Energy Management and Economics (EME)

Engineering professionals who intend to build their careers as energy managers need to understand principles related to the management and economics of energy. This module covers the setting up of energy management systems (including an introduction to ISO 50001), the formation of the energy management team and the integration of energy management systems into business practice. Also covered are Singapore's energy management policies and energy market tariff structure to enable better evaluation of supply contracts for reducing energy costs. Participants will also learn how to evaluate financial attractiveness of energy retrofit projects using simple payback, ROI, time value of money, etc and understand the various energy performance contracting models such as guaranteed savings and shared savings. Candidates taking the EME paper are to be familiar with:

1. Energy Conservation Act 2012; Energy Conservation (Energy Management Practices) Regulations 2013; revised 31st May 2014; amended 2 May 2017
2. SS/ISO50001 Energy Management Systems – Requirements with guidance for use
3. Energy Market Authority–Electricity Policies and Regulations

The following published standards are useful references:

1. ISO 50004-Energy management systems—Guidance for the implementation, maintenance, and improvement of an energy management system
2. ISO50006-Energy management systems—Measuring energy performance using energy baselines (EnB) and energy performance indicators (EnPI)—General principles and guidance
3. ISO50015-Energy management systems—Measurement and verification of energy performance of organizations—General principles and guidance

Energy Measurement and Appraisal (EMA)

Accurate energy measurement and analysis are essential for any energy improvement program. Accurate and continuous measurement of sub-systems energy demand and efficiency has been proven to lead to sustainable and highly efficient buildings. This module will equip participants with knowledge to accurately measure and analyse energy demand and efficiency of common mechanical and electrical systems in buildings together with an awareness of legislative requirements. Participants will learn fundamental principles of measuring instruments such as KW meters, temperature meters, flow meters, pressure meters and lux meters, their accuracy ranges and calibration methods. Participants will be taught how to conduct different levels of energy audit on common systems such as chiller plants, FCUs, AHUs and lighting in buildings, depending on the purpose of the audit. They will learn how to apply the appropriate measuring instruments, collect data, analyse the data, and draw useful conclusions.

Air Conditioning and Mechanical Ventilation (ACMV) Systems

ACMV systems are a major energy consumer in hot humid Singapore. Energy managers need a basic knowledge of ACMV systems to run the ACMV plant and equipment. Besides meeting the objectives of providing thermal comfort to occupants and other requirements, the energy manager must have the skills to operate the plant in an energy efficient manner. This module aims to integrate knowledge of thermodynamics, heat transfer and fluid mechanics to analyse the operating conditions of the ACMV plant with the objective of energy optimization. Major topics discussed in this module include occupant comfort and health, applications of refrigeration and air conditioning, vapour compression cycle, P-h diagram, coefficient of performance; selection of chillers, pumps, fans, ductwork, piping and cooling towers; psychometrics of air conditioning processes, energy efficient design and sustainable practices, operations and maintenance. Interpretation of the relevant codes of practice listed below will also be covered.

1. SS530-Code of practice for energy efficiency standard for building services and equipment
2. SS553-Code of practice for air-conditioning and mechanical ventilation in buildings
3. SS554-Code of practice for indoor air quality for air-conditioned buildings

Motor Driven Systems (MDS)

Engineers who manage energy and facilities need a good understanding of how motor driven systems work. The module provides participants with a basic understanding and knowledge of motor driven systems and the application of these systems. Major topics that will be discussed in this module include concept of power and energy, operation and characteristics of electric motors (DC shunt motor, DC series motor, DC compound motor, induction motor, synchronous motor), motor efficiency, speed control methods, selection and sizing of motors. Participants will also learn about types and key features of VSDs; driven systems, (pumps, fans, compressors, lifts and hoist, conveyor), affinity laws, sizing of motors and energy saving opportunities arising from interfacing the motor with the driven system.

Energy Recovery and Reuse (ERR)

Pinch analysis technique for synthesizing and retrofitting heat exchanger networks has been found effective in many industrial applications for improving energy recovery and reuse. Engineers, particularly those dealing with heat transfer processes and heat transfer equipment such as furnaces, heat exchangers and coolers, should know pinch analysis concepts and its applications for improving energy efficiency. Major topics that will be discussed in this module include pinch analysis concepts, heat balances and data extraction, finding heat recovery targets, heat exchanger network design, selection of utilities, heat and power systems and evaluating achievable energy savings versus investment; Other energy

recovery techniques including the use of absorption chillers, expanders, heat engines, heat pumps, etc as well as techniques and equipment for retrofitting existing heat exchanger networks. Industrial applications will be outlined, and the potential of energy recovery and reuse for improving energy efficiency in these applications will be discussed.

Note to Candidates: It is recommended for Candidates who opt for the ERR module to have basic knowledge and relevant working experience in the correct industry

Steam and Compressed Air Systems (SCAS)

Steam and compressed air systems consume significant energy in industrial plants. In addition, there are many opportunities to recover waste heat from various industrial processes. Therefore, energy efficient design and appropriate operation strategies for these systems have the potential to significantly reduce energy consumption in industrial facilities. Major topics discussed include the function of the various components in steam and compressed air systems, heat and mass transfer analysis, evaluation of system performance, potential for heat recovery, influence of different variables on energy optimization, energy efficient design, operation and control strategies, sustainable practices, selection and arrangement of heat recovery devices, operations, and maintenance.

Combined Heat and Power (CHP) Systems

The use of sustainable CHP systems versus conventional electrical power plants and fuel fired boilers can reduce the energy loss resulting in reduced emission and environmental impact. These combined power plants can also be made to function as cogeneration or trigeneration systems producing two or three useful effects simultaneously. Major topics discussed in this module include thermal concepts of CHP, the Brayton Cycle, vapour power cycles, power equipment and systems such as gas turbines, microturbines, fuel cells, steam turbines, etc; cogeneration systems; feasibility studies and regulatory issues related to on-site generation. Candidates taking the CHP Systems paper are to be familiar with:

1. Energy Market Authority–Policy on Direct Supply of Electricity by Generating Sets to On-site Loads (2002) and subsequent revisions in 2006 and 2008.

Building Envelope and Lighting Systems (BELS)

The façade together with the rest of the building envelope and roof contribute most to the solar heat gain of a building. Energy managers should be well-equipped with knowledge and technical skills to minimise these loads. Possession of a good knowledge of lighting products, systems, design & methods of integrating supplementary daylight will help energy managers to save on lighting and thermal loads. Major topics discussed in this module include façade systems (monocoque & hybrid), curtain and glass wall systems, energy and sustainability with different types of envelopes-shades & louvres; daylighting design

principles, concepts, tools and standards; calculation of ETTV and RETV wall, roof and fenestration of a building; lighting principles, eco-friendly lighting design, characteristics of lamps, LED, ballasts, lighting design method, control-upgrades for energy-efficiency and life-cycle comparison. Candidates taking the BELS paper are to be familiar with:

1. Code on Envelope Thermal Performance for Buildings (www.bca.gov.sg/performancebased/others/retv.pdf
2. Guidelines on Envelope Thermal Transfer Value for Buildings
3. SS531-1: Code of practice for lighting of workplaces–indoor lighting of workplaces
4. SS530: Energy Efficiency Standard for Building Services and Equipment
5. Structural use of glass in building (The Institute of Structural Engineers, December 1999)

Note to Candidates

Candidates are to refer to the latest versions of the Standards, Codes of Practice listed in the short descriptions above.