# THE PROFESSIONAL CAREER OF THE SINGAPORE CERTIFIED ENERGY MANAGER (SCEM)

The programme envisions an SCEM as:

**A competent energy professional equipped to perform technical and managerial functions as a qualified person in the areas of:**

- Energy assessments, management and measurements
- Energy retrofitting services
- Consultation and procurement services
- Facility and energy management
- Energy engineering works
- Basic financial advisory services for energy efficiency measures and contracting

It is designed as a voluntary professional career upgrading scheme, supporting the national effort to enhance energy efficiency services for businesses.

## APPLICATION FOR SCEM TRAINING GRANT

The SCEM Training Grant is a co-funding scheme administered by NEA to develop local expertise and capability in professional energy management.

**Eligibility for SCEM Training Grant**

Candidates who sign up for the **full SCEM Programme** (4 core modules and 2 elective modules) at Professional Level are eligible for the Training Grant.

In addition, Candidate must:

- Have a relevant Degree in engineering or science
- Be a Singaporean or Permanent Resident
- Have at least 1 year of relevant engineering experience in energy management of facilities; and applicant must furnish a company's letter of support from current employer, stating support for SCEM training and Grant application (please follow the format given in the application form)

**Conditions**

- Qualifying candidate need only pay a one-time fee of S$900.00 upfront for the full 144-hour professional level SCEM Programme. The NEA would subsidize the rest of the fees.
- Candidate must achieve at least 80% class attendance and attended the course examination.

## APPLICATION FOR SCEM CERTIFICATION

<table>
<tr><th rowspan="2">Level</th><th colspan="3">Criteria</th></tr>
<tr><th>Education</th><th>Relevant Experience</th><th>SCEM Training</th></tr>
<tr><td rowspan="2">Professional</td><td>IES Recognised Engineering Degree</td><td>2 years</td><td rowspan="2">▪ Pass 4 core modules and 2 elective modules within 24 months<br>▪ Attain minimum 80% attendance for all modules<br>▪ Attain minimum credit points of 15 out of 24<br>▪ Apply SCEM certification within 5 years from the date that the applicants pass the last training module</td></tr>
<tr><td>Degree (Others)</td><td>3 years + 2000 word report</td></tr>
<tr><td colspan="4">Candidates who meet the certification criteria may apply for SCEM certification to the SCEM Registry. A Certificate of Registration which is valid for three years will be issued to successful applicants.</td></tr>
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**For more information regarding the NEA's training grant and certification scheme, please log-on to www.e2singapore.gov.sg/scem.html*

**DETAILS OF CORE MODULES**

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| **Modules:** | **Energy Management and Economics** |
| **Objectives:** | • Understand how to set up a successful energy management program<br>• Understand the Singapore Energy Market and its pertinent market components and rules<br>• Understand the energy economic fundamentals and life cycle cost concept and calculation<br>• Be capable to carry out financial analysis and cost prediction for energy saving assessment |
| **Description of Contents:** | **1. Introduction to Energy Management System**<br>• Energy management concepts<br>• Tool for appraising Energy Management Performance of Organization<br>- Energy accounting, discussion on commonly used indices<br>- Case studies on energy accounting system<br>• Methodology for setting up an Energy Management System<br>• Energy monitoring, targeting and reporting<br>• Integration of Energy Management System into Business Practice<br>• Case studies of Energy Management Program<br>**2. Energy Market Overview**<br>• General energy costs for different energy sources<br>• Pertinent energy market rules<br>• Discussion on components of utility rates<br>• Review of vesting contracts with energy retailers<br>**3. Economic Analysis in Energy Efficiency Investments**<br>• Life cycle cost concept in economic analysis<br>- The importance of life cycle cost concepts in the economic analysis of projects<br>- The life cycle cost approach is mandated as the means of evaluating cost effectiveness<br>- The characters considered in the life cycle cost<br>• Time value of money concept<br>- Introduction of the time value of money: interest and inflation<br>- Definition of the time value of money factors<br>- The mathematics of interest: simple interest and compound interest<br>- Calculation of different types of cash flows: single sum cash flows, series cash flows, uniform series cash flows and gradient series of cash flow<br>• Cost effectiveness analysis<br>- Introduction on the five (5) methods which are used to evaluate the attractiveness of a single investment opportunity - present worth, annual worth, internal rate of return, savings investment ratio and payback period.<br>- Definition and calculation of the five (5) methods<br>• Economic models of optimal energy use<br>- Review of the economic models which applied in optimizing energy usages<br>- Selecting the best economic models for individual application |

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| | • Energy policies (e.g. tax refunding and so on)<br>• Reviewing roles of energy performance contracting and case studies<br>• Case studies |

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| **Modules:** | **Energy Measurement & Appraisal** |
| **Objectives:** | • Be able to lead detailed energy audit, perform energy performance diagnosis and analysis, prepare and provide sound recommendation and report |
| **Description of Contents:** | **1. Introduction and definition of different Energy Audit Level[1]**<br>• The differences between these three (3) levels<br>- Level I Audit – Preliminary<br>- Level II Audit – Standard<br>- Level III Audit – Detailed<br>**2. Scope of Works of the Three (3) Audit Levels**<br>• Level I Audit – Preliminary<br>- Walk through assessment<br>• Level II Audit – Standard<br>- Facility data collection<br>- Utility bill analysis<br>- Energy-use profiling<br>- Comparison with benchmark<br>- Short-listing of energy saving measures<br>• Level III Audit – Detailed<br>- Introductory meeting and audit meeting<br>- Detailed data collection<br>▪ Boiler and steam distribution system<br>▪ Air-conditioning and refrigeration system<br>▪ Electrical supply system<br>▪ Lighting system<br>▪ Hot water distribution system<br>▪ Compressed air and air distribution system<br>▪ Motors and motor system<br>▪ Manufacturing Process<br>- Data analysis<br>- Identification of energy saving measures<br>▪ Common energy saving measures for building and industrial systems<br>▪ Analysis of technical and economic feasibility<br>- Baseline data for savings verification<br>• Energy audit work at level III- Case Studies on building and industrial sectors<br>**3. Energy Measurement and Verification (M&V)**<br>• Introduction of International Performance Measurement and Verification Protocol (IPMVP), ASHRAE 14P and other relevant internationally recognized protocols<br>• Setup of M&V processes and planning<br>• Different M&V methods and basic framework for M&V<br>• Common pitfalls which can result in unreliable data<br>• Case studies on process of designing a proper M&V program for projects, including |

[1] Energy Sustainability Unit, Application Guidelines for the Assessment and Accreditation of Energy Services Companies (Auditing Services), ESCO Singapore.

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| | cost/accuracy tradeoffs, baseline adjustments and the role of verifiers.<br><br>**4. Instrumentation and Measurement Accuracy**<br><br>• The need for measurement<br><br>• Instruments and sensors for building and industrial systems:<br>- temperature<br>- pressure<br>- flow<br>- level<br>- humidity<br>- electrical parameters<br>- light intensity<br><br>• Thermography<br><br>• Data acquisition system<br><br>• Calibration<br><br>• Impact of measurement accuracy (including instrument and system errors) on audit results<br><br>• Practical considerations<br><br>• Case studies<br><br>**5. Audit Reporting**<br><br>• Self-evaluation checklists<br>- Major factors of energy consumption in different audit levels (overall or specialized)<br>- Profile of energy uses and performance with established benchmarking systems<br>- Transferable techniques for saving energy<br>- Guidance to pinpoint modifications to reduce energy consumption<br><br>• Financial analysis for predicted savings<br>- Energy accounting system (accounting input & output)<br>- Identification of considerable impacts<br>- Methodologies of energy economic decision making<br><br>• Guidelines on the scope and contents of audit report, with case studies<br><br>**6. Workplace Occupational Safety and Health**<br><br>• Introduction to the local regulations and codes of practice<br><br>• General duties of person at workplace Individual responsibilities<br><br>Workplace safety management system (e.g. Electrical safety at work) |

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| **Modules:** | **Air-Conditioning and Mechanical Ventilation System (ACMV)** |
| **Objectives:** | • Understand the functions and components of the ACMV systems<br>• Understand and recognize ACMV systems energy performance characteristics and be able to analyze the potential energy saving in ACMV systems<br>• Be able to operate and maintain energy-efficient chilled water and air distribution systems, resulting in optimum ACMV system performance |
| **Description of Contents:** | • Introduction to heat flow and heat flow calculations for ACMV system<br><br>• Introduction of ACMV system, design, installation and operation & maintenance |

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| | • Fundamentals of air distribution systems: coils, dampers, filters and air cleaners, ductwork, valves, fans etc<br><br>• Review and comparison of different ACMV systems' types and new technologies<br>- Compressor types and application<br><br>• Understanding the vapour-compression cycle and the components necessary for operation<br><br>• Determining the air-conditioning loads<br><br>• Refrigerant management, rules and regulations<br><br>• Considerations for energy- and resource-efficient ACMV design (http://www.wbdg.org/resources/hvac.php?r=dd_hvaceng)<br><br>• Living style and buildings: concepts of indoor air quality and its relationship with ACMV system<br>- Heat-transfer processes used by the human body and factors influencing thermal comfort<br>- Solutions & prevention of IAQ problems<br><br>• Methods of optimizing and reducing energy consumption in ACMV systems<br>- Selection of system<br>- Pumps and piping<br>- Selection and operation of cooling towers<br>- Fan performance<br><br>• Commissioning of ACMV System<br><br>• Instrumentation for monitoring central chilled-water plant efficiency (ASHRAE Guideline 22-2008), with case studies on how it maximizes the chiller plant and components' efficiencies<br>- Discussion on methods and devices used to measure electrical usage, fluid flow, and temperature<br>- Site-specific procedures for acquiring the necessary data and calculating system efficiency<br><br>• Design process and the basic sequences involved in ACMV control system design |

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| **Modules:** | **Motor Driven Systems** |
| **Objectives:** | • Understand and recognize motor driven systems energy performance characteristics<br>• Be able to analyze the potential energy saving in motor driven systems/ processes |
| **Description of Contents:** | • Energy saving potential opportunities with energy efficient motors<br>- Introduction of different type of motors<br>- Choosing the motor size according to the load and motor configurations, with case studies<br><br>• Rewinding and motor replacement issues<br><br>• Identifying the factors that will affect the efficiency of motor driven systems (e.g. Motor efficiency, motor control, proper sizing, power (supply) quality, losses in the supply, mechanical transmission, maintenance practices, end-use efficiency and so on)<br>- Motors, pumps, fans, compressors and heat pumps<br><br>• Calculation of motor driven systems' efficiency / Definition and minimization of the losses in the motor driven systems (including partial load)<br><br>• Optimization of the motor driven systems<br><br>• Case studies |

**DETAILS OF ELECTIVE MODULES (INDUSTRY SECTOR)**

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| **Modules:** | **Combined Heat and Power (CHP) Systems** |
| **Objectives:** | • Be able to analyze the potential energy saving in industrial processes<br>• Understand and recognize industrial plants and systems energy performance characteristics, resource conservation and waste regeneration |
| **Description of Contents:** | • Introduction of district cooling, thermal storage and industrial plants with combined heat and power system- Deeding systems<br>- Cooling systems<br>- Power generation system<br>- Exhausting system<br>• Benefits of CHP<br>• Determine the Economics of a CHP<br>• Permitting, Installing, Operating & Maintaining A Cogeneration System<br>• Calculation on energy efficiency of a CHP<br>• Definition of the possibilities of reducing the energy losses inside a CHP<br>• Optimization of the CHP output energy |

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| **Modules:** | **Steam & Compressed Air Systems** |
| **Objectives:** | • Be able to analyze the potential energy saving in industrial processes<br>• Understand and recognize industrial plants and systems energy performance characteristics, resource conservation and waste regeneration |
| **Description of Contents:** | • Steam technologies and application<br>- General introduction and application of steam<br>- Utilization and development of steam turbine & steam engine<br>- Technologies of boilers<br>- Calculation of steam turbine & steam engine's efficiencies<br>- Steam management and pinch technology<br>• Compressed air system technologies<br>- General introduction and application of compressed air systems<br>- The components of compressed air system<br>- Optimization of the compressed air system<br>• Waste Heat recovery<br>- Classification of waste heat recovery systems<br>- Advantages and applications<br>- Commercially viable waste heat recovery equipment<br>- Saving potential<br>• Safety consideration in Steam and compressed air systems |