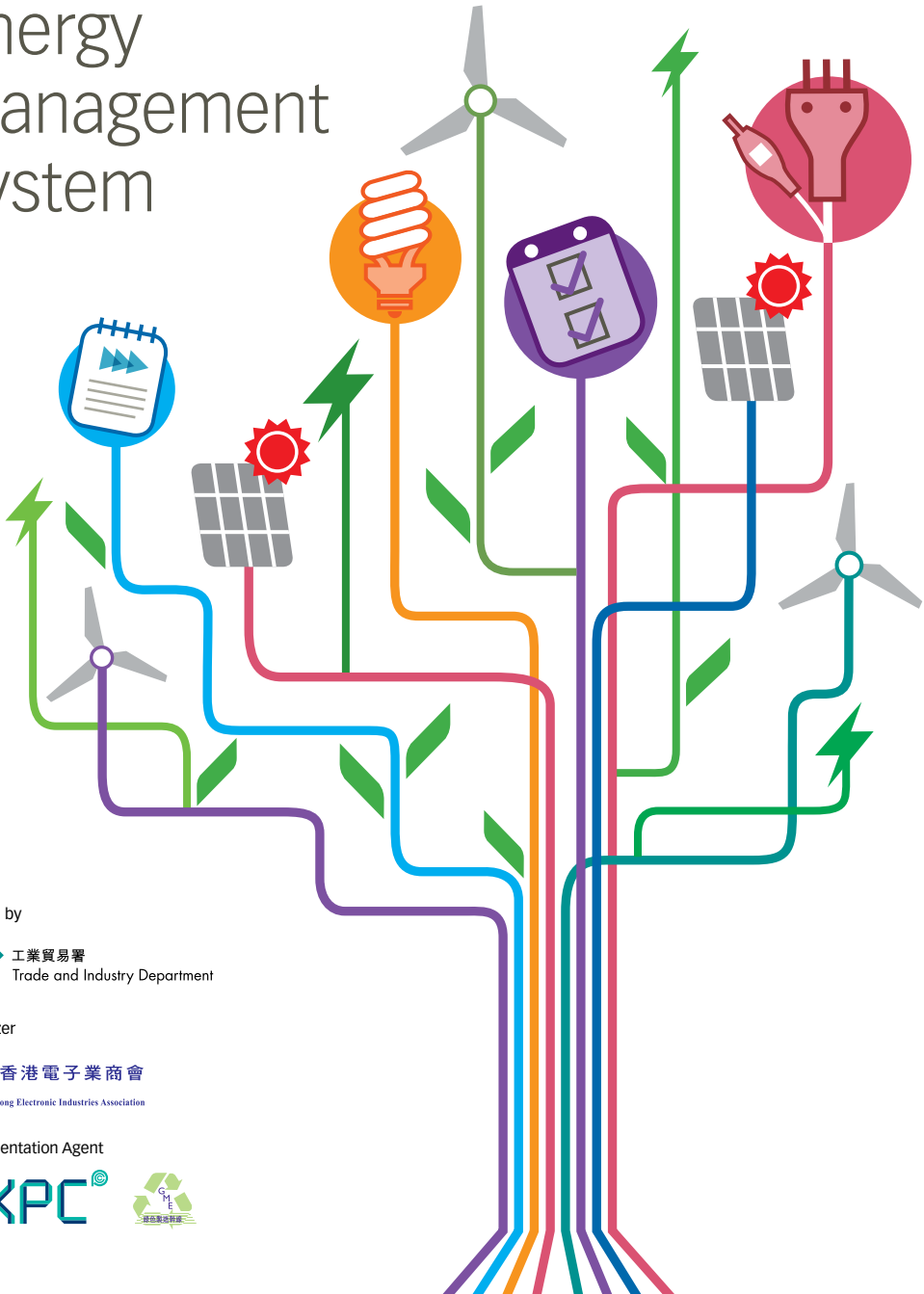
Guidebook for ISO 50001 Energy Management System



Funded by

工業貿易署
Trade and Industry Department

Organizer

香港電子業商會
The Hong Kong Electronic Industries Association

Implementation Agent

HKPC

Disclaimer

Any opinions, findings, conclusions or recommendations expressed in this material / event (or by members of the Project team) do not reflect the views of the Government of the Hong Kong Special Administrative Region, Trade and Industry Department or the Vetting Committee for the SME Development Fund.

This provided material / event is for information purpose only. Whilst every effort has been made to ensure the accuracy of the information supplied herein, the publisher of this material and the associated organizations in this Programme cannot be held responsible for any damage or claim resulting from use of the information.

The Hong Kong Electronic Industries Association (HKEIA)
Unit 1201, 12/F, Harbour Crystal Centre,
100 Granville Road, Tsim Sha Tsui East, Hong Kong
Tel: 2778 8328
Fax: 2788 2200
Email: hkeia@hkeia.org
Website: www.hkeia.org

Published: March 2013

Printed on recycled paper

SME Development Fund Project
"A Support Programme for SMEs to Adopt the ISO 50001 Energy Management System Standard"

About this Guidebook

With funding support by the SME Development Fund of the Trade and Industry Department, HKSAR Government, the Hong Kong Electronic Industries Association (HKEIA), in association with the Hong Kong Productivity Council, has implemented a Support Programme for SMEs to Adopt the ISO 50001 Energy Management System Standard ("this Programme").

This Programme aims to assist Hong Kong SMEs in understanding the requirements and the added-value of the ISO 50001 Energy Management System (EnMS) standard, and learning the essentials for practically implementing an EnMS in their businesses. In view of this objective, a wide range of activities have been carried out, such as seminars, initial gap assessment, training workshops, outreach to local industrial associations and through the website of this Programme. Serving as practical reference for the industries, this Guidebook covers topics such as a summary of the essential requirements of the standard, procedures to identify key energy processes and develop controls, documentation and auditing requirements for adopting an EnMS, as well as industry cases for experience sharing.

Acknowledgements

We would like to thank the following organizations for their support and contribution to this Guidebook (in alphabetical order):

Centre Testing International (Hong Kong) Co., Limited
Cheong Ming Press Factory Ltd.
Chung Tai Printing (China) Co., Ltd.
Clover Display Limited
Golden Cup Printing Co. Ltd.
IBM China/Hong Kong Limited
New Area Toys (Zhuhai) Limited
SGS Hong Kong Ltd.
The Hong Kong General Chamber of Small & Medium Business

Preface

With the depletion of natural resources, our world is facing energy crisis that can threaten our life. Largely due to the combustion of fossil fuels for supply of energy, the concentration of carbon dioxide in the atmosphere has been increasing rapidly in recent years, aggravating global warming and causing extreme weather patterns. As one of the energy consumers, the industries shall join forces to reduce energy consumption in order to preserve the environment.

While implementing individual energy saving measures, companies are encouraged to manage their energy related matters in a systematic approach to ensure continual improvement on their energy performance. The release of ISO 50001 has marked the worldwide introduction of Energy Management System (EnMS) requirements that companies with sound energy management could be recognized through third-party certification. As one of the major ISO management system standards, ISO 50001 has attracted a lot of attention among the industries and its principles may even likely become part of supply chain requirement in future.

In view of this challenge, the Hong Kong Electronic Industries Association (HKEIA) has taken the initiative on a forward-thinking industry support programme to assist local small and medium enterprises (SMEs) in establishing EnMS and preparing for the demand of global buyers. Due to the applicability and compatibility of energy management among different industries, the scope of this Programme is very comprehensive, including sectors of electronics, electrical products and equipment, textiles, apparel and accessories, watches and clocks, paper products and printing, plastics and rubber products, metal products, jewellery, toys and other manufacturing industries.

Throughout this Programme, I am glad to see that many local companies have taken a jump-start from showing interest to learn more at the beginning, to participating in pilot assessment during this Programme, and finally planning for acquiring certification for their business. As pioneers in Asia on adopting ISO 9001 quality management system and ISO 14001 environmental management system a number of years ago, I believe Hong Kong industries can grasp this new opportunity with the assistance of this Programme and this Guidebook to improve energy performance, reduce operation costs, gain additional market competitiveness, and most important of all protect our earth.

Ir Dr the Hon LO Wai Kwok, BBS, MH, JP
Legislative Council
Member
Functional Constituency - Engineering

Message from the Chairman

Energy management is now in the global spotlight, due to the pressing need to save energy and reduce greenhouse gas emissions worldwide. Energy-saving technologies and facilities are only part of the methodologies for improving energy efficiency. A more sensible and systematic approach to improve an enterprise's energy performance sustainably is to establish and implement a standardized, process-based energy management structure. Published on 15 June 2011, the ISO 50001 Energy Management System (EnMS) standard is a globally accepted framework for managing energy, providing technical and management strategies for enterprises to increase energy efficiency, reduce costs, and improve environmental performance. ISO 50001 can be used for certification and will affect up to 60% of the world's energy use.

Funded by the Trade and Industry Department's SME Development Fund, the Hong Kong Electronic Industries Association (HKEIA) has launched a support programme to assist SMEs in adopting the ISO 50001 EnMS standard. This Programme aims to help SMEs:

- understand the added-value of an EnMS;
- acquire a thorough understanding of the ISO 50001 EnMS standard; and
- learn the principles and essentials of implementing an ISO 50001 EnMS.

The aim of this Guidebook is to demonstrate how to achieve the ISO 50001 standard, including a summary of the essential requirements of the standard, procedures and skills to identify key processes and to develop controls, documentation and auditing requirements for the management of an EnMS, as well as industry case studies for experience-sharing. Apart from printed copy, this Guidebook will also be put on our website for widespread sharing.

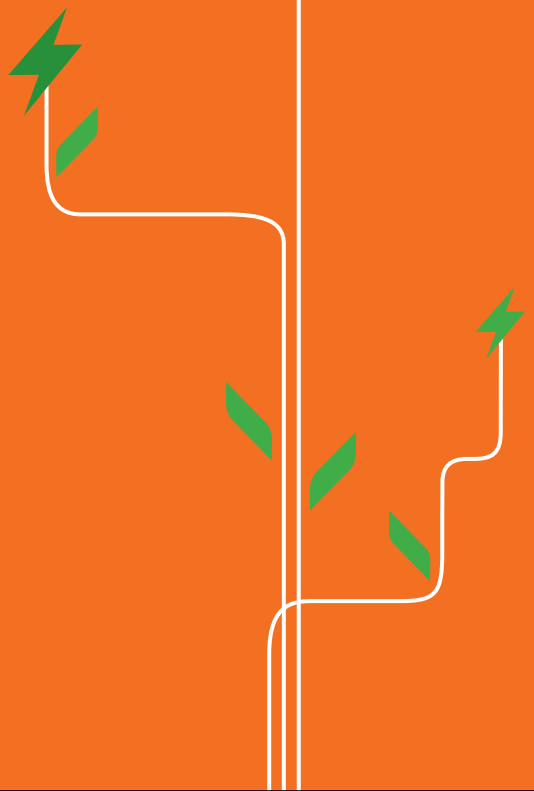
I hope it would be a good reference for the industries to set up and implement an EnMS for better energy management, and our industries could be able to achieve success in various markets in the world.

Mr. Johnny YEUNG
The Hong Kong Electronic Industries Association (HKEIA)
Chairman

1

Introduction

Developed by the International Organization of Standardization (ISO) Project Committee of Energy Management (ISO/PC 242), ISO 50001 Energy Management Systems (EnMS) – Requirements with Guidance for Use was published in June 2011. ISO 50001 standard has been developed based on the common elements that can be found in all of the ISO management system standards such as ISO 9001 quality management system and ISO 14001 environmental management system.



1.1 Demand for Energy Management

Over the recent years, the environment has become a more and more significant concern to the sustainability of global business community, and poses serious challenges to individual organizations, affecting their development in the long run. Out of many factors, the main reasons for the energy issue to draw a serious attention from businesses may come from global government initiatives to mitigate climate change and increasing expenses for obtaining natural resources to support daily operation.

Combating Climate Change

Climate change has caused extreme weather patterns and a rising sea level. The concentration of greenhouse gases (GHG) such as carbon dioxide, methane and nitrous oxide emitted by human activities keeps increasing, which leads to greenhouse effect and global warming. The primary anthropogenic source of carbon emissions is from direct burning of fossil fuels such as coal, oil and gas. Despite the recent development on renewable sources of energy (e.g. solar energy, biofuels, etc.), fossil fuels still play the major role in global energy mix as the primary source for generating electricity.

Since the announcement of Copenhagen Accord and Kyoto Protocol, the international community has been aware of the urgency of reducing GHG in order to limit the increase of global mean temperature below 2°C based on pre-industrial level. To this end, many countries have released new energy saving measures. For example, United States has released new fuel-economy standards, the European Union has established a target to cut down energy demand in 2020 by 20%, China has targeted a 16% reduction in energy intensity by 2015, and Japan has committed to cutting down its electricity consumption by 10% by 2030. Hong Kong, alongside 20 other Asia-Pacific Economic Co-operation economies, has set a target to achieve a reduction in energy intensity of at least 25% by 2030 (using 2005 as the base).

Driven by these national or regional energy targets and supporting policies, some jurisdictions have developed own energy management standards to assist the industries in creating their own strategy and roadmap. For example, there are energy management systems standard EN 16001 in Europe, ANSI/MSE 2000 in US, B0071 in Korea, VD14602 in Germany, DS 2403:2001 in Denmark, SS627750:2003 in Sweden, AS3595:1990 in Australia, PLUS 1140:1995 in Canada, and GB/T-23331 in China. The publication of ISO 50001 helps to synchronize the efforts by many different countries and regions, and to provide businesses with a standard approach to improve their energy management.

Sustaining Business

Energy costs have gone through a considerable increase over the past few years. Due to the increasing prices of oil and other natural resources, the global fossil-fuel subsidiaries in 2011 have reached US $523 billion, close to a 30% increase than previous year. Since modern business operation relies heavily on energy (e.g. electricity, fuel) to carry on, the direct impact of energy price fluctuation to overhead of organizations is not insignificant.

However, these burdens do not fall evenly on all industries or organizations. When there are economic uncertainties, there are also potential business opportunities. Companies that are able to forge their strategic position properly can gain additional competitiveness against their counterparts. In view of the connection between energy efficiency and business competitiveness, many buyers start to set their own targets related to energy performance, encouraging their supply chain to pay more attention to energy management. For example, the large international retailer TESCO aims to reduce its supply chain carbon emissions by 30% by 2020 and reach zero emissions by 2050; while another retailer giant Wal-Mart announced in 2010 to cut down 20 million tonnes of GHG by 2015 and to reduce energy use at stores by 30% by 2017.

Corporate Responsibility

The increasing public awareness on environmental issues is another driving force for businesses to reconsider their energy policy. People are paying more attention on the energy performance of organizations. As part of corporate responsibility, besides making profits, organizations should also practice their due diligence to sustainable development of the environment and community, including addressing the public concerns on climate change and resource depletion.

1.2 Benefits of Adopting Energy Management System

By offering a systematic methodology for any sizes of organization, including small and medium enterprises (SMEs), to establish own energy management system, ISO 50001 can provide organizations with a number of business benefits. These include:

- Helping to achieve energy use reduction and carbon emissions in a systematic way;
- Creating a clear picture of current energy use status, based on which new goals and targets can be set;
- Evaluating and prioritizing the implementation of new energy-efficient technologies and measures;
- Providing a framework to promote energy efficiency throughout supply chain;
- Providing guidance on how to benchmark, measure, document and report corporate energy use;
- Making better use of energy consuming assets, thus identifying potentials to reduce maintenance costs or expand capacity;
- Demonstrating to the stakeholders that corporate commitment to comply with their best practice to protect the environment; and
- Fulfilling the associated regulatory requirements and responding with confidence to green trade barriers in global market.

1.3 ISO 50001 vs Other Management System Standards

As a new member of international standards family, ISO 50001 has been developed based on the common elements shared by other major ISO management system standards, ensuring a high level of compatibility with them. It is notably aligned with ISO 9001 quality management system and ISO 14001 environmental management system standards. The comparison table below provides a quick overview on the comparison between the main clauses of ISO 50001, ISO 9001 and ISO 14001.

Table 1.1 Comparisons of ISO 50001 vs ISO 14001 and ISO 9001 Management Systems

Content	ISO 50001	ISO 14001	ISO 9001
Core concept for establishing guidelines	Based on energy consumption of the whole organization or particular production process	Based on relevant environmental aspects	Based on clients' quality requirements
Policy	Energy policy illustrates the strategy of the organization on energy management. The policy provides the frame for setting up associated objectives and targets to enhance energy performance.	Environmental policy illustrates how the organization handles environmental matters, commitment to environmental protection, as well as associated objectives and targets. Normally the policy will include the organizations' commitment to preventing pollution, regulatory compliance and continuous improvement.	Meet the clients' requirements
Strategy	Conducting energy reviews to identify significant energy use activities and set up energy baseline, as well as energy performance indicators Compliance to relevant regulatory requirements and setting up energy objectives, targets, and implementation plans	Compliance to relevant environmental regulatory requirements Setting up environmental objectives, targets and implementation plans	Setting up quality objectives, targets, and quality management plans
Baseline	Energy baseline is foundational to establish the system.	No such requirement	No such requirement

This publication, as a result, has been produced as a useful handbook to guide SMEs through understanding the background and development of ISO 50001 (Chapter 1), creating a practical preparation and implementation plan for establishing an energy management system (Chapter 2), referring to some best practices that can help companies to enhance their energy performance (Chapter 3), perceiving detailed certification process and auditing requirements (Chapter 4), as well as learning from peers' experience through a number of case studies (Chapter 5).

2

Overview of ISO 50001 Standard

According to the definition stipulated in ISO 50001 standard, energy can be in various forms, such as electricity, fuels, steam, heat, compressed air and renewable, which can be purchased, stored, treated, used in equipment or in a process, or recovered. The main purpose of adopting an Energy Management System (EnMS) is to enable an organization to improve its energy performance, which generally includes energy use, energy efficiency and energy consumption, in a systematic approach.

Similar to other management system standards published by the International Organization for Standardization (ISO), ISO 50001 is based on the PLAN-DO-CHECK-ACT approach to achieve continual improvement in energy performance. The relationship between its main elements is illustrated below.

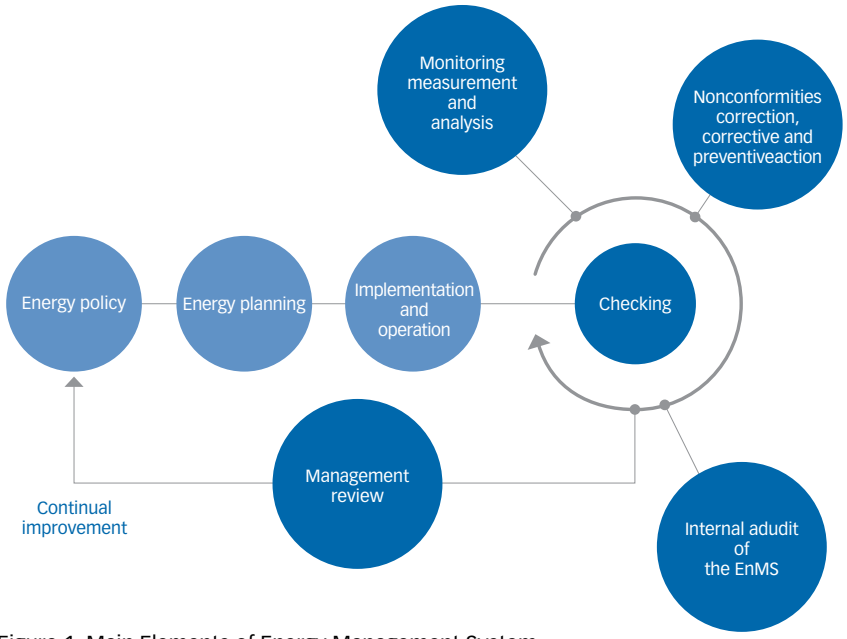


Figure 1. Main Elements of Energy Management System

This Chapter explains the core requirements of ISO 50001 standard in order to help the user understand and apply these requirements in a systematic manner. A self-assessment checklist is provided in Annex A to enable companies determining their gap and readiness against the ISO 50001 standard.

2.1 General Requirements

ISO 50001 Standard says……
It requires the organization to establish, document, implement and improve its EnMS according to ISO 50001 standard. The organization should define and document the scope and boundaries of its EnMS as well as how to achieve continual improvement of its energy performance and EnMS. (Item 4.1)

The purpose of ISO 50001 standard is to enable organizations to establish systems and processes necessary to improve energy performance. The standard applies to all factors affecting energy use that can be monitored and influenced by an organization. ISO 50001 standard does not specify energy performance criteria. It provides a general-purpose system that allows organizations to choose performance standards that they deem best meet their requirements.

Prior to developing the EnMS, the organization should define the scope and boundaries of its management system. The scope refers to the extent of activities, facilities and decisions that the organization addresses through an EnMS, which can include several boundaries. The boundaries are defined as physical or site limits and / or organizational limits as defined by the organization that could be a process, a group of processes, a site, an entire organization and multiple sites under the control of an organization.

The focus of an ISO 50001 EnMS is on improving management processes, practices, and procedures that control an organization's functions and activities with significant energy use. The overarching intent is that by implementing a management process and continually improving this management system, it will eventually lead to an improved energy performance.

2.2 Management Responsibility

2.2.1 Management Support and Commitment

ISO 50001 Standard says……
It requires the top management to demonstrate its commitment to support and continually improve the effectiveness of the EnMS. (Item 4.2.1)

In addition to providing general support, top management should provide the necessary resources such as time, personnel, financial, materials, etc. for the effective implementation of the EnMS. Top management commitment is crucial to the successful implementation of the EnMS. It must be communicated and made visible to the entire organization to encourage active participation of all staff members in adhering to the EnMS.

Key factors for successful implementation of an EnMS include:

- Top management support;
- Sufficient resources; and
- Management commitment.

To ensure effective operation of the EnMS, top management is required to appoint a management representative and approve the formation of an energy management team. The management representative (MR) is responsible for managing all aspects of the EnMS as it evolves. MR should have sufficient authority, competency and resources to ensure the overall effectiveness of the EnMS. The energy management team is responsible for ensuring the implementation of actions / measures of the energy management decisions. The composition and size of the energy management team should be determined with due consideration of the size and complexity of the organization.

2.2.2 Management Representative

ISO 50001 Standard says……
It requires the top management to appoint a management representative(s) to promote awareness and oversee the implementation of the EnMS. (Item 4.2.2)

ISO 50001 standard requires an organization to appoint a management representative to oversee the development and operation of the EnMS. He / she is the key person to help the organization achieve its energy objectives and targets and for improving energy performance. The management representative should be competent to perform the required duties and be capable of exerting influence throughout the organization to implement and improve the EnMS.

The selection of this person should be carefully considered in order to fulfill the following responsibilities:

- Selecting, training and leading the energy management team;
- Coordinating energy management team activities;
- Identifying and communicating resources needed for energy management activities;
- Working with senior management for planning of resources;
- Arranging to deliver energy management awareness training in the organization and for contractors;
- Being involved in drafting the policy and other EnMS documents;
- Providing information for and participating in energy management strategic planning;
- Ensuring appropriate monitoring, data collection and verification activities;
- Ensuring instrument calibration;
- Overseeing internal audit programme;
- Identifying training needs of staff members related to the EnMS; and
- Managing the corrective / preventive action system.

2.3 Energy Policy

ISO 50001 Standard says……
It requires the organization to define an energy policy to state its commitment for achieving energy performance improvement. (Item 4.3)

The energy policy is a cornerstone for implementing and improving an organization's EnMS and energy performance within its scope and boundaries. The policy provides a statement of the high-level overview of management's intent that members of the organization should apply to their work activities. The policy also provides a framework for an organization to set energy objectives and targets and associated energy management action plans to further improve its energy performance. ISO 50001 requires an organization to at least state the following commitments in the energy policy:

- Continual improvement in energy performance;
- Availability of information and of necessary resources to achieve objectives and targets; and
- Compliance with relevant legislation and other requirements related to energy use, consumption and efficiency.

In addition to these commitments, the policy will include the support for purchasing energy efficient products and services, as well as designing for enhanced energy performance. The policy should be defined and approved by the top management to show its commitment to meet the organization's goals. In terms of management, the policy must be communicated to all staff and be reviewed and updated in a systematic manner. Unlike other common standards, the organization can decide whether or not to make the policy available externally.

Example of an Energy Policy

We shall comply with all applicable legal and other requirements related to energy management.
We shall improve energy efficiency as a continuous improvement process.
We shall assure the availability of information and resources to meet our objectives and targets.
We shall incorporate energy efficiency as a key component for new equipment, major renovation, and new design.
We shall promote energy saving awareness to our staff.

Executive Director : _____ Date: _____

2.4 Energy Planning

2.4.1 Legal and Other Requirements

ISO 50001 Standard says……
It requires the organization to identify and have access to the applicable legal and other requirements in relation to its energy uses, consumption and efficiency to which it subscribes. (Item 4.4.2)

The element of legal and other requirements in ISO 50001 is intended to ensure that the organization complies with applicable legislation and other requirements related to energy use, consumption and efficiency to which it subscribes. Legal requirements include those international, national, regional and local governmental statutory requirements which are applicable to the energy use of the organization. Other requirements refer to customers' requirements, industry code of practices, government guidelines, voluntary programs, public commitments of the organization or its parent organization, and requirements of trade associations and others.

It is suggested that the following issues are addressed when conducting energy planning with regard to legal and other requirements:

- How to identify the applicable legal and other requirements;
- How to ensure the organization are compliant with applicable requirements;
- How to ensure the key staff members have the necessary knowledge to access legal and other requirements;
- How to communicate relevant information on legal and other requirements to other staff; and
- How to ensure the information on legal and other requirements is up to date.

Identification of legal and other requirements applicable to energy use, consumption and efficiency is usually demonstrated through the establishment of a register of applicable legal and other requirements. Once identified, the organization needs to ensure that it has implemented necessary actions to comply with these requirements. Moreover, the organization should stay abreast of new or revision of legal and other requirements related to energy uses. It involves first a review of such changes for their applicability; and second, if determined to be applicable, an evaluation of what those specific changes mean for the organization's facilities, processes, systems and / or equipment. Once the evaluation is completed and the impacts of the changes are understood, the organization should implement actions to ensure compliance with those new or changed requirements. This may include additional or modified training, operational controls, reporting, etc. depending on the nature of the new or changed requirements.

Examples of Energy Related Legislation and Other Requirements in Hong Kong:

- Buildings Energy Efficiency Ordinance (Cap 610)
- Energy Efficiency (Labelling of Products) Ordinance (Cap 598)
- Building (Energy Efficiency) Regulation (Cap 123M)
- Code of Practice for Water-cooled Air Conditioning Systems
- Code of Practice on Energy Labelling of Products
- Code of Practice for Overall Thermal Transfer Value in Buildings
- Guidelines on Performance based Building Energy Codes
- Guidance Notes on Code of Practice for Water-cooled Air Conditioning Systems
- Code of Practice for Energy Efficiency of Building Services Installation
- Code of Practice for Building Energy Audit

Examples of Energy Related Legislation and Other Requirements in Mainland China (available in Chinese only):

- 中國能源法
- 中華人民共和國可再生能源法
- 可再生能源發展專項資金管理暫行辦法
- 中華人民共和國節約能源法
- 中華人民共和國循環經濟促進法
- 中華人民共和國清潔生產促進法
- 清潔生產審核暫行辦法
- 淘汰落後生產能力、工藝和產品的目錄
- 能源效率標識管理辦法
- 清潔發展機制項目運行管理辦法
- 廣東省節約能源條例
- 廣東省清潔生產審核及驗收辦法
- 廣東省能源利用監測管理辦法
- 中華人民共和國煤炭法
- 中華人民共和國石油天然氣管道保護法
- 國家節能中心節能評審評價指標
- 國務院發佈《節能減排“十二五”規劃》

2.4.2 Energy Review, Baseline and Performance Indicators

ISO 50001 Standard says……

It requires the organization to develop, record and maintain an energy review as well as document the methodology and criteria used to develop the review. (Item 4.4.3)

It requires the organization to establish an energy baseline(s) for the measurement of the energy performance. (Item 4.4.4)

It requires the organization to identify appropriate energy performance indicators to monitor and measure its energy performance. (Item 4.4.5)

The organization must record and maintain an energy review with certain documented methodology and criteria. An energy review is a process to determine an organization's energy performance based on data and/or actual measurement, leading to identification of opportunities for improvement. The review provides useful information for the development of the energy baseline and the selection of energy performance indicators (EnPIs). It also establishes the monitoring capability to support effective continuous improvement of the EnMS in the future.

To conduct the review, the organization shall establish an equipment list and identify different energy use and obtain energy consumption details for a specified period, normally a full year on a monthly basis.

The following essential information should be available for the energy review:

- Name of equipment;
- Unique ID of major equipment (minor equipment such as fluorescence tubes, desktop PC could be grouped together);
- Equipment location;
- Rated power;
- Type of energy; and
- Measured energy consumption during a particular period (e.g. monthly record).

When conducting the energy review, the following items should be noted:

1. Major equipment with significant energy consumption should be itemized, i.e. energy consumption record should be provided for each equipment;
2. Installation of sub-meter to monitor and record the energy consumption (such as electricity, diesel, gas and steam) of each major equipment;
3. When measurement of actual consumption is not available, estimation of energy consumption by power rating and operating hours may be adopted. However, assumptions and justifications for energy consumption estimation shall be clearly stated;
4. The energy review should be updated when necessary to add new equipment and expel obsolete items; and
5. Replacement of estimation by actual data through measurement as far as possible to enhance the accuracy of the energy profile.

Creating an Energy Profile

Energy profile is a useful tool to allow management to have a closer look at the detailed energy consumption status of the organization. An example of an energy profile presented in a pie chart format is shown in Figure 2.

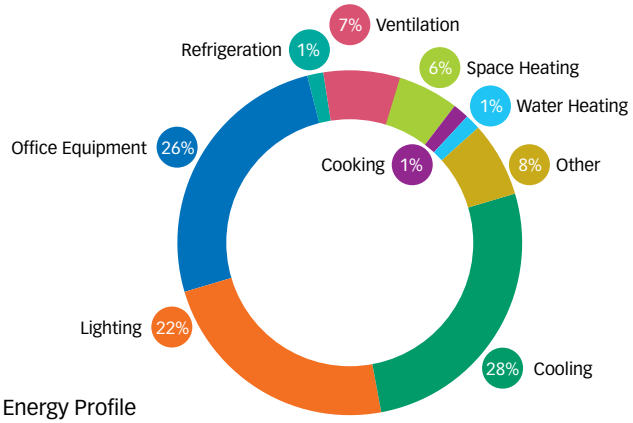


Figure 2 : Sample of an Energy Profile

To prepare an energy profile, comprehensive energy consumption data in relation to an organization's business operation must be collected. The organization should consider to record and maintain all the energy consumption data by using the collection sheet as shown in Table 1.

Table 1. Example of Energy Data Collection Sheet

Type of Equipment	Brand Name and Model No.	Unique ID and / or Serial No.	Equipment Location	Type of Energy	Power Rating (kW)	Energy Consumption in 2013 (kJ)			
						Jan	Feb	Mar	Apr
Chiller A									
Chiller B									
Chiller C									
Boiler 1									
Boiler 2									
Lighting at Workshop A									
Lighting at Workshop B									
PAU 1									
PAU 2									
Oven dryer									
20HP air compressor									

Determination of Energy Consumption

Energy consumption can be collected by reviewing energy bills, installing sub-meters and estimating from available technical data.

a. Analysis of energy bills
An organization may consume different types of energy in its daily operation including electricity, diesel, gasoline, liquefied petroleum gas (LPG), natural gas, coal and steam. All the relevant energy consumption bills should be properly maintained as they are a good source of information to determine the overall energy consumption as well as the consumption of specific equipment for the preparation of an energy profile. For example, an electricity bill provides the enery consumption information of an equipment; an oil filling bill tells you the gasoline or diesel consumption of a particular vehicle; a diesel tank filling record / bill provides the fuel consumption of a diesel boiler / emergency generator.

b. Energy measurement by sub-meters
It is necessary to obtain energy consumption data of different types of equipment in order to prepare the energy profile and monitor energy consumption continuously. To measure energy consumption of different equipment, it is suggested to install sub-meters for individual equipment, such as, electricity meters, diesel meters, LPG meters, steam meters, etc for diesel / coal boilers, fossil fueled ovens, burners, diesel generators, production machines and cooking stoves in a canteen kitchen. Reading of sub-meters should be recorded at least once a month. To ensure the accuracy of data, regular maintenance, checking and calibration of the sub-meters shall be arranged at the frequency recommended by the manufacturers or at least once a year. Human error in recording meter reading should also be avoided.

c. Energy estimation
When actual measurement of data is not available, estimation of monthly energy consumption by power rating and operating hours may be adopted for the preparation of energy profile. However, assumptions and justifications for the estimation of energy consumption shall be stated clearly. Nevertheless, energy estimation should be replaced by actual measurement as far as possible to enhance the accuracy of the profile.

After establishing the energy profile, the organization should identify appropriate Energy Performance Indicators (EnPIs) to monitor and measure its energy performance. EnPIs are useful tools to enable management to assess actual energy performance against expected outcomes. An EnPI can be a simple parameter, a simple ratio or a complex model. Typically, it measures energy use and its efficiency per unit of performance.

EnPIs could be

- energy consumption per time
- energy consumption per unit of floor area
- energy consumption per unit of production
- energy consumption per unit of material consumed
- energy consumption per unit of material transported

The organization can select and determine suitable EnPIs according to the operation to better reflect and measure its energy performance. The EnPIs should be updated when business activities or baselines change that affect their relevance. The methodology to determine and update the EnPIs should be recorded and reviewed regularly.

2.4.3 Energy Objectives, Targets and Action Plans

ISO 50001 Standard says.....
It requires the organization to establish, implement and maintain documented energy objectives, targets and action plans specified outcome or achievement defined to meet its energy policy related to improved energy performance. (Item 4.4.6)

Documented energy objectives and targets should be established to ensure compliance with the organization's energy policy, and to facilitate continual improvement in energy performance. Objectives should state what the organization wants to achieve; while targets should specify how the organization would achieve those objectives. The objectives and targets should be practical, achievable and measurable, and must conform to the organization's business objectives and preferably provide some challenge to the organization. For example:

Policy	We shall improve energy efficiency as a continuous improvement process
Objective	Reduce overall electricity consumption by 10%
Target	Reduce electricity consumption in production area by 15% and warehouse by 5% by December 2013

Action plans should be developed to address all of the organization's energy objectives and targets detailing how and when they are to be achieved, which will subsequently facilitate monitoring the progress in achieving the energy objectives and targets. The action plans should include schedules, resources and responsibilities for achieving the objectives and targets. However, they should be flexible and be able to be revised to reflect any changes in the objectives and targets.

2.5 Implementation and Operation

2.5.1 Competence, Training and Awareness

ISO 50001 Standard says.....
It requires the organization to ensure all staff and persons related to significant energy uses are competent. (Item 4.5.2)

Competence refers to persons who possess the required skills, knowledge, qualifications, and capacity to perform their duties that can significantly affect energy use or the implementation of the EnMS. It is normally assessed based on a combination of education, training, skills and experience of the relevant person. A competent workforce is essential in successfully implementing the organization's EnMS and achieving improved energy performance. The knowledge and skills that are necessary to implement the EnMS, ensure control of the significant energy uses and achieve the energy objectives and targets must be addressed.

Basically, appropriate training should be provided to all relevant personnel. This training should include general concept of energy management as well as skills training (usually on-the-job) to allow personnel to carry out their tasks with an awareness of the impact their activities can have on the energy performance. The level and degree of training will inevitably vary according to job function. For instance, general energy awareness training should be provided for all employees; and energy audit training should be provided for those who are responsible for the establishment of energy profile.

Table 2. Examples of EnMS Training Courses

Type of Training	Targets
EnMS Awareness	• All Employees
EnMS Implementation Training	• Middle Management • Management Representative • Energy Management Team
EnMS Auditor Training	• EnMS Internal Audit Team

In the event of any contractors working within the boundary of the organization, they should be required to provide details of their competence to carry out the work in an energy efficient manner and/or be provided with procedural guidance.

Examples of Competence and Training Records:

- Documented personnel job descriptions that include energy-related competencies;
- Personnel records describing the staff's competencies;
- Records of staff's training and education; and
- Records assessing the staff's competencies based on those required for their job description.

2.5.2 Communication

ISO 50001 Standard says……

It requires the organization to address internal communication in relation to its energy performance and EnMS. The organization should also decide whether to communicate externally about its energy policy, EnMS and energy performance. (Item 4.5.3)

For internal communication, the organization should clearly demonstrate communication links in both vertical and horizontal directions within the organization. An internal communication procedure could include how staff members are made aware of energy issues, how decisions are made or information is disseminated to staff etc. This should also make provision for the communication of suggestions / complains etc. relevant to energy management and how these are dealt with. The communication procedure should also cover the process in responding to comments and suggestions by contractors working for or on behalf of the organization. Methods for communication include, for example:

- meetings;
- videos;
- briefings;
- e-mails, posters, memos, circulars; and
- suggestion boxes, employee hotlines.

Externally, the organization should maintain a documented decision on whether it will communicate its energy policy, EnMS and energy performance. For those who choose to communicate this information externally, they should consider the following aspects:

- type and level of information to be communicated;
- targets of communication;
- mechanisms and responsible parties to handle and respond to enquiries;
- official response time; and
- recording system and format of communication and the associated correspondance.

2.5.3 Documentation

ISO 50001 Standard says……

It requires the organization to establish, implement and maintain information to describe the core elements of the EnMS and their interaction. (Item 4.5.4.1)

It requires to control all the EnMS documents. (Item 4.5.4.2)

Documentation within a management system will assist in both EnMS implementation and promoting understanding of system implementation. Documentation helps the organization communicate its intent and ensure that energy-related activities are performed consistently and according to the requirements. It provides information and supporting evidence to demonstrate the effectiveness and efficiency of the EnMS and could be in the form of electronic files or paper copies.

According to the ISO 50001 Standard, organizations are required to document information that describes the core elements of their EnMS. In short, the following should be documented in an EnMS:

- scope and boundaries of the system;
- energy policy;
- energy planning process including methodology and criteria used to develop the energy review, energy baselines and methodology for determining and updating the EnPIs;
- energy objectives, targets and action plans; and
- decision whether to communicate externally about information of energy performance.

In addition to the above specific documentation requirements referred to in the ISO 50001 Standard, the organization may consider developing other documents that are deemed necessary to support the implementation of the EnMS, as documentation is the most easiest and effective method of achieving this. Nevertheless, it should be borne in mind that the primary focus of the organization should be on effective implementation of the EnMS instead of creating a complex documentation system.

To ensure that there are no out-of-date or obsolete documents and valid version of each document is readily identifiable and available, a clear procedure should be established to control all EnMS documents. This should include mechanisms for amending, distributing, maintaining and updating relevant documents. The organization should first identify the types of information that should be controlled, how these documents will be distributed, and who will need access to them. This requirement is similar to that contained in the ISO 9001 quality management and ISO 14001 environmental management standards and therefore organizations with such management systems in place can base this EnMS requirement on the existing procedures.

2.5.4 Operational Controls

ISO 50001 Standard says……
It requires the organization to identify and plan operations and maintenance activities which are related to its significant energy uses in order to ensure that they are carried out under specified conditions. (Item 4.5.5)

Implementation of the EnMS is dependent on the establishment and maintenance of operational procedures and controls to ensure that the significant energy uses are being controlled and that the policy, objectives and targets are being met. The organization should consider the different operations and activities, which contribute to its significant energy uses, and establish / confirm and implement the requisite control procedures.

In order to identify operational controls, the organization should systematically review all of its significant energy uses to identify those which are not already controlled or where existing controls may be insufficient, and to subsequently ensure that control procedures are in place for all such areas.

It is suggested that the following are considered in relation to the preparation of operational control:

- level of detail of the control procedures required;
- target user of the procedures e.g. working level or management supervisory level;
- distribution to relevant staff and / or contractors, where applicable; and
- developing a matrix to cross check significant energy uses against operational controls to ensure that relevant procedures are in place for controlling each of the significant energy uses.

2.5.5 Design

ISO 50001 Standard says……
It requires the organization to consider energy performance improvement opportunities and operational control in the design of facilities, equipment, systems and processes that can have a significant impact on its energy performance. (Item 4.5.6)

This requirement is applicable to the design of new, modified and renovated facilities, equipment, systems and processes that can have a significant impact on an organization's energy performance. It requires an organization to consider energy performance improvement opportunities when preforming these activities.

It is recommended to consider and identify energy performance improvement opportunities at the beginning of design, renovation work or modification of any significant energy using facilities, equipment, systems and processes. The whole process involves identifying design inputs, reviewing and verifying the design. By incorporating the results of energy performance evaluation into the specification, design and procurement activities of relevant project(s), management can ensure that a sustainable design or an aggressive energy retrofit actually leads to targeted energy outcomes.

Examples of Energy Performance Considerations:

The following criteria could be considered in energy performance evaluation process during the design of new, modified and renovated facilities, equipment, systems and processes with significant energy impact:

- Any alternative energy sources?
- Any other possible energy saving measures?
- Energy saving percentage (i.e. compared with the traditional technology), investment cost and payback period
- Power rating, power factor and harmonic distortion
- Energy baseline
- Lifetime (i.e. frequency of replacement)
- Impact on efficiency, product quality, existing manufacturing process and production time
- Technical feasibility
- After-sale maintenance service

2.5.6 Procurements of Energy Services, Products, Equipment and Energy

ISO 50001 Standard says……
It requires the organization to inform suppliers that procurement is partly evaluated on the basis of energy performance when procuring services, products and equipment that have an impact on significant energy use. (Item 4.5.7)

Energy improvement of an organization could be achieved through procurement in twofold: firstly using more energy-efficient products and services; and secondly influencing supply chain to improve its energy behaviour which may indirectly improve the organizations' energy performance.

ISO 50001 requires an organization to inform suppliers that energy performance will be evaluated as part of the procurement assessment process when selecting services, products and equipment that have or may have an impact on its significant energy use. This requirement ensures that suppliers are in line with the organizations' energy policy and objectives in addition to the consideration of cost and service / product quality. To this end, organizations should establish energy-related criteria to facilitate the assessment of energy performance over the planned or expected operating lifetime during the procurement process. These requirements should be included in quotations and tender specification.

Below are three major items that an organization should consider for the procurement of energy using products, equipment and services which are expected to have a significant impact on energy performance:

- How suppliers are informed that procurement is partly evaluated on a basis of energy performance?
- What are the criteria for assessing energy use, consumption and efficiency over the planned or expected operating lifetime?
- How to define energy purchasing specifications for effective energy use?

The elements of energy purchasing specification could include energy quality, availability, cost structure, environmental impact and renewable sources.

Examples of Criteria to be Considered When Defining Energy Purchasing Specifications for Lighting System:

- Unit cost and total cost
- Number of lighting devices required
- Power rating
- Power factor
- Energy saving percentage (i.e. compared with the traditional mercury lamp) and its payback period
- Lifetime (i.e. frequency of replacement)
- Lux level
- Colour rending index
- Colour temperature
- Luminous efficiency in terms of lm/w
- Lumen depreciation
- Surface temperature (i.e. impact on operating cost of air-conditioning system)
- Any stroboscopic effect?
- Any need for special disposal arrangement? Any hazardous materials or heavy metals inside in the equipment?
- After-sale maintenance service

2.6 Checking

To gauge the effectiveness of the EnMS and monitor the actual energy performance, an organization is required to perform regular checking through energy-related data measurement and analysis, as well as carrying out internal audits.

2.6.1 Monitoring, Measurement and Analysis

ISO 50001 Standard says……

It requires the organization to monitor, measure and analyze the key characteristics of its operations that determine energy performance at planned intervals. Equipment used in monitoring and measurement of key characteristics should be calibrated to ensure data are accurate and repeatable. (Item 4.6.1)

With respect to monitoring of the key characteristics, the organization should review all significant energy uses to determine which aspects should be monitored in order to check that the controls are being effective. The results help management define appropriate energy performance improvement actions. A monitoring schedule could be drafted in order to facilitate the monitoring activities.

According to the standard, key characteristics required monitoring shall include at a minimum:

a. Significant energy uses and other outputs of the energy review;
b. The relevant variables related to significant energy uses;
c. EnPIs;
d. The effectiveness of the action plans in achieving objectives and targets; and
e. Evaluation of actual versus expected energy consumption.

Appropriate procedures should be in place to ensure the reliability of the data through the testing of equipment, calibration and sampling. Evaluation of actual versus expected energy consumption as well as review its measurement needs shall be carried out. The organization shall also investigate and respond to significant deviations in energy performance. These can be easily addressed through periodic meetings of the Energy Management Team or other working groups.

2.6.2 Evaluation of Compliance with Legal Requirements and Other Requirements

ISO 50001 Standard says……
It requires the organization to evaluate compliance with legal requirements and other requirements to which it subscribes related to its energy use and consumption at planned intervals. (Item 4.6.2)

The organization is required to maintain a process to evaluate compliance with legal and other requirements (identified under Item 4.4.2) regularly so as to enable management to monitor progress against planned milestones that meet all applicable requirements. Evaluation results should be recorded to demonstrate its compliance status.

After collecting all the information on the compliance status, the evaluation can be undertaken through periodic meeting of the Energy Management Team or other working groups.

2.6.3 Internal Audit

ISO 50001 Standard says……
It requires the organization to conduct internal audits regularly to ensure effective implementation of the EnMS. (Item 4.6.3)

According to the ISO 50001 standard, organizations should establish a programme to evaluate periodically on its EnMS implementation and check the effectiveness of the system in fulfilling their energy policy. The programme should include the scope and frequency of the audits. Internal audit of EnMS is different from an energy audit or assessment. The internal audit evaluates the processes, procedures and implementation of the EnMS to determine if they are appropriate to the organization, implementation status and conforming to requirements of the ISO 50001 standard. It helps identify nonconformities and opportunities for improvement of the EnMS. In practice, it can be performed by either internal or external persons, as long as they are competent, impartial and objective in conducting the EnMS audit.

At the end of the audit, proper records should be maintained and submitted to management for review.

In general, the audit programme and procedures should cover:

- specific activities / areas of the EnMS to be audited;
- frequency of audits (different elements of the EnMS may be audited at different frequencies);
- responsibilities and selection of auditor(s);
- communication of audit results;
- auditor competence; and
- process of conducting audits.

2.6.4 Nonconformities, Corrective and Preventive Actions

ISO 50001 Standard says……
It requires the organization to address nonconformities by making corrections, and by taking corrective action and preventive action. (Item 4.6.4)

The findings of monitoring and other reviews of EnMS implementation should be documented. In case nonconformities are identified, the necessary corrective and preventive actions must be initiated and implemented. A follow-up system should be maintained by management to ensure that corrective and preventive actions have been completed and effective.

A fundamental principle of the ISO 50001 standard is that organizations are capable of identifying and fixing the problems, as well as taking actions to eliminate the cause of the problem. According to the standard, corrective action refers to action to eliminate the cause of a detected nonconformity; while preventive action refers to action to eliminate the cause of a potential nonconformity. For organizations with ISO 9001 and ISO 14001 in place, addressing non-conformance should be relatively straight forward as the procedures developed under these standards can provide the basis for fulfilling ISO 50001 requirements.

Procedures addressing Nonconformities should include:

- analysis on the cause of non-conformance;
- identification and implementation of corrective actions;
- modification of existing controls, if necessary;
- establishment of preventive measures where appropriate;
- recording any changes in written procedures resulting from corrective or preventive actions;
- ensuring follow-up actions are in place to ensure satisfactory resolution of the non-conformance; and
- non-conformances should be reviewed in the Management Review process and Energy Management Team / Working Group meetings.

2.6.5 Control of Records

ISO 50001 Standard says……
It requires the organization to establish and maintain records to demonstrate conformity to the EnMS. (Item 4.6.5)

In order to demonstrate the effective functioning of the EnMS, organizations are required to keep legible, identifiable and traceable records. Records provide evidence of actions taken to adhere to the EnMS requirements and comply with the ISO 50001 standard. A comprehensive system for managing and maintaining records is necessary to ensure that records are easily identified, collated, indexed, filed, stored, retrieved and maintained for an appropriate length of time.

Records for the EnMS should cover but not necessarily be limited to, the following:

- Methodology, criteria and result of energy review;
- Opportunities for improving energy performance;
- Energy baseline;
- Energy performance indicators;
- Training records;
- Internal communication records;
- Decision on whether to externally communicate its EnMS and energy performance criteria and results;
- Design activity results;
- Monitoring and measurement results of key operational characteristics;
- Calibration records;
- Compliance evaluation results;
- Internal audit programme and results;
- Nonconformance records;
- Corrective and preventive action records; and
- Management review agenda and minutes.

When considering the management of EnMS records, the following issues should be addressed:

a. identifying the nature and extent of energy information that the organisation needs to manage;
b. what type of information should be made available to internal and external parties; and
c. location of records and responsibilities for maintenance including period of retention, signatures, dating, review and disposal.

2.7 Management Review

ISO 50001 Standard says……
It requires the top management to review the EnMS regularly to ensure its suitability, adequacy and effectiveness. (Item 4.7)

The management review will assist the organization to achieve continual improvement and to assess the suitability, adequacy and effectiveness of the EnMS. It should be noticed that although management review needs to cover the scope of the whole EnMS, not all the elements in system are required to be reviewed at once. The review process can take place over a period of time.

When conducting management review, the organization should also take into account the concept of continual improvement, which is achieved by evaluating the energy performance against the policies, objectives and targets. The management review should also address external issues relevant to the energy performance of the organization and identify opportunities for improvement and where appropriate changes of emphasis or direction.

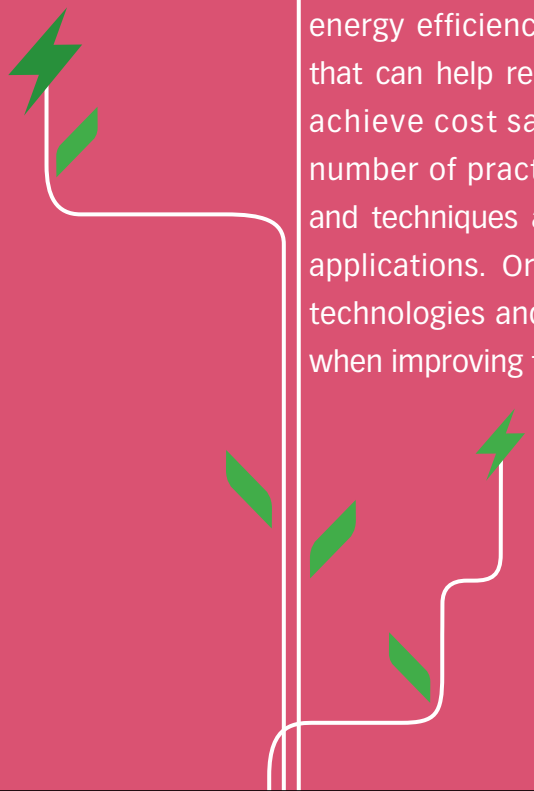
The Scope of Management Review should cover:

- Review of energy policy, objectives, targets and evaluation of overall progress in achievement;
- Findings of previous management review and EnMS audit;
- Evaluation of the effectiveness of EnMS, EnPIs and energy performance;
- Review of changes in: legislation, expectations and requirements of interested parties, products / activities of the organization, advances in technology, market preference, etc.;
- Evaluation of follow-up actions in relation to nonconformities;
- Projection of energy performance in the next period;
- Revision on policies, objectives, targets, resources or other elements of EnMS, if necessary;
- Review of resources allocation; and
- Identification of room for improvement.

3

Improvement on Energy Performance

Continual improvement on energy performance is the ultimate goal of implementing ISO 50001 Energy Management System (EnMS). In order to achieve it, organizations need to look closely at their specific operation. For manufacturing sector, a significant amount of energy is consumed by hardware installations, since their operations involve different types of production machines, equipment and auxiliary devices. With the advancement of technologies, production machines and auxiliary equipment with high energy efficiency are available in the market that can help reduce energy consumption and achieve cost saving. There are also quite a number of practical energy-saving measures and techniques applicable to various industrial applications. Organizations should take these technologies and measures into consideration when improving their energy performance.



This chapter aims to provide a quick overview on some of the practical energy-saving technologies and measures for manufacturing sector. Although these techniques and measures are categorized into particular industry sectors such as electronics; electrical products and equipment; textiles, apparel and accessories; watch and clocks; paper products and printing; jewellery; toys; metal products; plastics and rubber products, most of them can also be applied to other industries.

Note: *the investment payback period may vary dependent on different technologies, equipment brands, operation capacity and other technical and financial factors. Therefore, the estimation provided here is for reference only. Readers are advised to get more technical and financial information from suppliers for detailed evaluation.*

3.1 General Energy Saving Best Practices

Regardless of particular sectors, there are a number of general best practices and measures that can be applied by the industries to enhance energy performance. In contrast to some people's believe, many of these best practices do not necessarily involve much investment, yet bring noticeable improvement in energy performance.

The following table provides some typical energy-saving measures, which are illustrated by detailed case studies.

Table 3.1 Cases Illustration of Energy Saving Technologies Applicable to General Industries

Case No.	Technology Description	Estimated Payback Period*
3.1.1	Energy saving device for diesel power generator to achieve complete combustion	Short
3.1.2	Variable speed drive in central chilled water pumps	Short - Medium
3.1.3	The use of Light Emitting Diodes (LED) to replace traditional fluorescent tubes	Medium
3.1.4	Adjustment of room temperature setting of air conditioning system	No / Low investment
3.1.5	Regular maintenance and cleaning of air filters	No / Low investment

* Note: (Estimated Payback Period: Short: <=1 year; Medium: >1 and <=3 year; Long: >3 year)

Case No. 3.1.1

Technology Description

Energy Saving Device for Diesel Power Generator to Achieve Complete Combustion

Problem

In recent years due to main grid power shortage, some manufacturing facilities located in Mainland China face the challenge of intermittent power suspension from time to time. During the time of power suspension, factories usually rely on its own diesel power generators to supply electricity for production. Operating diesel power generators requires burning of a large quantity of diesel which may result in incomplete combustion of diesel and thus lower its energy efficiency.

Solution

This energy saving device for diesel power generator helps enhance the fuel quality through breaking down of large incombustible particles so as to achieve full combustion of diesel fuel. Equipped with advanced technology from overseas, this device can create a strong magnetic field of about 30,000 gauss to generate strong attraction and repulsion force continuously. When diesel passes through the strong magnetic field, larger particles can be broken down to no more than 0.03 mm in size which can be fully burned. Removal of large incombustible particles that would have otherwise been released to the environment can also help reduce dust deposition inside the combustion chamber and reduce fuel consumption of the diesel power generator.

Energy Saving Device for Diesel Power Generator

Cost Effectiveness

This device can save about 5-13% of diesel consumption and the average payback period is estimated to be about 1 year.

Case No. 3.1.2

Technology Description

Variable Speed Drive in Central Chilled Water Pumps

Problem

In general, the total cooling capacity of a central air conditioning system is designed according to the highest cooling load plus an amount of spare capacity. However, in actual operation, the cooling demand does not usually reach the highest load in most of the operating time. As a result, the energy consumption of the air conditioning systems is always higher than the actual demand. i.e. large amount of energy is wasted.

Solution

A variable speed drive (VSD) can be installed for chilled water pumps together with a control software to optimize the operation parameters of the air conditioning system, such as loading capacity and coefficient of performance (COP). With the installation of VSD, the cooling demand can be satisfied while the operation of the air conditioning system can be maintained efficient at all time. For example, when the factory temperature is high, the VSD will allow a higher chilled water flow by increasing the speed of the water pumps, and vice versa. During the night time, both the production activities and the number of workers in the factory are reduced, only minimal cooling power is required. The VSD can regulate the chilled water flow rate according to these fluctuations in actual demand in order to maximize the operation efficiency and achieve energy saving.

Control Panel of Chilled Water Pumps

Cost Effectiveness

The VSD can save about 53 - 81% of electricity consumption and the payback period is estimated to be about 3 months to 1.7 years.

Case No. 3.1.3

Technology Description

Use of Light Emitting Diodes (LEDs) to Replace Traditional Fluorescent Tubes

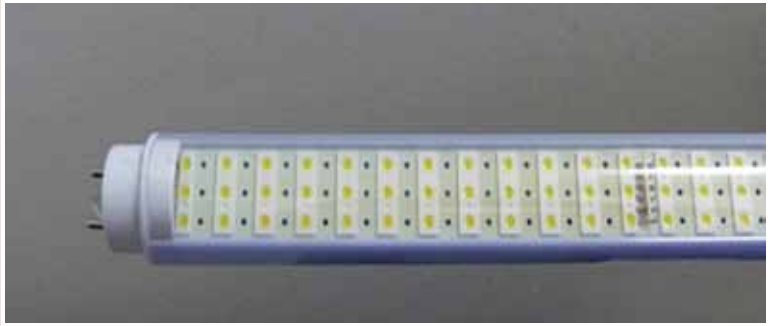
Problem

Production process in factory is usually labour intensive. Energy consumption of lighting is usually around 10-15% of the total energy consumption of a factory.

Solution

As a new generation of lighting technology, LED contains electro-luminescent materials on a chip, packaged with metal wires for connection and encapsulated with lens and silicone for protection. As a result, LED has good shock resistance.

LED is a solid state cool light source, which provides a high luminous efficacy and can convert around 80-90% of electricity to visible light. As comparison, the luminous efficacy of a traditional incandescent light bulb is about 20%. LEDs can also provide a longer service life.



LED Light Tube

Cost Effectiveness

Use of LEDs to replace traditional fluorescent tubes can save about 30-76% of energy consumption. The payback period is around 1 to 2 years.

Case No. 3.1.4

Technology Description

Adjustment of room temperature setting of air conditioning system

Problem

Indoor is always too cold in summer because the room temperature setting is too low.

Solution

Monitor room temperature continuously, and adjust the thermostat to a reasonable temperature, say 25°C; or repair / replace the thermostat if it is not functional. Every increment of 1°C of the room temperature can save approximately 1.5% energy of the air conditioning system per year. Without sacrificing occupant's thermo-comfort, the room temperature should be set higher as far as possible.

Cost Effectiveness

The energy saving is around 2 to 10%.

Case No. 3.1.5

Technology Description

Regular maintenance and cleaning of air filters

Problem

Filters in air conditioning system can reduce dust / particulate matters circulation within the indoor environment. However, after operation of a certain period, dust will accumulate on the air filter to increase the pressure drop and hence increase the energy consumption of air fans.

Solution

Clean regularly all filters of the air conditioning system. This can not only save energy due to the air fans, but also improve indoor air quality.

Cost Effectiveness

Cleaning of air filters can usually save 5 to 20% fan power.

3.2 Energy Saving Technologies Applicable to Specific Industries

Different industry sectors have their own specific production processes involving different energy-consuming process, therefore specific saving measures and technologies should be applied to these sectors to reduce energy consumption.

Some of the industry-specific energy-saving technologies and equipment are provided below.

Table 3.2 Cases Illustration of Energy Saving Technologies Applicable to Specific Industries

Case No.	Applicability	Technology Description	Estimated Payback Period**
3.2.1	Electronics	High-Frequency Switching-Mode Power Supply	Medium
3.2.2	Electronics	Maintaining Positive Pressure in Clean Room	Varied
3.2.3	Electrical products and equipment	Use of Electric Central Aluminum Furnace to Replace Diesel-fired Furnace	Short
3.2.4	Electrical products and equipment	Stamping Machine With Variable Speed Drive	Long
3.2.5	Textiles	Recovery of Steam Heat and Condensate from Ironing Process	Short
3.2.6	Textiles	Retrofitting of Servo Motor to Sewing Machines	Medium - Long
3.2.7	Watches and clocks	Air Source Heat Pump to Replace Traditional Water Heater	Varied
3.2.8	Watches and clocks	Air Compressor Retrofit with Automatic Constant Pressure Gas Supply Control	Medium

Case No.	Applicability	Technology Description	Estimated Payback Period**
3.2.9	Paper products and printing	Recovery of Steam Heat and Condensate from Production Line	Short - Medium
3.2.10	Paper products and printing	Fully Automatic Standby Power Management System	Long
3.2.11	Jewellery	Installation of Frequency Inverter to Exhaust Blower of Air Scrubber	Short
3.2.12	Toys	Plastic Injection Molding Machine with Servo Motor	Medium
3.2.13	Toys	Recovery of Residual Heat From Barrel of Plastic Injection Molding Machine	Varied
3.2.14	Metal products	Regenerative Waste Heat Recovery System for Melting Furnace	Short
3.2.15	Metal products	Addition of Low Temperature Degreasing Powder in Degreasing Solvent	Short
3.2.16	Plastics and rubber products	Adoption of Ozone Filtration System for Plastic Injection Molding Machine Water Cooling Tower	Medium
3.2.17	Plastics and rubber products	Using Energy Efficient Induction Heating Coil for Plastic Injection Machine	Medium - Long

** Note: (Estimated Payback Period: Short: <=1 year; Medium: >1 and <=3 year; Long: >3 year; Varied: depending on particular application)

Case No. 3.2.1

Technology Description

High-Frequency Switching-Mode Power Supply

Applicable Industry

Electronics

Problem

Currently, traditional Silicon-Controlled Rectifier is commonly adopted as power supply in electro-plating process. However, this kind of power supply system has the drawbacks of large in volume, high copper loss and eddy current problems. As a result, the electricity conversion efficiency is low and life span is short.

Solution

High-Frequency Switching-Mode Power Supply can integrate a metal oxide semiconductor field effect transistor (MOSFET) as switching element for electronic circuits. Together with micro control technology, the power supply can be operated under high frequency of 10kHz to 50kHz. This operating frequency not only enhances electricity conversion efficiency, but also reduces copper loss of the electro-planting process. The copper consumption by using this technology is only 30% of that by using the traditional technology. Furthermore, this technology can reduce energy loss due to eddy current.

Due to its fast response (in the order of micro seconds), this technology can enhance power output stability when the power grid experiences unstable conditions. In addition, the wave form of the power output can be adjusted according to specific requirement to suit different processes. The heat generation of the power supply using this technology also decreases due to reduced power loss.

High-Frequency Switching-Mode Power Supply

Cost Effectiveness

This technology can reduce energy consumption by around 25-30% compared to traditional Silicon-Controlled Rectifier Power Supply. The payback period of this technology is around 2-3 years.

Case No. 3.2.2

Technology Description
Maintaining Positive Pressure in Clean Room

Applicable Industry
Electronics

Problem
Large amount of treated air is required in clean room to maintain positive pressure inside and the air is free from outdoor particulate matters. Fresh air is supplied by an air conditioning system which composes of chiller(s) and fresh air fan(s). The system consumes a large amount of electricity to pre-treat and supply the fresh air to the clean room. The higher the air pressure value is set, the higher air flow is required to be produced by the fresh air fans, which will consume more energy.

Solution
Chillers and fresh air fans are major energy-consuming parts in the system. Without affecting the cleanliness of the room, the air pressure can be decreased to a reasonable value by reducing the speed of fresh air fans. At the same time, the changes of the clean room air pressure should be monitored continuously in order to keep a positive air pressure inside the room. With the air pressure being dropped, the energy consumption of chillers can be reduced.

Cost Effectiveness
The cost effectiveness of this measure depends on the pressure setting and the operation time of the air conditioning system. The more pressure reduction and longer operation time of the system, the more energy can be saved.

Case No. 3.2.3

Technology Description
Use of Electric Central Aluminum Furnace to Replace Diesel-fired Furnace

Applicable Industry
Electrical Products and Equipment

Problem
During die casting, metal needs to be melted using high temperature for further processing. This process requires a large amount of energy. Traditionally, diesel-fired furnaces are used in the metal melting process. However, their energy efficiency is relatively low. Furthermore, the airborne emission of fuel gas exhaust from diesel-fired furnaces will cause pollution to the environment.

Solution
Electric central aluminum furnace that adopts a proportional integral derivative (PID) controller allows automatic temperature adjustment with the accuracy of ±5°C less. The less temperature fluctuation during the process is resulted when using this technology. Hence, the associated process can be performed energy efficiently.

This technology not only reduces energy and fuel consumption significantly, but also reduces the indoor temperature of workshop.

Electric Central Aluminum Furnace and Control Panel

Cost Effectiveness
Payback period of this technology is around 5 months according to the experience of a factory.

Case No. 3.2.4

Technology Description
Stamping Machine With Variable Speed Drive

Applicable Industry
Electrical Products and Equipment

Problem
Stamping machine is one of the most commonly used production equipment in electrical products and equipment industry, and usually consumes a significant amount of energy. Even when it is not in operation, the electric motor of a stamping machine will normally keep running at the unloaded mode. Since the power factor of the machine tends to be low when the machine is operated with no or light loading, energy wastage will be resulted during such operation conditions.

Solution
If the stamping machine is equipped with a variable speed drive, the energy output will be automatically adjusted according to actual loading. Thus the energy wastage in unloaded and light loaded operating conditions can be minimized.

Variable Speed Drive for Stamping Machine

Cost Effectiveness
The amount of actual energy savings depends on the operating time for unloaded, light loaded and full loaded conditions. The longer operating time for an unloaded or lightly loaded status, the more energy can potentially be saved with this technology. The payback period is estimated to be about 3 to 4 years.

Case No. 3.2.5

Technology Description
Recovery of Steam Heat and Condensate from Ironing Process

Applicable Industry
Textiles

Problem
The residual steam generated from the ironing process in textiles factories used to be discharged into the environment directly. It wastes a significant amount of heat energy and water resource.

Solution
After installation of a steam recovery system, residual steam can be recovered to heat up the water for hot water supply in dormitory, to replace the gas fired boiler, oil fired steam boiler or electric boiler. Residual steam is collected from the production line by using pipes. Through heat exchange, fresh water can be heated up for employees to use.

When the water temperature difference between the dormitory water storage tank and the steam recovery system exceeds a pre-set threshold value, the dormitory water will be pumped into the recovery system to absorb thermal energy and then returned back to the dormitory water storage tank. This circulating process repeats until the difference in water temperature difference is reduced to the pre-set value. The water temperature in the recovery system is about 70-90˚C. The steam recovery system effectively recovers residual heat of steam and minimizes heat loss to the environment. It also helps to save energy consumption for heating up dormitory water.

Recovery System of Residual Steam

Cost Effectiveness
Annual cost savings range from RMB25,000 to RMB800,000. The payback period is about 0.3 to 0.7 year.

Case No. 3.2.6

Technology Description
Retrofitting of Servo Motor to Sewing Machines

Applicable Industry
Textiles

Problem
Traditional sewing machines are usually equipped with clutch motor. When traditional motors are in idle mode, the electric current that supplies the motors is still maintained at a high level and thus lots of electricity energy is wasted. Furthermore, traditional motors generate much noise which may affect the productivity of factory staff.

Solution
A servo motor is often the execution component of an automatic control system. When receiving a control signal for "action", the servo motor will rotate and generate angular velocity or speed as output. When the control signal diminishes, the motor speed decreases gradually before it stops. The rotation speed and operating current of a servo motor is normally controlled by a micro-processor. By adjusting the electric current, the servo motor can achieve the desired working speed. During the initial (idle) mode, the servo motor requires less electric current and rotates with lower speed than traditional clutch motors. When in operation, the electric current will go up and down depending on the motor speed.

Therefore, compared with its traditional counterpart, sewing machine equipped with a servo motor will generally consume less energy during the breaks between sewing motions. Servo motors are also quieter than clutch motors. Furthermore, since there are no moving parts in the controller, the life span of servo motor is also longer.

Sewing Machine with Servo Motor

Cost Effectiveness
Energy saving is about 50-80% for sewing machine equipped with servo motor compared with its traditional counterpart. The payback period is around 2 to 5 years.

Case No. 3.2.7

Technology Description
Air Source Heat Pump to Replace Traditional Water Heater

Applicable Industry
Watches and clocks

Problem
Huge amount of hot water is required in dormitories of factories. The heating of water consumes a large amount of energy when using electrical or diesel fueled water heaters.

Solution
The purpose of an air source heat pump is to absorb heat from the ambient air and treat it as a heat source to heat up water, such as providing hot water for dormitory use.

A compression heat pump system is mainly composed of an evaporator, a compressor, a heat exchanger and a throttle valve. During its operation, ambient heat is absorbed into the evaporator, where liquid refrigerant is vapourized. The vapour is then compressed to raise the temperature. Once entered the heat exchanger, the vapour with high temperature and high pressure release its thermal energy to heat up water. Afterwards, the refrigerant vapour is cooled down and will condense into its liquid state, passing through the throttle valve and return back to the evaporator to complete a full cycle.

Air Source Heat Pump and Water Storage Tank

Cost Effectiveness
After applying the air source heat pump for supplying dormitory hot water, about 60-80% of energy saving can be achieved. The result indicates that the air source heat pump has a higher Coefficient of Performance (COP) value and the fuel consumption cost can be reduced accordingly. The payback period is around 0.6 to 3.9 years.

Case No. 3.2.8

Technology Description
Air Compressor Retrofit with Automatic Constant Pressure Gas Supply Control

Applicable Industry
Watches and Clocks

Problem
Air compressor is commonly used in factories. However, this kind of equipment consumes a large amount of energy with low energy efficiency.

Solution
By retrofitting air compressor with variable speed motor, the output gas pressure can be controlled at a steady level to achieve energy saving. Besides controlling one single air compressor, this technology can be applied to a compressed gas distribution network with assistance of a compressed gas pressure control module. The working principle of this module is to closely monitor the compressed gas pressure at the distribution network (P), and compare it with the preset value of the distribution network (P0). The difference between P and P0 will be compared to generate an electronic control signal to the variable speed motor for maintaining a steady operational speed as well as reducing the pressure fluctuation. The compressed gas pressure monitoring system can maintain steady operation of the air compressor and thus achieve energy saving.

Compressed Gas Pressure Controller

Cost Effectiveness
Energy saving of this measure is around 10-30%, depends on the operation hours of the air compressor at light versus heavy loading. The estimated payback period is around 2 to 3 years.

Case No. 3.2.9

Technology Description
Recovery of Steam Heat and Condensate from Production Line

Applicable Industry
Paper Products and Printing

Problem
In general, steam required in the production line is provided by the coal fired steam boiler. During the production process, a significant amount of steam is released to the environment.

Solution
The residual steam will be collected and compressed by a steam recovery system for heating up water. The condensate will be circulated back to the steam boiler for reuse.

This system not only recovers a large amount of steam heat, but also recycles the steam condensate to the boiler system. As a result, fresh water supply which is required by the boiler system can be reduced.

Recovery System of Steam and Condensed Water Vapour

Cost Effectiveness
Due to the saving of significant amount of water and coal consumption with the application of this system, the payback period ranges from 9 months to 2 years based on the actual industrial applications.

Case No. 3.2.10

Technology Description
Fully Automatic Standby Power Management System

Applicable Industry
Paper Products and Printing

Problem
Factories may face grid power supply interruption or shut down in a short notice. Under such circumstances, all production lines must be paused and the organization has to use its own diesel generators provide power supply to resume the operation of the production lines. This practice will result in extra production time to production, which may cause economical loss.

Solution
The fully automatic standby power management system is able to control different sources of power supply by using microcomputer programme. It allows automatic power switching without interruption to the output power supply. This system can also allow automatic voltage and loading monitoring during the switching of power supply between utility grid and generators. It connects with individual power generators and optimize their operation to allow fuel saving.

Fully Automatic Standby Power Management System Control Panel

Cost Effectiveness
As the operation time of standby generators is reduced, the consumption of fuel and corresponding air pollutants generated due to the combustion of fuel are also reduced. The payback period is estimated to be around 3 to 6 years.

Case No. 3.2.11

Technology Description
Installation of Frequency Inverter to Exhaust Blower of Air Scrubber

Applicable Industry
Jewellery

Problem
In order to eliminate acid mist from workshop exhaust, air scrubber will be adopted to reduce acid gas emissions to the atmosphere. But when less acid gas is produced in the production line, the exhaust blower motor of air scrubber is still operating at constant speed. As a result, lots of electricity is wasted.

Solution
With a frequency inverter installed to the air scrubber exhaust blower, the speed of blower motor can be adjusted according to the actual production activities and the amount of acid gas emission. It can both help reduce energy consumption and achieve the desired working speed of exhaust blower.

The frequency inverter includes a close-loop control cycle made of a micro-processor, together with a PID digital module and pressure sensor devices. During operation, the frequency inverter can monitor and adjust its power output dependant on real time loading demand. When the exhaust gas blower is not at full loading condition, the frequency inverter will reduce the working voltage of the blower motor that the working current and power will lower and hence energy saving is achieved. The frequency inverter monitors actual loading continuously and modulates the power of the blower to enhance energy efficiency, while achieving the desired working speed of the operation cycle.

Industrial Air Scrubber and Exhaust Air Blower

Cost Effectiveness
Energy saving is about 20-30% for the exhaust blower of air scrubber equipped with frequency inverter compared with its traditional counterpart without frequency inverter. The payback period is around 1 year.

Case No. 3.2.12

Technology Description
Plastic Injection Molding Machine with Servo Motor

Applicable Industry
Toys

Problem
The motor and oil pump in traditional plastic injection molding machine are kept running in full operation mode during production, therefore the process is very energy consuming.

Solution
Servo motor drives the oil pumps, which subsequently governs the motion of a plastic injection molding machine. The use of servo motor can allow precise control of the pressure and oil flow rate of oil pumps. With such accurate power output, the plastic injection molding machine can provide the required speed and pressure for production process more efficiently.

Servo Motor

Plastic Injection Molding Machine with Servo Motor

Cost Effectiveness
The energy saving of this technology is around 30-70%. The payback period is estimated to be about 2 to 3 years.

Case No. 3.2.13

Technology Description
Recovery of Residual Heat from Barrel of Plastic Injection Molding Machine

Applicable Industry
Toys

Problem
Residual heat from the barrel of the plastic injection molding machine is often wasted. The residual heat can be recycled and used for drying purpose.

Solution
A heat recovery system is adopted to recover the residual heat from the barrel of the plastic injection molding machine to be used for the hopper dryer.

By increasing the insulation of the heating coil in the barrel to minimize the heat loss, the hot air between the insulation and heating coil will be blown to the hopper dryer for drying purpose and hence reduce the energy consumption of the hopper dryer. After passing through the hopper dryer, the particulates in the hot air will be removed by a filter. Then the residual hot air will be directed back to the space between the insulation and heating coil to form a thermal cycle. With the decrease in heat loss, temperature in the production line will also be lowered, while energy saving is achieved.

Barrel of Plastic Injection Molding Machine

Hopper Dryer

Cost Effectiveness
After applying this measure, it was found that the energy consumption of the hopper dryer could decease by 21-69%, while the energy consumption of the plastic injection molding machine reduced by 2-16%. The average payback period has been estimated to be about 0.4 to 4 years.

Case No. 3.2.14

Technology Description
Regenerative Waste Heat Recovery System for Melting Furnace

Applicable Industry
Metal Products

Problem
Major heat loss from metal melting and refinery is the hot exhaust gas through flue. The temperature of the flue exhaust may be higher than 450˚C. Some factories have installed a traditional heat recovery system on the melting furnace to recover the heat exhaust, but the recovery efficiency is not very satisfactory. Requiring longer time for preheating and combustion, this setup may also affect production volume and increase defective rate.

Solution
Regenerative waste heat recovery system can be used to replace the traditional heat recovery device. There are two independent heat recovery chambers full of regenerative balls which can absorb more residual heat from the flue exhaust effectively and enhance the ambient temperature of the chamber. Then it can help further preheat the fresh air for combustion interchangeably. Through this way, the heat recovery efficiency is more higher compared with that of the traditional heat recovery device. As a result, more residual heat can be recovered and time for preheating fresh air can be shorten and energy saving can be achieved.

Regenerative Waste Heat Recovery System

Cost Effectiveness
Energy saving efficiency is about 15-20% for the melting furnace equipped with regenerative waste heat recovery system compared with its traditional counterpart with traditional heat recovery system. The payback period is about 8 months.

Case No. 3.2.15

Technology Description
Addition of Low Temperature Degreasing Powder in Degreasing Solvent

Applicable Industry
Metal Products

Problem
In the past, degreasing solvent tank was required to heat up to 60-80˚C to enhance the degreasing effectiveness. Heating up and maintaining the degreasing tank at high temperature consumes significant electrical power.

Solution
In order to save energy consumption, low temperature degreasing powder can be added into the degreasing solvent tank. After applying this powder, the degreasing solvent tank can maintain similar degreasing effectiveness at room temperature (30-40˚C). As a result, it only needs to heat up the degreasing solvent in the winter, and hence energy used for the degreasing process can be greatly reduced.

Electric Heater for Degreasing Solvent Tank

Low Temperature Degreasing Powder

Cost Effectiveness
Energy consumption is reduced by 81% for the degreasing solvent tank with use of low tempearture degreasing powder compared with its traditional counterpart without low temperature degreasing powder. Cost saving of RMB 280,000 (about HKD 352,000) is achiceved per year. Payback period is about 11 months.

Case No. 3.2.16

Technology Description
Adoption of Ozone Filtration System for the water cooling tower of the Plastic Injection Molding Machine Water Cooling Tower

Applicable Industry
Plastics and Rubber Products

Problem
The plastic injection molding machine cooling system is for cooling down high temperature machine oil to avoid overheating which can lead to machine malfunction. Factories usually use cooling towers in this cooling process. However, when operated for a long time, the growth of bacteria and mosses in the cooling water will cause deposition of scale on the heat exchanger, which reduces its efficiency.

Solution
An ozone filtration system can be installed for the cooling tower system to kill bacteria and mosses, such that scale deposition on the heat exchanger can be minimized to maintain high heat exchange efficiency. This technology utilizes the high oxidation potential of ozone to kill bacteria and mosses in cooling water, to slow down scale deposition and to help loosen up accumulated organic and biotic scale materials. The residual scale material will then be removed by the filtration system to keep the cooling water clean. As a result, the heat exchange efficiency of the cooling tower is maintained even after operating for a long time. Furthermore, the ozone filtration system helps enhance the cooling rate of the plastic molding machine as the heat exchanger efficiency of cooling tower has been increased. Also, the overheating of plastic injection molding machine can be avoided so as to lower product defective rate.

Ozone Filtration System

Cost Effectiveness
The heat exchange efficiency has been enhanced by 70% for plastic injection molding machine water cooling tower equipped with ozone filtration system compared with its traditional counterpart without ozone filtration system. It refers to a cost saving of RMB 34,500 (about HKD 43,300) per year. The paybook period is about 2.8 years.

Case No. 3.2.17

Technology Description
Using Energy Efficient Induction Heating Coil for Plastic Injection Machine

Applicable Industry
Plastics and Rubber Products

Problem
Traditionally, the barrel tubes of plastic injection machines are heated up by the resistance heater coils around the barrel tube by conduction. A large amount of heat is lost from the surface of the tube to the ambient air, which also increases the ambient temperature of workshop.

Solution
Induction heating can be applied for plastic injection machine barrel tube heating. This technology uses induction to convert electricity to heat. The major components of the system include magnetic coils, a converter, a control box and a protection shield. The convertor will convert AC current into DC current and subsequently generate electric current with high frequency. When such current passes through the magnetic coils outside the tube, eddy current is induced inside the metal tube (inductor). As a result, heat is generated at the metal tube, which heats up the plastic inside the tube. With this technology, the heating coils do not need to be heated up, while the heat generating metal tube will be well-insulated to minimize the heat loss. Furthermore, this technology enables faster and more even heating to the barrel tube. In short, this induction heating application not only saves energy consumption of the plastic injection machine, but also produces less heat to the ambient temperature of the workshop and hence reduces air-conditioning demand.

Barrel Tube with Induction Heating Coil

Cost Effectiveness
Electrical energy saving of this technology is around 35% to 65% for plastic injection molding machine equipped with heating coil compared with its traditional counterpart with the resistance heater coil. The payback period is about 1 to 4 years.

4

Process and Auditing Requirements of ISO 50001 Certification

This chapter details the typical certification process in accordance with the requirements of ISO 50001 and ISO / IEC Guide 62 General requirements for bodies operating assessment and certification / registration of quality systems.

It should be noted that the certification process may vary between different certification bodies. The actual certification process should refer to the agreement with the corresponding certification bodies.

4.1 Accredited Certification Bodies

Certification of an EnMS will demonstrate to an organization's customers that the organization has attained an internationally recognized standard in terms of energy management and is continuously improving its energy performance.

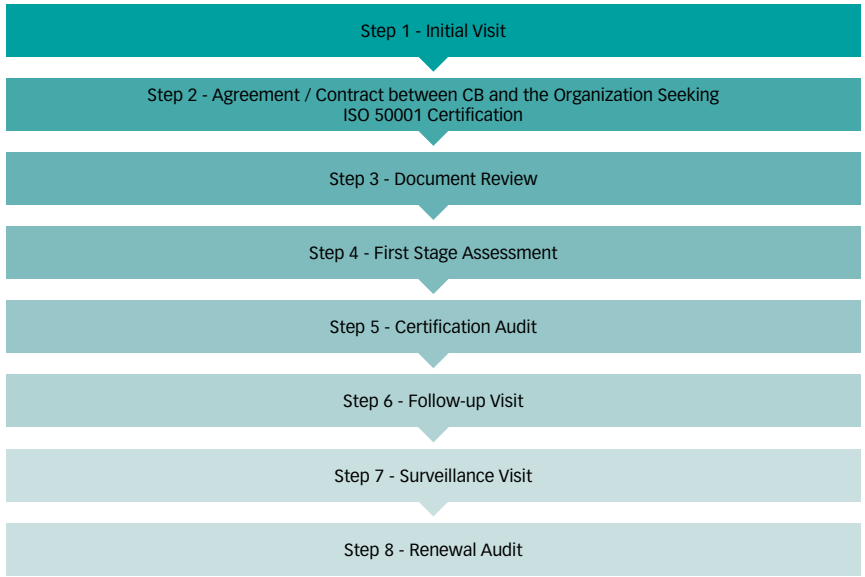
Using a Certification Body (CB) that has been accredited by an International Accreditation Body on ISO 50001 provides international recognition of the EnMS established. Accreditation is a process in which a CB is audited by a third party (e.g. Hong Kong Accreditation Service (HKAS)) in order to ensure the competence of the CB in the provision of relevant certification process.

The Accreditation Body will determine whether the CB has implemented, and is following, its certification management system in accordance with the following international guidelines:

- ISO / IEC Guide 62 General requirements for bodies operating assessment and certification / registration of quality systems; and
- Interpretations by the International Accreditation Forum (IAF) Guidance on the Application of ISO / IEC Guide 62 for bodies operating assessment and certification / registration of quality systems.

4.2 ISO 50001 Certification Process

The ISO 50001 certification process generally includes the following steps:



Step 1 Initial Visit

Some certification bodies may conduct an initial visit to evaluate the complexity of the energy management system to be audited or upon client's request. The initial visit allows certification body to understand the clients' activities, products and services and the potential significant energy use related to different stakeholders of the organization. In addition, the initial visit can ascertain the readiness of an organization's EnMS for the certification audit.

Before the initial visit, the certification body will send a preliminary questionnaire to organization seeking for certification. The questionnaire aims to obtain basic information about the organization and most importantly the information about the energy uses and consumptions in the organization. The questionnaire allows the certification bodies to better understand the certification scope and the procedures involved in the energy management system. In addition, it helps determine the audit scope and the durations for the audit.

Step 2 Agreement / Contract Between Certification Body and the Organization Seeking ISO 50001 Certification

After reviewing the questionnaire and conducting the initial visit, the Certification Body will send a quotation to the client for the certification process. The quotation will specify the number of man-days required to conduct the certification process, the experience of the audit team and the associated fee. An agreement or contract between certification body and the organization will be signed upon the acceptance of the quotation.

Step 3 Document Review

Certification body will conduct a document review in order to achieve the following objectives:

- To assess the compliance to ISO 50001 in documents and records;
- To verify the comprehensiveness and adequacy of the EnMS; and
- To identify areas to be audited in the First Stage Assessment (FSA).

In general, the following EnMS documentation will be reviewed:

- Energy Manual;
- Energy Policy;
- Energy Review;
- Energy Baseline;
- Energy Objectives, Targets and Action Plans;
- List of Significant Energy Uses;
- List of Legislative Requirements Related to Energy Uses and Procurement;
- Records of the internal audit results;
- Records of corrective and preventive actions;
- Records of management review;
- Complaints received & incidents; and
- Energy procedure and list of operational controls.

Step 4 First Stage Assessment (FSA)

The FSA usually starts with a site tour to allow the auditor(s) to understand the organization's operations and identify its potential significant energy uses. The FSA focuses on the system design and the key elements of the EnMS that normally include legal requirements, evaluation of internal audit, management review, training and communication.

It is not uncommon to find out a number of observations or non-conformities which need to be addressed before the Certification Audit during the FSA. Organization is required to follow up and rectify these observations and non-conformities to proceed with the Certification Audit.

Step 5 Certification Audit

The Certification Audit will be conducted approximately 1 month after the FSA to allow sufficient time for any non-conformities or observations identified in the FSA to be corrected. The Certification Audit focuses on the implementation of the documented system including the control of significant energy uses through various operational controls and the implementation of energy objectives, targets and action plans.

It is important that the EnMS established should meet the basic requirements of ISO 50001 including regulatory compliance and continual improvement in energy performance. The Certification Body will recommend the organization to receive the ISO 50001 certification if there is no critical non-conformity identified during the Certification Audit.

Step 6 Follow-up Visit

Follow-up visit will be conducted if serious NCs are identified in the Certification Audit. On-site visit will be conducted by the Certification Body to ensure these NCs are effectively addressed by implementing appropriate corrective actions.

Step 7 Surveillance Visit

Depending on the origin of the accreditation, Certification Body will conduct surveillance visits every 6 months or 1 year to check the EnMS implementation such as progress against objectives and targets. The auditor will also check whether there is any change in significant energy uses, energy baseline and regulatory compliance of the organization.

The use of the certificate and the certification logo will also be checked.

Step 8 Renewal Audit

The ISO 50001 certificate is issued for 3 years. Before the expiry of the certificate, renewal audit should be carried out. Similar to the FSA and certification audit as described earlier, the focus of the renewal audit will be on how the organization conduct energy review and the results as well as the identification of significant energy uses and the formulation of proper controls.

An approximate time from commencing system development to achieving certification could be between 6 and 12 months depending on the size and complexity of the organization and also the current state of the organizations' energy management and their existing management systems.

4.3 Certification Requirements

During EnMS audit, certification can only be granted if all of the criteria indicated below are met:

The EnMS must be effectively implemented at least to the extent that:

- the EnMS has been operational for a minimum of three months;
- the internal audit is implemented and can be shown to be effective;
- one management review has been conducted;
- all staff are aware of the energy policy, objectives and the energy management system; and
- staff involved in managing significant energy uses and associated impacts and have received training according to a training needs analysis.

In addition to the above mandatory requirements in certification, the certification bodies also focus on the following aspects, most of which are related to the energy review.

- The methodology in determining significant energy uses (SEU);
- Prioritization of areas for improvement in energy review;
- The analysis and evaluation of energy review;
- The methodology to determine the energy baseline for the organization or individual SEU;
- The methodology to determine the energy performance indicator(s) for the organization or individual SEU;
- The method and result verification for energy objectives, targets and action plans; and
- The operational control related to SEU.

4.4 Non-conformities

Non-conformities (NCs) are generally divided into two categories: major NCs which relate to serious omissions or failures of the EnMS; and minor NCs.

For those related to serious omissions or failures of the EnMS such as the following, a follow-up visit is likely to be required:

- absence of one or more system elements;
- ineffective implementation; and / or
- issues that could seriously affect capability to achieve policy and objectives.

To be classified into major NCs, the omissions or failures of the EnMS are normally associated with any, or a combination of:

- inadequate identification of significant energy uses;
- regulatory non-compliances; and / or
- no real policy, objectives and targets which would lead to continual improvement.

For minor NCs of a less serious nature, e.g. an isolated event such as not following a procedure, they can usually be resolved by an acceptable corrective action plan.

5

Industry Experience Sharing

This chapter collates the practical experiences from some selected companies in developing and implementing ISO 50001, from which their success factors, challenges and lessons learnt are illustrated to provide insights to those who plan to adopt ISO 50001 in their energy management strategy.

Five cases are presented following the alphabetical order:

- Cheong Ming Press Factory Ltd.
- Chung Tai Printing Holdings Limited
- Clover Display Limited
- Golden Cup Printing Co. Ltd.
- New Area Toys (Zhuhai) Limited

5.1 Cheong Ming Press Factory Ltd.

Established in 1962, Cheong Ming Press Factory Ltd. (Cheong Ming) has grown to become one of the largest packaging printers in Hong Kong, offering packaging boxes for toys, consumable products, electrical appliances, computer and electronic products. Over the years, Cheong Ming has been serving a growing customer base with an increasing variety of products which include children books, novelty, puzzles, game cards and paper products. Cheong Ming is headquartered in Hong Kong and operates its plants in Dongguan and Shenzhen employing over 3,000 staff.

The senior management team of Cheong Ming is very committed and concerned about the energy and emission reduction progress of the company. Under the multiple interactive forces between the launching of China's regulatory framework on energy conservation, growing customer expectation and production cost minimization, the senior management has given very useful advice to formulate the energy management strategy.

Cheong Ming has achieved successful energy reduction results after implementing various energy saving initiatives in the past years. Among these projects, some of which have been officially recognized as the demonstration projects by the Cleaner Production Partnership Programme, and they have successfully fulfilled the Energy Audit Requirement under the 12th Five-Year-Plan (FYP) of PRC (十二五節能規劃評審). From these various undertakings, Cheong Ming has acquired an immense amount of valuable experiences and lessons learnt, as well as identified some key factors which contribute to the success of its energy management system.

1. With regard to manpower allocation, we have established an "Energy Conservation Team" before registering for the Energy Conservation Assessment under the 12th FYP. The Team has been instrumental in the assessment process, and it has shouldered its leadership role to map out the implementation plan of Cheong Ming's energy conservation strategy. Under the Team's support on developing a formal guideline on energy conservation, we have been able to achieve a more systematic energy management system that maximizes our operational energy efficiency.

2. We have successfully established our energy use baseline and reduction targets, and these serve as useful indicators to assess the effectiveness of the implementation of various energy conservation initiatives. The targets are also useful tools to motivate different divisions and units to execute the energy saving policies and measures.

3. Collection of energy consumption data across various business units is another critical consideration. We established an inventory to record the energy usage of different business units to facilitate our cost accounting process. Upon the availability of these energy data, we are able to conduct timely monitoring of the energy efficiency of individual units, and make necessary adjustment in order to foster further improvement.

4. Staff awareness about the importance of energy conservation is another important factor to complement an effective energy management system. Properly trained personnel will help identify sources of energy wastage at ease and facilitate improvement over time.

5. Last but not least, continuous maintenance and upgrading of existing energy saving measures and engineering projects are useful to sustain the energy conservation undertaking of the corporation.

Following the publication of ISO 50001 standard, we intend to further improve our energy performance through establishing a comprehensive energy management system and documentation based on the ISO 50001 standard and our existing ISO 9001 system.

5.2 Chung Tai Printing (China) Co., Ltd.

Chung Tai Printing (China) Co., Ltd. was established in 1979. Chung Tai is headquartered in Fanling, Hong Kong, and has two production facilities located at Shenzhen. Over the past 30 years, we have continued to provide a wide range of printing services including production of labels and overlays, offset printing business as well as various paper products to the China and international markets.

Chung Tai is fully committed to promoting environmental protection and social responsibility. We have established a corporate policy and principle regarding environmental protection and sustainability. We have also attained a variety of quality and environmental management system standards including ISO 9001, ISO 14001 and OHSAS 18001.

By participating in the Initial Review in "A Support Programme for SMEs to Adopt the ISO 50001 Energy Management System Standard" organized by the Hong Kong Electronic Industries Association (HKEIA), we have managed to conduct detailed evaluation and analysis of our energy performance gaps and differences. As revealed from the assessment findings, we are now considering installing individual energy meters to measure the power consumption of our large scale machinery. This will help us monitor our energy performance effectively, in order to fulfill the basic requirement of ISO 50001 standard.

Active day-to-day management on energy consumption is another key component for a successful energy management system. In the beginning of 2012, we have engaged a consultant to conduct a comprehensive carbon audit and inventory establishment in order to define our base year performance, set carbon reduction targets, and devise an energy reduction programme for three progressive stages (Stage 1 to Stage 3). We have maximized the use of natural light to minimize the number of the operating lights, which helps us to save a reasonable amount of electricity consumption. We have also upgraded some of our large printing presses with variable speed control in order to enhance their energy efficiency. The first two stages of the energy reduction programme have successfully completed and we have so far managed to achieve remarkable energy reduction results which worth around RMB 3 million.

Following the recommendations of the on-site assessment conducted by HKPC, we are considering to develop an ISO 50001 energy management system and integrate it with our existing quality management systems.

5.3 Clover Display Limited

Clover Display Limited (Clover) was established in 1983. A strong R&D team & prototyping production line in Hong Kong allows Clover to continuously develop LCD and LCM for new applications. In 1993, Clover established a 8,000 square meter factory in Shunde that is specialized in custom designed LCD and LCM for applications in the field of instrumental, industrial, medical, and telecommunications. Clover has built up a good quality reputation in Europe, USA and Japan; and more than 70% of our business is for overseas market.

We have currently established various energy monitoring and reduction programmes, such as preferential purchase of energy efficient equipment and installing electricity sub-meters to closely monitor the electricity consumption of the production lines. We believe having a comprehensive ISO 50001 Energy Management System (EnMS) in place would definitely help us further cut down energy costs and continue to improve our energy management performance in an organized and systemic way.

To this end, Clover has joined "A Support Programme for SMEs to Adopt the ISO 50001 Energy Management System Standard" organized by the Hong Kong Electronic Industries Association (HKEIA). Through the programme, we understand the principles and essentials of implementing an ISO 50001 EnMS as well as how to integrate ISO 50001 EnMS with other management systems such as ISO 14001 environmental management system and ISO 9001 quality management system.

Since we have solid experience in implementing ISO 9001 and ISO 14001, it is anticipated that the implementation of the new ISO 50001 EnMS into our operation would not be difficult.

5.4 Golden Cup Printing Co., Ltd.

Golden Cup Printing Co., Ltd. (Golden Cup) was founded in Hong Kong in 1971 with the vision to become a world-class printer offering premium printing services to customers at home and abroad. We have developed from a small local printer to an industry leader with three production facilities in China as well as sales offices in Hong Kong and the United States. Golden Cup offers one-stop professional printing services covering every aspect of the production cycle, from design and pre-press to printing as well as a full range of binding and finishing processes.

We have realized the importance of sustainable and responsible business operations. With this revelation we have pioneered green printing in our production facilities at Dongguan, China, and have adopted innovative technologies and utilised new materials as a way to help protect the Planet Earth for our future generations. Our dedication to green manufacturing has rewarded us with the Cleaner Production Partner Recognition in 2009 and the Hong Kong Awards for Environmental Excellence – Bronze Award (Manufacturing Sector) in 2011.

Under the continuous endeavor on greening our manufacturing processes for the past 7 years, we have established a basket of energy management best practices. For instance, we have developed an inventory system for collecting our major energy consumption data, and conducted periodic review of energy data and performance as well as annual planning of energy reduction measures.

In terms of technology adoption, we are using a solar-powered water heating system which enables us to cut down electricity consumption by 250 thousand kilowatt-hours per year. We have also procured the more energy efficient 8-colour printing presses to substitute the 4-colour printing presses. We managed to save 1,700 kilowatt-hours per year. Within our facilities, we have minimized the air-conditioning dissipation by installing central vacuum pump and by diverting heat generated by the machines to outdoor via pipes. These have contributed to a further energy saving of about 140,000 kilowatt-hours annually.

In identifying further improvement opportunity, we have yet to establish a systematic Plan-Do-Check-Act management cycle with a comprehensive documentation process which is crucial for driving continual improvement in energy efficiency over time. We are now in the process of drafting all relevant documents and re-structuring all our current practices on energy management to align with the ISO 50001 system. We expect to derive fruitful results from making these positive changes.

The major difficulty we face in preparing for the ISO 50001 stems from the issue of data accuracy. To help us track the major sources of energy consumption, we have installed sets of mechanical energy meters at our facilities. However, due to technical wiring arrangement some energy consumption data could only be estimated at the best of our knowledge. There are also manual errors and meters' failure which affect the data accuracy.

To tackle this problem, our company is now exploring the feasibility of installing an electronic on-line energy management system. We expect this would save us money and manpower in data collection and help guarantee a more accurate set of data, which is essential to assisting our energy management work down the road.

5.5 New Area Toys (Zhuhai) Limited

New Area Toys (Zhuhai) Limited was established in 2002 and its mother company is Chee Wah (China) Toys Limited. We have employed more than 1,500 staff and our core business focuses on the production and export of toys. In the past 30 years of business operations in China, we have attained various management system standards and certifications including ISO9001, ISO14001, OHSAS18001, ICTI, C-TPAT and RoHS. In 2011, we have fulfilled five assessment and improvement criteria, and as a result won ourselves the "Hong Kong-Guangdong Cleaner Production Partners Recognition".

In order to complement the implementation of the Environmental Management System, we have actively carried out cleaner production to support the China's Policy on promotion of cleaner production. Building on the core principles of "energy saving and reduction, pollution reduction and enhanced efficiency", we strive to contribute to developing a sustainable society. Concurrently we are committed to achieving excellence in productivity to increase our competitiveness and sustainable development capacity.

With the growing public concern about the importance of energy management and the timely release of the ISO 50001 Energy Management System, we have sent our representatives to attend relevant seminars, training workshops and to get ourselves familiarized with the requirements and the importance of the system.

So far, we have identified some key shortfalls of our operation with respect to the ISO 50001 standard. Given the original infrastructural design of the electricity and water supply in the existing facilities' establishment, we will have to install a large number of individual energy meters for our facilities and machineries. Extra manpower and resources will need to be spent for such modification. This would present some challenges for us, however, we are confident that these will be overcome with the growing concern about sustainable development, corporate social responsibility and staying competitive in the industry.

After conducting an on-site assessment conducted by HKPC, we have identified our injection molding machines and the air compressors as the major sources of energy consumption. We will explore to conduct a more detailed energy assessment and audit in order to establish energy baseline and reduction targets to comply with the requirements of ISO 50001. We look forward to successfully fulfilling the requirement of the ISO 50001 energy management system audit in 2013.

Reference

1. World Energy Outlook 2012, International Energy Agency
   http://www.iea.org/
2. The British Broadcasting Corporation (BBC)
   http://news.bbc.co.uk/2/hi/science/nature/8422307.stm
3. United Nations Framework Convention on Climate Change
   http://unfccc.int/
4. European Commission
   http://ec.europa.eu/environment/climat/home_en.htm
5. Environment Protection Department
   http://www.epd.gov.hk/epd/english/climate_change/hkactions.html
6. Climate Change – What's Your Business Strategy?, by A. J. Hoffman and J. G. Woody, Harvard Business Press, 2008
7. TESCO Public Limited Company
   http://www.tescoplc.com/index.asp?pageid=153
8. Wal-Mart Stores, Inc.
   http://news.walmart.com/news-archive/2010/02/25/walmart-announces-goal-to-eliminate-20-million-metric-tons-of-greenhouse-gas-emissions-from-global-supply-chain
9. ISO50001:2011 Energy Management Systems – Requirements with Guidance for Use, International Organization for Standardization, 2011
10. Inside Energy – Developing and Management an ISO 50001 Energy Management System, by C. H. Eccleston, F. March and T. Cohen, CRC Press, 2012

Annex A Self Evaluation Checklist

Resources, roles, responsibility and authority

Requirements	Conformity		
	Y	N	N / A
1. Have the roles, responsibilities and authorities for energy management been defined and documented?			
2. Have a Management Representative and an Energy Management Team been designated?			
3. Have the roles, responsibilities, and authorities for the Management Representative and Energy Management Team been defined?			
4. Have the required resources (e.g. personnel, technology, finance) for implementation and control of the energy management system been provided by the management?			
5. Does the personnel appointed in energy management have the competence required?			

Energy policy

Requirements	Readiness		
	Y	N	N / A
1. Has the organization defined and documented its energy policy?			
2. Is the energy policy appropriate to the nature and the scale of, and the impact on the organization's energy use and consumption?			
3. Does the policy include commitments to • continual improvement of energy efficiency? • compliance with applicable legislation and other requirements? • support purchase of energy-efficient products and services?			
4. Does the energy policy provide a framework for setting energy objectives and targets?			
5. Has the energy policy been documented, implemented, maintained and communicated to all persons working for or on behalf of the organization?			
6. Has the energy policy been regularly reviewed and updated?			

Legal and other requirements

Requirements	Readiness		
	Y	N	N / A
1. Has a procedure been developed and implemented to identify applicable regulatory, legal and other requirements?			
2. Has the organization identified, implemented, and access to the applicable legal requirements and other requirements, which are related to its energy use, consumption and efficiency?			
3. Has the organization determined how the applicable legal requirements and other requirements apply to its energy use, consumption and efficiency?			
4. Are current copies of all applicable regulatory and other requirements accessible to personnel as necessary?			

Energy Review, Energy Baseline and Energy Performance Indicators (EnPIs)

Requirements	Readiness		
	Y	N	N / A
1. Has a procedure been established, implemented and maintained to identify the energy baseline and Energy Performance Indicators?			
2. Has energy baseline related to potential significant energy use been considered in establishing and implementing the EnMS?			
3. Has the organization identified the areas of significant energy use?			
4. Has the organization determined the current energy performance related to identified significant energy uses?			
5. Are all significant energy uses controlled by objectives, targets, and programmes, procedures or monitoring?			
6. Has the organization identified other relevant variables affecting significant energy uses?			

Energy objectives, energy targets and energy management action plans

Requirements	Readiness		
	Y	N	N / A
1. Have documented energy objectives and targets been established at relevant functions and levels within the organization?			
2. Are the energy objectives and energy targets specific, measurable, concrete and understandable?			
3. Are the objectives and targets consistent with the energy policy?			
4. Has an energy performance evaluation system been established to periodically review the achievement of the objectives and targets?			
5. Have action plans including the following items for the achievement of energy objectives and targets been established and implemented? • Designation of responsibility for achieving objectives and targets at each relevant function and level of the organization; • The means and time-frame by which the programmes are to be achieved; • The statement of the method by which an improvement in energy performance shall be verified; and • The statement of the method of verifying the results of the action plans.			
6. Have the action plans been documented and updated at defined intervals?			

Competence, training, and awareness

Requirements	Readiness		
	Y	N	N / A
1. Are all the personnel, related to significant energy uses, competent on the basis of appropriate education, training, skills or experience?			
2. Have training needs associated with the control of its significant energy uses and the operation of its EnMS been identified?			
3. Have procedures been established to assure that all the personnel working for or on behalf of the organization are aware of • the importance of conformity with the energy policy, procedures and the requirements of the EnMS? • their roles, responsibilities and authorities in achieving the requirements of the EnMS? • the benefits of improved energy performance? • the impacts, actual or potential of their activities and how their activities and behaviour contribute to the achievement of energy objectives and targets and the potential consequences of departure from specified procedures?			
4. Are training records, certificates and licenses maintained to demonstrate the competence?			

Communication

Requirements	Readiness		
	Y	N	N / A
1. Does the organization communicate internally with regard to its energy performance and the EnMS?			
2. Are procedures maintained for communication of energy issues between various levels of the organization?			
3. Has the organization established and implemented a process by which any person working for, or on behalf of, the organization can make comments or suggestions to EnMS?			
4. Has the organization decided whether its energy policy, EnMS and energy performance should be communicated externally?			
5. If so, are there any documented and implemented external communication plans?			

Documentation

Requirements	Readiness		
	Y	N	N / A
1. Have the core elements of the EnMS and their interaction been described in paper and / or electronic form?			
2. Are the following EnMS elements documented? • Scope and boundaries of the EnMS; • Energy policy; • Energy objectives, targets and action plans; and • Documents required by ISO 50001, e.g. energy review.			

Control of documents

Requirements	Readiness		
	Y	N	N / A
1. Are procedures maintained to ensure periodic review and appropriate approved distribution and revision of all required documents?			
2. Are current versions and changes of all required documents identified?			
3. Are documents of external origin that are to be necessary for the planning and operation of the EnMS identified and controlled?			
4. Is all documentation legible, readily retrievable and identifiable, and revision level or date identified?			
5. Are obsolete documents promptly removed or otherwise assured against unintended use?			

Operational control

Requirements	Readiness		
	Y	N	N / A
1. Have the operations and maintenance activities, which are related to significant energy uses and are consistent with energy policy, objectives and action plans, been identified and planned with the following considerations? • Establishing and setting criteria for the effective operation and maintenance of significant energy uses; • Operating and maintaining facilities, processes, systems and equipment in accordance with operational criteria; and • Appropriate communication of the operational controls to personnel working for the organization.			

Design

Requirements	Readiness		
	Y	N	N / A
1. Have procedures been implemented to identify and consider energy performance improvement opportunities and operational controls in the design of new, modified and renovated facilities, equipment, systems and processes?			
2. Are the design considerations documented?			

Procurement of energy services, products, equipment and energy

Requirements	Readiness		
	Y	N	N / A
1. Have the criteria for assessing energy use, consumption and efficiency over the lifetime of the product, equipment or service been established and implemented?			
2. Are specifications for items being purchased clearly defined and documented in the energy performance related requirements?			
3. Have energy performance related requirements been communicated to suppliers?			
4. Have suppliers been made aware that energy performance is part of the evaluation criteria?			

Monitoring and measurement

Requirements	Readiness		
	Y	N	N / A
1. Have procedures been documented and implemented to monitor the following key characteristics of operations that can have significant impacts? • Significant energy uses and other outputs of the energy review; • Relevant variables related to significant energy uses; • Energy performance indicators (EnPIs); • Effectiveness of the action plans in achieving objectives and targets; and • Evaluation of actual versus expected energy consumption.			
2. Are records available to track performance and conformity with the key characteristics?			
3. Has the energy measurement plan been defined and implemented?			
4. Are all monitoring equipment appropriately maintained and calibrated?			

Evaluation of compliance

Requirements	Readiness		
	Y	N	N / A
1. Are documented procedures established, implemented and maintained for periodical evaluation compliance with relevant energy legislation and other requirements related to energy use and consumption?			
2. Is the compliance status with regard to relevant energy legislation and other requirements related to energy use and consumption evaluated?			

Internal audit

Requirements	Readiness		
	Y	N	N / A
1. Have internal audit procedures been developed and implemented?			
2. Has the internal audit schedule been developed?			
3. Are the internal audits conducted to ensure that the EnMS • conforms to planned arrangements for energy management according to ISO 50001 standard requirements? • conforms with the energy objectives and targets established? • is effectively implemented and maintained, and improves energy performance?			
4. Are audit reports and records documented?			
5. Are the auditors conducting the audits competent and in a position to conduct the audits objectively and impartially?			

Nonconformity, corrective action and preventive action

Requirements	Readiness		
	Y	N	N / A
1. Have procedures been established to define the responsibility for handling, investigating and controlling, and mitigating nonconformity?			
2. Does the organization address the actual and potential nonconformities by making corrections, and by taking corrective and preventive actions with the following elements? • Reviewing nonconformities or potential nonconformities; • Determining the causes of nonconformities or potential nonconformities; • Evaluating the need of action to ensure that nonconformities do not occur or recur; • Determining and implementing the appropriate action needed; • Maintaining records of corrective and preventive actions; and • Reviewing the effectiveness of the corrective and preventive actions taken.			
3. Are procedures changed and / or updated as a result of corrective action and preventive action?			

Control of Records

Requirements	Readiness		
	Y	N	N / A
1. Have procedures been established and implemented for the identification, retrieval and retention of records?			
2. Are records legible, identifiable and traceable to the relevant activities?			
3. Does the organization retain the following records? • Training records; • Audit results; • Management review records; • Information on applicable energy laws and other requirements; • Inspection, maintenance and calibration records; • Information on significant energy use and energy performance indicators; • Procurement records; • Permits; • Monitoring data; • Details of nonconformities, incidents, complaints and follow-up actions; • Contractors and suppliers records; and • Process and product information.			

Management review

Requirements	Readiness		
	Y	N	N / A
1. Do periodic management reviews take place to ensure the continuing suitability, adequacy and effectiveness of the EnMS?			
2. Are management review records retained?			
3. Are the management reviews carried out based on the following documents or information? • EnMS audit reports; • Evaluation of compliance with legal requirements and other requirements to which the organisation subscribes; • Achievement of EnMS objectives and targets; • Communications and complaints on EnMS internally; • Energy policy; • Energy performance and related Energy performance indicators (EnPIs) of the organization; • Status of corrective and preventive actions; • Follow-up actions from previous management reviews; • Projected energy performance of the following period; • Changing circumstances, including developments in legal and other requirements related to its energy use; and • Recommendations for improvement.			
4. Are the management reviews included in the decisions or actions related to: • Energy performance of the organization; • Energy policy; • Energy performance indicators (EnPIs); • Objectives and targets of the EnMS; and • Allocation of resources.			

香港中小型企業總商會
The Hong Kong General Chamber of Small and Medium Business

日期：2013年6月10日(星期一)
時間：下午6：30 － 接待及雞尾酒會
下午7：00 － 晚會開幕
地點：香港會議展覽中心會議廳

【第八屆「最佳中小企業獎」及「中小企業最佳拍檔獎」頒獎典禮暨第十七屆周年晚宴就職典禮】

2012得獎企業 中小企業最佳拍檔獎 Best SME's Partner Award

最佳中小企業獎 Best SME's Award 2011-2012得獎企業

以上排名先後以會刊排列為準