



Objective

It is no doubt that the necessity of energy conservation is a pressing issue and we should use energy only when really necessary. In response to such growing awareness in energy efficiency and conservation for buildings relating to design, operation and maintenance, this Booklet has been produced to provide a general guideline for the parties concerned in any organisations so as to conserve energy and thus to achieve energy and cost savings. Whilst our primary target readers are the end-users and the building managers of existing buildings, this Booklet also includes very useful guidance applicable to all developers, architects, and building services engineers.

Energy Conservation

Nowadays, it is a worldwide trend to pursue development in sustainability that is defined as *“development which meets the needs of the present without compromising the ability of future generations to meet their own needs”*¹.

宗旨

毫無疑問，節約能源是一個迫切的課題，我們應該在真正有需要時才使用能源。為回應社會人士對這個課題的熱切關注，本小冊子就建築物設計、操作及保養各方面，為各界提供指引及建議，以達到節能和減少能源開支的目的。本小冊子主要為建築物的使用者和物業管理經理編寫，其中也不乏為發展商、建築師及屋宇裝備工程師提供有用的指引。

節約能源

可持續發展 (Sustainable Development) 已成為全球的大趨勢，其宗旨是「能夠滿足現在的需 求而不損害下一代對地球資源的需 要」¹。可持續發展鼓勵節約能源及保護自然資源和環境，並提倡有效的能源管理、廢物管理和運輸管理。節約能源是可持續發展的一個重要環節，若我們希望持續發展能成功，現在便應該開始節約能源。



Sustainable development encourages the conservation and preservation of natural resources and of the environment and the management of energy, waste and transportation. Energy conservation is an important component contributes to sustainable development. If sustainable development is to be successful, we should start energy conservation now.

Fossil Fuel Shortage

Hong Kong has no indigenous energy source, therefore we can only rely on the importation of fossil fuels (coal, oil and gas) for electrical power supplies, gas supplies and petrol supplies. The more energy we use now, the less this non-renewable energy source will be left for the future. Sooner or later, unless positive steps are taken towards energy conservation, fossil fuels will no longer be economically accessible. This is not only a local but also a global issue. That explains why many countries have already implemented essential long-term energy conservation programmes into their plan for the future.

Air Pollution and Greenhouse Gas Emissions

The burning of fossil fuels creates serious air pollution and this has raised an international concern in recent years on



化石燃料的短缺

香港本土沒有能源資源，只能依靠進口的化石燃料（煤、石油、天然氣）來生產電力、氣體燃料和汽油。我們現在不斷使用這些非可再生能源，結果只會減少將來可用的資源。除非我們現在開始積極節能，否則在不久的將來，即使我們願意支付更龐大的費用，也未必能獲得足夠的化石燃料供應。這不僅是香港的問題，更是一個全球性課題。





the adverse effects brought along on the complex control mechanisms which regulate climate of the earth. Poor energy management results in wastage and excessive burning of fossil fuels. A large amount of carbon dioxide and other pollutants such as carbon particles, sulphur dioxide, nitrogen oxides, etc. will be generated as the by-products in the burning process. Some of these gases are greenhouse gases and will contribute to the global warming effect, while the other gases are harmful and have a long-term impact to the health of human beings.

As per the First Assessment Report² of Intergovernmental Panel on Climate Change (IPCC)³, air pollution and global warming have been escalated in an exponential rate in recent years.

Most countries already have plans to cut down the

空氣污染和溫室氣體的排放

燃燒化石燃料會嚴重污染空氣，改變地球氣候模式，帶來負面影響，故這問題近年已引起國際關注。不妥善的能源管理可能引致浪費及過量燃燒化石燃料，在燃燒過程中更會釋放出大量二氧化碳及其他污染物，例如碳粒子、二氧化硫、氮氧化物等，其中更包括溫室氣體以導致全球氣溫上升，其餘的有害氣體亦會對人類健康造成長遠的影響。


政府間氣候變化專業委員會²的首份評估報告³指出，近年空氣污染和全球暖化問題日趨嚴重，多個國家因而制訂了削減二氧化碳排放的計劃。例如，在日本京都舉行的聯合國氣候變化會議中⁴，已採納京都條約的國家均定出削減溫室氣體排放的目標。

減省能源開支

負責任的發展商、物業管理經理會盡量避免在建築物內浪費能源，以達致節約能源的目的。

若發展商、物業管理經理能積極響應節能，再加上用戶的參與，節能的結果將會事半功倍。在大多數情況下，只需作出少量，甚至是零投資，便能夠達到理想的節能效果。若遵從本小冊子提供的節能方案，以及建立良好的能源使用習慣，要減省 10% 的能源開支絕不困難。





release of carbon dioxide. For example, in the UN Conference on Climate Change held in Kyoto⁴, those countries which had adopted Kyoto Protocol set out targets in cutting the greenhouse gas emission. Being an international city, Hong Kong shall progress at the same pace with other countries.

Energy Savings

Any responsible developers/building managers will seek to avoid wastage of energy consumed by the building. The elimination of such wastage is synonymous with energy conservation.

With the active and positive commitment from the developers and the building managers, especially on the end-users' participation, energy conservation can be easily achieved. In many cases, such savings can be attained with very little or even no up front expenditure. It is not difficult to achieve energy savings of 10% with good housekeeping and energy usage practices, which are mentioned in this Booklet.

Energy management consultants can be employed to explore additional opportunities in energy savings. The result of energy savings may be as high as 20% or above with some capital expenditure invested in the technical modifications of the systems. Very often, the payback period can be significantly short. In recent years, some large commercial buildings in Hong Kong can enjoy cost savings amounting to millions of dollars per annum as a result of implementing the recommendations of a thorough energy management study.

僱用能源管理顧問更可進一步提高減省能源開支的機會。如果對系統作出一定程度的投資，進行適當的技術修正，節能的效果更可提高逾20%，而且投資的回本期通常很短。近年香港一些大型商業建築物已紛紛進行能源管理，評估推行有關的節能建議，部分更可節省能源開支多達每年數百萬元。

小冊子的內容

本小冊子的結構及內容細則，旨在讓讀者掌握能源效益及節約的基本資料。

第二章：

與建築物之能源效益和節約有關的專業人士 — 闡述各專業人士所扮演的角色及如何影響建築物能源效益及節約。





Structure of Booklet

The structure of this Booklet and sequence of information are designed to provide a basic understanding of the principles behind energy efficiency and conservation.

Chapter 2:

Key Persons in Building Energy Efficiency and Conservation – describes the main role of different concerned parties towards building energy efficiency and conservation.

Chapter 3:

Suggestions on Building Energy Efficiency and Conservation – describes some of the energy consuming equipment/systems commonly installed in the building and the associated guidance and approaches on energy savings. There are also some “Useful Tips” which are suggestions for developers/architects/building managers/building services engineers/end-users to implement energy efficiency and conservation plans for buildings.

Appendix I:

Comparison between Glazing – compares different glazing selections in the aspect of building envelope.

Appendix II:

Sources of Information – introduces Codes of Practices, Guidance Notes/Guidelines and Energy Management Publications that have been commonly used in Hong Kong.

Appendix III:

Websites Relevant to this Booklet – introduces some useful information on the topics available on the internet in detail.

第三章：

建築物能源效益及節約的建議 — 提供一般安裝在建築物內的能源消耗裝置、系統的節能方法和指引，也有一些「實用小貼士」，供發展商、建築師、物業管理經理、屋宇裝備工程師和用戶在推行節能措施時參考。

附錄一：

各類外牆玻璃的比較 — 比較各類用作建築物外牆玻璃的表現。

附錄二：

資料來源 — 介紹香港普遍採用的節能及能源管理守則、指南、指引和能源管理刊物。

附錄三：

與本小冊子相關的網頁 — 介紹有用的網址，供讀者瀏覽有關資料。



Key Persons in Building Energy Efficiency and Conservation

與建築物能源效益和
節約有關的專業人士



Key Persons in Building Energy Efficiency and Conservation

與建築物能源效益和節約有關的專業人士

Building Function

The prime function of building is to provide a shelter in which human beings can work and rest. Over centuries, human beings have been trying to improve the internal environment of the building by introducing various systems of building services installations.

The more systems added, the more comfort the end-users can enjoy resulting in better performance on their work. All the while more energy is consumed at the same time. Therefore, the most ideal case is to install systems which consume the least energy yet achieving the required comfort and performance standards. To reach such ideal goal, the contribution of the future facility manager and end-users of the building is of utmost importance.

Project Team Members

All project team members, including the developers, architects, building services engineers and building managers should know the expected performance of the building well so as to set the design objectives and targets in advance. Each member is required to provide input to

建築物的功能

建築物為人類提供了所需棲息及工作的空間。經歷多個世紀，人類不斷引入各類型的屋宇裝備系統，致力改善室內環境。

安裝愈多屋宇裝備系統，愈能夠滿足用戶對室內環境的要求，從而提高工作表現。但另一方面，建築物同時消耗着珍貴的能源。因此，最理想是這些系統能在消耗最少能源的情況下，也能讓建築物的用戶在舒適的環境中發揮應有的工作效率。要達到這個目標，實在有賴各用戶共同合作，互相配合。



formulate the design brief in the early design stage in order to enable a proper documentation and a good understanding of the whole concept. Based on this design brief, the developers can appreciate the good practices of energy conservation to be implemented; the architects can work out their architectural theme incorporated with energy saving measures and the building services engineers can carry out the engineering design for various building services installations. All the elements contributing to the energy saving measures should be integrated with the comments and advice from the building managers as well as the end-users who will be the ultimate operators and users of the buildings.

Developer's Contribution

The developer is the one who is responsible for controlling the overall development and paying the construction costs of the project. The developer should understand the most cost-effective measures in implementing energy efficient design for buildings at the very beginning stage of the project.

Investment on Energy Efficient Design

An energy efficient design does not necessarily mean a costly design. In fact, the energy efficient design can be considered as a kind of investment. Most of these designs will not lead to substantial increase in the whole construction cost nor the life cycle cost. However, the gain in benefits will be great, not only on savings due to the reduction of operating costs, but also in projecting a better image of the developer to the public.

工程項目隊伍

工程項目隊伍的各成員，包括發展商、建築師、屋宇裝備工程師和物業管理經理，應該明瞭建築物的預期能源表現，從而訂定設計的方針和目標。每個成員應在設計初期各自提出意見，以便擬定設計文本，充分了解整體概念，並把整個理念清楚記錄在案。基於這設計文本，發展商能掌握實踐具良好節能方案的方法。建築師亦可以把節能設計配合樓宇的建築主題，再讓屋宇裝備工程師把有關設計應用到各個屋宇裝備系統中。此外，也應綜合各有助達致節能的元素，在情況許可下結合將來的物業管理經理和用戶的建議，把樓宇營運者及使用者的意見融入設計中。


發展商的角色

發展商控制了整個發展計劃的規模和負責建造開支，在工程展開初期，發展商應以最佳的成本效益來推行具高能源效益的設計方案。

能源效益設計所涉及的投資

具能源效益的設計不一定需要龐大的投資。事實上，具能源效益的設計可當作是一種投資項目。大多數節能設計都不會令建築費用或樓宇生命週期費用大幅增加，相反，採用節能設計可帶來不少好處，除了因營運費用下降而節省開支之外，亦可進一步提升發展商的公眾形象。

事實上，一些創新及可持續的設計，例如附設於建築物的光伏系統、自動收集垃圾系統等均有助發展商把其建築物提升為環保建築物。



In fact, some of the innovative and sustainable design, such as the Building Integrated Photovoltaic, Automatic Refuse Collection Systems, etc., will help the developer to benchmark its buildings against those green buildings also.

Energy-efficiency-oriented Approach

As the leader of a project, if the developer takes the lead by concerning himself/herself with the current building costs and future operating costs, then the architects, building services engineers and many other professionals will follow that lead with interest and enthusiasm. Therefore, when the developer is setting his/her design brief in energy-efficiency-oriented approach, it does well not only for the project itself, but also for Hong Kong as a whole.

Architect's Contribution

Architects can have great influence on space planning, selection of building material, building orientation, shading devices, building envelope, and so on. These elements will be further discussed in **Chapter 3**. All these building design elements will greatly affect the air conditioning loading and the lighting power consumption. Once the building is constructed, their design will affect the whole life of the building in respect of energy consumption. With their expertise, the built environment can meet the end-user's need while achieving the target of energy efficiency and conservation.

In most of the projects, architects also play a leading role in building design which will influence the selection of building services systems and equipment directly.



採用以能源效益為本的方法

發展商負責領導工程項目，如果能帶頭關注建築成本及日後的營運開支，則建築師、屋宇裝備工程師等其他專業人士亦會朝著這個目標進發，在他們的設計中應用這個理念。因此，發展商在設計文本中提出以能源效益為目標，不僅有助工程項目達致成效，亦為香港整體發展帶來好處。

建築師的貢獻

在設計建築物時，空間的應用、建材選擇、坐向、遮陽裝置、建築物外牆等都由建築師策劃。本小冊子**第三章**會進一步闡述各項元素。這些建築物的設計元素將決定空調冷量和照明裝置的耗電量。當建築物落成後，將終身地影響着建築物。憑着建築師的專業眼光及經驗，建築物不僅能滿足使用者的需要，亦能達致能源效益及節約的目標。

在大多數的工程項目中，建築師在建築物的設計上均擔當領導的角色，直接影響屋宇裝備系統及設施的選擇。



Building Services Engineer's Contribution

The energy consumption of building is mainly due to the operation of equipment/systems of various building services installations. Building services engineers should be closely involved in and should make contribution to energy efficiency and conservation at the inception stage. A good building services engineering design will usually require contribution from all project team members. The building services engineer will act as the key person to collect the operational requirements from the developer and to coordinate with the architect on the space allocation of plant rooms.

Building Manager's Contribution

The building manager is the key person to operate the equipment/systems so as to execute the design brief by the project team. A thorough understanding of the design concept of the various building services installation is essential for the building manager to operate equipment/systems properly and efficiently.

As the design assumptions may usually have some deviations from the real scenarios, suitable adjustment and fine-tuning of the system is necessary during actual operation of the equipment/systems. It is recommended that the building manager should be involved in an early design stage if possible so that he/she can understand the design brief and provide valuable advice in the early stage of the project.

屋宇裝備工程師的貢獻

建築物的能源耗用在各項屋宇裝備系統及設施上，因此，屋宇裝備工程師應該在項目展開初期便考慮具效能及可節能的參數。良好的屋宇裝備設計需要參與項目成員的配合。屋宇裝備工程師在此擔當重要角色，包括向發展商了解運作上的要求，並與建築師協調機房空間的分配。

物業管理經理的貢獻

物業管理經理負責各設備和系統的日常運作，亦是貫徹整個設計概念的主要人員。為確保能有效和適當地操作有關的設備、系統，物業管理經理必須徹底和深入了解設計文本中各個屋宇裝備的設計概念。

由於原本的設計與實際的應用情況會有偏差，故在設備和系統的運作過程中，往往需要作出適當的調節以作配合。在情況許可下，物業管理經理應在設計初期積極參與，了解設計的概念，並提供意見，供其他成員作為參考。



Housekeeping

Good housekeeping is of utmost importance so as to ensure the best energy performance of the equipment/systems. Some guidelines on housekeeping as described in **Chapter 3** of this Booklet can help the building manager to minimise the energy consumption.

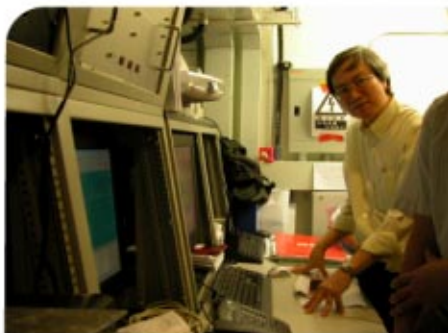
Energy Audit

Energy audits are recommended to be conducted frequently to identify any Energy Management Opportunities (EMOs). Extensive energy audits should be carried out, before any major alteration, addition and improvement works of the building. Please refer to *Guidelines on Energy Audit*⁵ published by EMSD for detail.

End-user's Contribution

The end-users are the ones who actually consume energy. An energy-conscious end-user can save energy directly. Some examples are:

- Turning off unused equipment, switching off lighting and air conditioning system for areas with no occupancy.
- Using energy-efficient lighting with an intelligent lighting control when carrying out any retrofit or renovation works.



內務管理

良好的內務管理能確保設備和系統發揮最佳的能源效益和節約。本小冊子的**第三章**會介紹一些內務管理的指引，使物業管理經理能把能源消耗盡量減低。

能源審核

能源審核有助找出可行的能源管理機會 (Energy Management Opportunities)，因此應經常進行。建築物在進行大型的改建、加建及改善工程之前，應先進行全面的能源審核。有關詳情，請參閱機電工程署出版的*如何進行能源審核*⁵。

建築物用戶的角色

用戶是實際使用能源的人。善用能源能直接減少能源的消耗，例如：

- 關掉沒有人使用的設備和系統，例如空置地點的照明及空調系統。
- 當進行翻新工程時，安裝具智能控制功能的節能照明系統。



Suggestions on Building Energy Efficiency and Conservation

建築物能源效益及節能的建議



Suggestion on Building Energy Efficiency and Conservation

建築物能源效益及節能的建議



Sustainable Resources

Architects and building services engineers are encouraged to consider employing renewable energy in their design so as to minimise the consumption of non-renewable energy such as fossil fuels. Some sustainable energy sources are discussed in the following sections.

Natural Ventilation

Instead of providing air conditioning for cooling, end-users in fact can tolerate far greater temperature ranges, if they are provided with openable windows that allow them to regulate air temperature and movement.

For buildings that are designed with both openable windows and traditional mechanical cooling (so-called “mixed-mode” buildings), installing switches on the window sashes which enable users to shut off air conditioning systems easily can minimise the potential energy use.

可持續的資源

建築師和屋宇裝備工程師應考慮在設計時應用可再生能源，以便把非可再生能源（例如化石燃料）的消耗量減至最低。我們將在以下部份介紹一些可持續使用的資源。

自然通風

用戶不一定要靠空調來維持適當的室內工作環境，縱使室外的溫度略高，透過開啟窗戶，用戶也可以適當地調節空氣流量，達致調節合適的室內工作環境的目的。

某些建築物既設有空調又有可打開的窗戶（即「混合模式」建築物），設計時可於窗框附近安裝開關掣，用戶在打開窗戶時，可決定是否關掉空調，減低能源的消耗量。



Day Lighting

Good selection of glazing can significantly utilise the benefits of day lighting. Architects should select a glazing with a high light-to-solar-gain ratio. Building services engineers should make good use of day lighting for enhancing the luminous efficacy of the lighting installation. For details, please refer to **Page 19 – Building Envelope**.

Save
Energy

Some Useful Tips

- Using devices for controlling and reflecting direct-beam sunlight into white ceilings.
- Using strategically-located lighting controls to adjust the levels of illumination in response to solar illumination.

Recycled Water

Wastewater from buildings contributes to the drainage loading of the water treatment plant. The recycling of wastewater will effectively reduce the drainage loading of the water treatment plant and thus the overall water consumption. Wastewater and rain water (grey water) can be collected and treated using advanced or tertiary treatment method, producing high quality water for further use in toilet flushing, landscape irrigation, general cleansing, etc.



日照

正確選擇外牆玻璃有助善用天然光，減少能源的消耗。建築師應選用高透光率而熱輻射率低之玻璃，而屋宇裝備工程師應利用日照減低照明系統的電力損耗。詳情請參閱**第 19 頁**有關建築物外牆的部分。

節約
能源

實用小貼士

- 加設反光裝置，把直接照射的太陽光反射到白色的天花板上。
- 在適當的位置安裝照明控制器，按照日光的光度來調節照明系統的光亮程度。

循環用水

建築物排放的廢水會加重污水處理廠的工作量，把廢水回收，循環再用可減少污水處理廠的工作量，又可減少整體用水。廢水及雨水（俗稱中水系統）經過先進而精密的收集和處理方法後，可循環再造成高品質的用水，供沖廁、灌溉或清潔之用。



New and Renewable Energy Technologies

The following new and renewable energy technologies have the potential to supplement or replace non-renewable energy for power supply in the future.



Save Energy

Some Useful Tips

- Using modern solar thermal heating systems to concentrate sunlight and to utilise its energy to produce hot water, steam and electricity.
- Using photovoltaic (PV) arrays to act as a power-generating device that produces direct current electricity when exposed to the sun.
- Using a wind turbine to convert kinetic energy of the wind into rotational motion in turning a shaft which connect to an electrical generator and producing power.
- Using biomass energy technology, i.e. the utilisation of plant matter, to produce energy.
- Using geothermal energy, i.e. the natural heat extracted from the earth's crust, to produce energy.
- Using fuel cells combining hydrogen gas and oxygen to produce direct current electricity and water (the reverse process to electrolysis).

新能源及可再生能源科技

以下是一些新能源及可再生能源科技，可以補充或取代非可再生能源，應付未來的電力供應。



節約能源

實用小貼士

- 使用高科技太陽熱能裝置把陽光聚合，利用太陽能產生熱水、蒸汽和電力。
- 安裝光伏板，這類裝置能在陽光直接照射下產生直流電，提供電力。
- 利用風力發電機把風的動能轉化為其他能量，藉著風車葉旋轉的動力來推動連接著發電機的旋轉軸，從而產生電力。
- 利用生物能技術，即利用植物物質來產生能量。
- 利用地熱能，即由地殼抽取的天然熱能來產生能量。
- 利用燃料電池將氫氣和氧氣混合，產生直流電和水（即水電解的相反步驟）。





Space Planning

By proper space planning, the utilisation efficiency of functional areas will be increased together with a reduction in energy consumption.



Save Energy

Some Useful Tips

- Minimising the non-functional areas where occupancy rate is low but requiring air conditioning, e.g. designing long corridor and large volume air-conditioned lift lobby.
- Providing sufficient plant room spaces to enable future maintenance of equipment/systems in achieving their highest operating efficiencies.
- Allocating the non-air-conditioned plant room locations to the external zone of the building to act as insulation buffers in screening off solar radiation.

Building Material

Careful selection of building material can have a dramatic effect upon energy consumed and the operating costs of the building.



Save Energy

Some Useful Tips

- Selecting roof insulation material with a low thermal conductivity when a metal roof is proposed.
- Selecting light-coloured building external finishes rather than dark-coloured ones.
- Selecting light-coloured floors, walls and ceilings in interior design.

空間設計

建築物若能配合適當的空間設計，不但能按功能善用空間，更可減少能源消耗量。



節約能源

實用小貼士

- 減少沒有指定功能的空間面積，特別是那些使用率低而又需要開啟空調的地方，例如多設計短走廊和較小體積的空調電梯大堂。
- 提供足夠機房空間，以配合日後設備和系統的保養需要，亦有助發揮設備和系統的最高操作效能。



- 把無須安裝空調系統的機房設置在建築物的外圍位置，以阻擋太陽輻射。

建築材料

選擇適當的建築材料能大大減低能源的消耗量和建築物的營運開支。



節約能源

實用小貼士

- 如選用金屬屋頂，應採用傳熱度較低的材料。
- 建築物外牆宜選擇較淺的顏色。
- 在室內設計方面，應選擇淺色的地板、牆壁和天花板。

Building Orientation

In Hong Kong, the energy consumption of buildings by the air conditioning system is approximately 30% to 50% of the total. Appropriate decision on building orientation can reduce the amount of solar radiation entering the building and in turn reduce the required cooling load by air conditioning system.

Architects may seek for advice from building services engineers regarding the solar heat gains in different building orientation options. As a general guideline, it is advisable to orient the longer building envelopes to face north or south and the shorter exposure to face east or west so as to reduce the solar heat gain while capturing useful day lighting.

External Shading Device

External shading devices such as canopy, fins, etc. provide a means of controlling excessive solar radiation entering the building and improving building aesthetics to some extent.

If the sizes and the locations of window openings are carefully calculated and designed, advantage can be taken by utilising solar radiation throughout the winter season as well as at morning and evening during other seasons.

Internal venetian blinds, preferably light-coloured, can also be installed to reflect direct sunlight during the summer season, although they are far less effective in blocking solar radiation when compared with external shading devices.

建築物的座向

一般的香港商業建築物，空調系統消耗了整座建築物 30 % 至 50 % 的耗電量。合適的座向能減少照射入室內的太陽熱輻射，從而減少空調系統的製冷量。

建築物的座向會影響太陽的熱增量，建築師可就此諮詢屋宇裝備工程師的意見。一般而言，建築物邊長的部份應面向北方或南方，而較短的部分應面向東方或西方，這樣便可善用日光，同時減少太陽熱增量 (Solar Heat Gain)。



外牆遮陽裝置

簷篷、遮陽片等外牆遮陽裝置，既可阻擋部份進入建築物內的太陽熱輻射，亦可美化建築物的外觀。

若窗戶的大小和位置經過精密的計算及設計，我們便可以在整個冬季及其他季節的早晚時段充份利用溫暖的日照。

在夏季，百葉簾亦有助阻擋太陽熱輻射，特別是淺色的系列，不過，其阻擋太陽輻射的效能則不及外牆遮陽裝置。

Building Envelope

A building envelope design is one of the most challenging jobs for the architect. In fact, the building envelope can act as a good thermal barrier between the internal and the external environments. It plays an important role in determining how effectively the building can utilise day lighting, natural ventilation, solar radiation and free cooling. Position, glazing, shape and colour of the envelope design can all contribute significantly towards its energy conservation.

The Overall Thermal Transfer Value (OTTV) can be employed as a yardstick for the architect to measure how well the building is achieved in terms of solar heat gain and thermal conductance. Architects are encouraged to design buildings with OTTV lower than the minimum requirements of *Code of Practice for Overall Thermal Transfer Value*⁵ under Building (Energy Efficiency) Regulation (Cap. 123 sub. leg.).

A good glazing selection can make buildings more attractive, more comfortable and less expensive to own and operate. The detailed comparison on glazing selection is shown in **Appendix I**.

In selecting the best glazing, the Life Cycle Assessment (LCA)⁷ should be carried out, taking account of the following items:

- Lifetime building energy consumption, including operating and maintenance costs of lighting, heating and air conditioning.
- Day lighting utilisation.
- The value of cooling equipment displaced by more advanced glazing systems.

建築物外牆

對建築師來說，設計建築物外牆是最富挑戰性的工作之一。事實上，建築物外牆是室內和室外環境之間的主要隔熱屏障，它亦決定建築物能否有效地利用日照照明、自然通風，太陽熱力和自然散熱。外牆的位置、玻璃外牆的選用、形狀和顏色均是影響建築物能否達致節約能源的主要因素。

建築師可利用總熱傳送值 (OTTV) 作為量度建築物在太陽熱增量和熱傳導兩方面的基準。建築師在設計建築物時，採用的總熱傳送值可低於按《建築物（能源效率）規例（第123章附屬法例）》下制定的**總熱傳送值守則**⁶所訂定的最低要求。

選擇合適的外牆玻璃不但能增加建築物的美感，令用戶感到更加舒適，而且能減省樓宇的建築成本及營運費用。有關各類外牆玻璃的詳細資料，可參閱**附錄一**。

為建築物揀選最合適的外牆玻璃時，應先進行生命週期評估 (LCA)⁷，以考慮下列各點：

- 建築物在使用期內的能源消耗量，包括照明、空調及供暖系統的運作及維修費用。
- 日照的應用。
- 以較先進的外牆玻璃系統去減少太陽熱增量，從而減低空調負荷和所涉及的費用。

同時利用一些建築物能源表現模擬軟件模擬計算建築物的總能源用量。機電工程署出版的「**成效為本建築物能源效益守則**⁸」可作為評估建築物的整體能源表現的指引及參考。

Some building energy performance simulation software can be utilised to simulate the total building energy consumption. The *Performance Based Building Energy Code*⁸ published by EMSD is also a good guideline and reference on the assessment of the total building energy performance.

Electrical Installation

EMSD has published a *Code of Practice for Energy Efficiency of Electrical Installations*⁹ and related guidelines which have illustrated how energy saving can be achieved in electrical installation of buildings. The aspect of power quality is also addressed.

Tariff Review

For good management of energy consumption, it is important to monitor the power consumption level of the building carefully since the electricity charge is based on the consumption rate as well as the maximum demand.

When the power consumption reaches a certain level, the end-user can apply to the power supply company for a special charge rate other than the general tariff. This will save a lot of energy cost as long as the energy consumption is maintained steadily throughout the day.

Power Quality Review

The power quality can be reviewed, if large amount of electronic equipment such as computers are connected to the power supply system. The optimisation of the harmonic content of the system can improve the stability and operational efficiency of electronic equipment. On the

電力裝置

機電工程署出版的 *電力裝置能源效益守則*⁸ 和相關的指引闡述如何在建築物的電力裝置方面節約能源，並探討了供電質素 (Power Quality) 的課題。

電費檢討

電費價格乃按照用電量和最大用電需求來計算，因此，若要有效地管理能源的消耗，必須小心監控建築物的耗電量。

若耗電量達到一定水平，用戶可向相關的電力供應公司申請以特惠價格繳付電費。當建築物能保持穩定的耗電量，這樣安排便可節省大量電費。

電力質素檢討 (Power Quality Review)

若電力分配系統連接大量的電子設備 (例如電腦)，可進行電力質素檢討。把系統內的諧波含量優化以改善電子設備的穩定性和操作效能。另一方面，良好的電力質素亦有助增加電力公司供電系統的穩定性。





other hand, a good power quality can improve the stability of the power supply system from the power supply companies.

Minimisation of Maximum Demand in Peak Hour

Maximum demand charges will be applied in peak hours for the Large Power Tariff. The end-user can reduce the maximum demand if the peak loads can be reduced to minimum by switching off all unnecessary loads during the peak period or rescheduling their use. In doing so, the power generation requirements of the power supply companies can be further reduced.



Some Useful Tips

- Checking to ensure the electricity supply voltage is correct.
- Checking to ensure the loads are balanced across the three phases.
- Improving the power factor¹⁰ if economically viable.
- Using high efficiency motors whenever appropriate.
- Using electronic device, variable frequency inverters and soft starters.
- Providing adequate ventilation to the overheated parts of machinery, e.g. motor.
- Lubricating frequently the moving parts of motors and drive bearings to avoid overheating and power losses.

Lighting Installation

A good lighting system design enhances the energy performance of buildings. In fact, an energy efficient lighting installation offers extraordinary opportunities for energy and cost savings.

減少繁忙時間的最大用電需求

在繁忙時間內，按「高需求用電價目」(Large Power Tariff) 計算電費的用戶須繳付最大用電需求 (Maximum Demand) 的電費。若用戶能在高峰用電時間關掉非必要的電力裝置，或改變這些電力裝置的使用時間，則可把最高耗電需求量減少。與此同時，亦可減少電力公司的供電需求。



實用小貼士

- 確保供電電壓正確。
- 檢查三個相位的電力負荷是否平均。
- 改善電器的電力功率¹⁰。
- 盡量使用高效能摩打。
- 使用軟起動器和可變速的可變頻率變流器。
- 為機件上過熱的部分 (例如摩打) 提供足夠的散熱設備。
- 經常在摩打及主動軸承的機件上加添潤滑劑，避免機件過熱和損耗電力。



照明裝置

良好的照明系統有助提升建築物的能源表現。事實上，具能源效益的照明裝置能有效節省能源及開支。

Please refer to EMSD's *Code of Practice for Energy Efficiency of Lighting Installations*¹¹ regarding various recommended lighting requirements. International standards such as *Code for Lighting*¹² also give recommendation on lighting requirements.

When replacing light fittings, high energy efficiency fluorescent tubes should be used whenever possible. They require no more than one-third of the energy consumed by incandescent lamps while achieving the same illumination level.



Some Useful Tips

- Using lamps with the highest luminous efficacy.
- Using high efficiency fluorescent tubes, e.g. T5 tubes or T8 tubes.
- Using open louvre type diffusers whenever acceptable.
- Using compact fluorescent lamps instead of incandescent lamps.
- Using colours with a high light-reflectance value when a room is to be redecorated.

由機電工程署出版的 *照明裝置能源效益守則*¹¹ 已詳列各類照明裝置的建議要求。一些國際標準 (例如 *照明守則*¹²) 也就照明的要求提出建議。

當更換照明裝置時，應盡可能使用能源效益較高的熒光燈。這類光管只需白熾燈三分之一或以下的電力，便可發同等亮度。



實用小貼士

- 使用具有最高發光效率的電燈。
- 使用高效率的熒光管，例如 T5 或 T8 熒光管。
- 在許可的情況下，使用百葉窗式的透光罩。
- 以緊湊型熒光燈取代白熾燈。
- 進行翻新工程時，選用反光度較高的顏色。
- 戶外及高位照明裝置應採用高強度發光系統，最好是金屬鹵化燈。

Comparison on Efficacy among Different Lamp Types 不同電燈類別之效能比較

Lamp Life (hours) 電燈壽命 (小時)	Lamp Type 電燈類別	Luminous Efficacy (Lm/w) 燈光效能 (流明/瓦特)
750 - 2500	Incandescent 白熾燈	8 - 21
4000	Tungsten-halogen 鎢絲鹵燈	18 - 24
24000	Mercury vapour 汞蒸氣燈	26 - 50
7500 - 20000	Metal halide 金屬鹵化燈	61 - 100
9000 - 20000	Fluorescent 熒光燈	70 - 100
16000 - 24000	High-pressure sodium 高壓鈉	57 - 125
18000	Low-pressure sodium 低壓鈉	150



- Using high-intensity-discharge (HID) systems, particularly metal halide, for outdoor and high-bay lighting.
- Using occupancy sensors in areas where lighting usage is not frequent.
- Using solid-state dimmers as a means of reducing lighting levels when higher lighting levels are not required.
- Using new technologies such as induction lamps, LED fire exit signs, etc.
- Using electronic ballasts for fluorescent light fittings, especially for those lights which need to be switched on permanently.
- Identifying unused lights by colour coding the individual lighting switches in multiple-switch circuits.
- Switching off the lights close to windows or in rarely occupied areas.
- Cleaning walls, floors and ceilings.
- Cleaning regularly light diffusers, globes and reflectors under a routine cleaning schedule.
- Replacing yellowed or hazy lenses.
- Replacing fluorescent lamps at the end of their rated life since their efficiency fall rapidly prior to failure.
- Re-scheduling of cleaning and other activities taken place outside normal working hours.
- Repainting the inner surfaces of light boxes.
- Removing tubes/lamps/ballasts when lightings cannot be switched off due to group switching arrangement.
- Rearranging the switching arrangement to enable lights that are only occasionally needed to be switched off individually.
- 在電燈使用率偏低的地方安裝用戶感應器。
- 使用電子光暗掣，按情況調較燈光的亮度。
- 使用新技術（例如電感燈、發光二極管火警逃生指示牌、硫磺燈等）。
- 為熒光燈裝置安裝電子鎮流器，尤其是需要長期亮着的電燈。
- 以顏色識別多重開關掣上不常用的獨立燈掣。
- 關掉窗戶附近或使用率偏低地點的電燈。
- 經常清潔牆身、地板和天花板。
- 編訂清潔時間表，定期清潔透光罩、燈泡及反光片。
- 更換已變黃或模糊不清的漫射器 (lens)。
- 在熒光燈預計壽命終結前把它換掉，以免其效率在損壞前急劇下降。
- 重新編排正常工作時間以外進行的清潔及其它活動。
- 在燈箱的內部重新髹上漆油。
- 若未能關掉受群組開關系統影響的照明裝置，在照明偏高的地方可拆除一些光管、電燈或鎮流器。
- 重新安排開關群組，以便能獨立關掉無需經常亮着的電燈。



Small Power and Office Equipment

Office equipment with energy efficiency label under the Energy Efficiency Labelling Scheme is recommended to be widely used, as it paves the way for long-term energy savings. The scheme as at February 2004 covered nine types of household appliances, including refrigerators, room coolers, washing machines, electric clothes dryers, compact fluorescent lamps, electric storage water heaters, electric rice-cookers, dehumidifiers and televisions as well as four types of office equipment, including photocopiers, multifunction devices, LCD monitors and laser printers.



Some Useful Tips

- Switching off all office equipment after office work.
- Extracting locally the heat from the office equipment.
- Isolating the power supply of unused office equipment, e.g. battery charger, calculator.
- Setting the office equipment to standby mode when not in use for a period of time during office hours.

低耗電量及辦公室設備

市民應選用按能源效益標籤計劃貼有能源效益標籤的辦公室設備，以達致長遠節能的目標。截至2004年2月，這項計劃已涵蓋九款家用電器，包括雪櫃、冷氣機、洗衣機、電乾衣機、緊湊型節能熒光燈（慳電膽）、儲水式電熱水爐、電飯煲、抽濕機及電視機，以及四款辦公室設備，包括影印機、多功能辦公室設備、液晶體顯示屏及鐳射打印機。



實用小貼士

- 離開辦公室前，關掉所有辦公室設備。
- 把辦公室設備所產生的熱力排走。
- 完全截斷供電給一些在非使用狀態下但仍耗電的辦公室設備（例如電池充電器、計算機等）。
- 於辦公期間，把辦公室設備設定為備用模式，以便在非使用時可節省用電。

Air Conditioning Installation

EMSD's *Code of Practice for Energy Efficiency of Air Conditioning Installations*¹³ and related guidelines provide a good guidance to save energy in air conditioning installation.





Air conditioning usually accounts for 30% to 50% or even more of the total energy consumption of commercial buildings in Hong Kong, enabling more EMOs to be identified. These energy savings, however, will inevitably require some initial expenditure as well as the fee of energy management consultants, if employed.

The building manager should be aware of the need to operate equipment/system at peak efficiency, to control operating times carefully and to follow proper maintenance practices. The best way to ensure energy efficiency in air-conditioning is to develop a detailed preventive maintenance programme based on the manufacturers' recommendations for the proper maintenance of the air conditioning equipment.



Some Useful Tips

- Using mechanical ventilation rather than cooling whenever appropriate.
- Adjusting the room temperature settings if the settings are too high or too low.
- Closing the doors between air-conditioned and non-air-conditioned spaces, e.g. outside the building, some lift lobbies, toilets and stores.
- Closing the windows at air-conditioned spaces when air-conditioning installations are turned on.

空調裝置

由機電工程署出版的**空調裝置能源效益守則**¹³及相關的指引闡述如何在空調裝置方面節約能源。

一般的香港商業建築物，空調系統消耗了整座建築物 30% 至 50% 甚至更多的耗電量，故在空調方面不難找到一些能源管理機會。不過，若採用這些節能措施，有可能需要一些開支，及要支付聘用能源管理顧問的費用。

物業管理經理應發揮設備和系統的最佳操作效能、小心控制操作的時間，並依照正常程序進行維修保養。若要在空調方面達致能源效益，必須按生產商的建議正確保養空調設備，及制定詳細的預防性維修保養計劃。



節約能源

實用小貼士

- 盡量利用機械通風系統，避免開啟冷卻裝置。



- 經常檢查室內溫度設定，避免過高或過低。
- 緊閉空調與非空調房間（例如建築物的外圍、電梯大堂、洗手間、儲物室等）之間的門。
- 在開啟空調時緊閉所有窗戶。

Central Control and Monitoring System

Central Control and Monitoring System (CCMS) provides the central control and monitoring of all BS installations. It is particularly useful to allow time-setting of operation for all equipment/systems such that they will be switched off automatically during the non-operating hours. This can greatly save the energy consumption of the building. Suitable selection of the space control equipment to cater for the part-load conditions can reduce the energy consumption as well as to ensure the controlled comfort conditions can be maintained.

Air Side System

To accommodate varying usage patterns efficiently, multi-zone systems with separate controls, such as the Variable Refrigerant Volume (VRV) system and Variable Air Volume (VAV) system, can be considered for installation. Sometimes it can be more energy efficient by using local air-conditioning units in lightly used areas, as well as by setting control valves to shut off the individual zones from the central system.



Some Useful Tips

- Cleaning regularly the cooling and heating fins to ensure that they are operating efficiently.
- Cleaning regularly all filters, e.g. main filters, pre-filters, bag-in-bag-out filters, etc.
- Checking regularly the insulation to identify any damage and loss of integrity.
- Using continuous exhaust fans in toilet areas with auto-switches control in lights and fans.

中央控制及監察系統

中央控制及監察系統可控制和監察所有屋宇裝備，尤其對於所有設備和系統裝置的開關時間作有效的控制，以便設施在非使用期間自動關閉，從而大大減少建築物的能源消耗量。適當選用空間控制設備，可因應局部負荷情況減少能源消耗量，並確保能維持舒適的室內環境。

送風系統

為配合各類使用模式，可考慮安裝有獨立開關的分區系統，例如可變式製冷系統 (VRV) 及可變式空氣流量系統 (VAV)。為達致最佳的節能效果，亦可在使用率偏低的地方使用獨立的空調裝置控制閥 (control valve)，以便分隔各獨立區域和中央系統的開關。



實用小貼士

- 定期清潔冷卻器或散熱器的葉片，確保其有效地運作。
- 定期清潔所有隔塵網，例如主隔塵網、預先過濾網、過濾袋等。
- 定期檢查隔熱設施，以便找出損壞及失效的部分。
- 於洗手間利用感應器來開關洗手間內的通風及部份照明系統。
- 定期檢查所有自動溫度控制裝置，確保這些裝置能妥善運作。
- 經常檢查所有風喉及設備有否漏風情況，特別是接駁位、盤管、機殼、出風口及應經常緊閉的控制閘 (damper)。



- Checking regularly all automatic temperature controls to ensure that they are operating properly.
- Checking frequently all ductwork and equipment to identify any leaks, especially around joints, coils, casings, access openings and dampers in their closed positions.
- Reviewing the location of room thermostats to ensure that they would not be mistakenly influenced by direct sunlight or factors affecting the room air temperature.
- Calibrating regularly all thermostats, adjusting the temperature settings of all thermostats to low in winter and to high in summer; locking all thermostats either at the desired setting or at a limited range of adjustment by the end-users.
- Controlling the system to ensure the space reaches the desired temperature just before the end-users arrive and automatically switching off the system a pre-determined time after they leave.

Water Side System

With multiple chillers operating at a part-load condition, the second chiller should not be brought on-line until the first one is up to a pre-determined capacity. Normally, the least energy is used by one chiller operating at 90% capacity as compared with that used by two chillers each operating at 45% capacity.


- 檢討恆溫器的位置，以免其因受陽光直接照射或其他因素而影響控制室溫的功能。
- 定期調校恆溫器，例如在冬季調低溫度設定，而在夏季則相應調高；把所有恆溫器鎖定在最理想或限定的溫度值。
- 預先設定程式，確保空調系統在用戶到達前達致理想室溫，並於沒有人使用房間的一段時間後自動關掉。

冷凍水系統

與其讓多部冷凍機同時處於局部負載狀態，不如待第一台冷凍機達到預定的製冷量時才啟動第二台冷凍機。在一般情況下，一台製冷量達90%運作的冷凍機，較兩台製冷量45%運作的冷凍機使用較少能源。

當有需要採用多部冷凍機，可考慮選擇製冷量不一的冷凍機。因冷凍機於接近最高製冷量運作時，較在低製冷量運作更能發揮效能。若冷凍機組由兩台製冷量不同的冷凍機組成，在大多數情況下，其中一部冷凍機會以接近最高製冷量情況下運作，與兩部製冷量相同但以較低製冷量運作的冷凍機組比較，前者能達到更佳效能。



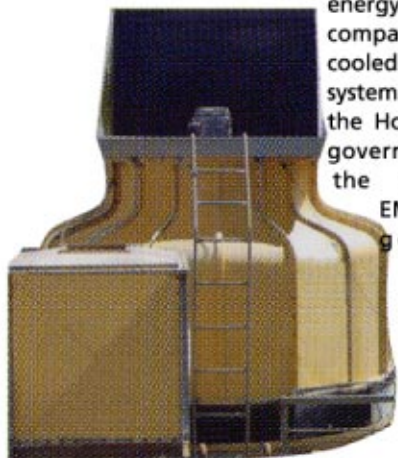


Select unequally sized machines for multiple chiller installations. Chillers operate more efficiently when they are loaded close to their full rating than they are only lightly loaded. If one chiller in a two-machine installation is smaller than the other, under most operating conditions, one or the other of the two chillers should be able to run close to full load. This will result in a more efficient operation than if one or two same-sized chillers are operating at a lighter load condition.

Variable Speed Drive (VSD) chiller compressor can be considered as replacement of traditional chiller in the future, as its cost has been gradually reduced. The VSD chiller compressor will allow the compressor to run at lower speed under part-load conditions, thereby yielding a lower compressor kW/ton rating under such circumstances than that typically achieved by ordinary centrifugal chillers in which part-load control is effected by inlet guide vanes.

Whenever feasible, water-cooled heat rejection system should be applied as this can achieve more than 20% in

energy savings, when compared with air-cooled heat rejection system. In June 2000, the Hong Kong SAR government, with the support of EMSD and other government



具有可變速驅動器 (VSD) 的冷凍機壓縮裝置由於價格持續下調，可考慮用以取代傳統的冷凍機。這類裝置令壓縮器在局部負載的情況下以低速度運行，其所產生的壓縮率（以千瓦/噸計算），較在局部負載情況下用進氣導流片 (inlet guide vane) 控制的離心冷凍機為低。

應盡量使用水冷式排熱系統，與氣冷式排熱系統比較，前者可節省逾 20% 的能源。在 2000 年 6 月，香港特別行政區政府在機電工程署及其他政府決策局及部門的支持下，於香港六個指定地區推行「非住宅樓宇水冷式空調系統廣泛使用淡水先行性計劃」，在 2003 年 8 月，這項計劃已推廣至 54 個指定地區。

節約
能源

實用小貼士

- 定期檢查冷凍機，確保其以最高效能運作，而且要清潔冷凝管、查看冷凍劑及冷凍水有否滲漏、校準儀表、為軸承適當添加潤滑劑及調較傳動帶。
- 當冷凍機發生故障時，應關掉冷凝器、水泵及冷凍水泵，以免設備在備用模式中消耗能源。



bureaus/departments, launched a “pilot scheme on the wider use of fresh water for water-cooled air conditioning in non-domestic buildings” in six designated areas in Hong Kong. It was subsequently expanded to cover a total of 54 designated areas in August 2003.



Some Useful Tips

- Checking regularly the chillers to ensure they are working at maximum efficiency with clean condenser tubes, no refrigerant leakage, no water leakage, calibrated gauges, lubricated bearings and properly tensioned belts.
- Shutting down the condenser, the water pump and the chilled water pump when the chiller is out of services, since the equipment in a standby mode still consumes energy.
- Adjusting the chilled water supply temperature at 9°C than at 5.5°C will result in 10% less energy consumed. The chilled water supply temperature should be raised as the need for cooling is reduced during cooler weather. Advice from to the chiller supplier should be sought, when in doubt.

Pumps and Fans

- Using energy efficient pumps and fans.
- Using variable frequency inverters.
- Following the manufacturers' recommended maintenance procedures of pumps and fans to maintain their maximum efficiencies.

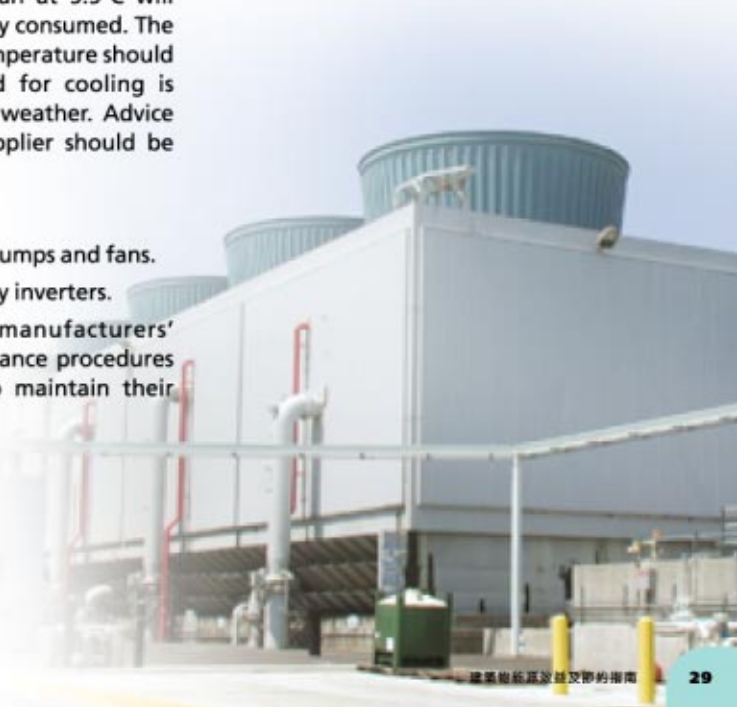
- 把冷凍水的供應溫度設定為 9 度，會較設定為 5.5 度節省能源約 10%。若天氣稍涼，冷量的需求會減少，因此應調高冷凍水的供應溫度。如有任何疑問，應向冷凍機供應商查詢。

泵和風扇

- 選用高能效的泵和風扇。
- 使用可變頻換流器。
- 參照製造商制定的維修保養程序，確保泵和風扇能在最佳效能下運作。

空調裝置

- 預先設定程式，確保空調系統在用戶到達前達致理想室溫，並於沒有人使用房間的一段時間後自動關掉。



Air Conditioners

- Programming the user-controlled air-conditioners to be switched on no earlier than 15 minutes before the space is to be occupied, and be switched off when the space is not occupied for a prolonged period.

Lift Installation and Escalator Installation

EMSD's *Code of Practice for Energy Efficiency of Lift and Escalator Installations*¹⁴ and related guidelines provide good guidance in designing lift installation and escalator installation.

In Hong Kong, the energy consumption of lift installation and escalator installation is almost as much as that of lighting installation in commercial buildings. This is mainly due to their invariably large electrical motors and virtually continuous operation throughout the day in many cases.

Lift Installation

The pattern of lift usage profile varies from time to time, so it is worth getting the lift maintenance company to conduct a periodic lift traffic analysis in order to examine whether the existing lift programming is operating optimally.



Save Energy

Some Useful Tips

- Using light-weighted decorations in the lift design.
- Using either a variable voltage variable frequency (VVVF) drive or a direct-current motor controlled by energy-efficient solid-state elements when replacing the lift drive system.

升降機及自動梯裝置

由機電工程署出版的 *升降機及自動梯裝置能源效益守則*¹⁴ 及相關指南為升降機及自動梯裝置的設計提供指引。

部份的香港商業建築物，升降機及自動梯裝置的能源消耗量竟多至與照明裝置的能源消耗量相約，主要原因是升降機及自動梯不必要地使用了過大型的電動摩打，而且在很多情形下都是整天不停地運作。

升降機裝置

由於升降機日常的使用模式會不時改變，因此應要求負責維修保養的公司定期分析升降機的使用情況，以便了解現行的運作安排是否最理想。



節約能源

實用小貼士

- 採用輕巧的內部裝飾設計。
- 當更換升降機的驅動裝置時，使用可變電壓可變功率 (VVVF) 驅動器，或以電子元件控制直流摩打的節能驅動器。
- 於辦公時間以外或假日只開啟一部或兩部升降機，以供使用。
- 鼓勵使用者步行一層或兩層樓梯，以代替乘搭升降機。
- 若發現升降機有不正常的情況，立即通知升降機保養公司。
- 當有人在升降機機房工作時才開啟電燈。
- 當無須使用升降機的摩打時，應關掉摩打所有耗電部分。



- Assigning only one or two lifts available to casual end-users after normal working hours and on holidays.
- Encouraging the end-users to walk up or down one or two storeys rather than taking the lift.
- Reporting the lift irregularities to the lift maintenance company immediately.
- Switching on the lighting in the lift machine room only when it is occupied.
- Switching off all energy-consuming parts of a lift motor when not in use.
- Switching off all lights and fans inside the lift car automatically when the lift is parked.
- Switching off all fans and air-handling units in the lift machine room when all lifts have been parked for a significant period (e.g. at night).



- 當升降機停泊中又無載客時，機廂內所有照明及通風系統應自動關掉。
- 若升降機已停止運作一段頗長的時間（例如在晚間），應關掉機房內所有風扇及鮮風機。

自動梯裝置

有關升降機裝置的建議同樣適用於自動梯裝置。因自動梯通常處於局部負載的情況下運作，適當地設定控制自動梯的開關，最能直接減少自動梯的能源消耗量。

Escalator Installation

The advice on lift installation is equally applicable to escalator installation. Control of on/off setting is probably the most significant factor affecting energy consumption of escalator installation, since escalators are running at part-load conditions most of the time.



Save Energy

Some Useful Tips

- Using VVVF drive systems.
- Using high efficient gear systems.
- Using optical sensors to start and stop escalators.
- Using power optimisers to achieve energy saving.



節約能源

實用小貼士

- 使用可變電壓可變功率 (VVVF) 驅動系統。
- 使用節能齒輪系統。
- 使用光感應器去探測有沒有使用者才啟動或關掉自動梯。
- 使用電力優化器 (Power Optimiser) 達致節能目的。



Plumbing and Drainage Installation

Potable Water Supply System

Potable water supply system consumes energy when water is pumped from the primary storage tank at a lower position to the secondary storage tank at a higher position.



Some Useful Tips

- Using self-closing taps to prevent waste and undue consumption.
- Using taps with sensor control.
- Using automatic flushing cisterns to serve urinals with sensor control.
- Repairing immediately when system has been broken down.
- Checking regularly all pipework and tanks for leaks.

Hot Water Supply System

Hot water supply system consumes a lot of energy especially in supporting the facilities such as showers, bathing, laundry, cooking, etc.



Some Useful Tips

- Using heat pumps to act as a source of hot water supply. When compared with electric heating and gas heating, there will be around 35% - 50% less fuel consumption by heat pumps¹⁵.
- Following the manufacturers' recommended maintenance procedures of hot water equipment, e.g. electric/oil-fired/gas-fired boilers, heat pumps, hot water pumps, etc.



供水排水裝置

自來水供應系統

當自來水由位置較低的主要儲水缸被抽往位置較高的輔助儲水缸，供水系統便會消耗能源。



實用小貼士

- 使用自動緊閉式水掣，防止浪費或非法用水。
- 使用配備感應器的水掣。
- 使用配備感應器的小便槽及自動抽水水箱。
- 當系統損壞時，應立即安排維修。
- 定期檢查所有喉管及水缸，以防滲漏。

熱水供應系統

熱水供應系統消耗大量能源，尤其是花灑及沐浴系統、洗衣房、廚房等設施。



實用小貼士

- 利用熱泵 (Heat Pump) 供應熱水，與電熱及氣體燃料加熱裝置比較，熱泵可節省 35% 至 50% 的能源¹⁵。
- 參照製造商的維修保養程序，妥善保養熱水裝置，包括以電力、燃油或氣體驅動的鍋爐和熱泵等。



Swimming Pools

Swimming pools with hot water and heating supply requirements consume a lot of energy in heating up both pool and shower water and in supplying hot water for showering.



Some Useful Tips

- Using heat pumps to act as a source of hot water supply.
- Considering the use of solar thermal heating system to provide hot water supply if there is a large roof area for installing solar panels and collectors.
- Following the manufacturers' recommended maintenance procedures to ensure equipment is operating at its maximum efficiency.

Water Fountains and Water Features

Water fountains and water features consume a lot of energy. Programmable timer schedule can be used to switch off the plant during non-essential period of operation. They should be run only when necessary.



Some Useful Tips

- Sizing the pump, piping and nozzles properly.
- Switching off unnecessary lights and appliances.
- Keeping the plant at good condition to avoid water wastage and to maintain the water quality.

游泳池

備有暖水及供暖裝置的游泳池，需要耗用大量能源為泳池及沐浴用水加熱，以及供應淋浴用熱水。



實用小貼士

- 利用熱泵供應熱水。
- 若天台位置足夠設置太陽能板及收集器，可考慮利用太陽能加熱裝置來供應熱水。
- 參照生產商制定的維修保養程序，確保設施能在最佳效能下運作。

噴水池及以水為專題的設計

噴水池及以水為專題的設計消耗大量能源。可裝置時間掣，以便在非主要運作時段把設施關閉，只在有需要時才啟動有關裝置。



實用小貼士

- 水泵、喉管及噴嘴應大小適中。
- 關掉不必要的燈光及設施。
- 定期進行檢查及維修，以免浪費用水，並可維持良好的水質。



Sewage Treatment and Water Recycling



Some Useful Tips

- Using automatic aeration controls for Oxidation Ditch Rotor.
- Using diffused air aeration instead of Oxidation Ditch Rotor.
- Using power factor improvement equipment for motor drivers.
- Using variable speed drives.
- Checking and reducing the supply pressure of the compressor air.
- Checking the operation of the disinfection systems to maintain the water quality.
- Checking and maintaining proper water levels to minimise the operation hours of the pumps.
- Monitoring the plant loading profile in looking for sheddable loads.
- Improving dewatering process with optimal dosage of polymers and chemical.

Town Gas and Liquefied Petroleum Gas

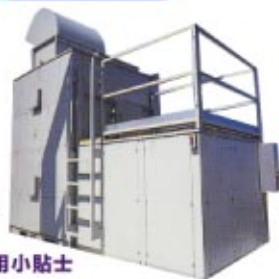
Town Gas and Liquefied Petroleum Gas (LPG) should be switched off when not in use. Even when the system is turned off only for a short period, the pilot flame should also be switched off simultaneously.



Some Useful Tips

- Ensuring that ovens are not pre-heated for a prolonged period.
- Ensuring that all gases within each cylinder is discharged before changeover occurs, when an automatic changeover device has been installed.

污水處理和循環用水系統



實用小貼士

- 利用自動通風系統控制氧化溝渠轉片。
- 以滲透式通風系統代替氧化溝渠轉片。
- 選用備有可提升電力功率設備的摩打推進器。
- 使用可變速驅動器。
- 檢查及減低壓縮空氣的加壓供應。
- 檢查消毒系統的運作，確保水質良好。
- 檢查及維持水位正常，將水泵的操作時間減至最少。
- 監察系統的負載記錄，從而找出可減省的負荷部份。
- 加入最恰當劑量的聚合物及化學製品，改善脫水程序。

煤氣和石油氣

無需使用煤氣和石油氣時，應把系統關掉。即使有關裝置只關掉一段短時間，也應同時把引燃器的火焰 (pilot flame) 一併關掉。



實用小貼士

- 確保焗爐的預熱時間不會過長。
- 當安裝了自動變換裝置 (changeover)，應確保瓶內的氣體已完全耗盡才進行變換到另一瓶。

附錄一 Appendix I Comparison between Glazing 各類外牆玻璃的比較



The best glazing selection depends on local climate, orientation, shading and interior space usage in order to achieve low thermal conductivity, low radiant heat transmissivity and high visibility. The following Table shows a detailed comparison for glazing selection.

在選擇外牆玻璃時，應考慮建築物所處位置的氣候、坐向、遮陽裝置及室內空間的運用，以達致較低的導熱性和輻射能傳熱性，以及較高的透光度。下表詳列各類外牆玻璃的特性。

Characteristic 特性	Double glazing with coatings 有塗層的雙層玻璃	Single glazing with coatings 有塗層的單層玻璃	Low emission double glazing 低放射性的雙層玻璃	Single glazing without coating 沒有塗層的單層玻璃
Properties 特質	<ul style="list-style-type: none"> Two layers of glass separated by a spacer 雙層，中間留有空間 Coating provides a reflective barrier with various choice of colours such as silver, bronze and gold etc. 塗層具反射作用，備有銀色、銅色、金色等多種顏色可供選擇 	<ul style="list-style-type: none"> Only one layer of glass 單層玻璃 Coating provides a reflective barrier with various choice of colours such as silver, bronze and gold etc. 塗層具反射作用，備有銀色、銅色、金色等多種顏色可供選擇 	<ul style="list-style-type: none"> Invisible metallic coating admits visible light but blocks radiant heat 塗層為看不見的金屬塗層，可透光亦能阻隔熱輻射。 Two layers of glass separated by a spacer 雙層玻璃，中間留有空間 Clear or laminated colours 透明或可塗上顏色 	<ul style="list-style-type: none"> Typical clear glass without any treatment or coating 一般的透明玻璃，沒有經過任何處理或加上塗層。 Only one layer of glass with custom choice of colours or clear 單層玻璃，可以是透明，亦可自選顏色。
Thermal transfer value, ($W/m^2 \text{ } ^\circ C$) 熱傳送值 (瓦特/平方米度攝氏)	2.4 - 3.29	4.88 - 5.96	1.6 - 1.87	5.22 - 6.76
Shading coefficient 遮陽系數	0.4 - 0.89	0.23 - 0.47	0.12 - 0.45	0.73 - 0.89
Sound Reduction Index (dB) 隔音 (分貝)	Max. 33 最高值為 33	Max. 25 最高值為 25	Max. 32 最高值為 32	Max. 25 最高值為 25
Solar load 日光負載	Medium 中等	Medium 中等	Lowest 最低	Highest 最高
Transmission load 透熱度	Medium 中等	Highest 最高	Lowest 最低	Highest 最高
Glare pollution 室外炫光效果	Slightly High 稍高	Highest 最高	Slightly Low 稍低	Lowest 最低
Reflectance 反射系數	Slightly High 稍高	Highest 最高	Slightly Low 稍低	Lowest 最低
Visibility 透光度	Lowest 最低	Lowest 最低	Highest 最高	Highest 最高



To promote energy efficiency, EMSD has published a set of Codes of Practice, Guidance Notes/Guidelines and Energy Management Publications related to building energy efficiency, namely:

Codes of Practice

- Code of Practice for Energy Efficiency of Lighting Installations
- Code of Practice for Energy Efficiency of Air Conditioning Installations
- Code of Practice for Energy Efficiency of Lift & Escalator Installations
- Code of Practice for Energy Efficiency of Electrical Installations
- Performance-based Building Energy Code
- Addendum No. 1 to Code of Practice for Energy Efficiency of Lighting Installations
- Addendum No.1 to Code of Practice for Energy Efficiency of Air Conditioning Installations
- Addendum No. 1 to Code of Practice for Energy Efficiency of Lift & Escalator Installations
- Addendum No. 1 to Code of Practice for Energy Efficiency of Electrical Installations

Guidance Notes/Guidelines

- Guidelines on Energy Efficiency of Lighting Installations
- Guidelines on Energy Efficiency of Air Conditioning Installations
- Guidelines on Energy Efficiency of Lift and Escalator Installations

為推廣能源效益，機電工程署出版了一系列與建築物能源效益有關的守則、指南、指引及能源管理刊物，包括：

守則

- 照明裝置能源效益守則 (英文版)
- 空調裝置能源效益守則 (英文版)
- 升降機及自動梯裝置能源效益守則 (英文版)
- 電力裝置能源效益守則 (英文版)
- 成效為本建築物能源效益守則 (英文版)
- 照明裝置能源效益守則補訂篇 1 (英文版)
- 空調裝置能源效益守則補訂篇 1 (英文版)
- 升降機及自動梯裝置能源效益守則補訂篇 1 (英文版)
- 電力裝置能源效益守則補訂篇 1 (英文版)

指南及指引

- 照明裝置能源效益指引 (英文版)
- 空調裝置能源效益指引 (英文版)
- 升降機及自動梯裝置能源效益指引 (英文版)
- 電力裝置能源效益指引 (英文版)
- 成效為本建築物能源效益指引 (英文版)

- Guidelines on Energy Efficiency of Electrical Installations
- Guidelines on Performance-based Building Energy Code
- Addendum No. 1 to Guidelines on Energy Efficiency of Lift & Escalator Installations
- Addendum No. 1 to Guidelines on Energy Efficiency of Electrical Installations
- Guidelines on Energy Efficient Equipment
- Guidelines on Energy Audit

Energy Management Publications

- Standards of Power Quality with Reference to the Code of Practice for Energy Efficiency of Electrical Installations
- Induction Lamps Installations at Kowloon Bay Indoor Games Hall
- Digital and Addressable Lighting Control at Kowloon Bay Indoor Games Hall
- Interference Problems of Fluorescent Lamps Operating on High Frequency Electronic Ballasts with Infrared Remote Control Equipment and Infrared Simultaneous Interpretation System
- Report of high-output T5 lighting project at East Kai Tak Indoor Games Hall
- Innovative Energy-efficiency Pilot Projects
- T5 Lamp Testing and Application Report
- Self-Luminous EXIT Signs Testing and Application Report
- Application Guide to Electronic Ballasts
- Application Guide to Variable Speed Drives (VSD)
- Application Guide to Central Control and Monitoring Systems (CCMS)

- 升降機及自動梯裝置能源效益指引補訂篇 1 (英文版)
- 電力裝置能源效益指引補訂篇 1 (英文版)
- 節能設備指引 (英文版)
- 如何進行能源審核指引 (英文版)

能源管理刊物

- 由電力裝置能源效益工作守則看供電質素標準 (英文版)
- 九龍灣室內運動場電感燈照明裝置 (英文版)
- 九龍灣室內運動場數碼可定位照明控制系統 (英文版)
- 高頻電子鎮流器推動的熒光燈對紅外線控制設備及紅外線即時傳譯系統的干擾 (英文版)
- 東啟德室內運動場高輸出 T5 熒光燈試驗計劃報告
- 創新節能設備試驗計劃 (英文版)
- T5 熒光燈測試及應用報告
- 自行發光的出口標誌測試及應用報告 (英文版)
- 電子鎮流器之應用指引 (英文版)
- 變速驅動器之應用指引 (英文版)
- 中央控制及監察系統之應用指引 (英文版)

Websites Relevant to this Booklet 相關網頁



Brundtland Report
Brundtland 報告

[http://www.brundtlandnet.com/
brundtlandreport.htm](http://www.brundtlandnet.com/brundtlandreport.htm)

Electrical and Mechanical
Services Department
機電工程署

<http://www.emsd.gov.hk>

Energy Design Information
能源設計資訊

<http://www.energydesignresources.com>

Global Warming Information Page
全球變暖資訊網頁

<http://www.globalwarming.org/>

International Ground Source
Heat Pump Association
國際地熱供給資源協會 /
國際地熱供電協會

<http://www.heatpumpcentre.org>

Intergovernmental Panel
on Climate Change
政府間氣候變化專家小組

<http://www.ipcc.ch/>

Sustainable Development Unit
可持續發展委員會

[http://www.susdev.gov.hk/
html/en/index.htm](http://www.susdev.gov.hk/html/en/index.htm)

United Nations Framework
Convention on Climate Change
(UNFCCC)
聯合國氣候變化框架公約

<http://unfccc.int>



Notes 備註

- 1 The definition is extracted from the *Brundtland Report*, also known as *Our Common Future* in 1987. This report alerted the world to the urgency of making progress towards economic development that could be sustained without depleting natural resources or harming the environment.
- 2 In 1990, the IPCC's First Assessment Report had a powerful effect on the general public. By confirming the scientific basis for concern about climate change, this four-volume report inspired governments to establish the Intergovernmental Negotiating Committee, which adopted the UN Framework Convention on Climate Change in 1992.
- 3 In 1998, the World Meteorological Organisation (WMO) and the United Nations Environmental Programme (UNEP) established the Intergovernmental Panel on Climate Change (IPCC) to assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts and options for adaptation and mitigation. It is open to all Members of the UN and of WMO.
- 4 The text of the Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) was adopted at the third session of the Conference of the Parties to the UNFCCC in Kyoto, Japan, on 11 December 1997; it was open for signature from 16 March 1998 to 15 March 1999 at United Nations Headquarters, New York. By that date the Protocol had received 84 signatures. Those Parties that have not yet signed the Kyoto Protocol may accede to it at any time.
- 5 *Guidelines on Energy Audit*, issued by EMSD of HKSAR
- 1 此定義摘錄自 1987 年出版的 *Brundtland Report*，又名 *Our Common Future*。此報告提醒世界關注一個急切性的課題——應當在沒有耗損自然資源或破壞環境的步伐下持續發展經濟。
- 2 世界氣象組織 (WMO) 與聯合國環境規劃署 (UNEP) 在 1998 年成立政府間氣候變化專業委員會 (IPCC)，從科學、科技及社會經濟學角度評估與氣候變化有關的資料，其帶出的影響和衝擊，以及選擇適應現實或緩和情況的各項建議。所有聯合國及 WMO 的會員均可參與。
- 3 於 1990 年發表的政府間氣候變化專家小組的首份評估報告對社會大眾影響深遠。此份合共四卷的報告提出以科學分析氣候變化，不但引起各界的關注，更促使各國政府於 1992 年採納聯合國氣候變化框架公約，成立政府間談判委員會。
- 4 聯合國氣候變化框架公約 (UNFCCC) 的草案內容，於 1997 年 12 月 11 日假日本京都舉行的 UNFCCC 會員大會第三節中獲採納，並於 1998 年 3 月 16 日至 1999 年 3 月 15 日假紐約聯合國總部公開接受簽署。截至該日為止，此草案已獲得 84 個政府簽署，尚未簽署的會員亦可隨時加入。
- 5 由香港特別行政區機電工程署出版的 *能源審核指引*。

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- 6 *Code of Practice for Overall Thermal Transfer Value in Buildings*, issued by Buildings Department of HKSAR in 1995.
 - 7 LCA is an objective process to evaluate the environmental burdens associated with a product, process or activity by identifying and quantifying energy and materials uses and releases to the environment and to evaluate and implement opportunities to affect environmental improvement. The definition is extracted from *Guidelines for Life Cycle Assessment: A Code of Practice (First Edition)*, Society of Environmental Toxicology and Chemistry (SETAC), Brussels, Belgium and Pensacola, Florida, USA, 1993.
 - 8 *Performance Based Building Energy Code*, issued by EMSD of HKSAR
 - 9 *Code of Practice for Energy Efficiency of Electrical Installations*, issued by EMSD of HKSAR
 - 10 Power factor deals with the ratio of active power to the apparent power; please refer to the *Code of Practice for Energy Efficiency of Electrical Installation* for further information.
 - 11 *Code of Practice for Energy Efficiency of Lighting Installations*, issued by EMSD of HKSAR
 - 12 *Code for Lighting*, issued by CIBSE, 2002. This updated Code for Lighting (which replaces the 1994 *Code for Interior Lighting*) includes sections on the Visual Effects of Light, Lighting Recommendations, Equipment, Lighting Design, a Calculations Guide and Appendices.
 - 13 *Code of Practice for Energy Efficiency of Air Conditioning Installations*, issued by EMSD
 - 14 *Code of Practice for Energy Efficiency of Lift and Escalator Installations*, issued by EMSD of HKSAR
 - 15 Some international websites e.g. <http://www.heatpumpcentre.org> can provide information on the heat pump design.
 - 6 香港特別行政區政府屋宇署於1995年出版的樓宇的總熱傳送值守則。
 - 7 生命週期評估 (LCA) 是一個以目標為本的過程，透過確定和量化能源及在環境中耗用和釋出的物質評估產品、過程或活動對環境造成的影響，並評估及推行有助改善環境的措施。其定義摘錄自1993年出版的 *Guidelines for Life Cycle Assessment: A Code of Practice (First Edition)*, Society of Environmental Toxicology and Chemistry (SETAC), Brussels, Belgium and Pensacola, Florida, USA, 1993。
 - 8 香港特別行政區機電工程署出版的成效為本建築物能源效益守則。
 - 9 香港特別行政區機電工程署出版的電力裝置能源效益守則。
 - 10 電力功率指有效功率與表現功率的比率，詳情請參閱電力裝置能源效益守則。
 - 11 香港特別行政區機電工程署出版的照明裝置能源效益守則。
 - 12 英國屋宇裝備工程師學會於2002年出版的 *照明守則*，為1994年出版的 *室內燈飾守則* 修訂版，內容包括燈光的視覺效果、燈光推介、設施、燈光設計、計算指南及附錄。
 - 13 機電工程署出版的空調裝置能源效益守則。
 - 14 香港特別行政區機電工程署出版的 *升降機及自動梯裝置能源效益守則*。
 - 15 某些國際網址，例如 <http://heatpumpcentre.org>，提供有關熱泵設計的資料。

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