

ESG TRAINING WORKSHOP

ESG 環境, 社會和管治培訓工作坊

SECTION 5: ENERGY SAVING UPGRADE IN TOY INDUSTRY

第五節:玩具行業的節能提昇

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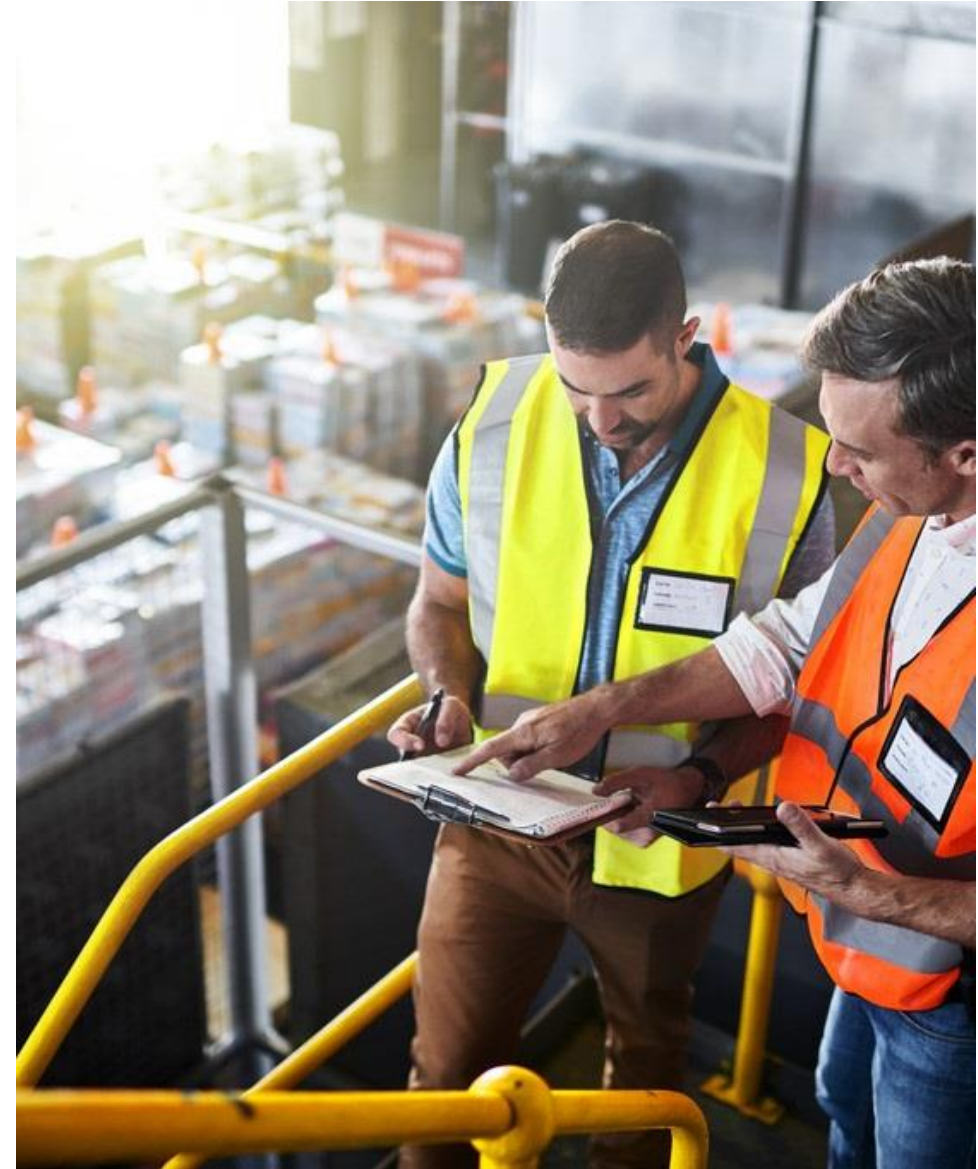
ENERGY MANAGEMENT SYSTEM (ENMS) AND PLANNING IN OPERATION

能源管理系統 (ENMS) 和營運規
劃

BASIC FRAMEWORKS OF ISO 50001:2011

ISO 50001:2011 基本框架

- ISO 50001: Energy Management System (EnMS) ISO 50001：能源管理系統 (EnMS)
- P-D-C-A 計劃-執行-行動-檢查
- Continual Improvement 持續改進
- Energy Performance Indicator (EnPI) 能源績效指標 (EnPI)



DRIVING FORCE 推動力



Organizations used this standard increasingly want to reduce the amount of energy they consume. This is driven by the need or desire to use this standard. Organizations increasingly want to reduce the amount of energy they consume. This is driven by the need or desire to use this standard. Organizations increasingly want to reduce the amount of energy they consume. This is driven by the need or desire to use this standard.



- Reduce costs 降低成本
- Reduce the impact of rising costs 減少成本上升的影響
- Meet legislative (e.g. EMSD Energy Saving Plan 2015-2025, ESG or Sustainability requirement) or self-imposed carbon targets 滿足立法（例如機電工程署節能計畫2015-2025、ESG或永續發展要求）或自行設定的碳目標
- Reduce reliance on fossil fuels, and adopt renewable energy sources 減少對化石燃料的依賴，採用再生能源
- Enhance the entity's reputation as a socially responsible organization 提高實體作為有社會責任的組織的聲譽



ISO 50001 REQUIREMENT

ISO 50001 要求

ISO 50001 can be integrated easily to the other 3 management systems ISO 50001 可以輕鬆整合到其他 3 個管理體系

There are seven major components to ISO 50001:

ISO 50001 有七個主要組成部分：

1. General Requirements 一般要求
2. Management Responsibility 管理責任
3. Energy Policy 能源政策
4. Energy Action Plan 能源行動計劃
5. Implementation and Operation 實施及營運
6. Performance Audits 績效審核
7. Management Review 管理審查



ISO 50001 Family



ISO 50001:2011, Requirements with Guidance for use 要求及使用指南

ISO 50002:2014, Energy audits – Requirements with guidance for use 能源審計 – 要求和指南

ISO 50003:2014, Requirements for bodies providing audit and certification of energy management systems 提供能源管理系統審核和認證的機構的要求

ISO 50004:2014, Guidance for the implementation, maintenance and improvement of an energy management system 能源管理系統的實施、維護與改進指南

ISO 50006:2014, Measuring energy performance using energy baselines (EnB) and energy performance indicators (EnPI) – General principles and guidance 使用能源基準 (EnB) 和能源績效指標 (EnPI) 衡量能源績效 – 一般原則和指南

ISO 50015:2014, Energy management systems – **Measurement and verification of energy performance of organizations – General principles and guidance** 能源管理系統 – 組織能源績效的測量和驗證 – 一般原則和指南

02

**Measurement and verification
in Energy Management and
Optimization System(EMOS)
solutions**能源管理和最佳化係
統（EMOS）解決方案的測量
和驗證





ISO 50015 M&V in ISO 50000 series

ISO 50000 系列中的 ISO 50015 M&V

Relationship in ISO 50000 SERIES:

ISO 50000 系列中的關係：

This International Standard ISO 50015 establishes general principles and guidelines for the process of **measurement and verification (M&V)** of energy performance of an organization or its component

此國際標準 ISO 50015 為組織或其組成部分的能源績效**測量和驗證 (M&V)** 流程製定了一般原則和指南

This International Standard can be used independently, or in conjunction with other standards or protocols, and can be applied to all types of energy

本國際標準可以單獨使用，也可以與其他標準或協議結合使用，可適用於所有類型的能源



What is M&V 什麼是 M&V

“Measurement and Verification” (M&V) is the process of using measurement to reliably determine actual savings created within an individual facility by an energy management program. 「測量與驗證」(M&V) 是使用測量來可靠地確定能源管理計畫在單一設施內創造的實際節省的过程。

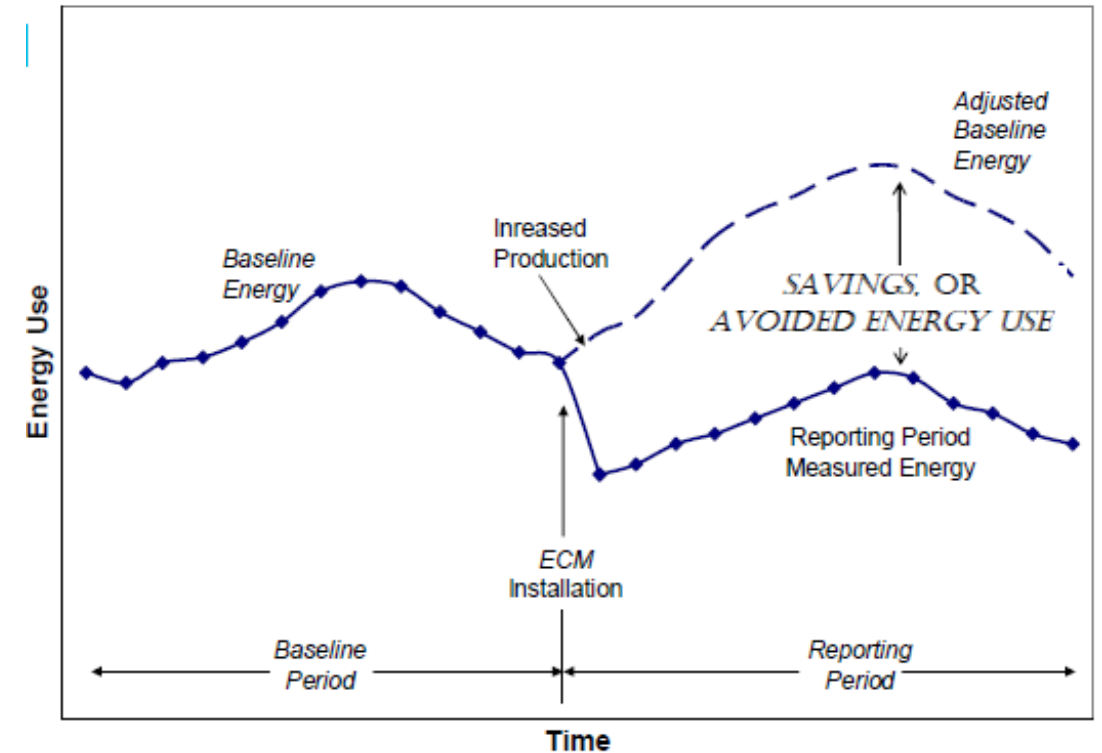
Savings are determined by comparing measured use before and after implementation of a project, making appropriate adjustments for changes in conditions. 節省量是透過比較專案實施前後的測量使用情況並根據條件變化進行適當調整來確定的。

Savings = (Baseline consumption or demand – reporting period consumption or demand) ± Adjustments*

節省 = (基準消耗或需求 – 報告期間消耗或需求) ± 調整*

*Adjustments – routine conditions caused by weather changes or occupants changes, etc.

*調整 - 因天氣變化或居住者變化等引起的常規情況。



Measurement and Verification Plan



There are six fundamental steps in the M&V process which are specified in the M&V plan:
M&V 計畫中指定了 M&V 流程的六個基本步驟：

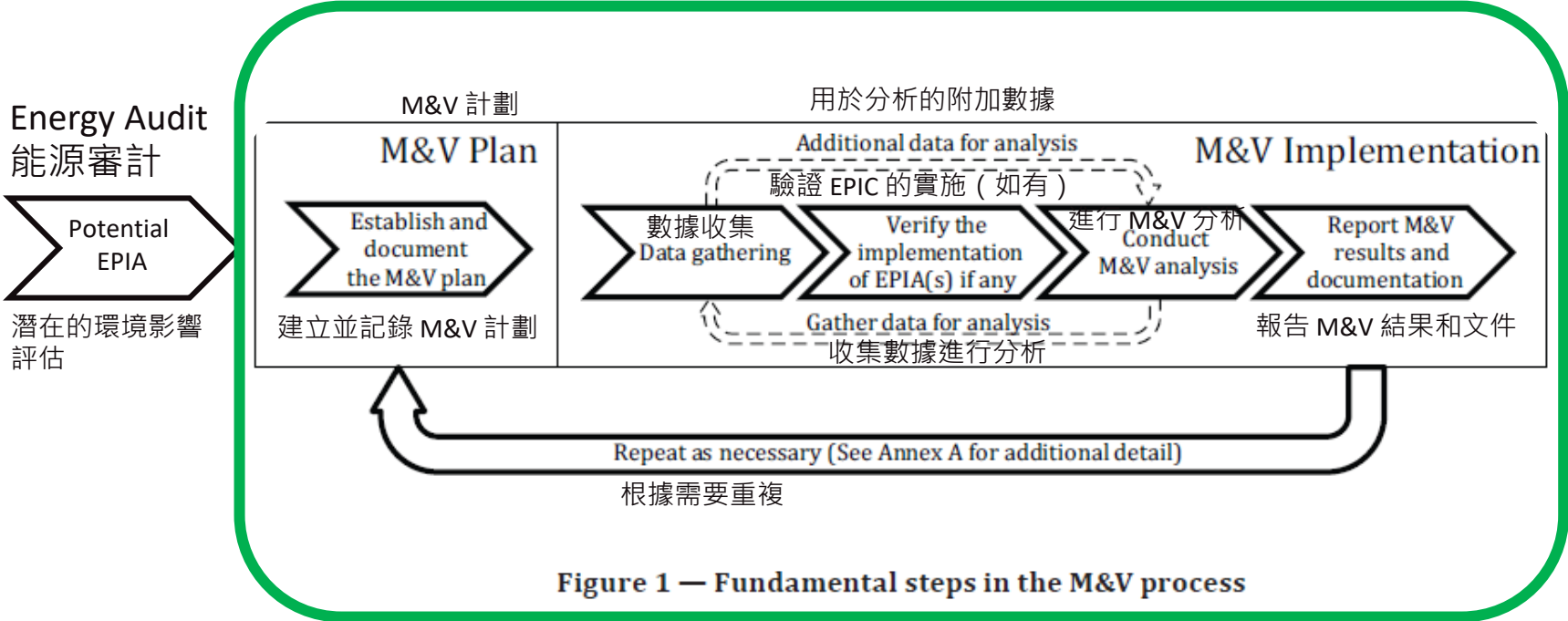


Figure 1 — Fundamental steps in the M&V process

圖 1 - M&V 流程的基本步驟

Source: ISO 50015

Key Function of M&V Plan in EnMS

M&V 計劃在 EnMS 中的關鍵作用



The purpose of this International Standard:

本國際標準的目的：

- To establish a common set of principles and guidelines to be used 建立一套通用的原則和指南
- Provide **flexible optional** measurement method in selection 提供靈活可選的測量方式
- **Consist to** Energy Performance indicator (**EnPI**) and Energy Performance Improvement Action (**EPIA**) defined in EnMS and Energy Audit 符合EnMS和能源審計中定義的能源績效指標 (EnPI) 和能源績效改善行動 (EPIA)
- Can be used independently or in **conjunction with other standard** and protocols, e.g. IPMVP 可以獨立使用或與其他標準和協定結合使用，例如IPMVP
- Individual M&V practitioner can provide technical advices on **measurement methodology** and **3rd Party verification assurance** 單獨的 M&V 從業者可以提供有關測量方法和第三方驗證保證的技術建議



Source: EVO IPMVP



Key Function of M&V Plan in EnMS

M&V 計劃在 EnMS 中的關鍵作用

The purpose of this International Standard:

本國際標準的目的：

- M&V adds value by **increasing the credibility** of energy performance and energy performance improvement results M&V 透過**提高能源績效和能源績效改善結果的可信度**來增加價值
- Credible results can contribute to the **pursuit of energy save** 可信的結果有助於**追求節能**
- Have a **supporting document / data** for reporting and document in EnMS according to ISO 50001 standard 根據 ISO 50001 標準，擁有用於報告和 EnMS 中的文件的**支援文件/數據**
- Have a **supporting document / data** for reporting in other global requirement, e.g. ESG / CSR / Sustainability 擁有用於報告其他全球要求的**支援文件/數據**，例如**ESG/企業社會責任/永續發展**
- **Appropriate measuring tools** on verify the energy saving result in Retro-commissioning Plan (RCx) 適當的**測量工具**可驗證重新調試計劃 (RCx) 中的**節能效果**



Source: EVO IPMVP

Manufacturer
Level

03

**ENERGY SAVING
IMPROVEMENT IN GENERAL
UTILITIES**
一般公用事業的節能改進



ENERGY SAVING SOLUTIONS 節能方案



Factory General Utilities 工廠基本設備

Such as lights, air-conditioning, electrical system, boiler and compress air equipment, etc.

如照明、暖通空調、電力系統、鍋爐、壓縮空氣系統

Specific Industrial Equipment 特有工序設備

Such as sewing machine, injection molding machine, computer aided machine (CAM), milling machine , etc.

如縫紉機、注射製模機、電腦輔助製造機、銑床

Management system and software monitoring and control 管理系統及監測軟件

Such as IoT sensors, energy management system, building management system(BMS), etc.

如接物聯網感應器、能源管理系統、建築物管理系統

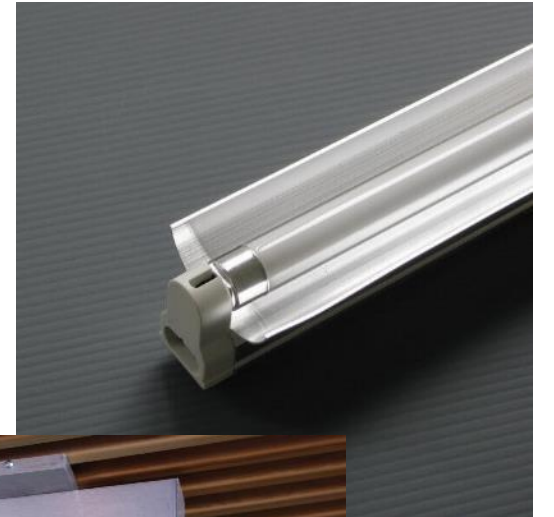


FACTORY GENERAL UTILITIES 工廠基本設備



Lighting System (middle investment cost) 照明系統 (成本：中等)

- Phase out Incandescent Light Bulbs (ILB) (Reflector type halogen lamp 、 General Lighting Service (GLS) lamps)
取代烏絲燈膽 (反射型鹵素燈、一般照明用途的烏絲燈膽)
- ILBs are generally shorter in life expectancy, lower in energy efficiency, and are expected to raise the power consumption of cooling system
烏絲燈膽壽命短、能源效率較低及增加冷氣消耗
- Possible replacement lamps: Light Emitting Diode (LED) Lamps and Compact Fluorescent Lamps (CFL)
可更換為LED燈膽或慳電膽
- Substitute T8 lamps for T5 lamps or LED lamps
用T5 或 LED光管取代T8 光管
- T5 lamps can achieve a 30% more energy-efficiency improvement and also an energy reduction of cooling system, whereas LED lamps are the most durable
T5比T8 光管有更佳能源效率多於大約30%、可減低冷氣消耗。LED 更能提供更長使用壽命
- Installation of high-performance reflector, enhancing the efficiency of light reflection and illumination
另加裝高效能反射式燈罩、增加反射率

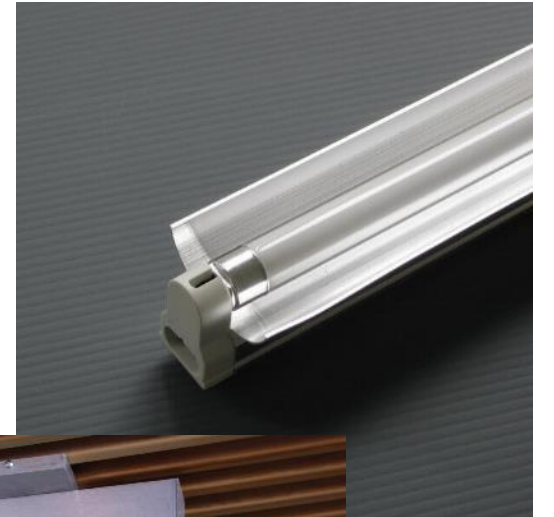


FACTORY GENERAL UTILITIES 工廠基本設備



Lighting System (middle investment cost) 照明系統 (成本：中等)

- Replace conventional "Exit" signs with LED "Exit" signs
以發光二極體製作的“出口”標誌取代傳統的“出口”標誌
- Use occupancy sensors in area where lighting usage is not frequent (e.g. in storeroom area, stair lighting, toilet lighting)
在照明設備使用率較低的地方，裝設用戶感應器
- Solar LED lighting in the outdoor area
在室外範圍使用太陽能LED燈
- Re-layout the lighting zoning control, adjust the reasonable lighting density (lux per sqm) and adopt the centralized lighting main switch for master on/off control.
重新設置開關佈局，因應室內使用情況調節合理的燈具控制安排及安排中央燈具開關控制



FACTORY GENERAL UTILITIES 工廠基本設備



Lighting System (Low or no investment cost) 照明系統 (成本：低)

General housekeeping measures (zero-cost strategy) 運作管理 (零成本) 措施

- Turn off lighting if it is not needed
不需要的時候關掉照明
- Turn off some lighting when the occupancy is low (e.g. during lunch, on Saturdays and after office hours)
若人不多 (例如午飯時段, 週六, 辦公時間後), 應關閉部分照明
- Specify the lighting level requirement base on task force in factory
根據廠內員工人數制定相應的照明級別
- Cut down number of lamps/luminaires in area over-lighting by artificial lighting and in perimeter area sufficiently lit by natural daylight (e.g. near the windows)
在人工照明過多或自然光線充足的周邊地方, 應減少照明設備 (如: 窗邊)
- Improve maintenance/repair plan (e.g. monthly or quarterly cleaning)
加強維護/修理, 例如: 定期清潔

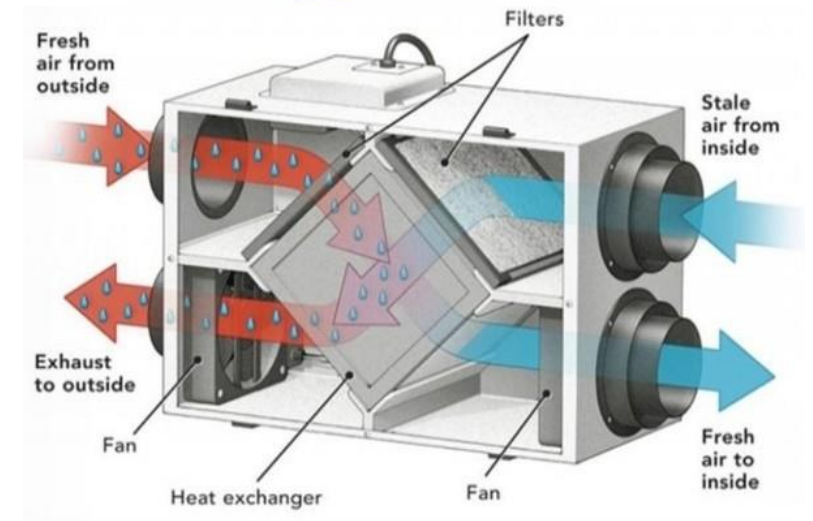


FACTORY GENERAL UTILITIES 工廠基本設備



HVAC System (High investment cost) 暖通空調系統 (成本：高)

- Air handling unit retrofitted with variable speed control. The payback period can be as low as 2-3 years
空氣處理機組加裝可變速度控制，回本期約2-3年
- Control the fresh air volume by carbon dioxide (CO₂) sensor device. The payback period can be as low as 1-2 years
鮮風控制系統加裝二氧化碳感應裝置，回本期約1-2年
- Add heat exchanger in fresh air supply to reduce the cooling load on fresh air
採用空氣熱交換裝置幫助鮮風和排風進行熱能交換，從而達到高效率的冷回收
- Replacing an Air-Cooled Chiller in energy efficiency/ inventor type
更換風冷冷水機組至高效能款式
- Add heat recovery system in Air-Cooled Chiller System and reuse the heat by thermal energy storage system into production
於水冷冷水系統增加全熱交換系統

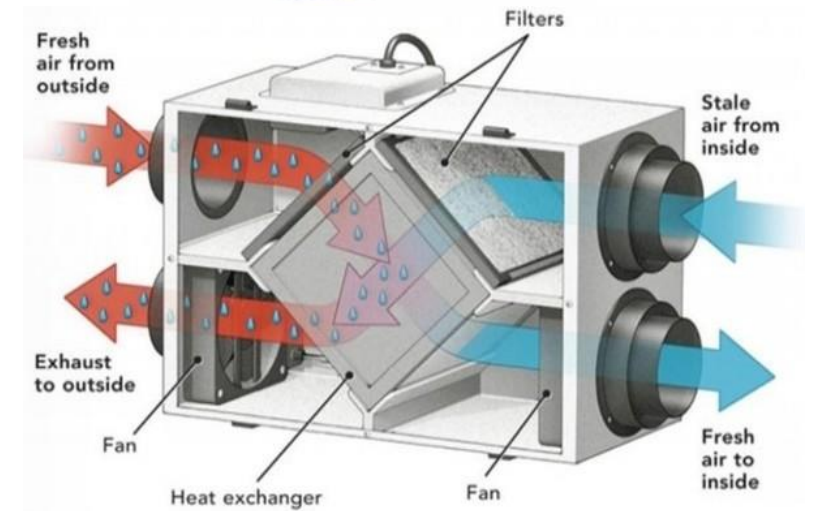


FACTORY GENERAL UTILITIES 工廠基本設備



HVAC System (High investment cost) 暖通空調系統 (成本：高)

- Replace the old air-cooled water tower with a water-cooled type, which can save 20%-30% of energy. The payback period can be as low as 1-2 years
更換舊式風冷冷水機為水冷冷水機，可節約20%-30%能源，回本期可低至1-2年
- A thermal energy storage system can also reduce the size of a cooling system by shifting peak electricity consumption beyond the evening. Therefore, the rated cooling capacity of the cooling system can be much less than the maximum cooling demand of the building.
加裝熱蓄能系統能將高峰期的用電量轉移到晚上之外，熱蓄能系統還可以縮小製冷系統的規模。因此，製冷系統的額定製冷能力可以比建築物的最大製冷量需求小得多
- Re-layout the air zoning control, adjust the reasonable cooling load in specify room conditions and adopt the centralized HVAC main switch for master on/off control.
重新設置開關佈局，因應室內使用情況調節合理的空調控制安排及安排中央暖通空調開關控制

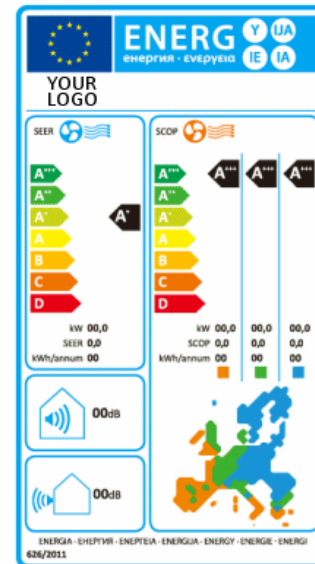


FACTORY GENERAL UTILITIES 工廠基本設備



HVAC System (middle investment cost) 暖通空調系統 (成本：中等)

- Install curtains or sticking solar film on windows to reduce the heat gain from of sunlight entering the room
在窗戶上安裝百葉簾或防曬隔熱玻璃貼膜，阻隔室外熱力
- When needed, replace with a new energy efficient of room air conditioner with grade 1 or 2 energy efficiency label
更換新的、更節能、貼有1級或2級能效標籤的冷氣機
- Zoned control of the air conditioning system and installation of user-sensing controls so that the air conditioning unit automatically turns off when the room is not in use
分區控制空調系統及安裝用戶感應控制器，以便空調設備在房間無人使用時自動關閉
- Install curtains or partitioning film to provide zone control of the air conditioning area on main working place
於主要工作地方安裝門簾或隔板從而分區控制空調
- Use water curtains to reduce heat gain on factory area without AC provided
於沒有空調提供的地方使用水簾去降低熱能累積



FACTORY GENERAL UTILITIES 工廠基本設備



HVAC System (low or no investment cost) 暖通空調系統 (成本：低至中等)

- Use the air conditioner only when the outdoor temperature is higher than specified temperature (e.g. 27 degrees)
當室外溫度高於27度時才使用空調
- Wearing casual clothes in summer can reduce the need for air conditioning
夏天穿著便服可以減少對空調之需求
- Activate the air conditioning system based on the building's office hours
根據建築物的辦公時間來啟動空調系統
- Avoid pre-cooling. The time to start the central air conditioner in the morning in the office should not exceed 30 minutes
避免預冷，辦公室早上提前開動中央空調的時間不應超過30分鐘
- All the air conditioning system should be turned off with 15 minutes before leaving the room
離開房間前15分鐘，應關閉部分或全部空調系統
- Install a thermometer to monitor the indoor temperature, and set the constant temperature of the air-conditioning system to 25.5 degrees or above
安裝溫度計監察室內溫度，設置空調系統的定溫為25.5度或以上
- Changing the room temperature set point by 1°C can cause energy consumption to vary by more than 3% energy consumed.
改變室溫設定點攝氏1度可能導致能源消耗變動超過3%
- Air distribution or fresh air supply can be adjusted to the appropriate level when needed
需要時可以將氣流分佈或鮮風供應量調整到適當水準
- Avoid to setting the air conditioner to "low cooling" mode. Fans can be used to improve indoor air circulation for thermal comfort
將房間冷氣機或整體式空調設定為「低冷量」模式。可使用風扇改善室內空氣流通以獲得舒適

FACTORY GENERAL UTILITIES 工廠基本設備



HVAC System (low or no investment cost) 暖通空調系統 (成本：低至中等)

- Regularly clean air conditioners and dust filters periodically
定期清潔空調設備和隔塵網
- Develop a maintenance plan to ensure that the air conditioning system is operating effectively
制定一個維修保養計劃，確保空調系統有效運行
- Refill the air conditioner refrigerant under maintenance works if necessary and use of eco-friendly type of refrigerant
於維修保養時添加雪種，並選擇環保雪種
- When the air conditioner is running, the doors and windows should be closed to reduce the infiltration of outdoor air
冷氣機運行時，應關閉門窗以減少室外空氣滲入
- Check all pipes and equipment frequently to ensure there are no leaks. Ensure the insulation material was full protected the pipe works
經常檢查所有管道和設備，以確保沒有任何洩漏情況。必要時更換密封墊圈和密封劑
- Replace gaskets and sealants in air gap if necessary
有需要時更換風口的密封墊及密封劑
- Check all automatic temperature controllers regularly to ensure they are in proper operating condition
定期檢查所有的自動溫度控制器，確保它們處於適當的運行狀態
- When provide the heating air, the use of air conditioners should be avoided when the outdoor temperature is higher than 20 degrees
對於需要使用空調採暖的建築物，當室外溫度高於20度時應避免使用空調採暖

FACTORY GENERAL UTILITIES 工廠基本設備



Air Compressor System (High and Low investment cost) 空壓機系統 (成本：低至高)

- Control the using pattern of air compressor and avoids frequent on/off the air compressor motor. Install of air receiver can store the compress air and reduce high current when switch on
空壓機變頻技術的運用，避免頻密啟動空壓機電動機，避免了啟動時的大電流和啟動給空氣壓縮機帶來的機械衝擊
- Variable speed control and high efficiency motor are adopted into air compressor
使用可變速及高效能馬達
- When the air compressor is working, the heat carried by the high temperature and high-pressure oil and gas is roughly equivalent to 1/4 of the power of the air compressor, and its temperature is usually between 80 °C and 100 °C.
空壓機餘熱利用，空氣壓縮機工作時，高溫高壓的油和氣所攜帶的熱量大致相當於空氣壓縮機功率的1/4，其溫度通常在80°C—100°C之間
- Utilize the waste heat generated from air compressor, and return the heat energy back to production or dormitory use (e.g. provide hot water in dormitory)
充分利用空壓機所產生的餘熱，將熱能傳送到生產線或宿舍（如：為宿舍提供熱水）



FACTORY GENERAL UTILITIES 工廠基本設備



Air Compressor System (High and Low investment cost) 空壓機系統 (成本：低至高)

- Optimization of pressure setting with balancing on the demand use
根據使用需求優化壓力設定
- Master computer control of multiple air compressors on/off pattern to reduce standby loss on the non-loading machine
使用電腦統籌控制系統控制空壓機開關，從而減少待機損耗
- The inspection and measurement contents include:
檢查和測定的內容包括：
 - a. Determine the gas output pressure point;
確定氣體輸出壓力點
 - b. Reduce the resistance and loss of the pipeline;
減少管道的阻力與損耗
 - c. Reduce leakage of pipes and containers;
減少管道和容器的洩漏
 - d. Keep clean in air filter periodically
定期清潔空氣濾網





FACTORY GENERAL UTILITIES 工廠基本設備

Before & After improvements for air compressor (middle investment cost) 更換空壓機前後的能源使用對比

A new VFD compressors with heat recovery system will be replaced the old compressor and 4 hot water boilers
有熱回收的變頻空壓機將取替舊的空壓機及四部鍋爐

Improvement comparison 更換前後對比	Old air compressor 舊的空壓機	Hot water heater 鍋爐	New VFD air Compressor with heat recovery 有熱回收的變頻空壓
Power / kWh 電量/千瓦·時	40	9	32
Quantity 數量	1	4	1
Working Time 運作時間	24 hrs*350 days	8hrs * 180 days	24 hrs *350 days
Annual Electricity Consumption / kWh 年度用電量	336,000	51,840	268,800
Energy Saving / kWh 能源節省/千瓦·時	$=336000+51840-268800 = 119040$		
Energy Saving / % 能源節省/%	30.7		

FACTORY GENERAL UTILITIES 工廠基本設備



Heat Pump System (middle investment cost) 熱泵系統 (成本：中等)

- A heat pump is composed of an evaporator, an air compressor, a condenser and other parts. It uses a small amount of working energy to collect and compress the low-temperature and dispersed heat in a specific environment to make it useful heat energy.
熱泵是由蒸發器、空氣壓縮機、冷凝器等部分組成，利用少量的工作能源，以吸收和壓縮的方式，把一特定環境中低溫而分散的熱聚集起來，使之成為有用的熱能
- Suitable to provide large amount of hot water processes (e.g. electric plating, textile dyeing processes)
適合需要使用大量熱水的工序 (如：電鍍、紡織業漂染)
- Results: It can reduce the energy consumption of the traditional water heater by about 60%, and the investment return period is about 2 years.
成效：可以減少60%左右熱水系統的能源消耗，投資回本期約為2年



FACTORY GENERAL UTILITIES 工廠基本設備



Thermal Insulation coating on roof floor (middle investment cost) 太陽隔熱塗料 (成本：中等)

- Reflects 95% of solar radiation
反射95%的太陽輻射
- Reduce air conditioning energy consumption by more than 60%
減少超過60%的空調能耗
- Create a healthy, comfortable, natural built environment
創建健康、舒適、自然的建築環境



Green Planting on roof floor 天台綠化

- Reduce carbon emission 減少碳放
- Green education 環境教育
- Provide a healthy, relax and comfortable place 提供健康舒適的環境



FACTORY GENERAL UTILITIES 工廠基本設備



Induction cooker in kitchen area (high or middle investment cost) 飯堂使用電磁爐 (成本：中至高)

- Use of the induction cooker (frying stove and soup stove) to replace the existing diesel stove for cooking, so it can reduce the waste heat emission of diesel and exhaust gas. Energy efficiency up to 70-80 percent rate.
對廚房改用電磁爐 (炒爐及湯爐) 替代現使用的柴油爐煮食，達至減少柴油及廢氣廢熱排放量。能效高達70-80百分比率
- Reduce the carbon emission from diesel or town gas consumption, replaced the use of renewable energy from electricity plant
減少因使用柴油或煤氣的碳排放
- Clean and low temperature of working area in kitchen
更清潔及低溫的廚房工作環境



FACTORY GENERAL UTILITIES 工廠基本設備



Capacitor Bank (Power Factor Compensation Cabinet) (middle investment cost)

智慧電容 (功率因數補償電櫃) (成本：中等)

- Power factor is the cosine of the phase difference between current and voltage
功率因數是電流及電壓之間的相位差餘弦
- Power factor should be higher than 0.95, ideally to be 1.0. Reduce current and power consumption, there should be reducing electricity use.
功率因數應高於 0.9%，理想數位為 1。減少電流及供電耗損，從而減少電費開支



Solution 解決方案:

- Conduct on-site measurements of the power system to determine the source of harmonics and low power factor for improvement follow-up
進行電力系統實地測量確實造成諧波及低功率因數的源頭以作出改善跟進
- According to the power load characteristics in spot check, the correct design of the filter and capacitor compensation are recommended to be result and monitored by periodically review. Install the monitoring meter / system for regular maintenance
根據實地測量的電力負荷特性，正確的設計濾波器及電容補償命組合。加裝監測系統，進行定期維護

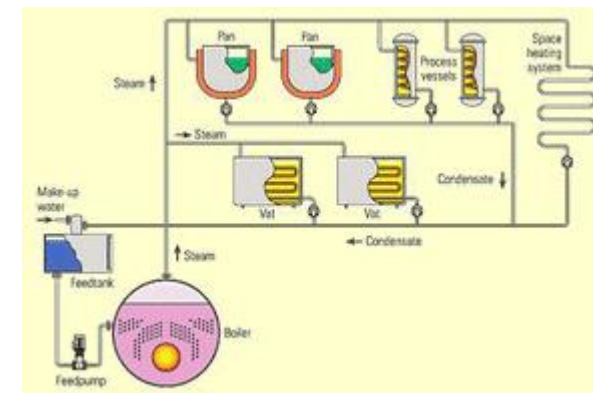


FACTORY GENERAL UTILITIES 工廠基本設備



Steam Boiler (high investment cost) 蒸氣鍋爐 (成本：高)

- Some enterprises will use steam or heat-conducting oil for heating steam during production and processing, which will cause certain losses during the transmission and use of heat-conducting medium.
有些企業會使用蒸氣或導熱油用於加熱工序，但使用這些加熱媒介會導至熱能損失
- Use of clean energy, such as Natural Gas, Bio-oil / fuel instead of traditional diesel oil or coal boiler, it can reduce in carbon emission
使用清潔能源，如：天然氣、生物燃料取替傳統柴油或煤以減少碳排放

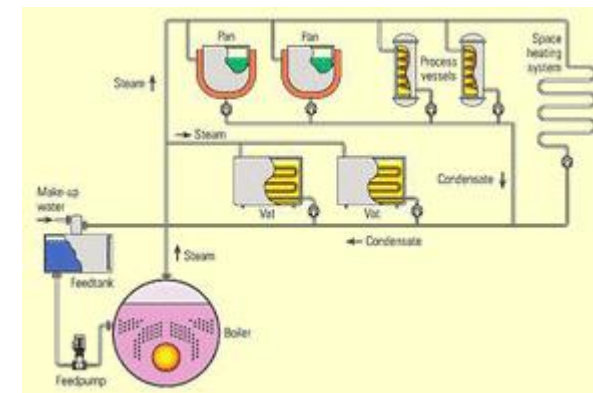


FACTORY GENERAL UTILITIES 工廠基本設備



Steam Boiler (high investment cost) 蒸氣鍋爐 (成本：高)

- Leak check should be conducted periodically to avoid steam leakage
定期檢查蒸汽管，預防蒸汽洩漏
- The common transformation measures are: 常見措施
 1. Strengthen the insulation of pipes and valves;
加強管道隔熱
 2. To reduce steam leakage, regularly check steam pipe fittings such as traps
為預防蒸汽洩漏，定期檢查蒸汽管配件如疏水閥
 3. Recycling of steam condensate water
蒸汽凝結水回收
 4. Waste heat utilization
廢熱利用



MANAGEMENT SYSTEM AND SOFTWARE MONITORING AND CONTROL

管理系統及監測軟體

Energy monitoring system (middle investment cost) 能源監控系統 (成本：中)

Install the management system to automatically monitor the central energy consumption, so that it can make energy efficiency evaluation and formulate good management measures, thereby saving energy consumption.

安裝管理系統去監測中央總耗能，使之能作出能效評價和制訂良好的管理措施，從而節省能源消耗。

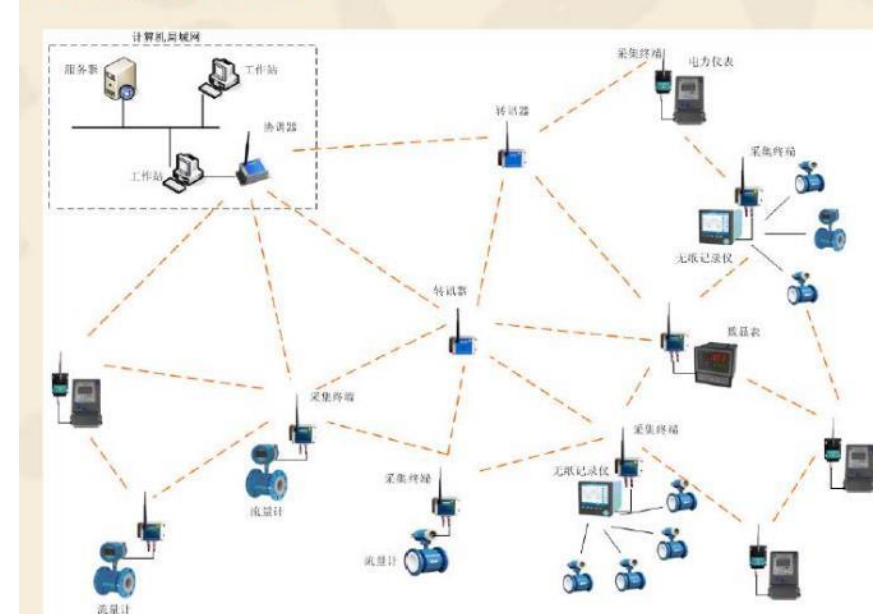
Energy Meter 能源儀錶：

- Power meter 電力儀錶
- Fuel consumption meter 耗油儀錶
- Gas consumption meter 燃氣消耗儀錶
- Steam consumption meter 蒸汽消耗儀錶

Indoor Air Quality Meter 室內空氣質素儀錶：

- CO2 sensor 二氧化碳感應器
- VOC sensor 揮發性有機化合物感應器

2. 4G低功耗无线通讯系统:



MANAGEMENT SYSTEM AND SOFTWARE MONITORING AND CONTROL

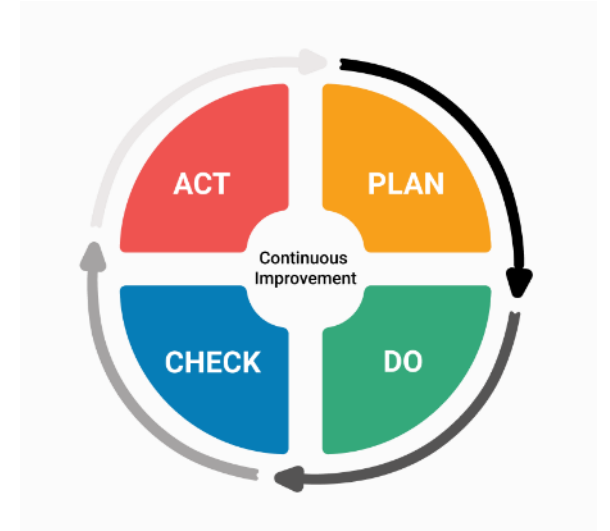
管理系統及監測軟體



Energy / Environmental Management System (low investment cost) 環境及能源管理系統 (成本：低)

ISO 14001 and ISO 50001

- The ISO50001 standard for energy management system was officially launched as an international standard on June 17, 2011.
能源管理體系ISO50001標準已於2011年6月17日正式推出國際標準。
- Establish a framework for energy management in a factory, operating facility or organization to assist companies in energy management, improving energy efficiency, reducing costs and improving environmental performance.
為工廠、經營設施或組織的能源管理建立一框架，以協助企業進行能源管理、提高能源使用效率、減少成本支出及改善環境效益。
- Set energy-saving and carbon-reduction goals. 定立節能及減碳目標。
- Establish a complete evaluation system for enterprises to promote energy conservation and carbon reduction, corporate responsibility and sustainable development plan.
為企業建立節能及減碳、行企業責任及持續發展計劃的完整評估體系。
- Publish carbon data regularly in corporate responsibility/sustainability reports.
定期於企業責任/可持續發展報告發佈碳數據。



MANAGEMENT SYSTEM AND SOFTWARE MONITORING AND CONTROL

管理系統及監測軟體



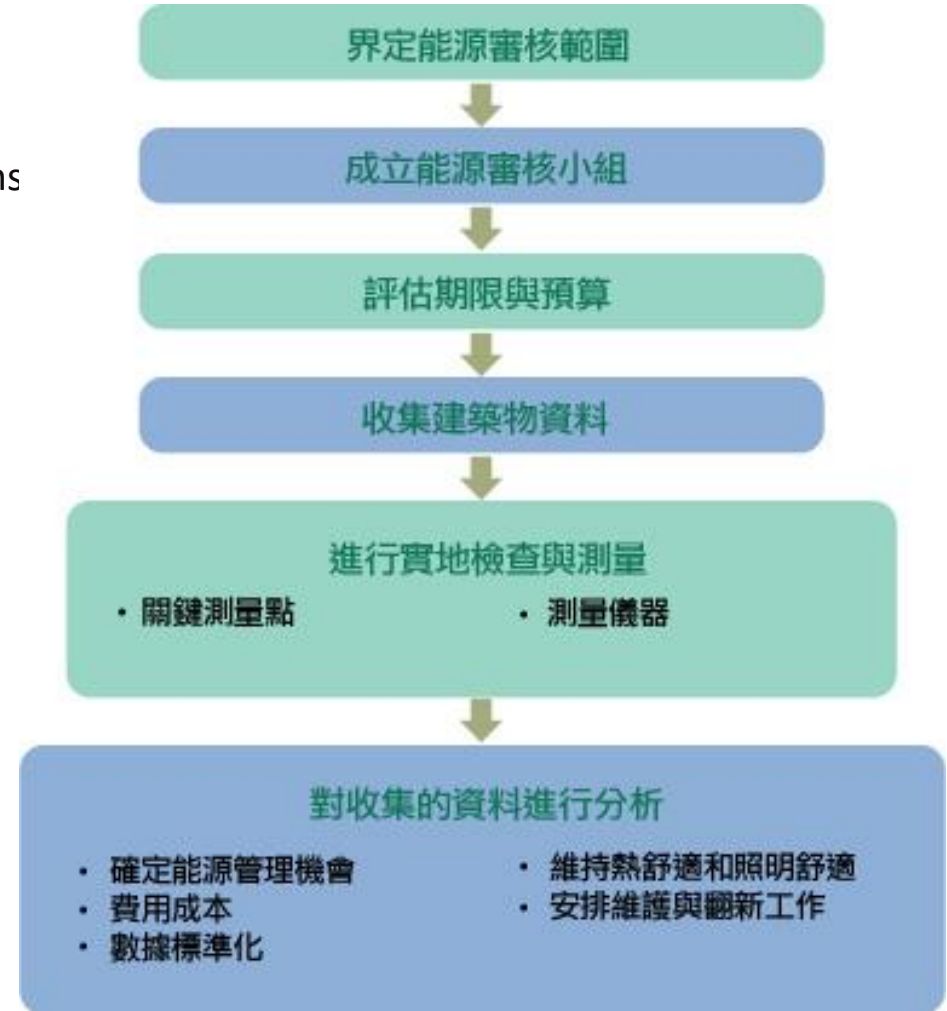
能源審計 (低投資成本) 能源審核 (成本 : 低)

On-site measurement, recording and verification of electricity consumption patterns
實地量度、紀錄及核實用電模式

- Efficiency of equipment and systems 設備和系統的效率
- Actual demand and power consumption 實際需求與電力消耗

Energy analysis 能耗分析

- Analyze electricity consumption patterns and view energy consumption and demand status. 用電模式分析、檢視耗能及需求狀況
- Efficiency reviews and specific recommendations for equipment and systems. 設備和系統的效率檢視及具體建議
- Provide advice on possible actions and relevant return data. 提供可行措施的建議及相關回報數據



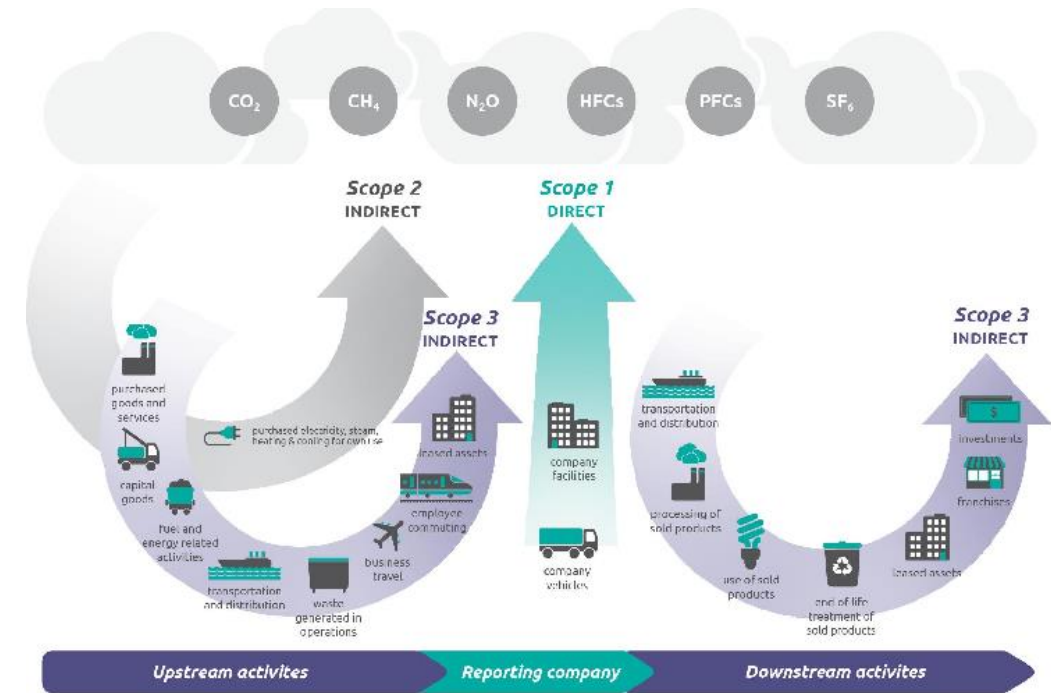
MANAGEMENT SYSTEM AND SOFTWARE MONITORING AND CONTROL

管理系統及監測軟體



Carbon audit (low investment cost) 碳審核 (成本：低)

- Find out that the production process causes greenhouse gas emissions.
找出生產的過程中會引致溫室氣體的排放
 - Greenhouse gases absorb infrared light, trapping heat released from the ground in the atmosphere, causing the greenhouse effect.
溫室氣體能吸收紅外線，令地面釋放的熱量被困於大氣層中，造成溫室效應
 - A carbon audit can provide a carbon management service to assist in understanding and managing greenhouse gas emissions and developing strategies to reduce emissions
碳審核能提供一個碳管理服務，以協助瞭解和管理溫室氣體的排放，並制定減排的策略
- Scope 1: Direct GHG emissions and reductions
範圍一：直接的溫室氣體排放和減除
 - Scope 2: Indirect emissions from energy consumption
範圍二：能源消耗的間接排放
 - Scope 3: Other indirect greenhouse gas emissions
範圍三：其他間接的溫室氣體排放



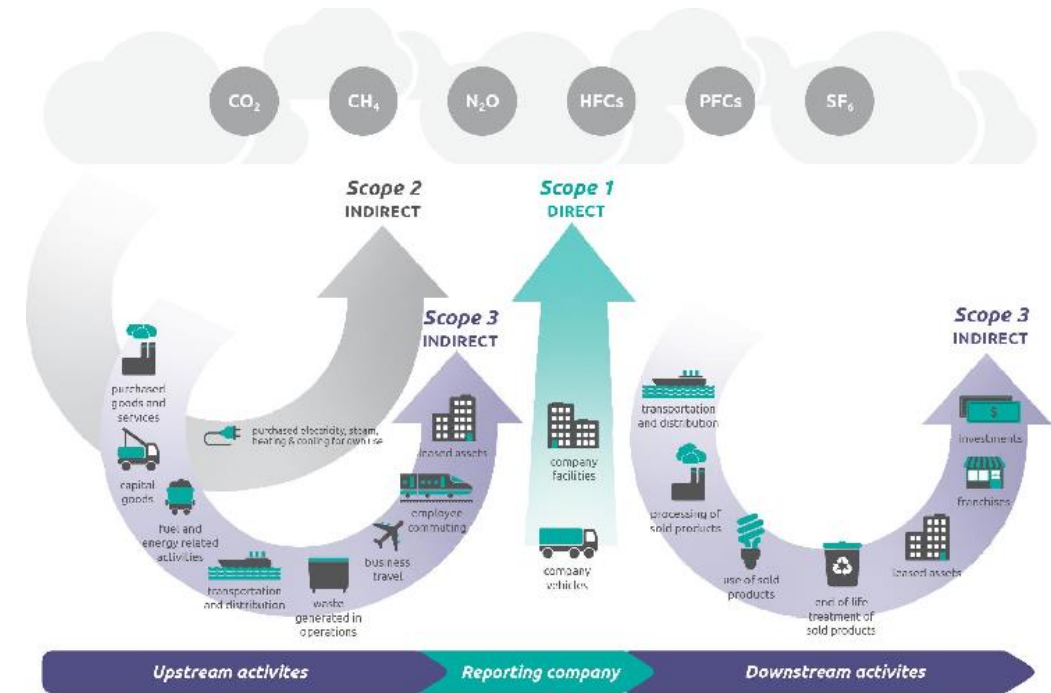
MANAGEMENT SYSTEM AND SOFTWARE MONITORING AND CONTROL

管理系統及監測軟體



Carbon audit (low investment cost) 碳審核 (成本：低)

- Report and analyze energy consumption and carbon data.
報告及分析能耗、碳數據
- Performance status of energy consumption systems.
能耗系統現狀及表現
- Recommendations include addressing energy consumption system operations, device settings or system
建議包括針對能耗系統操作、設備設定或系統
- Recommend the no/low/medium/high-cost energy saving measures.
推薦無/低/中/高成本費用節能措施



04

**Energy saving in toy
manufacturing process**
玩具製造過程中的節能





SPECIFIC INDUSTRIAL EQUIPMENT 特有工序設備

Energy-saving in Drying Processes(high investment cost)

烘乾、固化、保溫爐節能方案 (成本：高)

- The waste heat from the previous drying furnace, curing furnace and hot chamber /oven is discharged on the roof through the pipe. Install heat exchanger to recycle waste heat to preheat incoming air, or to heat hot water for pre-treatment process, which can reduce the energy consumption of the furnace.
以前烘乾爐、固化爐和熱室的廢熱經喉管在天臺排放。加裝熱交換器，將餘熱回收作預熱進機空氣，或作前處理工序的熱水加熱，可減少焗爐的能耗
- Use electric induction type of heating method, instead of traditional burning or resistance heating method.
使用電保溫爐代替柴油保溫爐
- Use infrared drying lamps type of heating method, instead of traditional burning or resistance heating method.
使用紅外線烘乾燈
- Install the insulation curtain at inlet/outlet of oven method to reduced heat loss
於熱室出入口安裝隔熱簾以減少熱能損耗
- Optimization of temperature setting with balancing on the acceptable temperature requirement
優化溫度設定



SPECIFIC INDUSTRIAL EQUIPMENT特有工序設備



Energy-saving in Injection molding machine (high investment cost)

注塑機節能技術 (成本：高)

- Injection molding machine electromagnetic heating gun instead of traditional heating wire to reduce excessive heating
使用電磁炮筒加熱代替傳統發熱線，減少過度加熱
- Frequency conversion (variable speed) injection molding machine:
The injection molding machine is installed with a frequency converter to adjust the output pressure.
變頻注塑機：注塑機安裝變頻器可調整輸出壓力
- Optimization of temperature and pressure setting with balancing on the acceptable temperature and pressure requirement
將注塑機於不同程式的控制信號，經處理后作為變頻器的程式控制信號，以調節液壓油泵的供油流量和壓力，滿足各注塑過程對壓力的要求
- Adopt waste heat recovery into injection molding machine gun, and reduce the energy in temperature rise to the setting point.
注塑機炮筒廢熱回收：收集注塑機炮筒熱能，再轉移到烘料筒作烘料使用



SPECIFIC INDUSTRIAL EQUIPMENT特有工序設備



Energy-saving in Sewing and Cutting Process (high investment cost) 縫製和切割的節能技術（成本：高）

Sewing process縫製工序

- Adoption of energy saving servo-motors in sewing machine
採用伺服馬達縫紉機
- Energy analysis the production flow in sewing production line, to reduce the energy and time loss in between processes
為縫製工序進行能量分析以減少工序之間的能量損耗
- Control of stitching speed setting to achieve energy saving
控制縫紉速度以達至節能

Cutting Process切割工序

- Adoption of cutting CAM to improve the efficiency
使用切割CAM以改善效能
- Analysis between manual and CAM cutting in appropriate to get energy saving
分析手動及CAM的切割表現以節省能源
- Design the multiple chopping method to improve the efficiency
設計不同的切割方法以改善效能



SPECIFIC INDUSTRIAL EQUIPMENT 特有工序設備



Energy-saving in Sewing and Cutting Process (high investment cost)
縫製和裁剪的節能技術 (成本：高)

Other Process 其他工序

- Optimization of machine performance, such as machine capability study, efficiency, repeatability, maintenance, idling time...etc;
最佳化機器性能，如：機械能力、效能、重複性、維修、閑置時間
- Adoption of energy saving or variable speed device;
採用節能措施或變頻器
- Minimization of defect rate.....etc.
次品率最少化





SPECIFIC INDUSTRIAL EQUIPMENT 特有工序設備

Centralized cooling for Lathing Machine (high investment cost)
車床的中央空調系統 (成本：高)

Benefit of Centralized HVAC 中央空調的好處：

- Reduce electricity consumption 減少用電
- Reduce working temperature 降低工作空間溫度
- Extend facilities' life 延長設施壽命



Improvement comparison 更換空調前後對比	Old individual cooling system 舊獨立空調系統	New Centralized cooling system 新中央空調系統
Water Exit Temp 出水溫度	25	21
Water Return Temp 入水溫度	32	24
Annual Cooling Requirement / kWh 年度冷卻用電量/kWh	449,064	449,064
Annual Electricity Consumption / kWh 年度用電量/kWh	148,206	95,760
Energy Saving / kWh 能源節省/kWh		52,446
Energy Saving / % 能源節省/%		35

05

**Renewable energy sources in
manufacturing**
製造業的可再生能源



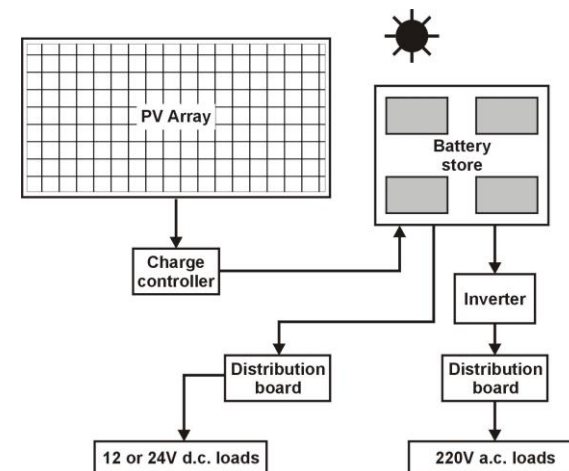
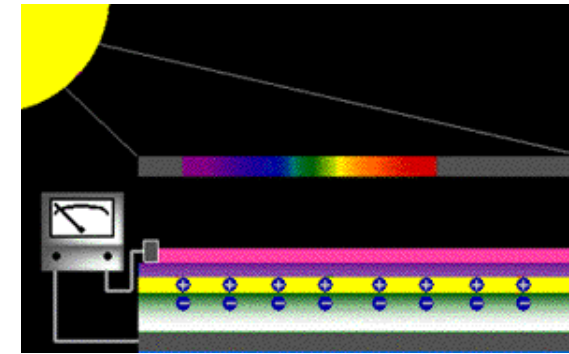
Renewable energy in living / working



1) Solar Panel Technology

Photovoltaic (PV) modules are made up of semiconductor devices (solar cells) capable of directly converting light energy into electricity. PV modules can be connected to form small or large arrays, from several hundred watts capacity to hundreds of kilowatts. And the associated equipment including **charge controllers or inverters, batteries, electric cables and switchgear, surge arrestors, etc.**

The AC output of the PV system is connected to the electrical distribution system of a site or a building, and therefore the PV system **operates in parallel** with the electricity supply from the grid to meet the electricity consumption of the site or building.



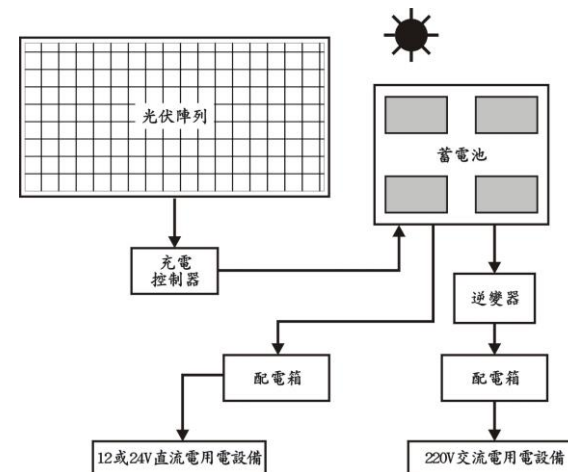
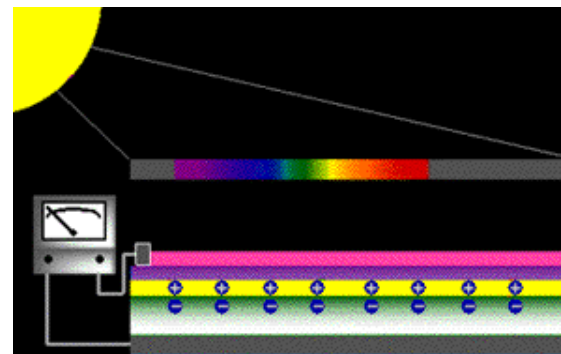
生活/工作中的可再生能源



1) 太陽能板技術

光伏(PV)模組由能夠直接將光能轉換為電能的半導體裝置(太陽能電池)組成。光電模組可以連接形成小型或大型陣列,容量從幾百瓦到數百千瓦。以及相關設備,包括**充電控制器或變頻器、電瓶、電纜和開關設備、避雷器等。**

光伏系統的交流輸出連接到場地或建築物的配電系統,因此光伏系統與電網的供電**並聯運行**,以滿足場地或建築物的用電。





Specific features:

1) Solar Panel Technology

Each PV module can be characterized by its performance curve, i.e. the current-voltage curve (I-V curve). The performance of solar module is tested under standard testing conditions (STC) as defined in the IEC 60904 standards: cell temperature of 25 degrees Celsius, incident solar irradiance of 1000 W/m^2 max., spectral distribution of the light spectrum with an air mass $AM = 1.5$. Actual efficiency around

10~15%.

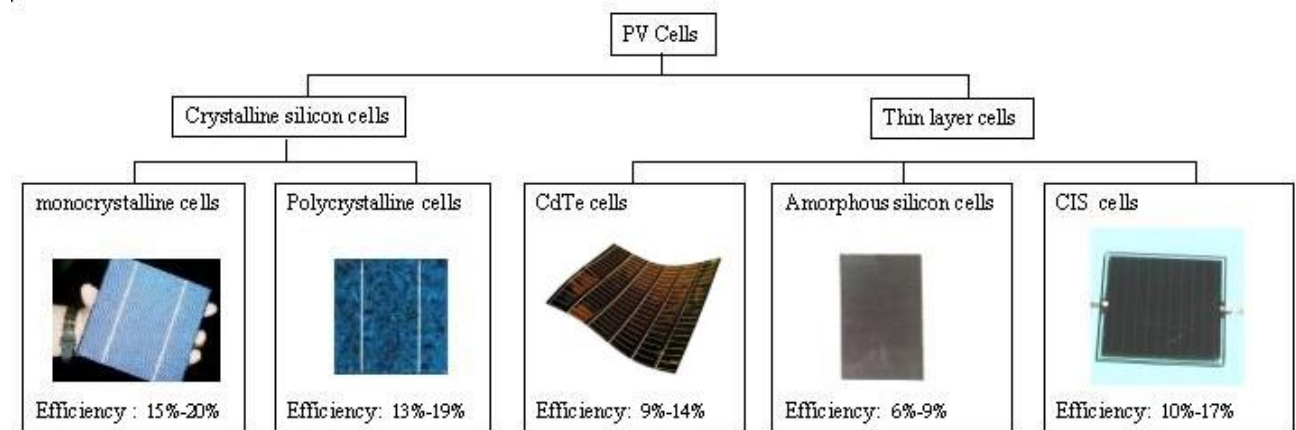
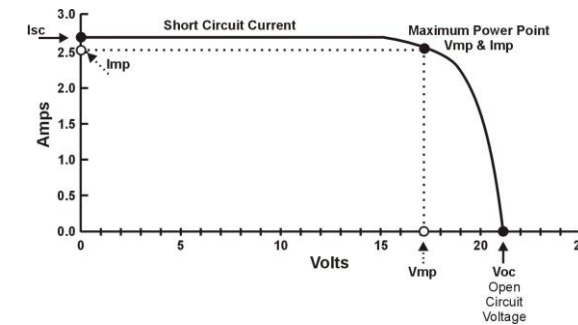
Assumption:

House size – 100m^2

Roof area – 80m^2

We setting half of roof area 40m^2 for solar panel system, so we can get the energy generated **4-6kWh per hour.**

Since the solar panel facing to South in our design, so it only to capture the solar power during morning period around 6 hours, the total energy generated around **30kWh per day.**





具體特點：

1) 太陽能板技術

光伏組件的工作特性可以用工作曲線來表達，比如電流／電壓曲線（I-V 曲線）。光伏組件的工作性能須要在 IEC（國際電工標準）60904 所規定的標準測試條件下進行測試，包括：電池溫度為攝氏 25 度，太陽輻射強度為 1000 瓦／平方米，光譜分佈為大氣質量 1.5 時情況下的光譜分佈。實際效率約為 **10-15%**

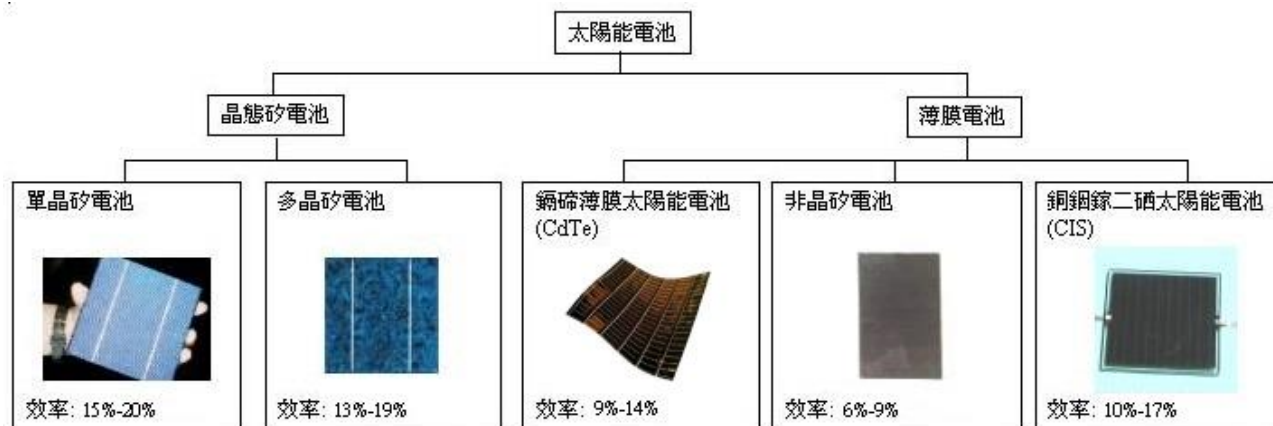
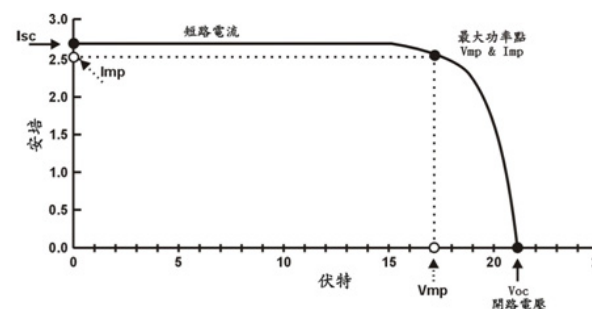
假設：

房屋面積- 100m²

屋頂面積- 80m²

我們將屋頂面積 40 平方公尺的一半設定為太陽能板系統，這樣我們每小時可以獲得 **4-6kWh** 的能量。

由於我們設計的太陽能板朝南，所以只在早上 6 小時左右捕獲太陽能，每天總發電量約 **30kWh**。





Specific features:

2) Wind Turbine Technology

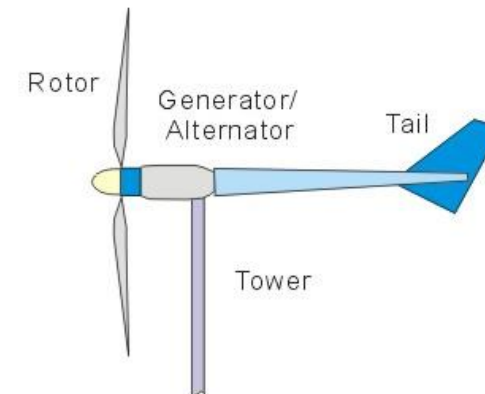
Wind is the result of air movement due to the variation in solar radiation absorption on different parts of the earth and the dynamic effects from the earth's rotation. It can be considered an indirect form of solar energy.

A wind turbine is a device which **converts the kinetic energy** of the wind into rotational motion of the turbine rotor to drive an electric generator **producing electricity**.

Small wind turbines are often used in remote locations, sometimes in **conjunction with PV panels**, to provide off-grid power. Small wind turbines can be several hundred watts, or up to tens of kW in power capacity.



Basic Parts of a Small Wind Turbine





具體特點：

2) 風力發電機技術

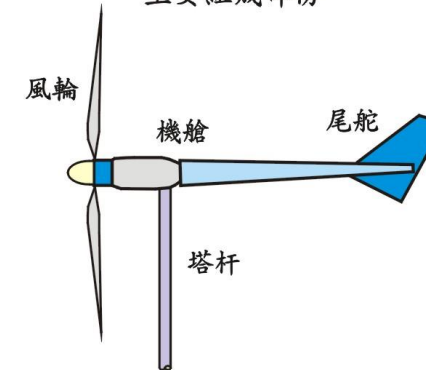
風是由於地球不同部分對太陽輻射吸收的變化以及地球自轉的動態影響而引起的空氣運動的結果。它可以被認為是太陽能的一種間接形式。

風力渦輪機是一種將風的動能**轉換為渦輪轉子**的旋轉運動以驅動發電機發電的裝置。

小型風力渦輪機通常用於偏遠地區，有時**與光伏電池板結合**使用，以提供離網電力。小型風力渦輪機的功率可達數百瓦，甚至可達數十千瓦。



小型風力發電機的主要組成部份





Specific features:

2) Wind Turbine Technology

The power of the wind flowing through a certain area is given by:

$$\text{Power} = 1/2 \times \text{Air Density} \times \text{Area} \times (\text{Velocity})^3$$

Assumption:

Rotor swept diameter 1.8m, area 2.5m², rated power 1kW (at 12.5m/s)

Dry air has a density of approximately 1.225 kg/m³

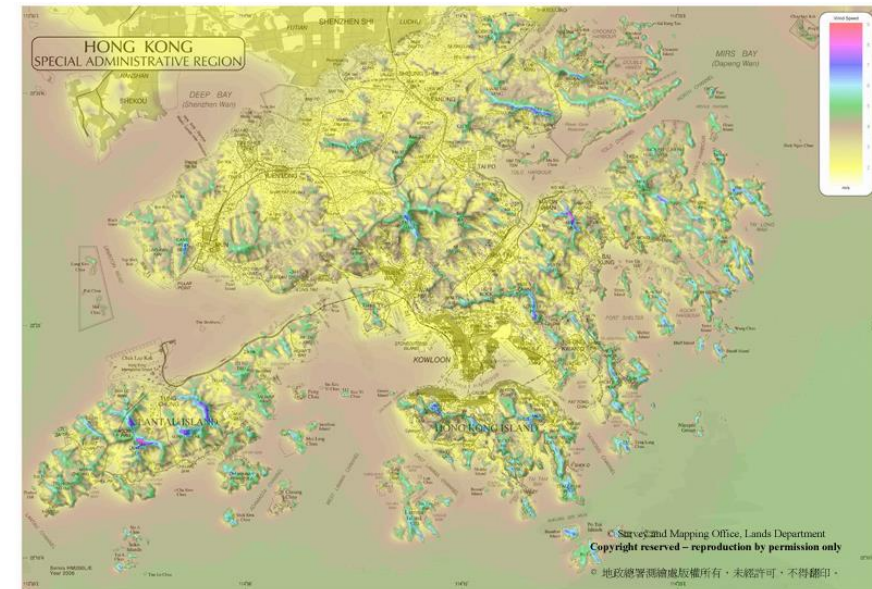
Velocity average 3m/s at 15m elevation, 4.5m/s at 100m elevation

So we can get the energy generated

0.14kWh per hour @100m

The total energy generated for 24 hrs

around **3.4kWh per day @100m**





具體特點：

2) 風力發電機技術

流經某一區域的風的功率由下式給出：

$$\text{功率} = 1/2 \times \text{空氣密度} \times \text{面積} \times (\text{速度})^3$$

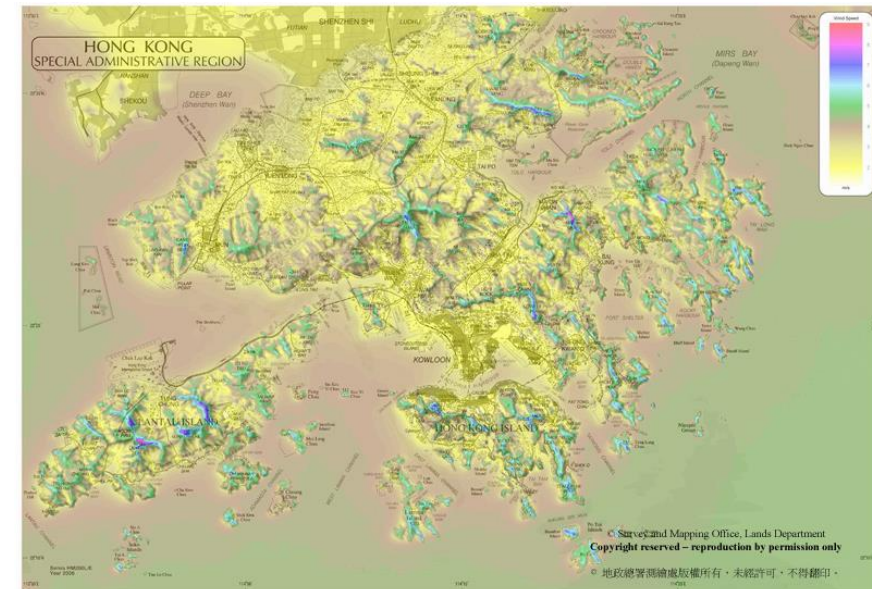
假設：

轉子掃掠直徑1.8m, 面積2.5m², 額定功率1kW(12.5m/s時) 乾燥
空氣的密度約為 1.225 kg/m³ 15m海拔處平均速度3m/s, 100m海
拔處平均速度4.5m/s

這樣我們就可以得到每小時產生的能量

0.14kWh@100m

每天24小時總發電量約**3.4kWh**@100m





Specific features:

3) Solar Water Heating

Solar water heating systems harness the heat in solar radiation to produce hot water. Domestic solar water heating system usually comprises of solar collectors and a **water tank**. In application, we can use the stored heat water for shower, instead of the electricity consumed for boiling water.

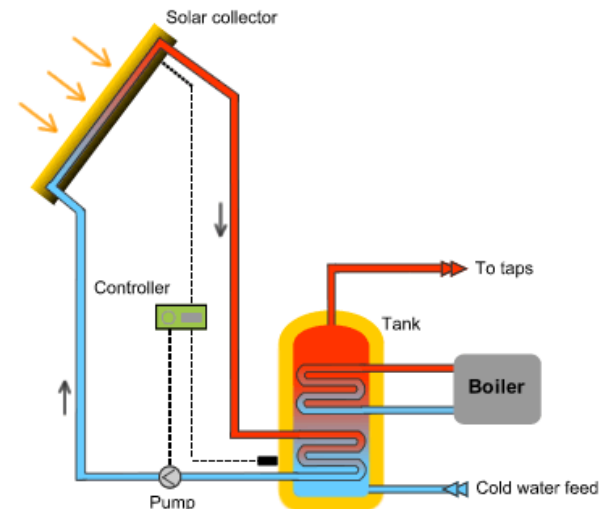
Assumption:

House size – 100m²

Roof area – 80m²

We setting half of roof area 40m² for solar panel system, rated 110W/m² with 50% efficiency, so we can get the energy generated **2.2kWh per hour**.

Since the solar panel facing to North in our design, so it only to capture the solar power during afternoon period around 6 hours, the total energy generated around **13.2kWh per day**.





具體特點：

3) 太陽能熱水器

太陽能熱水系統利用太陽輻射的熱量來生產熱水。家用太陽能熱水系統通常由太陽能集熱器和水箱組成。在應用中，我們可以用儲存的熱水來淋浴，而不是燒水所消耗的電力。

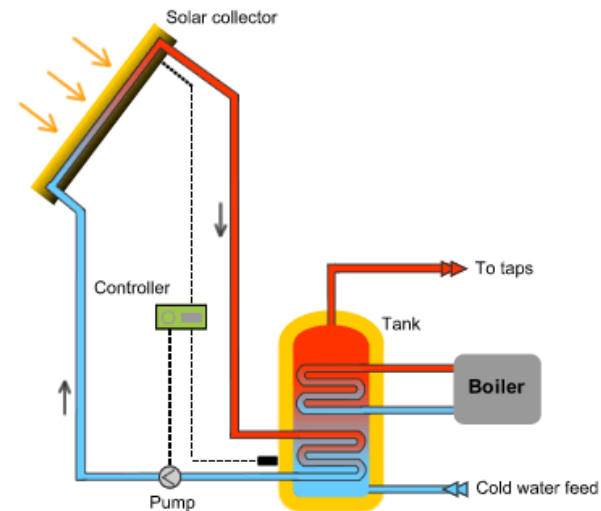
假設：

房屋面積– 100m²

屋頂面積– 80m²

我們將屋頂面積的一半設定為40平方米的太陽能板系統，額定功率為110W/平方米，效率為50%，這樣我們每小時可以獲得**2.2kWh**的能量。

由於我們設計的太陽能板朝北，所以只在下午6小時左右捕獲太陽能，每天總發電量約為**13.2kWh**。

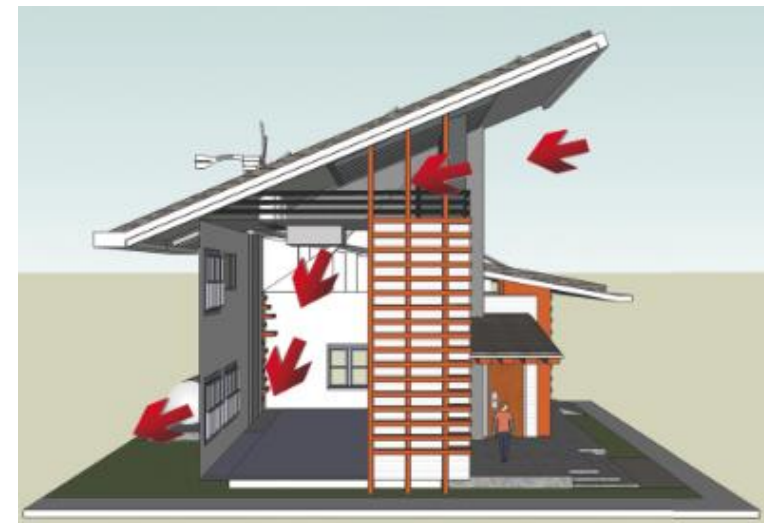




Specific features:

4) Natural Air Ventilation

- Natural ventilation is the process of **supplying and removing air** through an indoor space without using mechanical systems. It refers to the flow of external air to an indoor space **as a result of pressure or temperature differences**.
- Good air ventilation can reduce the using time of air conditioners. Since air conditioning part is the highest energy consumed equipment in residential house, which is **over 35%** of electricity consumed.
- Good air ventilation can improve the indoor air quality (IAQ), **reduce CO, VOC, Dust...etc**

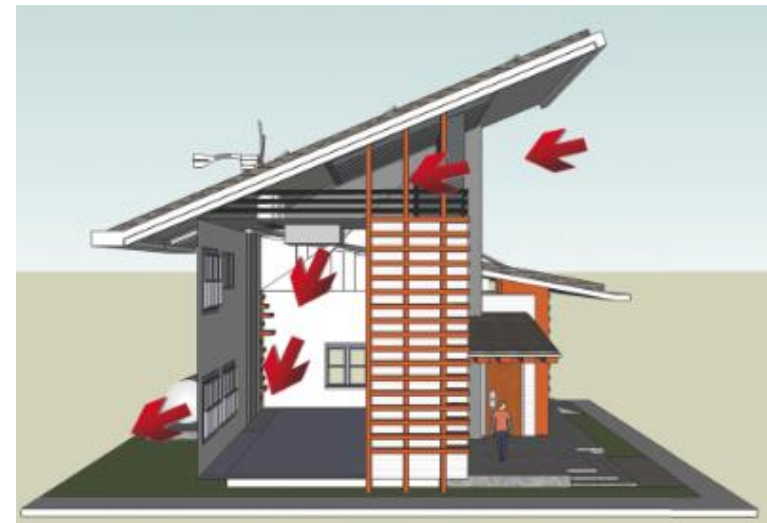




具體特點：

4)自然通風

- 自然通風是在不使用機械系統的情況下透過室內空間供應和排出空氣的過程。它是指由於壓力或溫度差異而導致外部空氣流向室內空間。
- 良好的空氣流通可以減少空調的使用時間。由於空調部分是住宅中能耗最高的設備，佔用電量的**35%以上**。
- 良好的空氣流通可改善室內空氣品質 (IAQ)，**減少CO、VOC、灰塵...等**



Commercial or
non-industrial
Level

06

**ENERGY SAVING IN OFFICE
AREA**
辦公室節能方案





ENERGY SAVING APPROACHES IN USING OF OFFICE APPLIANCES

辦公室用電節能方案

Reference: Energy saving tips for office

https://www.emsd.gov.hk/energyland/filemanager/common/pdf/EMSD_office_Eng.pdf

For general 整體方案

1. Switch off equipment that is not in use.
關掉不需使用的設備
2. Avoid leaving appliances in standby mode.
避免讓設備長期或於非辦公時間內停留在備用狀態
3. Procure energy efficient equipment or equipments with energy label.
購買辦公室設備，選用具有高能源效益的型號，例如那些貼有能源標籤的產品
4. Carry out regular maintenance of equipment.
定時保養辦公室設備，以維持其最佳能源效益
5. Notices/ Reminder stickers/ wallpaper/ education training can be applied to enhance the idea of energy saving.
可使用告示、標貼、培訓去高提節能意識



Source by EMSD



ENERGY SAVING APPROACHES IN USING OF OFFICE APPLIANCES

辦公室用電節能方案

For Air Conditioning System 空調系統

6. Turn off the AC in offices, meeting rooms, etc. right after use. (default the timer setting for office hours)
在辦公室、會議室等房間使用完畢后，應關掉空調及通風設備（定時器設定在辦公時間內）
7. Clean dust filters and fan coil units regularly. (~10% save)
定期清洗空調及風機盤管元件的隔塵網（節省約10%用電）
8. For HVAC system, use a high fan speed rather than lowering the temperature setting to cater for increased cooling demand.
如室內人數增多或冷凍需求增大，可先調高盤管風機的扇速而非調低溫度設定
9. Set and maintain air-conditioned room temperature between 24°C and 26°C in summer.
在夏天，調校並維持空調室溫在攝氏24至26度
10. Refill refrigerant to achieved back to designed performance.
添加雪種以回復最原始性能
11. UV block window film to protect the heat energy enter from the windows, reduce energy consumption on temperature rise in daylight.
在窗戶上安裝防曬隔熱玻璃貼膜，阻隔室外熱力，減低室內溫度，減少用電



ENERGY SAVING APPROACHES IN USING OF OFFICE APPLIANCES

辦公室用電節能方案

For Lighting System 照明系統

11. Turn off light that is not in use. Affix “save energy” stickers near the switches as a reminder. (e.g. Lunch time)
關掉不需使用的照明裝置，並在開關掣附近貼上「節約能源」的貼紙，以作提示（如：午飯時間）
12. Cut down the number of lamps in areas with ample daylight.
在有充足日光的地方減少燈的數量
13. Make use of daylight whenever possible to reduce lighting cost.
盡量善用日光
14. Replace T12 or T8 fluorescent tube with T5. For a 1000m² office, an electricity cost of up to \$10,000 can be saved each year.
以T5光管替代T12或T8光管，以一個1000平方米的辦公室而言，可每年節省高達\$10,000電費
15. Install occupancy sensors to turn off lights automatically in public areas such as corridors, toilet etc.
在公用地方例如走廊、洗手間，安裝使用者/移動感應器用以控制照明設備的開關
16. Replace conventional internally illuminated exit and directional signs with LED type for energy saving and longer lamp life.
以使用LED的出口指示牌及方向指示牌取代傳統的內置照明裝置指示牌，既可省電，指示牌的燈源也更長壽
17. Promoting policy of last person who left the area will be responsible to turn off the light.
離開辦公室前，安排最後離開的員工檢查及關掉所有無需使用的照明



ENERGY SAVING APPROACHES IN USING OF OFFICE APPLIANCES

辦公室用電節能方案

For Photocopier and Printer 影印機和印表機

19. Switch off photocopiers and printers after office hours. (Use timer to auto switch off)
非辦公時間將影印機和印表機關掉 (設定時間制)
20. Set the “low power” and “Off” mode default intervals to the lowest settings.
設定影印機和印表機於閑置狀態下儘快進入低電量或關閉模式
21. Follow the maintenance schedules of appliances.
按照維修計劃進行檢查維修
22. Photocopy in batch as it can minimize energy consumption due to less frequent start. (reduce harm up time and energy)
整批複印檔可減少因頻密啟動影印機而消耗的能源
23. Arrange the “last-man-out” to turn off all photocopiers and printers or use timer switches to reduce power consumption.
使用時間掣或安排最後離開的員工在下班前關掉影印機和印表機，以減少能源消耗
24. Use “print preview” function to check the layout and style of documents before printing.
在列印前，使用列印預覽功能檢查及確定檔編排和樣式符合要求，減少因 列印錯誤而浪費的紙張及能源
25. Adjust the margins and font size of documents in order to optimize use of paper. (Multi-page)
調整每頁檔的版面邊界和字體大小，以更有效用紙



ENERGY SAVING APPROACHES IN USING OF OFFICE APPLIANCES

辦公室用電節能方案

For Computer 電腦

27. Switch off computers after office hours can save up to \$600 electricity cost for each computer each year.
在非辦公時間或離開工作間前關掉電腦能節省高達每枱電腦每年\$600的電費
28. Choose energy efficient computers and monitors, such as those with an energy label.
購買電腦及顯示器時，選擇具能源效益的型號，例如那些貼有能源標籤的產品
29. Avoid using screen savers as they do not save energy.
關掉顯示器比使用「螢幕保護程式」更能節省能源
30. Use the power management function to turn the PC into "sleep" or "hibernation" mode as appropriate when it is idle.
透過「電能管理」功能使個人電腦在閑置時進入適當的睡眠或休眠模式
31. Reduce the brightness level of the screen to the lowest comfortable level.
把顯示器光度調較至最低而消費者感覺舒適的水準
32. The energy wasted by a photocopier left in "standby" mode overnight is enough for making up to 700 copies of A4 size paper.
避免讓影印機長期處於備用狀態。一台處於備用模式的影印機於一個晚上所浪費的電力，足夠影印700張A4大小的檔
33. The power wasted by a desktop printer left in "standby" mode after office hours accounts for 70% of the total energy consumed by the printer.
避免讓印表機長期處於備用狀態。一台桌面印表機在非辦公時間處於備用模式所浪費的電力，占該印表機總耗電量的七成
34. Implementation of smart sockets, automatic switch off the associated devices
使用智慧拖板自動關掉周邊設備

LIGHTING FIXTURES IMPROVEMENT (FREE INVESTMENT)

電燈節能改善措施



Case Sharing 個案分享

According to a lighting audit result based on Code of Practice for Energy Efficiency of Lighting Installation
根據一個參考《照明裝置能源效益守則》所做的照明審計的結果

- Illumination value measured in Room A : 728 lux to 800 lux in general
Room A的亮度是 728 - 800lux
- Lighting power density of the area is 30.31 W/m²
該範圍的照明功率密度是30.31 W/m²
- These implied energy management opportunity exist for saving energy and money
這代表在節能和降低成本方面均有進步的空間

Remark:

1. Optimum average illumination value required by Labor department: 500 lux for general office, 750 lux for Drawing workstation.
根據勞工處指引，辦公室最佳照明度為500 lux; 繪圖台最佳照明度為750 lux
2. According to Building energy code, maximum allowable lighting power density for office is 17W/m²
根據《照明裝置能源效益守則》，辦公室的最高可容許照明功率密度為17W/m²



Form LG-2	
Lighting Power Density	
Calculated LPD	Maximum Allowable LPD
$\frac{\{N\} \times \{CW\}}{\{A\}}$	
(W/m ²)	(W/m ²)
30.31	17



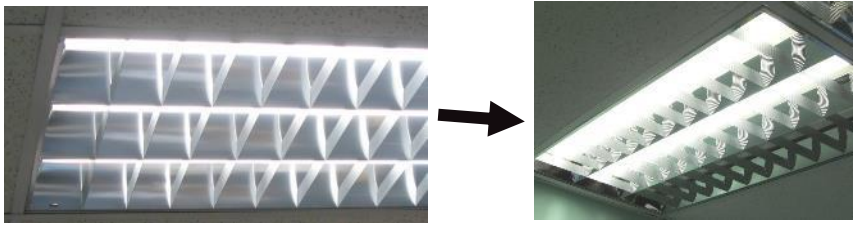
LIGHTING FIXTURES IMPROVEMENT (FREE INVESTMENT)

電燈節能改善措施



Case Sharing 個案分享

- Total Area with fixed lighting installation: 400.29m²
有固定照明的總面積：400.29m²

	Before audit 審計前	By removing 1 fluorescent tube in every luminaire 從每個照明器中移除一條燈管	After audit 審計后
Total Installed lighting power 照明功率	10988W		7728W
Illumination value measured 照明度	728 lux (最佳照明度為500lux)		589 lux
Energy saved 能源節省	3260W per hour (29.7% of lighting power consumption)		
Money saved 成本節省	around \$6780 dollars per year (assume \$1=1kWh)		

OFFICE EQUIPMENT POWER MEASUREMENT

量度辦公室設備用電量



Case Sharing 個案分享

According to the *on-site check* performed among on Company B (~300 staffs) after office hours
根據在公司B (約300名員工) 非辦公時間進行的實地檢測

	Power Consumption 用電量	No. that was left vacant 空置數量
Computers (sleep) 電腦(休眠)	3.4W	21
Monitors (standby) 螢幕(待機)	0.6W-0.65W	49
Monitors (on) 螢幕(開啟)	12W-13W	20

- 363W was wasted per hour, around \$0.4HKD equivalent
每小時浪費了363W，約\$0.4HKD
- Approximate save \$2672HKD per year when the computers still running in non-working hours
如在非辦公時間關掉電腦，可每年節省約\$2672

Remarks:

Sleep mode of computer: showing "computer is locked" on screen 休眠狀態為螢幕顯示“鎖定”

Standby mode of monitor: display is off but power indicator is in 待機狀態為已關掉螢幕但電源指示燈仍亮著



LOCAL REQUIREMENTS (HK) 香港本地要求



Mandatory Energy Efficiency Labelling Scheme (MEELS) 強制性能源效益標籤計劃

- Under MEELS, energy labels are required to be shown on the prescribed products for supply in Hong Kong to inform consumers of their energy efficiency performance.

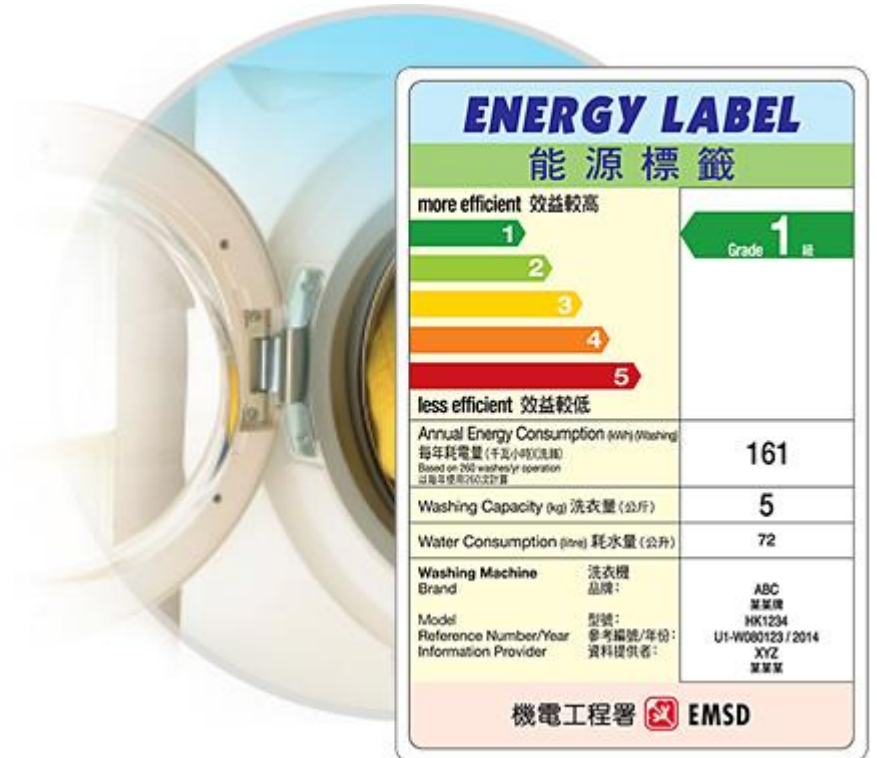
根據強制性標籤計劃，在本港供應的訂明產品須貼上能源標籤，讓消費者知悉有關產品的能源效益表現。

What does the label contain?

標籤上有哪些資料？

- annual energy consumption figure
每年耗電量
- energy efficiency grading
能源效益級別
- other important data relevant to the types of the appliances
其他該產品的相關資料

(Source: EMSD)



The (anticipated) commencement date of MEELS Phase 4 is September 1, 2023, and (anticipated) full implementation is December 1, 2024. Scope of the scheme will be extended to **LED Lamps, Gas Instantaneous Water Heaters, and Gas Cookers.**
強制性能源效益標籤計劃預計會於2023年9月1日開始至2024年12月1日結束。計劃涵蓋的範圍將延伸至**LED燈、煤氣恆溫熱水爐及櫃爐**

MANDATORY ENERGY EFFICIENCY LABELLING SCHEME (MEELS)

強制性能源效益標籤計劃



- Room air conditioners 空調機
- Refrigerating appliances 冷凍器具
- Compact Fluorescent Lamps 緊湊型螢光燈 (慳電膽)
- Washing machines 洗衣機
- Dehumidifiers 抽濕機
- Televisions 電視機
- Storage type electric water heaters 儲水式電熱水器
- Induction cookers 電磁爐

香港 碳中和
Carbon Neutral@HK

25週年紀念
ANNIVERSARY

機電工程署
EMSD

強制性能源效益標籤計劃

Mandatory Energy Efficiency Labelling Scheme

ENERGY LABEL

能源標籤

more efficient 效益較高

1
2
3
4
5

less efficient 效益較低

From 1

Annual Energy Consumption (kWh)	38
Diagonal Screen Size (cm)	106
Energy Efficiency Index (能源效益指數)	0.11

Television	電視機	ASG
Brand	品牌	WYD
Model Reference Number / Year Information Provider	型號參考號碼 / 年份資料提供者	1000001 / YYY XXX ZZZ

機電工程署 EMSD

認住能源標籤

你我齊節能 地球更精神

Look for the Energy Label Save Energy for a Greener Planet

在香港供應強制性能源效益標籤計劃訂明的任何產品，有關產品必須附有符合指明規定的能源標籤。

All prescribed products under the Mandatory Energy Efficiency Labelling Scheme shall bear energy labels that comply with the specified requirements when being supplied in Hong Kong.

獨家贊助機構 Exclusive Sponsor

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The Hong Kong Jockey Club

查詢 Enquiry 1823
www.emsd.gov.hk/energylabel

再造成印刷
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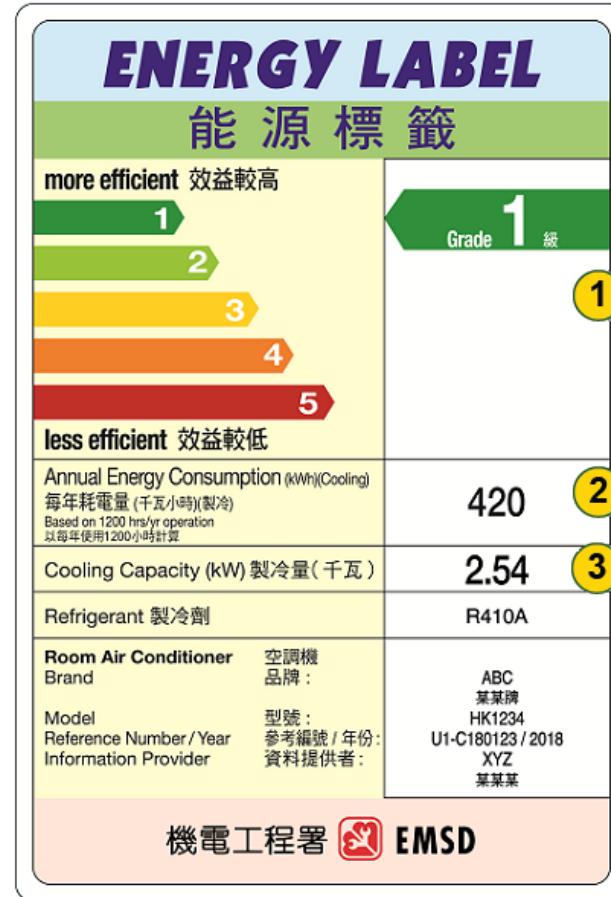
Source: <http://www.energylabel.emsd.gov.hk/en/about/background.html>

MANDATORY ENERGY EFFICIENCY LABELLING SCHEME (MEELS) 強制性能源效益標籤計劃



Room Air Conditioner 空調機

- Grade 1 products are most efficient (green) and Grade 5 products are least efficient (red).
能源效益級別：1級能源效益最高（綠色），5級則最低（紅色）。



1 能源效益級別。1級能源效益最高（綠色），5級則最低（紅色）。

2 每年耗電量。你可利用這數字比較不同型號可節省多少電費。

3 最大製冷量（千瓦）

MANDATORY ENERGY EFFICIENCY LABELLING SCHEME (MEELS)

強制性能源效益標籤計劃



Room Air Conditioner 空調機

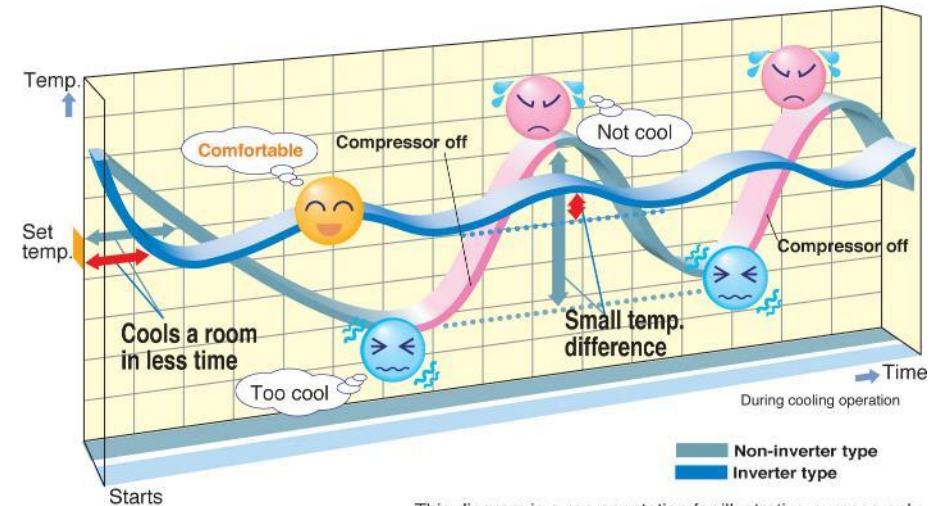
Performance comparison: 性能比較

- Split vs window type ~ 14% saving 分體式 vs 視窗式 ~ 節省14%
- Inverter vs traditional type ~20% saving 變頻 vs 傳統 ~節省20%
- Grade 1 vs Grade 3 ~15% saving 等級一 vs 等級三 ~ 節省15%

Energy Saving Opportunities: 節能方法

- Cleaning filters regularly ~10% saving 定期清潔濾網 ~ 節省10%
- Increase 1 degree C ~ 3% saving 調高一度 ~ 節省3%
- Refill refrigerant ~6% saving 加製冷劑 ~節省6%

Comfortable Temperature Control



MANDATORY ENERGY EFFICIENCY LABELLING SCHEME (MEELS) 強制性能源效益標籤計劃



Refrigerating appliances 冷凍器具

- Grade 1 products are most efficient (green) and Grade 5 products are least efficient (red).
能源效益級別：1級能源效益最高（綠色），5級則最低（紅色）。

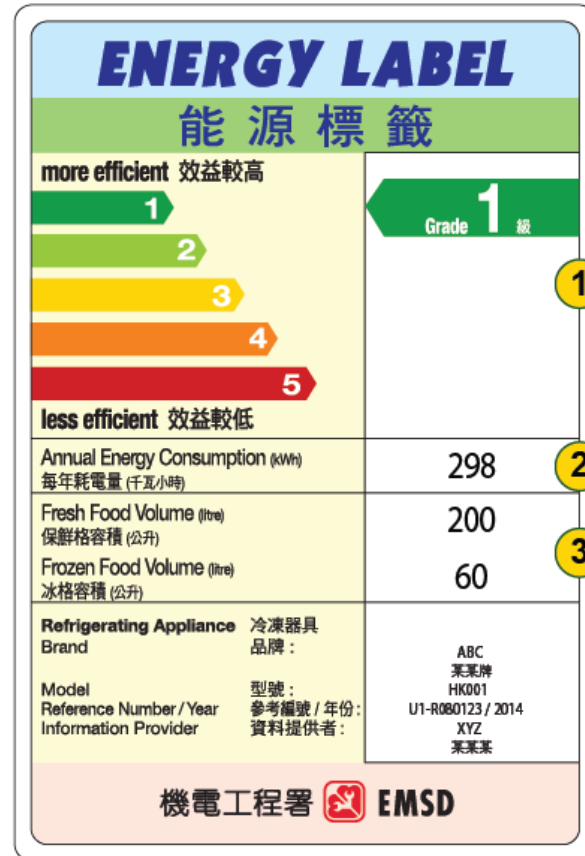


Performance comparison: 性能比較：

- Inverter type available (but not common) 有變頻型號但不普遍
- Grade 1 vs Grade 3 ~35% saving
等級一 vs 等級三 ~ 節省35%

Energy Saving Opportunities: 節能方法

- Check leakage 檢查有否洩漏



1 能源效益級別。1級能源效益最高（綠色），5級則最低（紅色）。

2 每年耗電量。你可利用這數字比較不同型號可節省多少電費。

3 保鮮格及冰格容積。

MANDATORY ENERGY EFFICIENCY LABELLING SCHEME (MEELS) 強制性能源效益標籤計劃



Compact Fluorescent Lamps 緊湊型螢光燈 (慳電膽)

- Grade 1 products are most efficient (green) and have an average lamp life of 8,000 hours or above. Grade 5 products have an average lamp life of below 6,000 hours (red).
一級能源效益最高 (綠色) ，平均電燈壽命8,000小時或以上。五級的平均電燈壽命少於6,000小時 (紅色) 。



Performance comparison 性能比較：

CFL vs incandescent ~ 75% at least
慳電膽 vs 白熾燈：至少省75%
Grade 1 vs Grade 3 ~14% saving
等級一 vs 等級三 ~ 節省14%

Energy Saving Opportunities 節能方法：

- No heat gained to increase air conditioning loads
不會增加熱能所以不會增加冷卻負荷



1 一級能源效益最高(綠色)，平均電燈壽命8,000小時或以上。五級的平均電燈壽命少於6,000小時(紅色)。

2 電燈發光效率。數值愈大表示該產品的能源效益愈高。

HK WATER EFFICIENCY LABEL SCHEME (WELS) 自願參與用水效益標籤計劃



- The water efficiency grading (1 to 4): different grades shown with different colours and Grade 1 being the most water efficient (i.e. the most water saving)
用水效益級別 (1至4級)：每個級別以不同顏色標示，而第1級的用水效益為最高 (即最節省用水)

- ❖ showers for bathing 沐浴花灑
- ❖ water taps 水龍頭
- ❖ washing machines 洗衣機
- ❖ urinal equipment 小便池用具
- ❖ flow controllers 節流器
- ❖ water closets 水廁

用水效益級別	在用水效益標籤上展示的標誌	混合式*水龍頭 標稱流量 f (公升/分鐘)	非混合式*水龍頭 標稱流量 f (公升/分鐘)
第1級	1滴水點	$f \leq 5.0$	$f \leq 2.0$
第2級	2滴水點	$5.0 < f \leq 7.0$	$2.0 < f \leq 4.0$
第3級	3滴水點	$7.0 < f \leq 9.0$	$4.0 < f \leq 6.0$
第4級	4滴水點	$f > 9.0$	$f > 6.0$

CHINA ENERGY LABEL (CEL) 中國能效標識



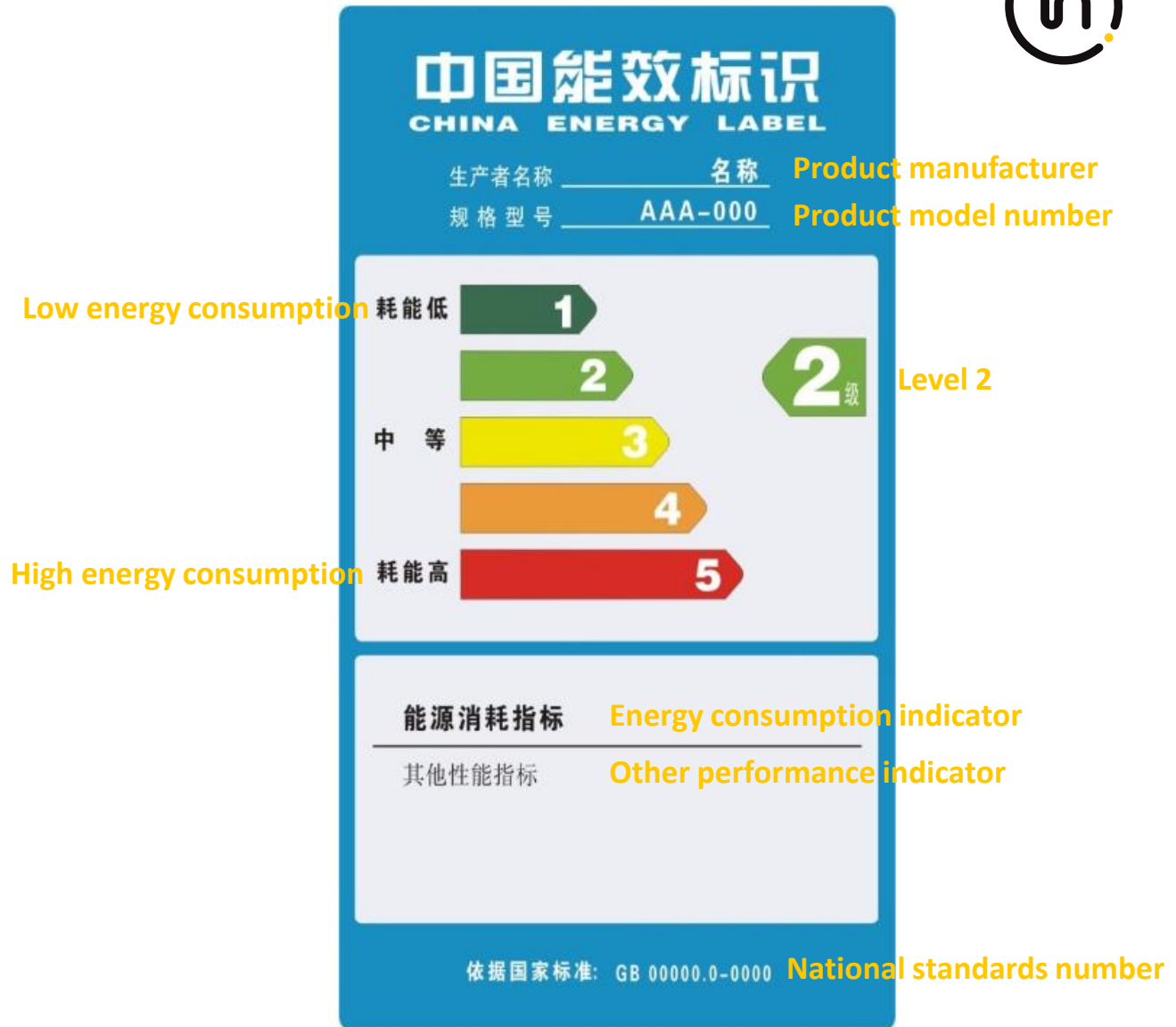
- Level 1 indicates that the product has reached the international advanced level, and the most power-saving;; Level 2 indicates that it is more power-saving; Level 3 means that the product's energy efficiency is on the average level of the Chinese market; level 4 means that the product's energy efficiency is lower than the market average level; level 5 is the market access indicator, products below this level are not allowed to be produced and sold.

能效標識將能效分為1、2、3、4、5共五個等級，等級1表示產品達到國際先進水準，最節電，即耗能最低;等級2表示比較節電;等級3表示產品的能源效率為我國市場的平均水準;等級4表示產品能源效率低於市場平均水準;等級5是市場准入指標，低於該等級要求的產品不允許生產和銷售。

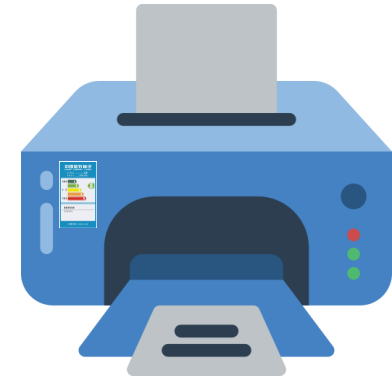
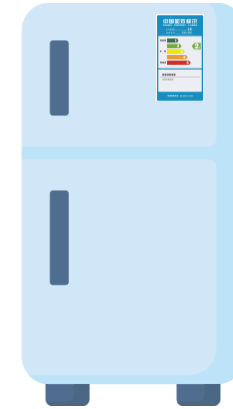
Source:

<https://www.energylabel.com.cn/index.htm>,

<https://baike.baidu.com/item/%E4%B8%AD%E5%9C%8B%E8%83%BD%E6%95%88%E6%A8%99%E8%AD%98/4269142#5>



CHINA ENERGY LABEL (CEL) 中國能效標識



Products that are subject to mandatory energy efficiency in China include 中國能效強制實施的產品有：

Household refrigerators, indoor air conditioners, household electric washing machines, unit air conditioners, self-ballasted fluorescent lamps, high-pressure sodium lamps, chillers, small and medium-sized three-phase asynchronous motors, household gas instant water heaters/gas heating water heaters, speed controllable types Room air conditioners, multi-connected air conditioners, storage-type electric water heaters, household induction cookers, computer monitors, photocopiers, printers and fax machines, electric cookers, AC fans, AC contactors, positive displacement air compressors, power transformers, ventilators, flat-screen TVs, household and similar microwave ovens, digital TV receivers, remote condensing unit refrigerated display cabinets, household solar water heating systems, microcomputers, range hoods, heat pump water heaters (devices), household gas stoves Appliances, commercial gas stoves, water (ground) source heat pump units, lithium bromide absorption chillers, non-directional self-ballasted LED lamps for general lighting, projectors, household and similar AC ventilation fans, self-contained condensing units, commercial freezers

家用電冰箱、室內空調、家用電動洗衣機、單元式空調、自鎮流螢光燈、高壓鈉燈、冷水機組、中小型三相異步電動機、家用燃氣快速熱水器/燃氣採暖熱水爐、轉速可控型房間空氣調節器、多聯式空調、儲水式電熱水器、家用電磁爐、電腦顯示器、影印機、印表機和傳真機、電鍋、交流電風扇、交流接觸器、容積式空氣壓縮機、電力變壓器、通風機、平板電視、家用和類似用途微波爐、數位電視接收器、遠置冷凝機組冷藏陳列櫃、家用太陽能熱水系統、微型電腦、抽油煙機、熱泵熱水機（器）、家用燃氣爐具、商用燃氣爐具、水（地）源熱泵機組、溴化鋰吸收式冷水機組、普通照明用非定向自鎮流LED燈、投影機、家用和類似用途交流換氣扇、自攜冷凝機組商用冷櫃

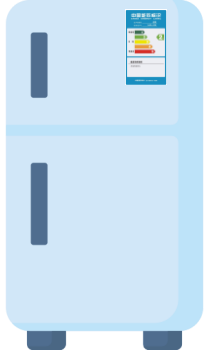
Source:

<https://www.energylabel.com.cn/index.htm>,

<https://cogp.greentrade.org.tw/%E9%A9%97%E8%AD%89%E4%B8%80%E8%A6%BD/6>

CHINA ENERGY LABEL (CEL) 中國能效標識



		268升的家用電冰箱 268L domestic use refrigerator
 <p>能效1級 vs 5級 Grade1 vs Grade5</p>	每天節省 (kWh) Energy saved per day	0.7
	每年節省 (kWh) Energy saved per year	260
	整個使用壽命期節省 (¥) (以電費每度0.5元、使用壽命12年計算) Money saved throughout the whole service life (assuming ¥0.5/kWh, 12 years of service life)	1,560

Source:

<https://www.energylabel.com.cn/index.htm>,

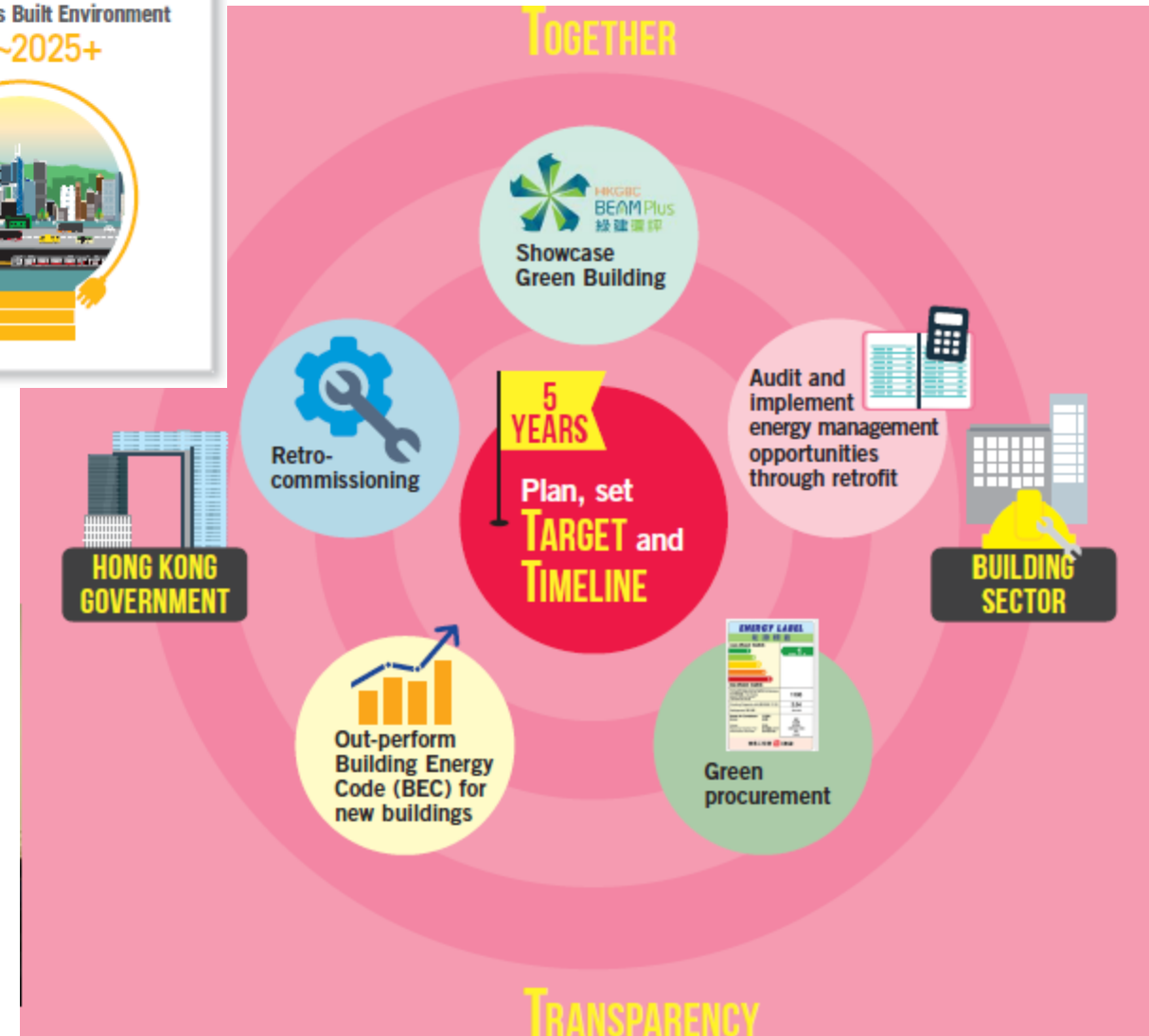
<https://baike.baidu.com/item/%E4%B8%AD%E5%9C%8B%E8%83%BD%E6%95%88%E6%A8%99%E8%AD%98/4269142#5>

ENERGY SAVING PLAN FOR HK'S BUILD ENVIRONMENT 2015-2025+



What are the key actions?

- Compare to base year 2005, **40%** saving target for Energy Intensity by 2025 .
- New Buildings, to promoting rating through the **BEAM Plus** system giving economic incentive to new building (granting more GFA)
- Existing Buildings, to require more frequent **audit**? And adopt **retro-commissioning**?
- Government Building and Schools, to achieve the energy reduction target **5%**

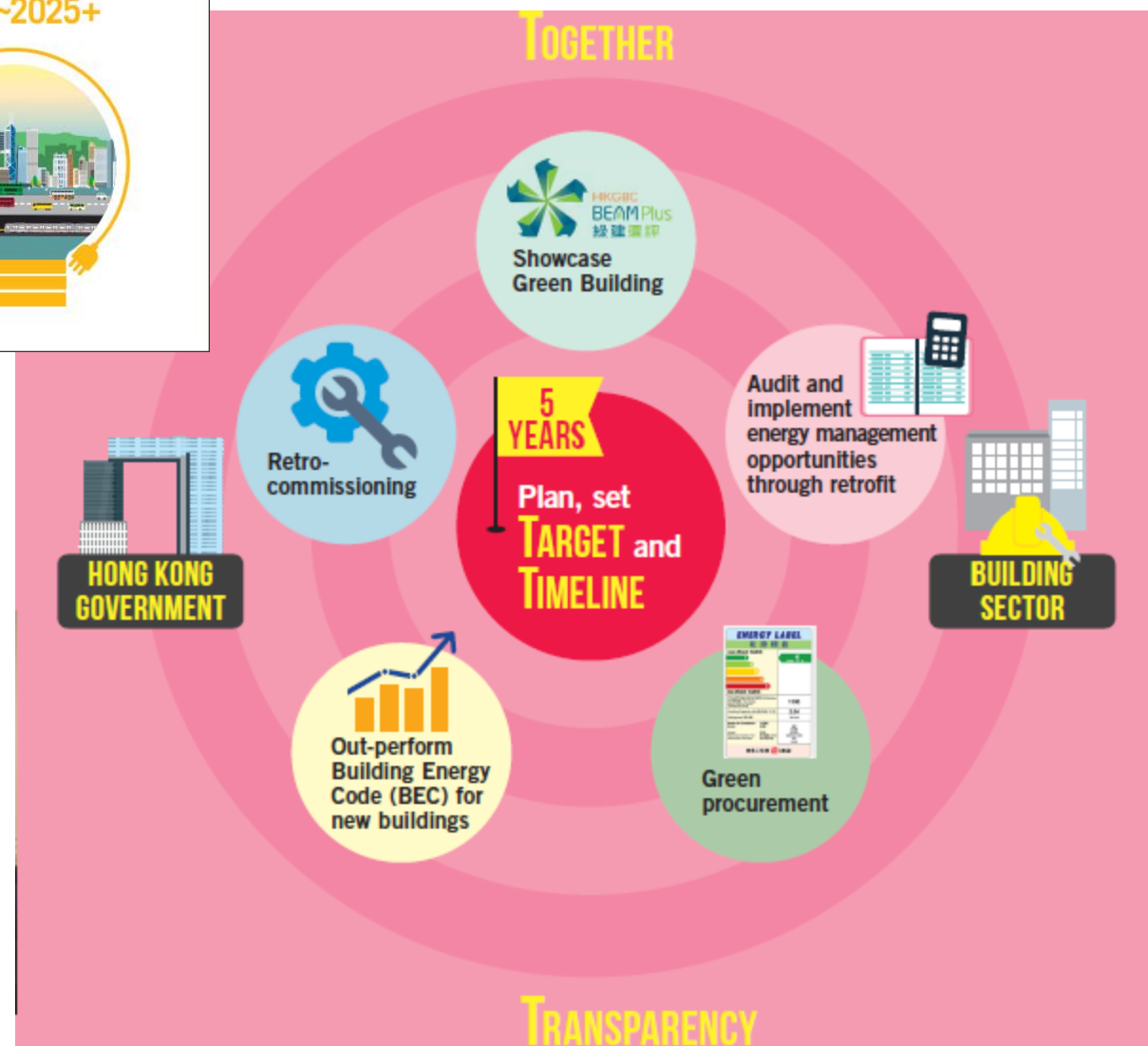


香港都市節能藍圖2015~2025+



有哪些關鍵措施？

- 與 2005 年基準年相比，到 2025 年能源強度節省約 40% 的目標。
- 新建築，透過 BEAM Plus 系統提升評級，為新建築提供經濟誘因（授予更多建築面積）
- 現有建築物需要更頻繁的審計嗎？並採用回溯調試？
- 政府大樓及學校，達成節能 5% 目標



BUILDING ENERGY REQUIREMENT



HK : Building Energy Efficiency Ordinance (Cap. 610) from 2012

About 90% of total electricity consumption in Hong Kong is contributed by buildings. Through enhancement of building energy efficiency, greenhouse gas emissions can be effectively reduced.

In October 1998, the Electrical and Mechanical Services Department has launched the voluntary Hong Kong Energy Efficiency Registration Scheme for Buildings to promote the application of the Building Energy Code. To further promote building energy efficiency, the Government enacted the Buildings Energy Efficiency Ordinance (BEEO) which has come into full operation since **21 September 2012**.



建築能源需求



香港：《建築物能源效益條例》（第 610 章）自
2012 年起

香港總用電量約90%由建築物消耗。透過提高建築能源效率，可以有效減少溫室氣體排放。

機電工程署於1998年10月推出自願性香港建築物能源效益註冊計劃，以推廣《建築物能源效益守則》的應用。為進一步推廣建築物能源效益，政府制定了《建築物能源效益條例》（BEEO），並於2012年9月21日起全面實施。





BUILDING ENERGY REQUIREMENT

HK : Building Energy Efficiency Ordinance (Cap. 610) from 2012

The 3 key requirements of the Ordinance:

- The developers or building owners of newly constructed buildings should ensure that the 4 key types of building services (BS) installation (**air-conditioning installation, lighting installation, electrical installation**) as well as lift and escalator installation, comply with the design standards of **Building Energy Code (BEC) (NEW REVISED 2018)**.
- The responsible persons (i.e. owners, tenants or occupiers etc.) in buildings should ensure that the 4 key types of BS installation therein comply with the design standards of the BEC when “ major retrofitting works” are carried out.
- The owners of commercial buildings (including the commercial portions of composite buildings, e.g. shopping malls under residential storey) should carry out **energy audit** for 4 key types of central BS installation therein in accordance with **Energy Audit Code (EAC) every 10 years**.



建築能源需求



香港：《建築物能源效益條例》（第 610 章）自 2012 年起

該條例的 3 項關鍵要求：

- 新建建築物的開發商或業主應確保4種主要的建築設備安裝（**空調安裝**、**照明安裝**、**電氣安裝**）以及電梯和自動扶梯安裝符合**建築設計標準能源法規 (BEC)**（2018 年新修訂）。
- 建築物內的負責人（即業主、租戶或占用人等）在進行「大型改造工程」時，應確保建築物內的4種主要類型的BS裝置符合BEC的設計標準。
- 商業建築（包括綜合建築的商業部分，例如住宅層下的商場）的業主應根據《**能源審核守則**》（**EAC**）每10年對其中4種主要類型的中央基地台裝置進行**能源審核**。



RETRO-COMMISSIONING (RCX)

Technical Guidelines on Retro-commissioning established on 2017

What is Retro-commissioning?

A cost-effective systematic process to periodically check an existing building's performance

The process identifies operational improvements that can effectively save energy and thus lower energy bill

The process can be performed alone or with a retrofit project

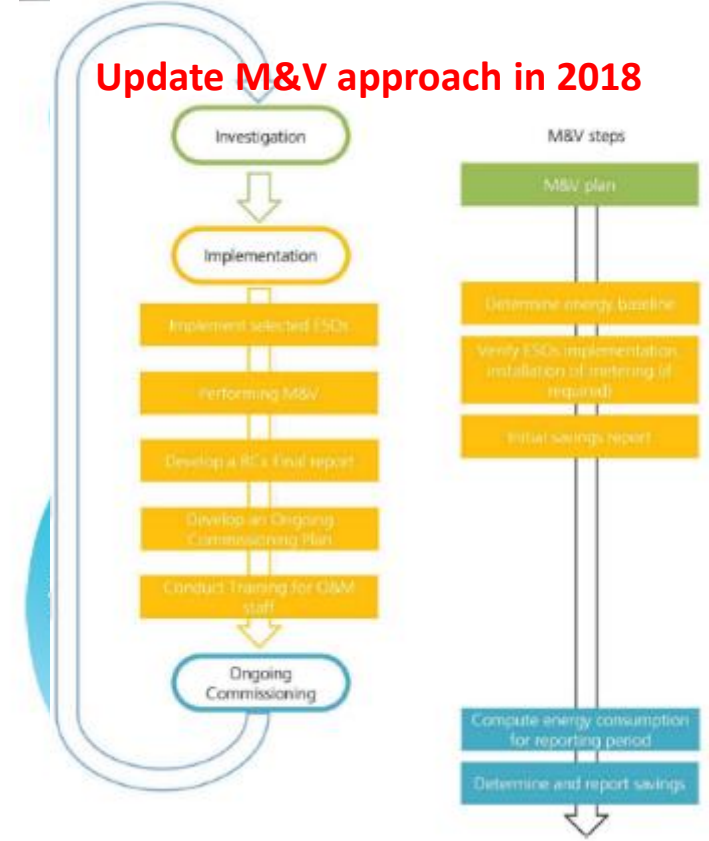
The Benefits

- Improve building performance;
- Improve occupant comfort and productivity
- Improve building system efficiency and extended equipment useful life
- Improve system reliability
- Reduce maintenance cost
- Provide appropriate training to O&M staff
- No or Low cost –short payback

Source: EMSD



Update M&V approach in 2018



重新調試(RCX)

2017年制定恢復調試技術指南

什麼是重新調試？

定期檢查現有建築性能的經濟高效的系統流程

該過程確定了可以有效節省能源並從而降低能源費用的營運改進

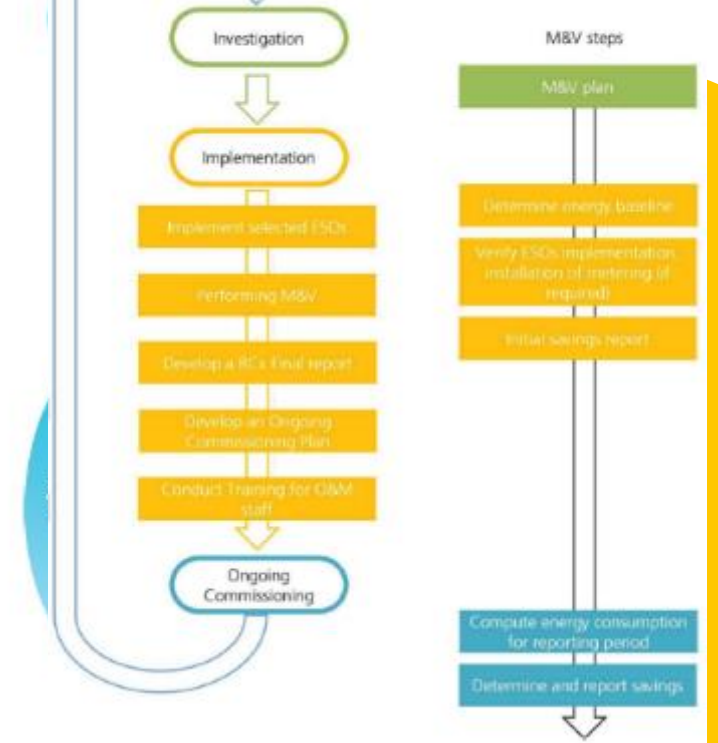
該過程可以單獨執行或與改造項目一起執行

好處

- 提高建築性能；
- 提高居住者的舒適度和生產力
- 提高建築系統效率並延長設備使用壽命
- 提高系統可靠性
- 降低維修成本
- 為維運人員提供適當的培訓
- 無成本或成本低 - 投資回收期短



Update M&V approach in 2018

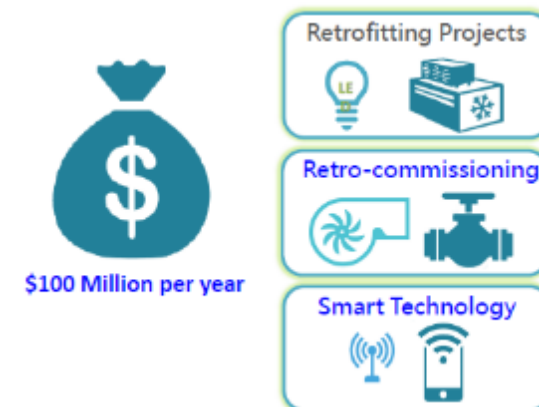


GREEN FUNDS



Eco-Building Fund (EBF) of CLP

- These funds will support retrofitting, retro-commissioning, and implementing smart technologies for communal areas of residential, commercial and industrial buildings
- Fund Size: HK\$100 million/year for EBF
- EBF: Effective 1 October, 2018, target 400 buildings/year, subsidy 40-50% of project cost



Smart Power Building Fund (SPBF) of HK Electric

- Building including residential, commercial, industrial and composite buildings, HK\$25 million per annum, up to 50% of project cost
- Announcement of details: October 2018
- Open for application: 1 November, 2018

Electrical Equipment Upgrade Scheme (EE&C) of CLP

- Supporting fund for new publish or upgrade high energy efficiency facilities
- Will be launch on 2019



Source: CLP & HK Electric website, or LC Paper No. CB(1)840/17-18(01)

綠色基金

中電生態建設基金 (EBF)

這些資金將支持住宅、商業和工業建築公共區域的改造、重新調試和實施智慧技術

- 基金規模：EBF 1億港幣/年
- EBF: Effective 1 October, 2018, target 400 buildings/year, subsidy 40-50% of project cost



港燈智慧電力建設基金(SPBF)

- 建築物包括住宅、商業、工業及綜合用途樓宇，每年2,500萬港元，高達工程成本的50%
- 詳情公佈：2018年10月
- 開放申請：2018年11月1日

中電電力設備升級計畫(EE&C)

- 新建或升級高能源效率設施扶持資金
- 2019年推出





FEED-IN-TARIFF (FIT)

FiT Scheme encourage for adopt RE in HK, allow the **solar photovoltaic** systems and **wind** systems connected to the grid. The FiT rates are defined as below for intended to help achieve a **10-year payback period**:

System Generating Capacity FiT Rate

≤10 kW	HK\$5/kWh
>10 kW to ≤200 kW	HK\$4/kWh
>200 kW to ≤1 MW	HK\$3/kWh

- CLP will begin receiving FiT applications on **4 May 2018**, with its scheme commencing on 1 October 2018.
- HK Electric will begin receiving FiT applications on **1 September 2018**, with its scheme commencing on 1 January 2019.

Application Process

Step 1:



Submit Application and Required Documents

Step 2:



Technical Assessment, System Test and Installation before CLP Smart Meter Installation

Step 3:



Completion and Grid Connection



上網電價補助 (FIT)

FIT計畫鼓勵在香港採用再生能源，讓**太陽能光電系統**和**風能系統**併入電網。FIT 費率定義如下，旨在協助實現 **10年**投資回收期：

系統發電容量上網電價補助率

≤10 kW	HK\$5/kWh
>10 kW to ≤200 kW	HK\$4/kWh
>200 kW to ≤1 MW	HK\$3/kWh

- 中電於 2018 年 5 月 4 日開始收到上網電價補助申請，計畫於 2018 年 10 月 1 日開始實施。
- 港燈將於2018年9月1日開始接受上網電價補助申請，並於2019年1月1日開始實施。

Application Process

Step 1:



Submit Application and Required Documents

Step 2:



Technical Assessment, System Test and Installation before CLP Smart Meter Installation

Step 3:



Completion and Grid Connection

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