



INDUSTRIAL ENERGY EFFICIENCY FOR MALAYSIAN MANUFACTURING SECTOR (IEEMMS)

OUTPUT AND IMPACT OF THE IEEMMS PROJECT

Kuala Lumpur

April 2017

PROJECT DETAILS, UNIDO AND THE FUND

Project Details

Project Name:	Industrial Energy Efficiency for Malaysian Manufacturing Sector (IEEMMS) ¹
Project Duration:	29 th June 2011 to 30 th April 2017
Funded By:	The Global Environment Facility (GEF) Trust Fund
Implementing Agency:	United Nations Industrial Organisation (UNIDO)
Registration Details	UNIDO project No.: GF/MAL/11/002 UNIDO SAP ID: 103042 GEF ID: 3908
Executing Agency:	MITI; SME Corporation
Coordinating Agency:	SIRIM Bhd. (Training); Suruhanjaya Tenaga, Federation of Malaysia Manufacturers
Major Partners:	Ministry of International Trade and Industry (MITI), Ministry of Ministry of Energy, Green Technology and Water (KeTTHA); Economic Planning Unit

UNIDO

The United Nations Industrial Development Organization (UNIDO) is a specialized agency of the United Nations that promotes and accelerates inclusive and sustainable industrial development in developing countries and economies in transition, for poverty reduction, inclusive globalization and environmental sustainability².

UNIDO's Industrial Energy Efficiency (IEE) Division³ is responsible for promoting the efficient use of energy by industry and the dissemination of industrial energy efficiency (EE) best operating practices and technologies in order to accelerate economic growth and enhance competitiveness and job creation, while addressing climate change. The IEE Division places

¹ <http://ieemms.org/>

² <http://www.unido.org/who-we-are/unido-in-brief.html?L=2%27A%3D1%27>

³

https://www.unido.org/fileadmin/user_media_upgrade/What_we_do/Topics/Energy_access/UNIDO_ENE_RGY_Branch_2015.pdf

particular emphasis on addressing the energy efficiency (EE) requirements of SMEs, as they represent the backbone of socioeconomic development in a country.

As of November 2016, the UNIDO IEE Division's project portfolio amounts to around US\$ 105 million, with a widespread geographical coverage of over 20 countries, including 4 least developed countries. The three core thematic areas of the UNIDO IEE programme are: (a) policy development and standards; (b) capacity-building and awareness-raising; (c) technology demonstration and upscaling. Furthermore, UNIDO's IEE programme focuses on promoting the implementation of energy management systems based on the International Organisation for Standardization's (ISO) 50001 energy management standard, and energy system optimization; both approaches assist industry in continual and system-wide IEE improvement.

As UNIDO is already managing similar programs to the IEEMMS project in a number of other countries, it is envisaged that Malaysia will benefit from the shared development of high value materials and software, as well as program implementation experiences and suggestions. Additionally, UNIDO provides an access to internationally recognized UNIDO experts with extensive industrial experience, who will train the national experts on a practical approach to energy management and system optimization.

The Fund

The GEF was established at the 1992 Rio Earth Summit, to act as a catalyst for action on the environment. Through its strategic investments, GEF funds projects and programs that protects the global environment. It also aims to reduce poverty, strengthen governance and achieve greater equality between women and men⁴.

The fund allocation criteria include:

- i. Projects that contributes to the national priorities, and have the support of the country involved.
- ii. Supports the improvement to the global environment or advance the prospect of reducing risks to it.

GEF funds are available to developing countries and countries with economies in transition to meet the objectives of the international environmental conventions and agreements. GEF support is provided to government agencies, civil society organisations, private sector companies, research institutions, among the broad diversity of potential partners, to implement projects and programs in recipient countries.

³ <https://open.unido.org/api/documents/4882105/download/Energy%20Vision%202020%20-%20Sustainable%20Energy%20and%20Climate%20Action%20for%20Inclusive%20Industrial%20Development>

⁴ <https://www.thegef.org/>

ACKNOWLEDGEMENT

As the IEEMMS Project has been tasked with promoting energy efficiency improvements in the Malaysian manufacturing sector, namely through the implementation of the National Energy Management Standard and application of System Optimization, it had the opportunity to work closely with various different government ministries/ agencies, and its related subsidiaries and organisations.

The Program Manager is based at UNIDO headquarters in Vienna. From 2011 - 2015 the Program Manager was Mr. Khac Tiep Nguyen and he was subsequently replaced by Mr Sanjaya Shresta in 2016. The Project Management Unit (PMU) in Malaysia was led by a National Project Manager - Ir. Dr K S Kannan since December 2011 and Assistant Project Manager, Ms. Kaveta Chelliah since February 2012. They have contributed to the successful collaboration, cooperation and implementation till the end of the project.

At the Project Steering level, the Project Management Unit (PMU) worked closely with Ministry of Energy, Green Technology and Water (KeTTHA) and Ministry of International Trade and Industry (MITI), whose continuous support resulted in the accomplishment and achievement of desirable outcomes for the project.

The project also partnered various different government ministries/ agencies as well as related subsidiaries and organisations to implement and execute the various components of the project. The Policy Development component was supported by KeTTHA, ST and EPU. The Energy Awareness component was coordinated with SME Corp, ST and FMM, and the Energy Management component was implemented with SIRIM, ST and FMM. The PMU teamed with FMM for the System Optimization component and for the Financing component, the project cooperated with SME Corp and financial institutions. The beneficiaries were the industries (large and medium- sized) and their participation has been key to the project's success. The project's close relationship with the project executing and coordinating partners listed above enabled it to thrive and achieve many milestones during the implementation stage.

The Technical Advisory & Coordinating committee represented by FMM, ST, SIRIM as well as the industry players was also instrumental in supporting the UNIDO IEEMMS project team throughout the project implementation stage. Indeed, the support provided to the national team has been invaluable.

The Project's secretariat was based at SME Corp Malaysia and was centrally located. UNIDO acknowledges the space and facilities provided by SME Corp and thanks all related SME Corp staff for their assistance and cooperation rendered towards the implementation of the project

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ABBREVIATIONS

APEC	Asia-Pacific Economic Cooperation
EC	Energy Commission
EE	Energy Efficiency
EnMS	Energy Management System
EPC	Energy Performance Contract
EPU	Economic Planning Unit
eTOU	Enhanced Time of Use
FMM	Federation of Malaysian Manufacturers
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gas
GJ	Gigajoules
GoM	Government of Malaysia
GTFS	Green Technology Financing Scheme
IEE	Industrial Energy Efficiency
IEEMMS	Industrial Energy Efficiency for the Malaysian Manufacturing Sector
ISO	International Standard Organisation
KeTTHA	Ministry of Energy, Green Technology and Water
MAESCO	Association of Energy Service Companies
M&E	Monitoring and Evaluation
MIDA	Malaysian Investment Development Authority
MIEEIP	Malaysian Industrial Energy Efficiency Improvement Project
MITI	Ministry of International Trade and Industry
MPO	Malaysia Productivity Organisation
MS	Malaysian Standard
MTE	Mid-term evaluation
MW	Megawatt
NDC	Nationally Determined Contributions
NEEAP	National Energy Efficiency Action Plan
PIR	Project Implementation Report
PMU	Project Management unit
PSC	Project Steering Committee
QAS	Quality Assurance Systems
RE	Renewable energy
RM	Malaysian Ringgit
SCORE	SME Competitiveness Rating for Enhancement
SEC	Specific Energy Consumption
SEDA	Sustainable Energy Development Authority
SME	Small and medium enterprises
SO	System Optimization
TAC	Technical Advisory Committee
t	tonne(s)
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework on Climate Change Convention
UNIDO	United Nations Industrial Development Organisation
UNITEN	Universiti Tenaga Nasional
WWF	World Wildlife Fund

EXECUTIVE SUMMARY

As two-thirds of the current global greenhouse-gas (GHG) emissions are generated from energy production and use, the energy policies are looking into transformational changes. The global trend is heading towards transition to low-carbon development paths, low-carbon energy systems, scaled-up actions in energy efficiency and adoption of renewable energy options.

The total energy consumption in Malaysia for 2014 for industrial sector is 13,162 ktoe, the second largest consumer of energy (25.2%). As the total energy use of transport, industrial and commercial sectors are increasing over past years, progressive actions are needed to reduce nation's energy consumption. This will also support the commitment to reduce Malaysia's GHG intensity of Gross Domestic Product (GDP) by at least 35% by 2030, relative to the emissions intensity of GDP in 2005. For energy sectors, proactive EE measures, investments and incentives, introduction of National Energy Efficiency Action Plan (NEEAP) and Minimum Energy Performance Standards (MEPS), removing market distortions by rationalising subsidies and enhanced Time of Use (eTOU) tariff scheme are a few major actions formulated to improve our nation's energy use and efficiency.

The IEEMMS project was implemented from 1st December 2011 until 30 April, 2017. It is also instrumental for initiation of a few EE actions by Malaysia as listed above. The IEEMMS project is a recipient of GEF climate finance with the objective to promote energy efficiency improvements in the manufacturing sector, namely through the implementation of the National Energy Management Standard (EnMS) and application of System Optimization (SO) for large and small to medium enterprise (SME) industries in Malaysia.

The project facilitates EE improvement in the manufacturing sector by supporting the development of a National Energy Management Standard and energy efficiency services, as well as the creation of demonstration projects. The IEEMMS project implementation has enhanced the national EE regulatory framework, widespread awareness of the benefits of EE amongst SMEs and larger industries, produced a cadre of highly specialized EnMS and SO experts from the public and private sectors, as well as supported the access to technical and financial assistance for implementing EE projects.

The project has worked closely with various different government ministries/ agencies, its related subsidiaries and private organisations. The primary target groups of the project are industrial decision-makers (managers), engineers, vendors and other professionals and IEE policy-making and/or implementing institutions. For coordination purpose, a Project Steering Committee (PSC) co-chaired by both KeTTHA and MITI was established. The activities implementation is managed by the Project Management Unit (PMU) and for continuous project design improvement, a Technical Advisory Committee (TAC) was established.

The IEEMMS project implementation activities encompasses awareness raising and capacity building. It has identified and invited more than 2,000 organisations in Malaysia from different industries and organisation to be trained in the EnMS standard. The capacity building programmes were conducted in three stages; a half-day awareness workshop, 2-days User Training on Malaysian Standard (MS) ISO 5001 and EnMS experts training.

The half-day awareness workshop was delivered across the nation with in-kind contribution from government agencies and business associations. The 2-days User Training on MS ISO 50001 was participated by about 530 participants (those who already attended the half-day awareness workshop). The EnMS experts' intensive training (mentoring and on-the-job) was delivered by the UNIDO international team experts to 280 national experts from 39 organisations. Among the 39 organisations, 5 companies have successfully been certified with ISO 50001. About 149 factories are in various stages of implementing EnMS associated operational improvement. To date 38 companies are implementing MS ISO 50001 compatible energy management plans.

The overall energy efficiency practices in industries requires SO at both the design and operational levels. The IIEEMMS SO project were also designed at three levels; experts, users and vendors. The ½ Day Equipment Vendor Trainings were organised to local equipment vendors, suppliers and manufacturers. This training was designed to be supplementary to the 2-days User Training. The 2 days User Training was conducted on equipment, systems assessment, and identification of optimization measures, development and implementation of operational improvements. The selected equipment for trainings are Pumps, Fans, Air Compressors and Boilers according to the demand in the emerging energy market. The Experts training is an intensive training delivered by leading international SO experts to national energy efficiency experts, service providers, equipment vendors and industry engineers. This training provided more in-depth technical information on troubleshooting and making improvements to industrial systems.

The project has resulted in extensive capacity building and involvement of industries both in the implementation of MS ISO 50001- Energy Management System and System Optimization. The IIEEMMS project implementation has an approximate total energy saving of 4,865 GWh, derived from 69 companies (both EnMS and SO), since 2014. The total annual cost reduction from energy saving is estimated as RM 73.65 million, with GHG reduction of approximately 3.4 million tCO₂. Summary of project implementation and results are summarized below:

IEEMMS PROJECT OUTPUTS	
Item	Details
Policy	<ul style="list-style-type: none"> ✓ Participated in NEEAP, RMK 11, MEPS (electrical motor) ✓ Proposed database system for Energy Commission
Awareness	<ul style="list-style-type: none"> ✓ Awareness training throughout the country ✓ Trainings in collaboration with stakeholders, municipalities and other agencies
Information Exchange	<ul style="list-style-type: none"> ✓ Project brochures ✓ Project website ✓ Information and project management network – Basecamp, GoToTraining, Dropbox and others ✓ Newsletters (3 editions) ✓ IEEMMS Open Day and Final Certification Ceremony (2 major events) ✓ Project Video
Capacity Building	<ul style="list-style-type: none"> ✓ Energy Management System (EnMS) in line with MS ISO 50001 <ul style="list-style-type: none"> ○ User Training: 14 trainings attended by 530 participants & ○ Expert Training : 2 rounds with 77 participants ✓ Compressed Air System Optimization (CASO) <ul style="list-style-type: none"> ○ User Training: 8 trainings attended by 269 participants ○ Expert Training : 2 rounds with 48 participants ✓ Pump System Optimization (PSO) <ul style="list-style-type: none"> ○ User Training: 7 trainings with 289 participants ○ Expert Training : 2 rounds with 35 participants ✓ Fan System Optimization (FSO) <ul style="list-style-type: none"> ○ User Training: 7 trainings with 286 participants ○ Expert Training : 2 rounds with 31 participants ✓ Steam System Optimization (SSO) <ul style="list-style-type: none"> ○ User Training: 9 trainings with 217 participants ○ Expert Training : 2 rounds with 40 participants <p>Total number of EnMS Experts produced: 51 Total number of Systems Optimizations Experts produced: 88</p>
EnMS & SO Implementation	<ul style="list-style-type: none"> ✓ Total number of industries reached; direct = 309 direct & indirect = 1,500 industries ✓ Total number of successfully completed EnMS and Systems Optimization implementation = 49 ✓ Number of industries completed ISO 50001 requirement/guideline = 40 ✓ Number of industries with ISO 50001 certification (that was involved directly with the project) = 5
Financing	<ul style="list-style-type: none"> ✓ Brochures ✓ Number of workshops = 4 meetings and 1 workshop ✓ Concept of ESCO/EPC ✓ Financing mechanism – Proposal to SME Corp for Green Financing

1.0 INTRODUCTION

1.1 Energy Efficiency and UN Framework Convention on Climate Change (UNFCCC) commitments

Energy production and use account for around two-thirds of global greenhouse gas (GHG) emissions. Thus, the fight against GHG emissions reduction and climate change has become a defining feature in global energy policy making. Although countries pledged their emission reduction goals under the United Nations Framework Convention on Climate Change (UNFCCC), there will still be about 13.7 billion tonnes of CO₂ or 60% above the level needed to remain on track to limit global warming to 2°C until 2035.

The Paris Agreement negotiated at COP 21 in December 2015 is a major milestone for a transformational change for the energy sector. The Paris Agreement on climate change entered into force in November 2016, and it is anticipated that the climate pledges shall slow down the energy sector emissions growth dramatically, with the transition to low-carbon development paths and low-carbon energy systems. Delivering on the promise of the Paris Agreement will require an unprecedented shift in global energy systems, both to implement the current Nationally Determined Contributions (NDCs) and to go beyond them⁵.

Scaled-up action in EE and renewable energy is vital to deliver the NDCs, and these measures will also be the largest contributors in moving beyond the NDCs to a pathway consistent with limiting warming to 2°C, as shown in Figure 1. Technologies and others actions i.e. carbon capture and storage (CCS), nuclear energy and end-use fuel switching will also support to meet the NDC targets.

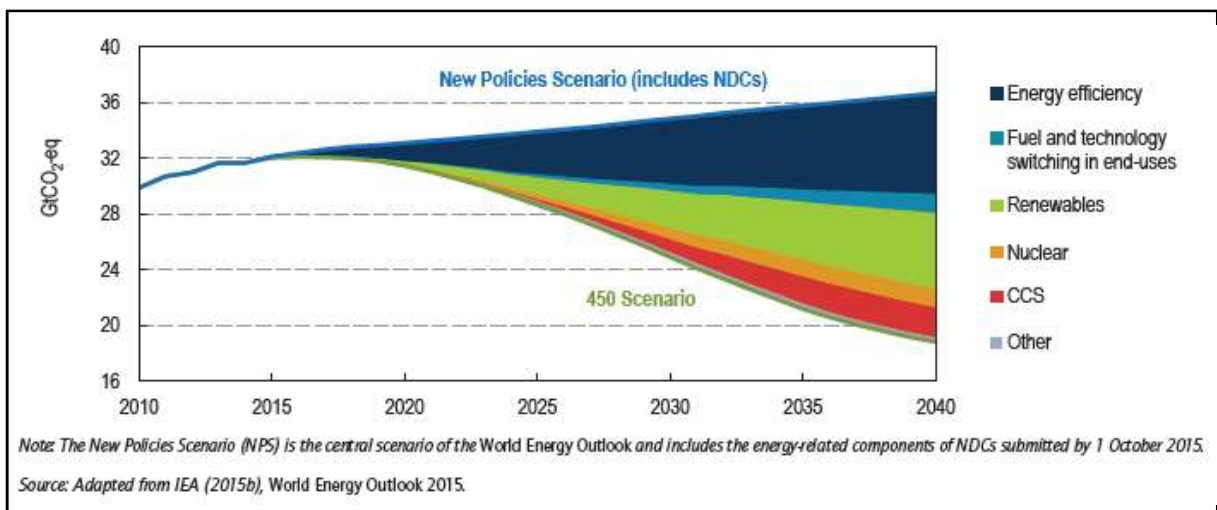


Figure 1: Measures needed to surpass current NDCs to reach trajectory (450 scenario), 2010 to 2040⁶

⁵ <http://www.iea.org/publications/freepublications/publication/ECCE2016.pdf>

⁶ <http://www.iea.org/publications/freepublications/publication/ECCE2016.pdf>

1.1.1 Malaysia and UNFCCC Commitment

The Malaysian environmental policy started as early as in the 1970s, with significant changes in early 2000s. Malaysia ratified the UNFCCC on July 13, 1994 and the Kyoto Protocol on September 2002. As part of the obligations assumed as a party of the UNFCCC, the Ministry of Natural Resources and Environment (NRE) Malaysia submitted its First National Communication (NC) Report in 2000 and the Second NC Report was submitted in January of 2011 with the assistance of the UNDP/GEF⁷.

Due to the recognised challenges presented by climate change and the need for a comprehensive approach, in 2005 the NRE, in collaboration with the Institute for Environment and Development (LESTARI) and the Universiti Kebangsaan Malaysia (UKM), initiated a Policy Study on Climate Change. Resulting from this, the 2009 National Policy on Climate Change consists of several key elements that include objectives, principles, strategic thrusts, and key actions aimed at ensuring climate-resilient development and low carbon economy. In parallel, the Ministry of Energy, Green Technology and Water (KeTTHA) pursued relevant policies including support for alternative fuels and green technology and the formulation of a National Policy on Green Technology, including green vehicles. As the energy use and CO₂ emissions are acknowledged as important issues, individual government projects and policies are aimed at curtailing energy consumption and GHG emissions.

For national Intended Nationally Determined Contributions (INDC) declaration, Malaysia intends to reduce its greenhouse gas (GHG) emissions intensity of GDP by 45% by 2030 relative to the emissions intensity of GDP in 2005. This consists of 35% on an unconditional basis and a further 10% is conditional upon receipt of climate finance, technology transfer and capacity building from developed countries⁸. Malaysia also reaffirmed its commitment to maintain at least 50% level of forest and tree cover during COP 21 in Paris.

1.1.2 Malaysia and Industrial Energy Consumption Analysis

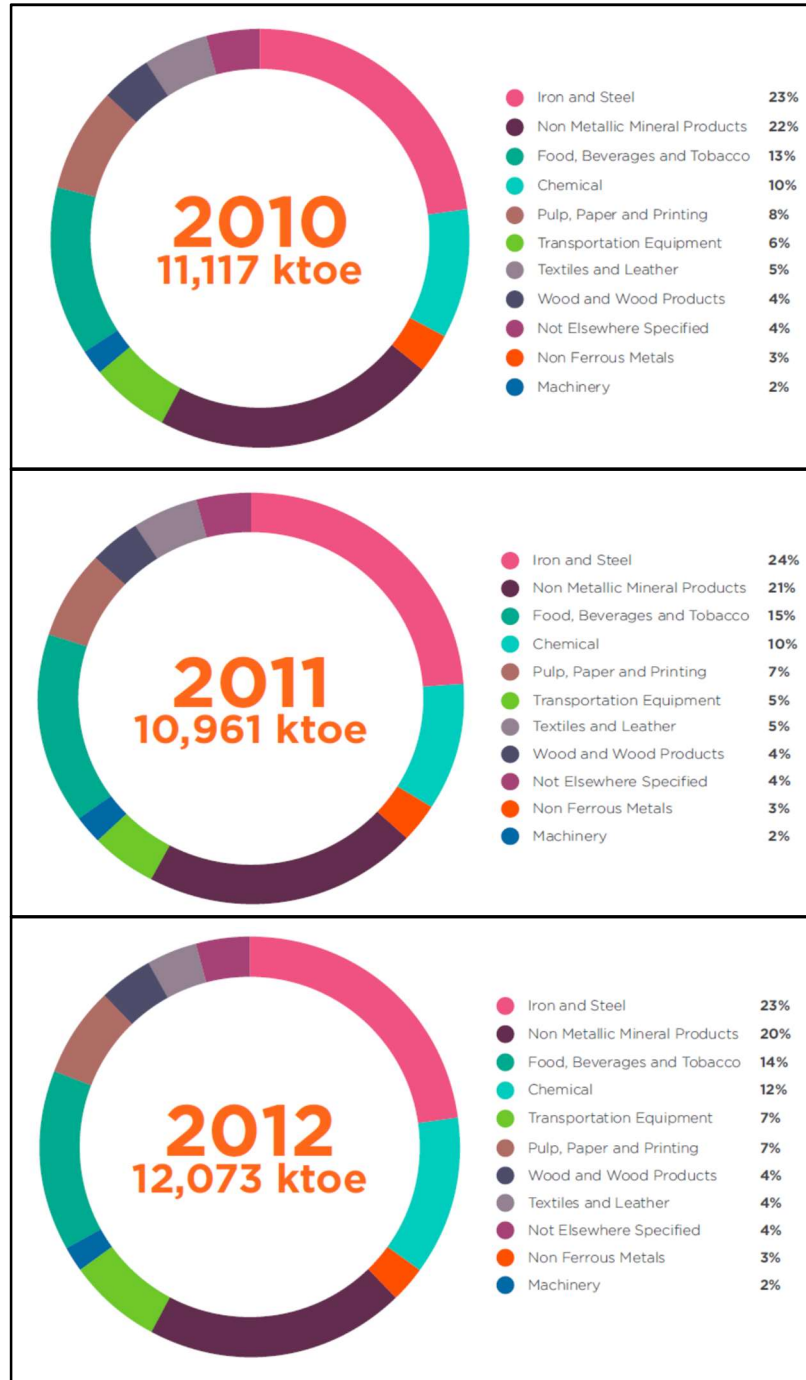
The National Energy Balance 2014 include a chapter on manufacturing industry in Peninsular Malaysia, reporting the energy consumption of the surveyed 520 manufacturing industries. The sub-sectors of the manufacturing industry were iron and steel, chemical (including petro-chemical), non-ferrous metals, non-metallic mineral products, transportation equipment, machinery, food, beverages and tobacco, pulp, paper and printing, wood and wood products, textiles and leather and not-elsewhere specified industry. The breakdown of sub-sectors was

⁷ <https://info.undp.org/docs/pdc/Documents/MYS/TNC%20signed%20prod.doc.pdf>

⁸ Intended Nationally Determined Contribution (INDC) of the Government of Malaysia, Final, 27th November 2015

referenced to the International Energy Agency (IEA) and APEC format of classification of the industrial sector.

Monthly data of energy consumption were collected from 2010 to 2014 for eight types of energy source; electricity, natural gas, petrol, diesel, fuel oil, LPG, kerosene and coal. Figure 2 summarizes the final energy consumption by sub-sectors in the manufacturing sector, 2010 – 2014.



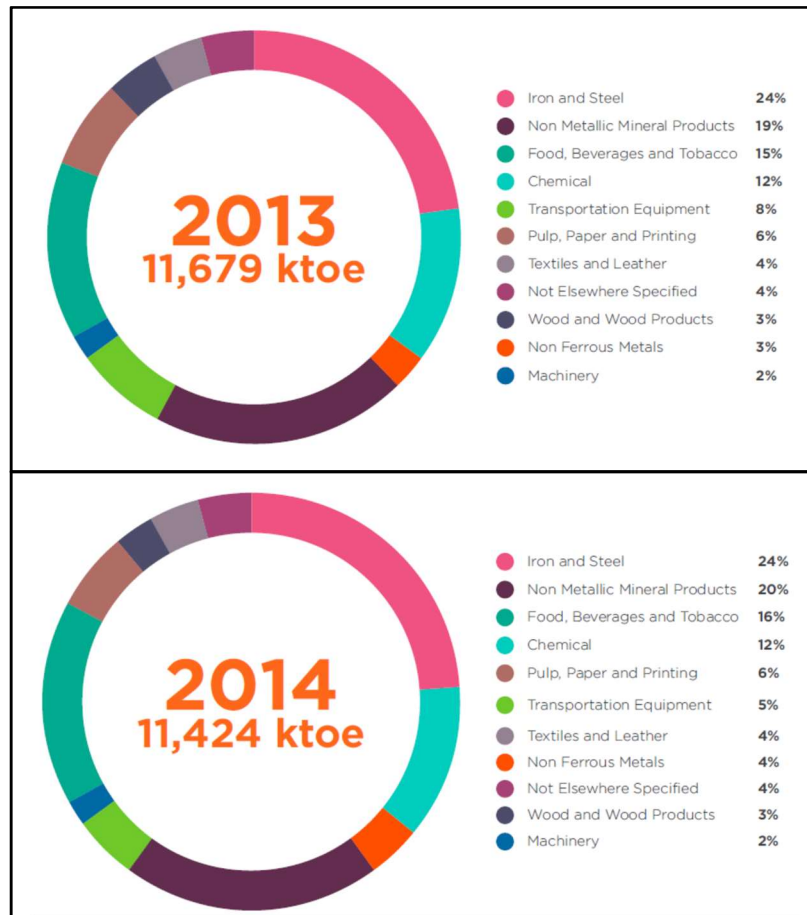


Figure 2: Analysis of the final energy consumption by sub-sectors in manufacturing sector, 2010 – 2014

However, there are no recent studies on energy consumption within the industry end use energy consumption (the internal process). The data collected in a study by Masjuki H.H. et.al back in 2006 summarizes that electrical motors consumed the highest amount of energy (47.05%), followed by pumps (13.75%), air compressors (8.85%), air conditioning systems (7.21%), workshop machines (6%), lighting (5.65%), overhead cranes (3%), ventilation (1.96%), furnace (1.26%), conveyor systems (1%), boilers (0.88%), refrigeration systems (0.49%) and other equipment (2.9%).

Figure 3 shows the breakdown of end use energy consumption in industries. As electric motors consume the major part of industrial energy, several measures could be taken to reduce their energy consumption. From the survey and data analysis it was found that most factories still use standard motors even though some have knowledge of energy efficient motors.

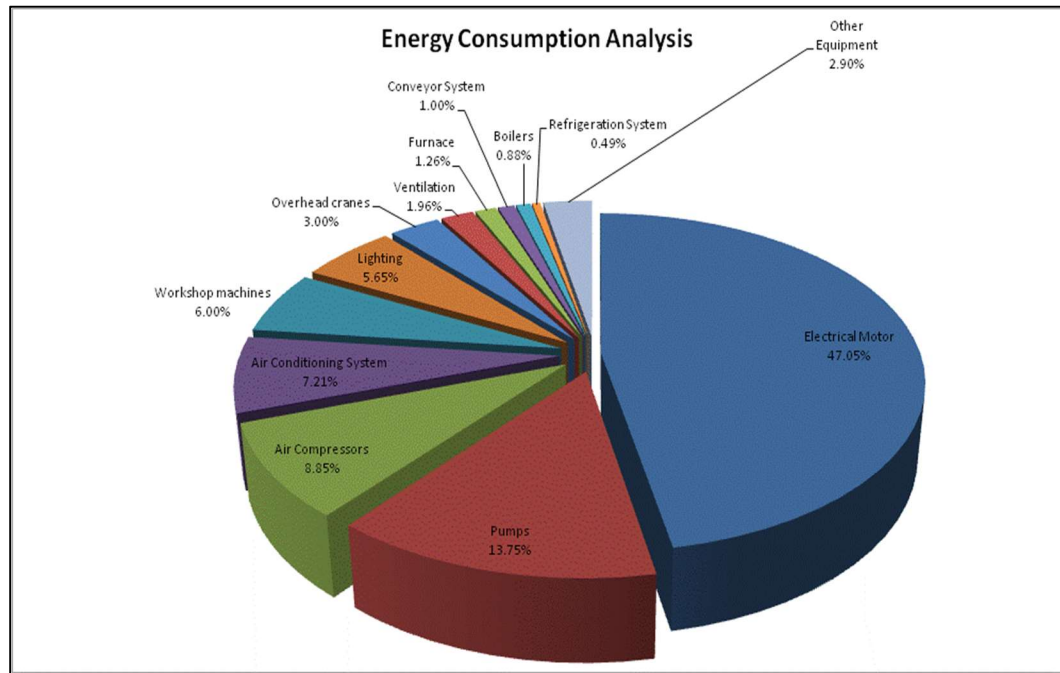


Figure 3: Breakdown of end use energy consumption in industries⁹ (2006)

Data from the study, was also used to compute the Specific Energy Consumption (SEC) in particular industrial sub-sectors. The total specific energy (fossil fuel and electrical) of each sub sector is given as a range. It was found that the SEC varies significantly from one industry to another, even in the same sub sector, depending on the production process, products and raw materials used. Table 1 gives the specific energy consumption of selected industry sub sectors.

Table 1: Total specific energy consumption of industry sub sectors

Industry sub-sector	Total SEC (electrical + fossil fuel) (GJ/ton of production)	
	Range	Average
Food products	3.89 – 52.6	15
Wood and wood products	49.3 - 1358	506
Paper and paper products	48.4 – 579.8	290
Chemicals	74.8 – 90.58	83

⁹https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1CAFA_enMY609MY612&ion=1&espv=2&ie=UTF-8#

Petroleum refineries	41.41 – 53.07	47
Rubber and rubber products	114 - 1152	675
Fabricated metal products	489.6 – 802.8	598

Source: *Energy and Electricity consumption analysis of Malaysian industrial sector by Masjuki H.H. et al*

1.2 Industrial Energy Consumption in Malaysia¹⁰

The final energy consumption recorded a positive growth of 1.2 percent in 2014, at 52,209 ktoe compared to 51,584 ktoe in 2013. There was an increase in energy consumption by the transport, residential and commercial sectors. However, the energy consumption by industry, non-energy and agriculture sectors have shown reductions.

The total energy consumption by the industrial sector decreased by 2.54 percent and settled at 13,162 ktoe in 2014, compared to 13,496 ktoe in 2013. With the share of total energy demand at 25.2 percent, industry is the second largest consumer of the total energy used in Malaysia. In 2014, the transport sector became the leading consumer of the total energy with its share of 46.6 percent with a positive growth rate of 8.81 percent comparison to 2013.

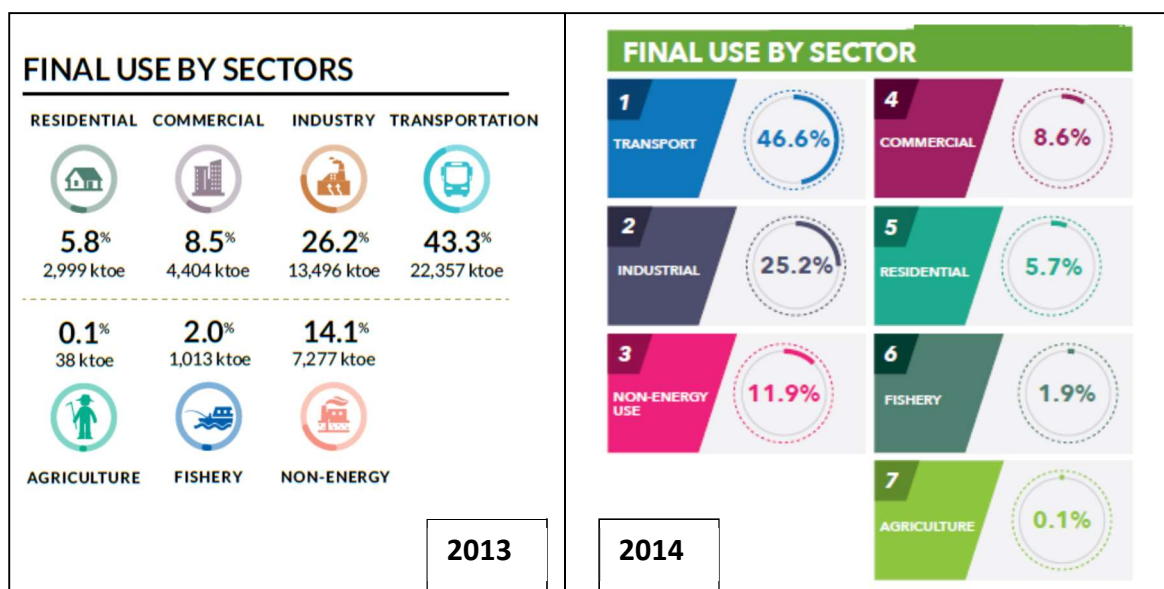


Figure 4: Energy Balance Flowchart 2013 & 2014 in ktoe

¹⁰ National Energy Balance, 2014. <http://meih.st.gov.my/documents/10620/5bb0f85c-fc99-4743-a8a9-8ee0d65f1299>

Table 2: Final Energy Consumption by Sectors (ktoe)¹¹

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014
Industrial	15,248	16,454	16,205	14,312	12,928	12,100	13,919	13,496	13,162
Transport	14,825	15,717	16,395	16,119	16,828	17,070	19,757	22,357	24,327
Residential & Commercial	5,429	6,196	6,205	6,336	6,951	6,993	7,065	7,403	7,458
Non-energy Use	2,809	2,958	2,876	3,868	3,696	6,377	7,497	7,277	6,217
Agriculture	253	281	287	211	1,074	916	1,053	1,051	1,045
Total	38,564	41,606	41,968	40,846	41,477	43,456	49,291	51,584	52,209

Table 3 shows the annual growth rates of GDP at 2010 prices, the primary and final energy demand, and electricity demand from year 2006 to 2014.

Table 3: Average Annual Growth Rates (%)¹²

Average Annual Growth Rates (%)									
Year	2006	2007	2008	2009	2010	2011	2012	2013	2014
GDP at 2010 Prices	5.58	6.30	4.83	(1.51)	7.42	5.29	5.47	4.71	5.99
Primary Energy Supply	1.22	8.01	5.03	(1.91)	2.98	3.23	9.09	4.90	1.94
Final Energy Consumption	0.74	7.88	0.87	(2.68)	1.54	4.77	13.43	4.65	1.21
Electricity Consumption	4.72	5.65	3.94	3.76	8.53	2.69	8.40	5.78	4.27

- i. GDP at 2010 prices for year 2014 in RM million is 1,012,506, calculated based on GDP and Population data from the Department of Statistics, Malaysia
- ii. Primary Energy Supply for year 2014 is 92,487 ktoe
- iii. Final Energy Consumption for year 2014 is 52,209 ktoe
- iv. Electricity Consumption for year 2014 is 128,330 GWh

The industry GDP¹³ for Malaysia in 2014 is 459,682 million RM and registered a positive growth of 5.25 percent compared to 2013. Malaysia's industrial energy intensity for 2014 is 44 toe/RM million at 2010 prices, a decrease of 12 percent from the previous year.

¹¹Malaysia Energy Statistics Handbook 2016. <http://www.st.gov.my/index.php/en/all-publications/item/735-malaysia-energy-statistics-handbook-2016>

¹²National Energy Balance, 2014. <http://meih.st.gov.my/documents/10620/5bb0f85c-fc99-4743-a8a9-8ee0d65f1299>

¹³Defined as total GDP for Agriculture, Forestry and Fishing, Mining and Quarrying, Manufacturing and Construction. Industrial GDP for year 2006 – 2009 was calculated by Energy Commission.

1.3 ISO 50001/MS ISO 50001 & Industrial EE Initiatives in Malaysia

1.3.1 ISO 50001/MS ISO 50001

Energy Management Standard is a proven framework for industrial facilities, commercial facilities or entire organisations to manage energy including all aspects of energy procurement and use. The ISO 50001 is based on the management system model of continual improvement used for other well-known standards such as ISO 9001 or ISO 14001.

ISO 50001 was published in June 2011 and adopted as MS ISO 50001 in October 2011 by Standards Malaysia. ISO 50001 supports organisations in all sectors to use energy more efficiently, through the development of an Energy Management System (EnMS). By certifying to MS ISO 50001: 2011, an organisation can show that it has established a systematic approach to continually improve its energy performance, energy efficiency and sustainable energy use and consumption, leading to a reduction in greenhouse gas emissions, energy cost and other environmental impacts. In Malaysia, the accredited certifying body for this purpose is SIRIM QAS Sdn. Bhd.

EnMS provides a viable policy mechanism for encouraging energy efficiency in industrial facilities. Energy use in the industrial sector is much more related to operational practices than in the commercial and residential sectors. This makes it easier for industries to integrate energy management into their other management system.

The support from IEEMMS project provided exposure to government personnel on EnMS, resulting in the government promoting the MS ISO 50001. It also raised awareness and interest amongst the manufacturing stakeholders, ESCOs, energy consultants and government personnel in an MS ISO 50001 framework on how to approach the effective implementation of EE measures in a structured manner. The new and effective approaches also provided many large industries with sustainable EE investments.

1.3.2 11th Malaysia Plan

During the Eleventh Plan, measures will be taken to identify potential improvements and appropriate approaches to ensure efficient use of energy in buildings, industries and households. These measures include increasing competencies of energy service providers, especially Registered Electrical Energy Managers, and promoting the implementation of Energy Performance Contracting for government buildings. User awareness will be enhanced on energy labelling and the availability of standards such as ISO 50001 for buildings and MEPS for appliances will be promoted. Other specific measures will include

introduction of Enhanced Time of Use (EToU) tariff scheme and gradual abolishment of the Special Industrial Tariff for energy intensive industries. Infrastructure related initiatives such as implementation of smart grids and highly efficient co-generation technologies for combined heat and power system will be promoted.

1.3.3 Efficient Management of Electrical Energy Regulations 2008

These regulations under the Energy Commission apply to any installation which receives or generates electrical energy from a licensee or supply authority with a total electrical energy consumption equal to or exceeding 3,000,000 kWh as measured at one metering point or more over any period not exceeding six consecutive months

Such installation is required, upon notice from the Commission:

(a) to appoint or designate a registered electrical energy manager to carry out the functions and duties under regulation 16 at the installation;

(b) to submit a written confirmation of such appointment or designation under paragraph (a) to the Commission containing the name and particulars of the registered electrical energy manager as well as the date of expiry of his registration as an electrical energy manager;

(c) to submit information regarding - (i) the statement of policy for efficient electrical energy management of the installation; (ii) the objectives of efficient electrical energy management; and (iii) the accounts and documents pertaining to efficient electrical energy management;

The registered Electrical Energy Manager shall have the following functions and duties:

(a) he shall be responsible – (i) to audit and analyse the total electrical energy consumption or total net electrical energy generation at the installation, including the significant end use of electricity; (ii) to advise the private installation licensee or consumer in developing and implementing measures to ensure efficient management of electrical energy at the installation; and (iii) to monitor effective implementation of the measures referred to in subparagraph (ii);

(b) he shall supervise the keeping of records on efficient management of electrical energy at the installation and verify its accuracy; and

(c) he shall ensure that the private installation licensee or consumer submits the information and report within the periods as specified

***The above requirements have elements of MS ISO 50001 requirements
Most of the IEEMMS EnMS experts are registered Electrical Energy Managers***

1.3.4 National Energy Efficiency Action Plan (NEEAP), 2014

KeTTHA spearheaded the introduction of the National Energy Efficiency Action Plan (NEEAP) in 2010, a ten-year plan created after consultations with more than 60 industry stakeholders, including government ministries, agencies, industry associations and the private sector.

IEEMMS PMU and consultants participated in the discussions/meetings

The NEEAP was adopted by Cabinet in January 2016.

The Malaysia Energy Efficiency Action Plan presents a strategy for a well-coordinated and cost-effective implementation of energy efficiency measures in the industrial, commercial and residential sectors, which will lead to reduced energy consumption and economic savings for the consumers and the nation. However, it must be borne in mind that the Malaysia Energy Efficiency Action Plan is only confined to electricity usage and does not cover the other aspects of the energy sector. The aim of the plan is to promote energy efficiency in order to meet the following policy direction:

”Promote energy efficiency to ensure productive use of energy and minimise waste in order to contribute to sustainable development and increased welfare and competitiveness.”

The target of Malaysia Energy Efficiency Action Plan is to save electricity and reduce electricity demand growth. The effective and efficient implementation of the Malaysia Energy Efficiency Action Plan supported with sufficient resources will be able to save 50,594 GWh of electricity over the plan period against a business-as-usual (BAU) scenario. The corresponding electricity demand growth reduction at the end of the plan is 6.0%.

1.3.5 Minimum Energy Performance Standards (MEPS), 2013

The minimum energy performance standards (MEPS) refer to the minimum performance level for electrical appliances to be available in the local market. The implementation of MEPS has been found to be an effective way of improving the energy efficiency of appliances in the market of many countries. It can be implemented with a relatively lower cost than most other methods of energy efficiency promotion programmes. It can lead to behavioural changes among the consumers and impacts manufacturers' decisions on the efficiency of the appliance models they choose to manufacture. This will lead to the elimination of inefficient products and encourage the stocking and selling of energy efficient appliances.

The introduction of MEPS is usually preceded by the introduction of energy efficiency standards and labelling programmes. In Malaysia, such standards and voluntary energy efficiency labelling (1 to 5 stars) of electrical appliances were introduced prior to 2005. As the take up rate of the voluntary labelling was found to be low, mandatory labelling and subsequently MEPS was introduced. This is usually set at the 2-star category level.

To enable MEPS, the Electricity Regulations 1994 was amended and gazetted in May 2013. At present MEPS has been implemented for

- Refrigerators
- Air Conditioners
- Domestic Fans
- Televisions
- Lamps
- Fluorescent Lamp Ballasts

The draft MEPS for electrical motors has been prepared and the IEEMMS consultants served as members of the working group.

1.3.5 Enhanced Time of Use (eTOU) tariff scheme

The government is also looking into the Introduction of Enhanced Time of Use (eTOU) tariff scheme and the gradual abolishment of the Special Industrial Tariff for energy intensive industries.

eTOU tariff scheme is introduced as an extension to the TOU tariff. Under this scheme, there will be three (3) time zones for energy charge with Peak, Mid-Peak and Off-Peak rates. On the other hand, Maximum Demand charge will have two (2) time zones with Peak and Mid-peak rates.

1.3.6 Removing Market Distortions by Rationalising Subsidies

The abolishment of subsidies for gasoline and diesel started from December 2014. The pricing will be based on a managed float system. In line with the overall strategy to rationalize subsidies, energy subsidies were reduced with the goal of achieving market pricing by 2015. Gas prices for the power and non-power sectors will be revised every six months to gradually reflect market prices.

1.3.7 Incentives & Governance

Malaysia introduced several fiscal incentives for EE, such as 100% tax exemption of statutory income for a period of 10 years for companies providing energy conservation services. Import duty and sales tax exemptions were also introduced for companies which import EE equipment or purchase it from local manufacturers for 3rd party use.

2.0 OBJECTIVE OF THE PROJECT

Project Objective: To promote energy efficiency improvements in the Malaysian manufacturing sector through the development of national energy management standard and application of system optimization.

Development Objective: Facilitate energy efficiency improvements in the manufacturing sector (with a focus on small and medium enterprises) through supporting the development of a national energy management standard and energy efficiency services, as well as the creation of demonstration projects.

Implementation Strategy: Implementation of energy management system based on the ISO 50001, energy management standards and the application of energy system optimization.

The implemented GEF project in Malaysia contributes to the reduction of energy use through energy efficiency practices, and this is in line with Malaysia's national plans. This project complements Malaysia's effort in developing National Standards on Energy Management and also the implementation of the Efficient Management of Electrical Energy Regulations 2008. To achieve this objective, IEEMMS was designed to achieve 5 outcomes as follows:

Outcome #1: Enhanced regulatory framework facilitating increased implementation of energy efficiency (EE) in the industrial sector in both large and small to medium enterprise (SME) industries;

Outcome #2: Widespread awareness amongst SMEs and larger industries of the benefits of energy efficiency;

Outcome #3: Availability of a cadre of highly specialized energy management experts from the public and private sectors;

Outcome #4: Availability of a cadre of highly specialized systems optimization experts from the public and private sectors;

Outcome #5: SMEs and larger industries have coordinated access to technical and financial assistance for implementing energy efficiency projects.

2.1 Project Main Stakeholders

The **Economic Planning Unit (EPU)** is the government policy making agency and the agency which coordinates external assistance. It is responsible for the formulation of national energy strategies and policies including matters pertaining energy security, diversification of energy sources and energy efficiency. EPU is committed to support energy efficiency initiatives in line with the government of Malaysia's steps towards reducing CO₂ emissions.

The role of **Ministry of Energy, Green Technology and Water (KeTTHA, Kementerian Tenaga, Teknologi Hijau dan Air Malaysia)** is to facilitate and regulate the electricity sector in the country, to ensure affordable energy is available to consumers throughout the country, to monitor energy programs and to promote energy efficiency and renewable energy. As the country is moving towards 'green technology', the Ministry of Water, Energy and Communications (MEWC) was re-branded as KeTTHA in April 2009. Within the broader policy framework, the government formulated a National Green Technology Strategy in 2009 and made KeTTHA the focal institution for promoting renewable energy, energy efficiency, and green technology in Malaysia.

The Ministry, in coordination with the **Economic Planning Unit** (of the Prime Minister's Office), provides the general direction, strategies and determines the level of implementation. In general, these strategies are largely outlined in Five-Year Development Plans. KeTTHA published *National Energy Efficiency Master Plan (NEEMP)* in 2010, and a study has been commissioned to restructure and realign the Malaysian electricity sector. The NEEMP aims to achieve a reduction of 6% in electricity demand growth over the 10-year period of the plan and forecasts a total reduction of 90 million tCO₂ over the life-time of the EE technologies adoption. This project will provide input to the industrial EE policy and revise incentive schemes to facilitate the implementation of the EE Act for Malaysia in future.

The **Energy Commission (Suruhanjaya Tenaga, EC)** has been the regulatory agency for the electricity and piped gas supply industries in Malaysia since 2001. The Commission's main tasks are to provide technical and performance regulation for the electricity and piped gas supply industries, safety regulation for electricity and piped gas and to advise the Minister on all matters relating to electricity and piped gas supply and to ensure consumer protection. One of functions of the Commission is to promote the use of renewable energy and the conservation of non-renewable energy. The Commission is currently implementing the 'Efficient Management of Electrical Energy Regulations 2008 which has been gazetted on 15th December 2008. On February 28th 2012 the Energy Commission launched the Malaysia Energy Information Hub. This project will assist to set up an energy management portal and database on energy management.

The **Ministry of International Trade and Industry (MITI)** has the functions of planning, formulating and implementing policies on industrial development, international trade and investment; encouraging foreign and domestic investment; promoting Malaysia's exports of manufacturing products and services by strengthening bilateral, multilateral and regional trade relations and cooperation as well as enhancing national productivity and competitiveness in the manufacturing sector. MITI is the focal point for UNIDO

Under MITI, the **Malaysian Investment Development Authority (MIDA)** is the government's principal agency for the promotion of the manufacturing and services sectors in Malaysia. MIDA assists companies which intend to invest in the manufacturing and its related services sectors, as well as facilitates the implementation of their projects. The range of services, provided by MIDA, include providing information on the opportunities for investments, as well as facilitating companies which are looking for joint

venture partners. MIDA also assists companies interested in venturing abroad for business opportunities.

SME Corp Malaysia is the government agency (under MITI) that provides information and advisory services for SMEs in Malaysia. Its functions include providing advice on SME policies and implementation of programmes for government ministries and agencies, providing business advice and on availability of funds and incentives, management on data and info dissemination on SMEs and providing financial and capacity building support to SMEs. SME Corp. also functions as the secretariat to the National SME Development Council. SME Corp will be the implementing agency for this project. Direct beneficiaries of the project will be SMEs.

Ministry of Natural Resources and Environment (MNRE) is the GEF Focal point in Malaysia and its major areas are as follows: (i) Natural resources management (ii) Conservation and management of environment and shelters and (iii) Management of land survey and mapping administration. MNRE will monitor the CO₂ reduction resulting from this project implementation.

The **Department of Standards Malaysia (Standards Malaysia)** is an agency under the ambit of Ministry of Science, Technology and Innovation (MOSTI). Standards Malaysia is the national standards and accreditation body for Malaysia. Its roles and functions are governed by the Standards of Malaysia Act 1996 (Act 549), which establishes the Malaysian standards development structure. Standards Malaysia is also the national representative for Malaysia in international and regional standardization activities.

The **Malaysian Standards and Accreditation Council (MSAC)** is an advisory body to advise the Minister in respect of standardization policies, programmes, schemes, projects and activities. Malaysian Standards are the consensus documents developed by Standards Development Committees (SDC) within the structure, and finally approved by the Minister of Science, Technology and Innovation (MOSTI) in accordance with Act 549. Malaysian Standards (MS) specify the optimum requirements of quality and safety or voluntary use by the public. A standard becomes mandatory when a regulatory agency enforces its use through the relevant Acts or Regulations.

Standards Malaysia has appointed **SIRIM Berhad** as the sole 'national standards development agency'. SIRIM Berhad is a wholly-owned company of the Government (incorporated in 1996). While Standards Malaysia is responsible at a policy level, SIRIM is responsible at the technical level for the development structure in Malaysia and representation in relevant regional and international standards committees to meet the expectation of all stakeholders. Industrial Standards Committees (ISCs) are established by the National Standards Committee (NSC) to oversee and coordinate the standards development process within their respective scopes as endorsed by NSC. 'Energy management' will fall under the ISC on Environmental Management.

SIRIM Bhd. has two subsidiaries, SIRIM Training Services Sdn. Bhd. and SIRIM QAS International Sdn. Bhd. SIRIM QAS is Malaysia's leading body providing management system certification (including ISO 9001 Quality Management and ISO 14001 Environmental Management), product certification, product testing and inspection

services. This project will assist SIRIM to train Energy Management System experts who will be capable to implement the MS 500001 in industries.

The **Federation of Malaysian Manufacturers (FMM)** was established in 1968 and is Malaysia's largest private sector economic organisation in Malaysia, representing over 2,000 manufacturing and industrial service companies of varying sizes. FMM is the officially recognized and acknowledged as the voice of the industry in Malaysia. The FMM institute offers training courses to upgrade the skills and knowledge of employees in the manufacturing sector. The project will provide capacity building to FMM to continue offering training at expert and factory personnel level in energy management and systems optimization. It is also planned to strengthen FMM as a Regional Training Centre.

2.2 Project Primary Target

The IEEMMS project seeks to address some of the existing barriers to industrial energy efficiency (IEE) in the Malaysian manufacturing sector, and to influence how Malaysian industries could manage energy through an integrated approach that combines capacity building and technical assistance interventions at the policy and energy efficiency project level. The primary target groups of the project are industrial decision-makers (managers), engineers, vendors and other professionals as well as IEE policy-making and/or implementing institutions.

2.3 Project Components and Outcomes

In order to achieve the project objective, it is expected that the five project components will result in the following outcomes:

Table 4: IEEMMS Project Components and Outcomes

Component	Outcome
1. Development of a national industrial energy efficiency policy and plans	Enhanced regulatory framework facilitating increased implementation of EE in the industrial sector
2. Awareness creation on energy management and systems optimization	Widespread awareness among SMEs and larger industries of the benefits of energy efficiency; strong interest by industry (and other sectors participating in EnMS, such as institutional and government) in energy management, systems optimization as well as energy efficient equipment and services in general.
3. Energy management systems	A cadre of highly specialized energy management experts from the public and private sectors is available as a long-term technical resource to industry and the country.
4. Systems optimization	A cadre of highly specialized systems optimization experts from the public and private sectors is available as

	a long-term technical resource to industry and the country.
5. Access to finance for industrial EE improvement	SMEs and larger industries have coordinated access to increased technical and financial assistance for implementing energy efficiency projects, including system optimization.

2.4 Project Implementation

Overall responsibility for project implementation lies with Ministry of International Trade and Industry (MITI) as shown Figure 5. The Multilateral Trade Policy and Negotiations Division of MITI will have specific responsibility for overseeing the current UNIDO/GEF project. The **local implementing agency** will be SME Corp. and will host the Project Management Unit. Coordination among government agencies is achieved through a Project Steering Committee.

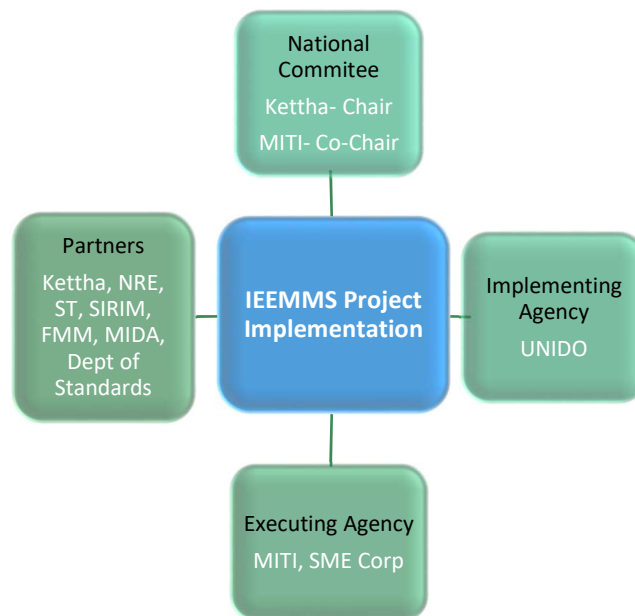


Figure 5: Project Implementation Agency

Project Steering Committee (PSC) which will be chaired by the Ministry of Energy, Green Technology and Water (KeTTHA), with MITI as Co-Chair. The PSC provides strategic guidance and oversight to the project implementation, and the PSC meets at least once a year and invite experts for specific meetings, as needed.

The members of the PSC are as shown in the Figure 6 below.



Figure 6: The PSC members of IEEMMS Project

The PSC's responsibility is to:

- Approve project progress reports, including the inception report.
- Approve and provide strategic guidance for the project work plan for the coming six months
- Approve major changes in the project document in term of outcomes, outputs, and budgets.
- Take initiative to ensure sustainability and avoid duplication of activities
- Take initiative to mobilise all relevant stakeholders and partners
- Provide recommendations to the project in terms of relation to specific priorities not foreseen at the time of writing this project document.
- Take decisions on the issues brought to its notice by UNIDO and other cooperating institutions and advice regarding efficient and timely execution of the project
- Initiate remedial action to remove impediments in the progress of project activities that were not envisaged earlier.

The **Project Management Unit (PMU)** is responsible for the daily management of the project implementation, and is also the Project Steering Committee secretariat. It provides guidance/advice in the implementation of each project component, in accordance with project document.

The Project Management Unit will comprise of:

- National Project Manager(NPM)
- Assistant National Project Manager
- Training Coordinator
- Administrative & Finance Executive
- Training and IT Assistant (part time)
- Equipment Assistant (part time)

In order to improve the design and implementation of the various programs a **Technical Advisory Committee (TAC)** was set up and chaired by the National Project Manager (NPM). The TAC is composed of the following members whose combined expertise and experiences cover all the technical and implementation aspects of the project components:

- National Project Manager (Chairperson)
- Project Component Managers
- MITI representative
- Industry representative (FMM)
- Technical Advisors
- SME Corp staff

The TAC meets up when needed and is responsible for:

- Reviewing and clearing job descriptions of key project personnel, Term of References for major sub-contracts, candidates for expert level training, and selection of industries for system assessment and demonstration.
- Reviewing annual work plan and budget of the project for timely submission to the Project Steering Committee and UNIDO
- Conducting monthly programme review of project activities and identifying any problems in implementation
- Reviewing semi-annual and annual reports, which will be prepared by the PM

The PSC meeting was held yearly form 2012 till 2016 to discuss on the project progress and challenges.

Table 5: The PSC Meeting date and Objective

PSC Meeting Date	Purpose of Meeting
20 April 2012	Introduction of the project objectives to all members and adoption of Inception report.
17 January 2013	Shared information on the activities planned and collaboration with relevant organisations.
17 September 2013	Reported the progress of the project including the collaboration activities with relevant organisations such as KeTTHA, FMM, SMI Association and ST.
1 July 2014	Updated on project progress and shared challenges in implementation of the activities.
17 August 2015	Updated the outcome and success stories of the project.
14 June 2016	Continuation of EE programmes and establishment of EE and Water Institution.

The PMU participated in several workshops conducted during the drafting of the NEEAP. It is mentioned in the 11th Malaysia Plan (11MP) (2016 - 2020), that measures will be taken to identify potential improvements and appropriate approaches to ensure efficient use of energy in buildings, industries and households. Availability of standards such as ISO 50001 is mentioned.

The National EE Action Plan (NEEAP) is finalized and has been approved by the cabinet in January 2016. Measures to improve EE in industries through Energy Performance Contract (EPC) implementation is in progress.

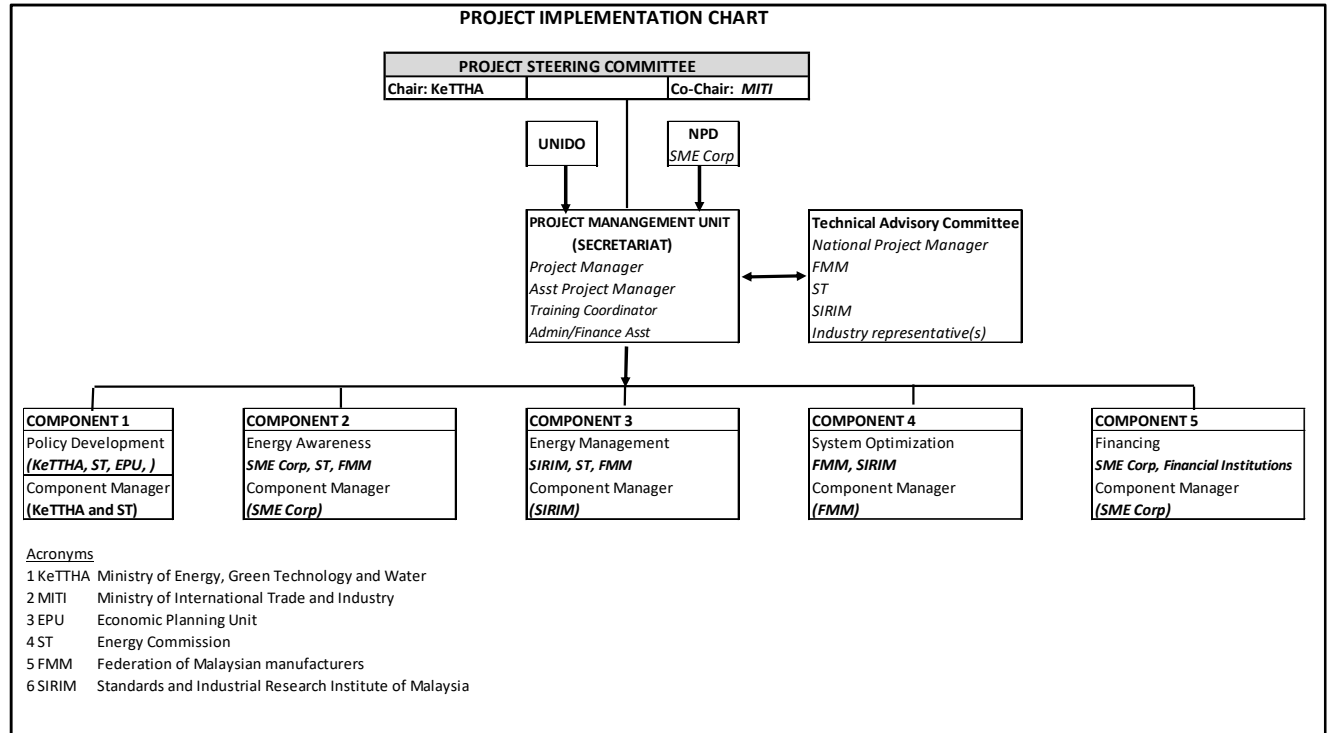


Figure 7: Project Implementation Management Organogram

2.5 Project Methodology

The IEEMMS project team initiated the project by awareness trainings to factories on the topic of industrial energy efficiency, energy management systems and MS ISO 50001 targeted to enterprise top managers from various industries and organisations. This was to create widespread awareness amongst SMEs and larger industries of the benefits of energy efficiency and to promote strong interest by industry (and other categories participating in EnMS, such as energy consultants and government) in energy management, systems optimization as well as energy efficiency equipment and services in general.

Awareness raising is a part of the project deliverables for the IEEMMS project. Increased awareness can lead to:

- Increased productivity;
- Improved employee morale;
- Better working conditions;
- A reduction in greenhouse gas emissions; and

- An enhanced image of the company as a leader in environmental stewardship within the community.

The programme was divided into main 2 topics; Energy Management System (EnMS) and System Optimization (SO) as shown in Figure 8. Awareness workshops are promoted through the project website and stakeholder's newsletters (FMM). Informational pamphlets on the project, EnMS and Systems Optimization (SO) have been produced and distributed to promote the objectives of the project and raise awareness;

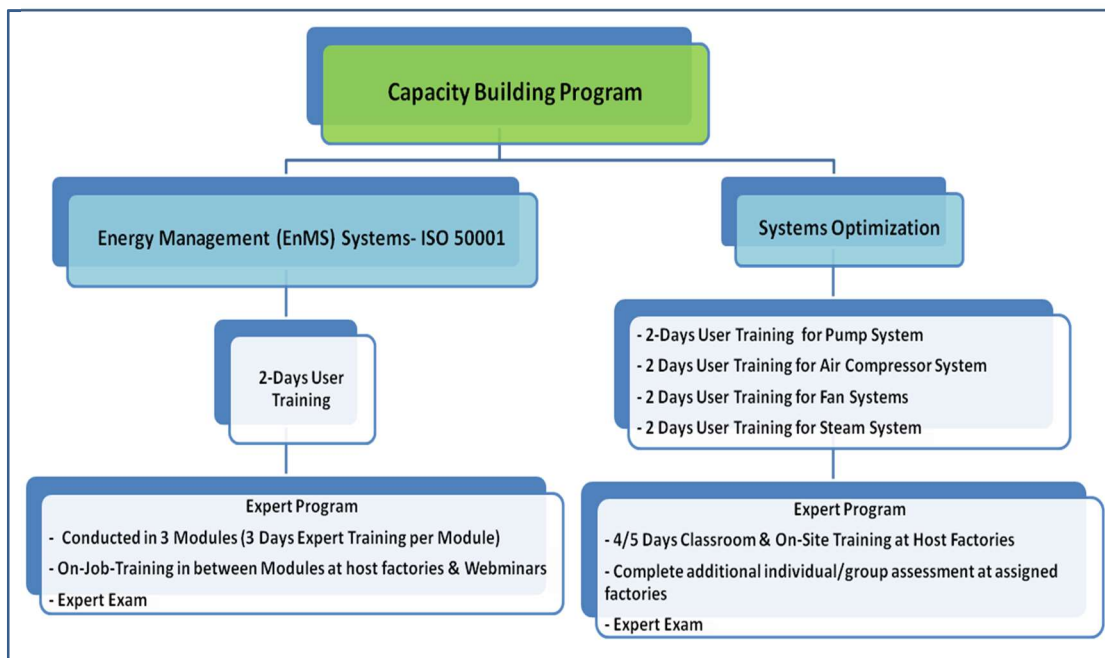


Figure 8: The Project Capacity Building Program

2.5.1 Energy Management System (EnMS): Capacity Building

Energy Management Standards – MS ISO 50001 provides:

- A framework for understanding significant energy use
- Action plans to continually improve energy use
- Documentation to sustain energy performance improvement
- At least 5-15% savings of energy cost with “no cost” or “low cost” improvements.

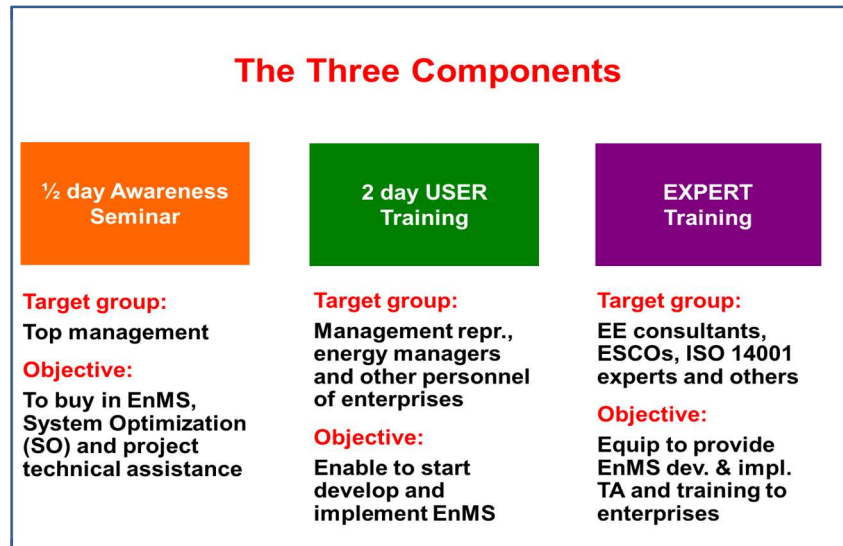


Figure 9: EnMS Capacity Building Activity Components

The 2-days Users training is targeted to person(s) designated by enterprises as responsible for energy management. The training will guide participants through the Plan-Do-Check-Act cycle as it applies to the MS ISO 50001 energy management standard. Instructions and tools were provided on how to establish an effective energy policy, review energy use, identify what is significant and opportunities for improvement, set objectives and targets, establish an energy baseline and performance indicators.

The energy management system experts training is a comprehensive package of training materials and tools to equip these future local experts as the resource person in providing technical assistance on energy management system to industries to help them achieve the MS ISO 50001 certification. The energy management system is in line with MS ISO 50001. The Expert training is an intensive program on EnMS implementation by International EnMS experts.

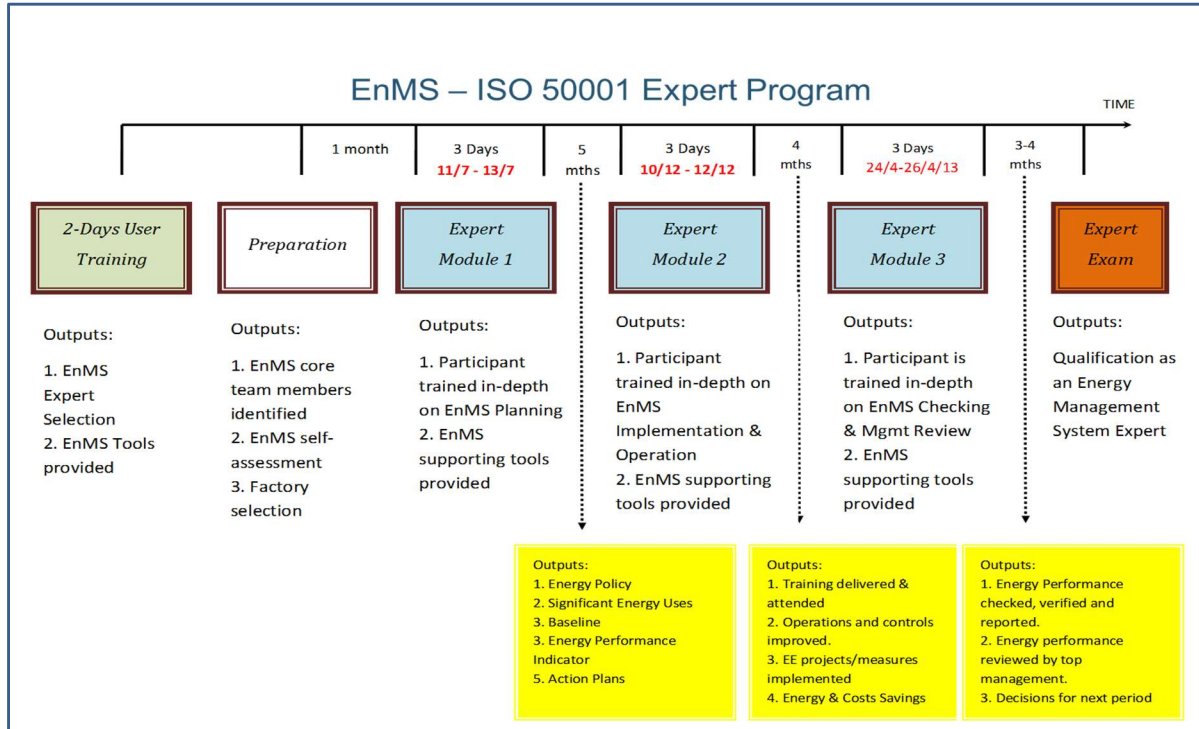


Figure 10: The EnMS Expert Training Module

2.5.2 Systems Optimization: Capacity Building

System Optimization (SO) was introduced to industrial experts as shown on Figure 11 below.



Figure 11: System Optimization (SO)

Compressed air Systems Optimization Training (CASO)

The participants learn the basics of compressors, air treatment equipment, compressed air systems and system dynamics. They will be able to use this information to make recommendations concerning existing systems to improve the energy efficiency of the system in a cost-effective manner. These improvements will be what is termed as low hanging fruits in that they require little capital investment, resulting in very quick payback periods.

Learning objectives include:

- The benefits of improving compressed air system performance.
- The system energy flow for generating of compressed air. The most significant losses occur during the initial compression cycle itself.
- How to differentiate the supply side of the system from the demand side
- The different types of compressors and their applications from an energy point of view, focusing on the typical used compressors in the industry (rotary screw compressors).
- Air treatment, including dryers, filters, piping etc and energy related aspects.
- The importance of baselining the system to determine operating costs, identify problems and determine efficiency.
- The effect of leakage, artificial demand and inappropriate use on system efficiency.
- The basic application of compressed air storage and how it can affect system efficiency.
- Typical compressed air efficiency measures, both supply side and demand side.
- How to determine the actual system pressure requirements and evaluate the distribution system versus the actual point of use demand to determine which is driving the pressure requirements using a basic block diagram.
- How compressor controls affect system pressure and efficiency.
- How end use installation practices can affect system performance.

Fan Systems Optimization Training (FSO)

Learning Goals:

- The participants will learn the basics of fans, fan systems, system dynamics, identifying and qualifying using FSAT tool to quantify fan systems optimization opportunities.
- They will be able to use this information to make recommendations concerning existing systems to improve the energy efficiency of the system in a cost-effective manner. These improvements will be what is termed as low hanging fruit in that they require little if any capital investment, resulting in very quick payback periods.

Learning Objectives:

- Discuss key terms and concepts of FSO
- Explain the benefits of FSO
- Prioritize potential enterprise-wide FSO opportunities ‘
- Calculate the cost of operating fans
- Estimate how well a fan is meeting specific enterprise process needs
- Report your key take-away from the training

Steam Systems Optimization Training (SSO)

Learning goals - To train end-users and consulting engineers in doing steam systems assessments and optimization

Learning Objectives:

- Help industry assess steam systems and achieve energy and cost savings through proper operation and controls, system maintenance, appropriate process uses of steam, cogeneration and application of state-of-the-art technologies
- To conduct field assessments and identify projects to demonstrate actual energy and cost savings achievable using the systems approach
- Introduce and demonstrate the functionality of US DOE publicly available steam system optimization assessment software tools

Pump Systems Optimization Training (PSO)

The training focuses on:

- Pump System Optimization / LCC/ Prescreening
- Pump Systems & Process Demands
- Pump Types
- Pump System Fluid Relationships
- Fundamental Hydraulics
- Total Head
- System Curves
- Pump Performance Characteristics
- Pump System Energy Use
- PSAT Introduction

Expert Training

Trainees that successfully completed the user training are eligible for recruitment by UNIDO to deliver USER training and carry out assessments. The target groups are energy managers, energy efficiency, consultants, service providers, industry engineers and experts as elaborated in Figure 12.

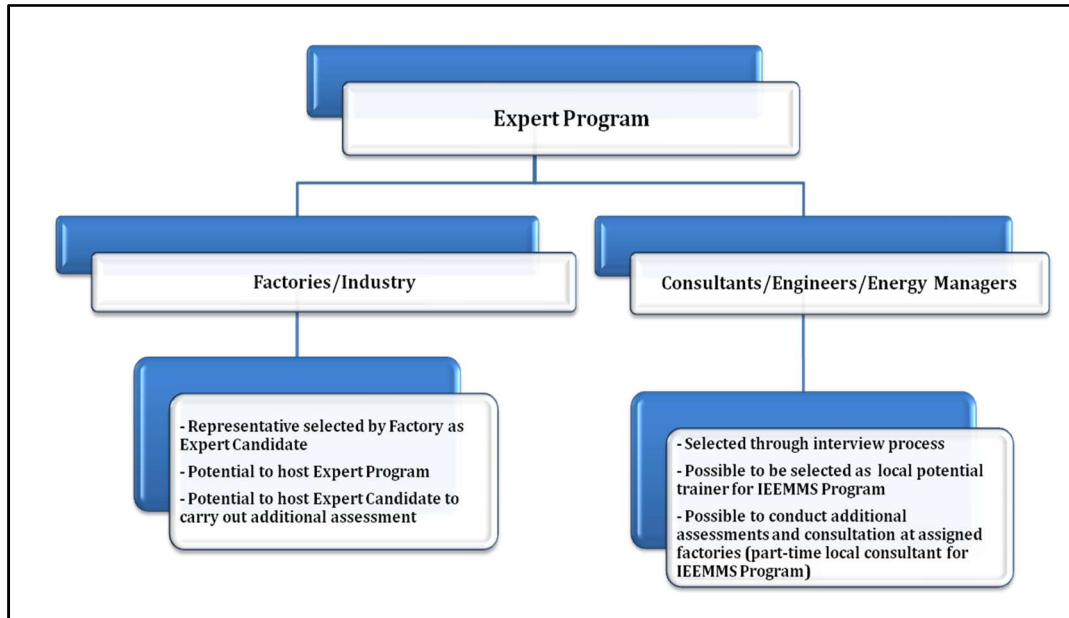


Figure 12: Expert Program Participants Eligibility

The Expert Training structure and schedules explained in details in Figure 13 below.

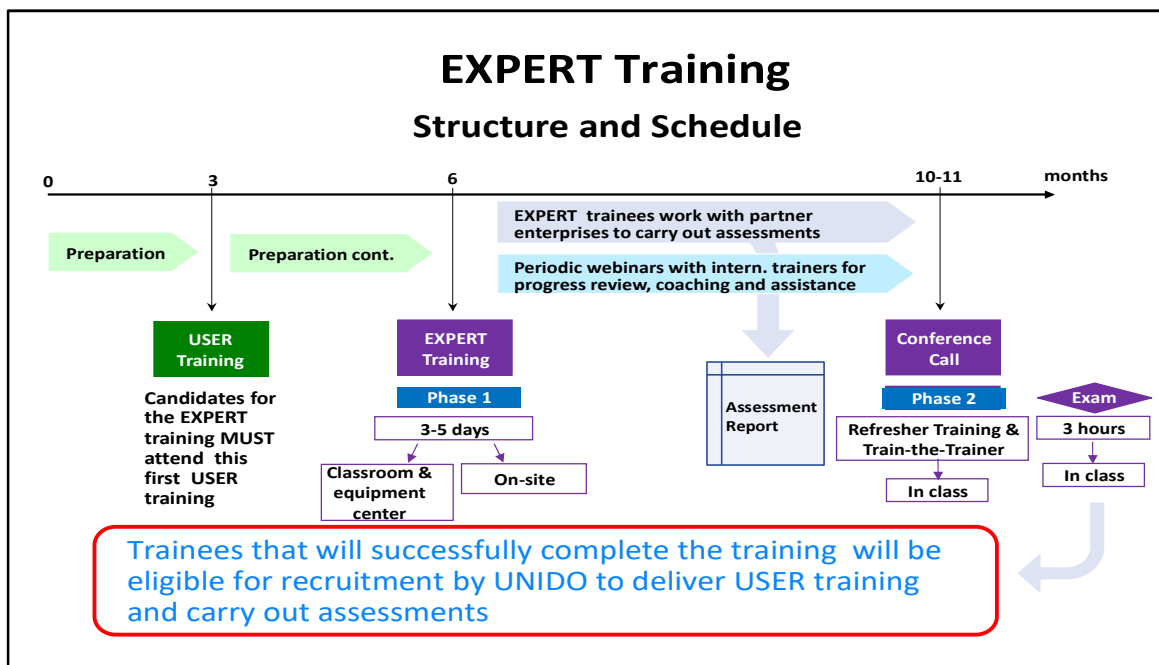


Figure 13: Expert Training Sturcture and Schedule

3.0 Project Impact Analysis of Capacity Building Programme

3.1 Energy Management Systems (EnMS ISO 50001)

The IEEMMS project has identified and invited more than **2,000 organisations** in Malaysia from different industries and organisation to be trained in the EnMS standard. The capacity building programmes were planned into three stages as shown in Figure 14 below.

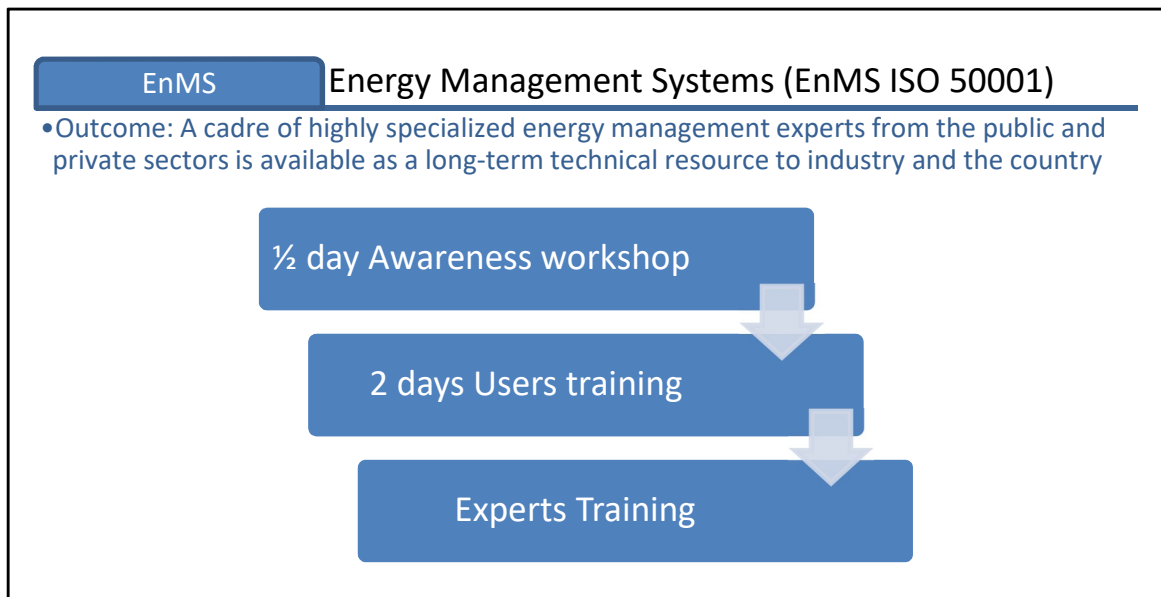


Figure 14: Three Stages of Capacity Building Programme

3.1.1 Half-Day Awareness Workshop

The awareness workshops were arranged and conducted in collaboration with the business associations, social associations and sports clubs. These associations were identified as the best platform for business networking, to reach out for more interested organisations to attend the organised workshops/ training and for learning new skills. Popular topics such as Energy Efficiency in Industries by professional speakers has encouraged more organisations to participate and share their experiences.

With the support of UNIDO's international team and trained national experts, the capacity building programme were conducted at main cities in Malaysia from 2012-2016 as shown in the Figure 15 below.

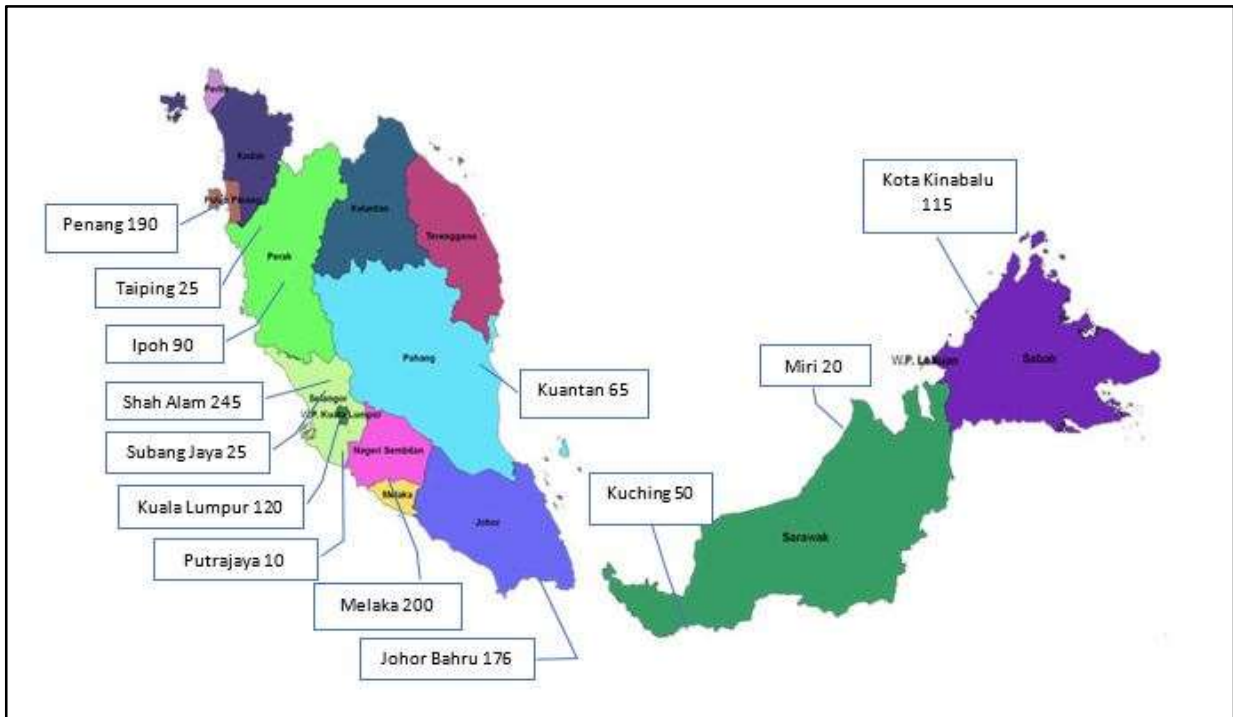


Figure 15: Awareness programme in different cities with no. of participants

39 energy management half-day awareness workshops were conducted with in-kind support from government agencies and business associations in Malaysia (including in Sabah and Sarawak) such as MIGHT, SIRIM, FMM, a number of golf clubs, SMI association, Shah Alam City Council and WWF Sarawak. A total of 1331 participants from various organisations attended the workshops.

Furthermore, the awareness programme was extended to more organisations throughout Malaysia by participation in stakeholder events. About 809 officers from different organisations and with different backgrounds participated in the awareness training co-organised by UNIDO with other associations. The UNIDO experts were given a half day slot to speak on the benefits of EnMS and energy efficiency at the stakeholder seminars.

In addition, UNIDO also participated in other stakeholders' bigger events which had a large number of participations to promote EnMS. These included Penang Council Expo 2012, SMIDEX 2013 & 2014, SMI business conferences, IGEM 2013 and ASEAN SME showcase and conference in 2015.

3.1.2 Two-Days User Training on MS ISO 50001

530 participants from various background such as energy managers, factory personnel and consultants received a follow-up 2-days user training on MS ISO 50001 and internal auditing to enable them to implement energy management plans at their organisations or at their clients' offices. These participants has attended the half day awareness and then

join the 2-days User Training to obtain more knowledge on MS ISO 50001. From some organisations, two or more participants took part in the user training. Referring to Table 6 below, a total of 14 user trainings organised for a total of 120 consultants, 304 industries, and 84 government agencies as well as for 22 universities, and utility companies and hospital. 14 EnMS trainings were conducted for 97 industries.

Table 6: 2-Day User Training for MS ISO 50001

Year	No of training	2-Day EnMS User Training				
		Consultants	Industry	Others	Government	Total
2012	4	67	111	14	26	218
2013	1	7	38	2	4	51
2014	8	31	128	5	43	207
2015	1	15	27	1	11	54
Total	14	120	304	22	84	530

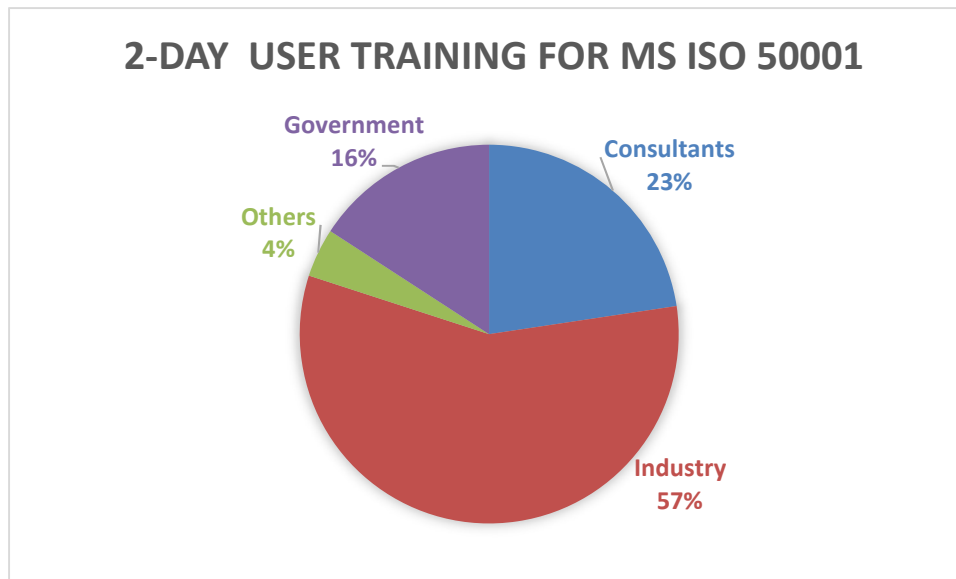


Figure 16: Percentage of 2 days EnMS User Training by Sector

3.1.3 EnMS Experts Training

The UNIDO international team experts delivered intensive training (mentoring and on-the-job) to 280 national experts from 39 organisations to a level such that they can train others. Two or more officers from the same organisation participated in the expert training course. These individuals subsequently assume roles as ‘national energy management experts’ to become a source of national energy management expertise and serve as multipliers for project impacts. Upon completion of the training, these new ‘Energy Management Systems Experts’ received certificates that recognizes their accomplishment.

A project website has been developed at www.ieemms.org, and has been updated with project video, sample case studies and with a list of successful EnMS and Systems Optimization local experts. The website will be also externally linked to stakeholder's websites such as FMM and Energy Commission.

The peer-to-peer network Basecamp was established and GoTo Training/GoTo Meeting and Skype were used for on-going communication between national experts, international consultants and the project team.

Table 7: Details of EnMS Expert Training (2012 – 2015)

Date	Details	Location	Participants				Total
			Consultants	Industry	Others	Government	
EnMS Expert Module Training 1							
2012	3 days	ST, Putrajaya	18	10	1	2	31
EnMS Expert Module Training 2							
2012	3 days	ST, Putrajaya	18	7	1	2	28
EnMS Expert Module Training 3							
2013	3 days	ST, Putrajaya	18	7	1	2	28
EnMS Expert Module Training 4 (May 2014)							
2014	3 days	Melaka	34	16	2		52
EnMS Expert Module Training (Sept 2014)							
2014	3 days	FMM Penang	30	21	0		51
2014	3 days	SME Corp	0	0	0	7	7
EnMS Expert Module Training Round 2 (April 2015)							
2015	3 days	FMM Penang	21	14	5	3	43

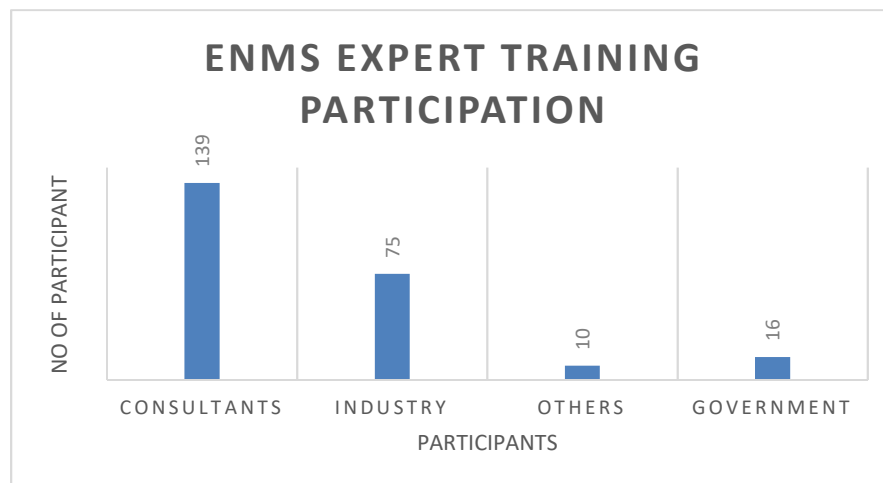


Figure 17: EnMS Expert Training Participation by sectors

The trained personal from several organisations have implemented operational improvements in their industrial processes with the knowledge gained from the UNIDO system optimization sustainability training and fully implemented MS ISO 50001. Among the 39 organisations, 5 companies were successfully certified for MS ISO 50001 and 8 companies are in process of being certified. The remaining 26 companies are planning to be certified in the next one or two years' time.

The participants who joined in the EnMs Expert training were tested, and among 77 who sat for the exam, 51 had passed and received a certificate. The balance 26 participants needed further guidance to fully understand the ISO 50001 and familiarise themselves with the system.

Table 8: Participation by industry category

Sector & no. of companies			
Semiconductor	3	Cement	3
Oil & Gas	1	Needle & Pins	1
Car Parts	2	Food	3
Electrical Components	1	Lime Stone products	1
Resort	1	Steel	2
Solar Cell	1	City Council	1
Oleochemical	2	Paint	1
Power Plant	1	Latex products	1
Glass Sheets	1	Eletrical Panel	1
Chemical	1	Car	1
Fabric	2	Utilities	1
Palm Oil and Flour Mill	1	Aluminum products	1
Steel	1	Wood board	1
Tiles	1	Copper Wire	1
Multinational conglomerate involved in 5 core sectors: plantations, property, industrial, motors and energy & utilities			1

About 149 factories are in various stages of implementing EnMS and had associated operational improvement. Currently, 13 local EnMS consultants are assisting factories to implement the ISO 50001 requirements. To date 38 companies are implementing ISO 50001 compatible energy management plans. UNIDO has compiled case studies of 31 companies and sites who had reported on their efforts on energy and greenhouse gas emissions savings as well as their energy management system. The participating factories have been registered for the peer-to peer network. The success stories of the project will be discussed in the next section. Additional 10 factories are being assisted by local EnMS

consultants towards ISO 50001 certification and plan to go for certification between year 2017 to 2018.

3.2 System Optimization (PSO, FSO, SSO and CASO)

New technologies and policies applied to energy usage in the country can positively influence the overall energy efficiency practices in industries. The Malaysian policy directive on reduction of greenhouse gases, increased share of renewable energy in power system and improvement in energy efficiency, encouraged more industries to make use of exact optimization techniques and heuristic methods. The large application of optimization methods to the renewable and sustainable energy is an effective option to find a rapid and good solution in improving energy efficiency in the country.

The industrial systems optimization promotes the use of a comprehensive approach to improve the energy efficiency of industrial processes at both the design and operational levels. This is concerned with the effective utilization of the total resources of modern manufacturing and process industries so as to minimize waste of time, money, materials, energy and other resources. It is thus clear that optimization in industrial systems is crucial for the competitiveness of any industry in a high competitive economic environment. Consequently, system optimization attracted the interest of many engineers, practitioners and consultants to get up to date on the progress in this area, especially to improve the EE of large industrial facilities with complex energy system.

The UNIDO System Optimization capacity building program conducted with the purpose of building technical capacity at three levels: Experts, Users and Vendors. The figure below shows the elements of the Systems Optimization capacity building program.

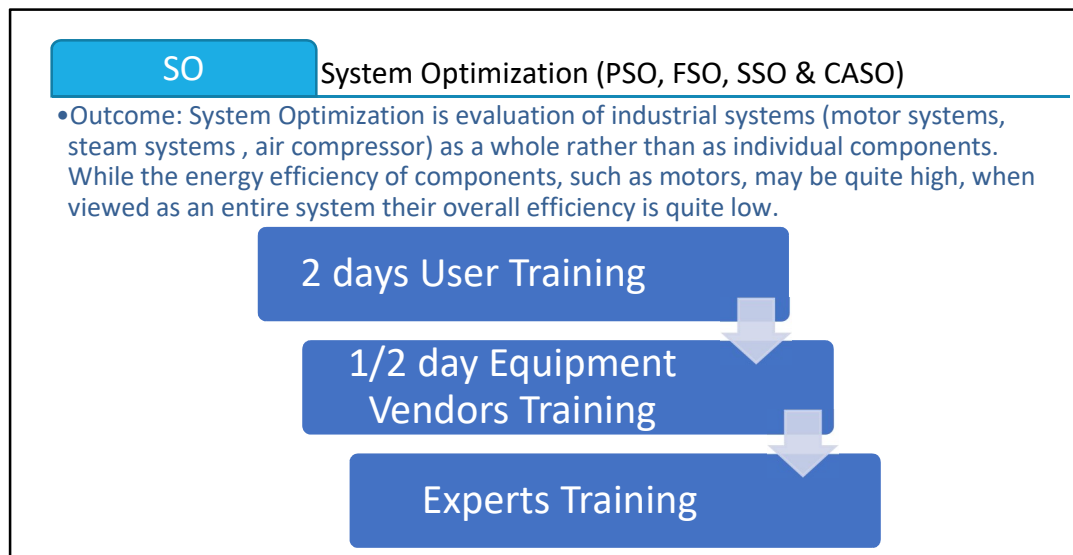


Figure 18: System Optimisation (PSO, FSO, SSO and CASO)

The UNIDO Optimization Systems covered pumps, fans, air compressors and boilers used in industries. UNIDO's international team delivered intensive training for each of the 4 energy systems; compressed air, pumps, motor or fan and steam to 40 national staff to a level such that they can train others.

3.2.1 2 Days User Training

The 2 Days User Training was conducted on equipment, systems assessment, and identification of optimization measures, development and implementation of operational improvements. The selected equipment trainings were conducted on Pumps, Fans, Air Compressors and Boilers in four different cities according to the demand in the emerging energy market. UNIDO collaborated with FMM and SIRIM to organize these trainings. The Pump Systems Optimization (PSO) was held in 5 different places with total of 289 participants. Meanwhile, UNIDO has arranged seven Fan System Optimization (FSO) trainings for interested personnel from different sectors at 6 different cities all over Malaysia. About 286 participants attended the FSO training.

The Steam Systems Optimization (SSO) trainings were conducted in a few more new locations such as in Penang, Melaka, Johor Bahru, Kuantan, Genting Highlands, Ipoh and Kuching. It covered almost all over Malaysia with 217 officers trained by the end of nine SSO trainings. At the same time, the training on Compressor Air Systems Optimization (CASO) was extended to Kota Kinabalu and other cities. A total of 269 personnel from different backgrounds received the training as shown in the table below. Among them, 87 has qualified as SO experts.

Table 9: No of Trainings by sectors for 2 Days User Training

Training	No. of Training	<i>2 Days User Training for System Optimization</i>				
		Consultants	Industry	Government	Others	Total
Pump	7	94	140	33	22	289
Fan	7	76	168	20	22	286
Steam System	9	32	145	29	11	217
Compressor	8	58	175	26	10	269

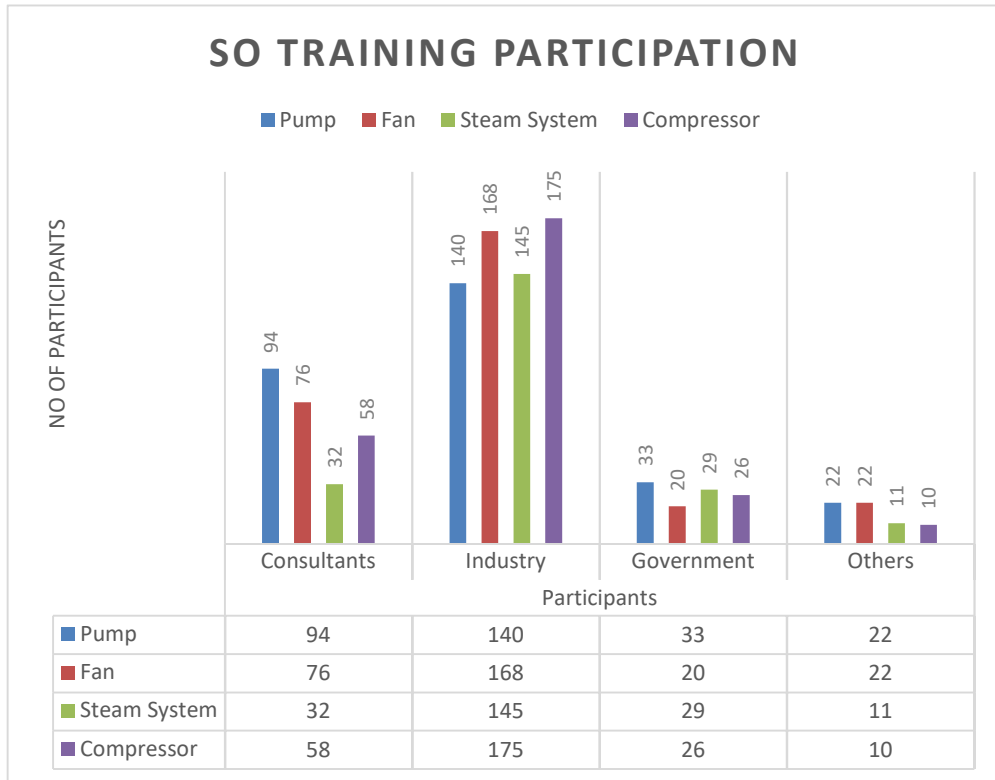


Figure 19: Number of Participants for PSO, FSO, SSO and CASO trainings

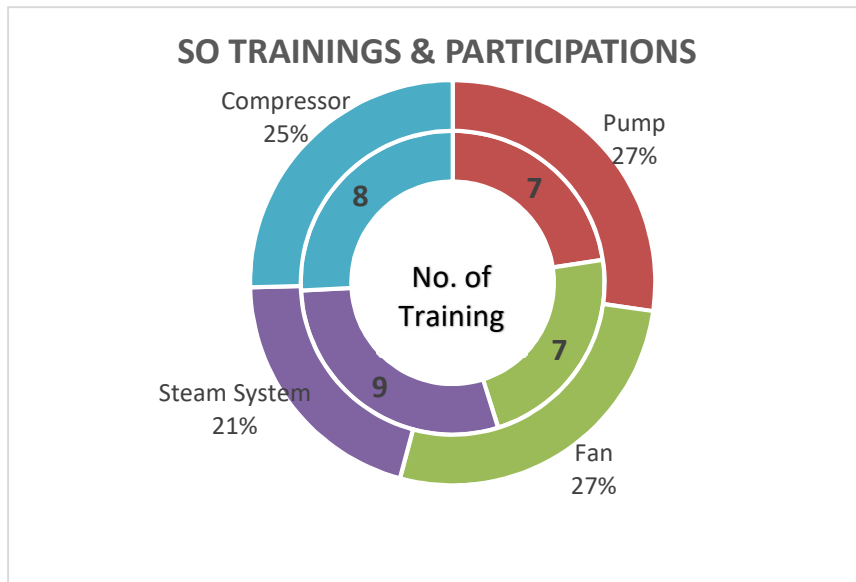


Figure 20: No of Participation by Percentage for Each System Training

3.2.1.1 Pump System Optimization Training (PSO)

The PSO User Trainings were arranged with the support of state FMM at 4 locations; Penang, Ipoh, Kuala Lumpur and Melaka. Among 289 participants, 94 participants were consultants, 140 people are industry personnel, 33 are government representatives and 22 were from universities and other sectors as shown in Table 10.

Table 10: PSO Training conducted in 3 years by sectors (2012 – 2015)

Year	No. of Training	PSO Training				Total
		Consultants	Industry	Government	Others	
2012	3	54	58	8	14	134
2014	3	23	49	22	8	102
2015	1	17	33	3	0	53
TOTAL		94	140	33	22	289

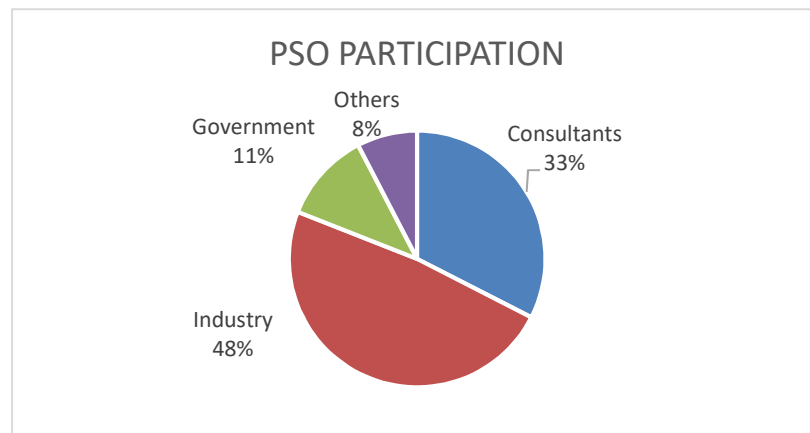


Figure 21: Percentage of PSO participation by sectors

3.2.1.2 Fan System Optimization Training (FSO)

Participants from Penang, Kuala Lumpur, Johor, Port Dickson and Ipoh received the FSO training at their respective cities or town. The FSO training were covered in almost all towns in West Malaysia and total of 276 participants from different background attended. Similar to PSO, a total of 76 were consultants, 168 officers were from industry, 20 were government officials and 22 are academician as shown in table 11 below.

Table 11: FSO Training conducted in 4 years by sectors

Date	No of training	FSO Training				
		Consultants	Industry	Government	Others	Total
2012	2	48	49	8	13	108
2013	2	18	68	6	4	96
2014	2	8	38	2	0	48
2015	1	2	13	4	5	24
TOTAL		76	168	20	22	276

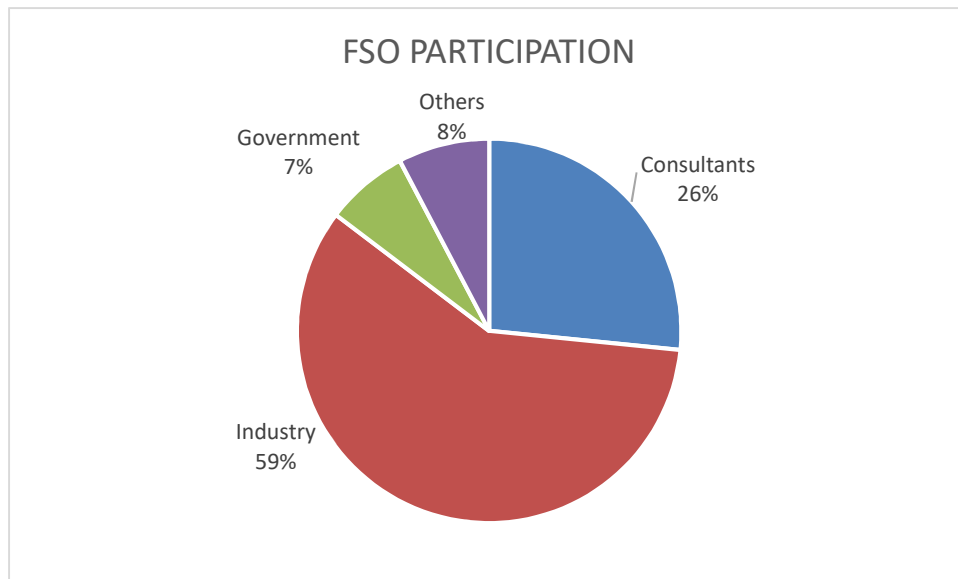


Figure 22: Percentage of FSO participation by sectors

3.2.1.3 Steam Systems Optimization Training (SSO)

The trend of attending the 2-day user training are similar to other trainings whereby the number of participants from factories were always higher than other category. The participation from government and university were lesser for all trainings as shown in table below.

Table 12: SSO Training conducted in 2 years by sectors

Date	No of Training	SSO Training				
		Consultants	Industry	Government	Others	Total
2013	4	17	107	13	1	138
2014	5	15	82	18	10	125
TOTAL		32	189	31	11	263

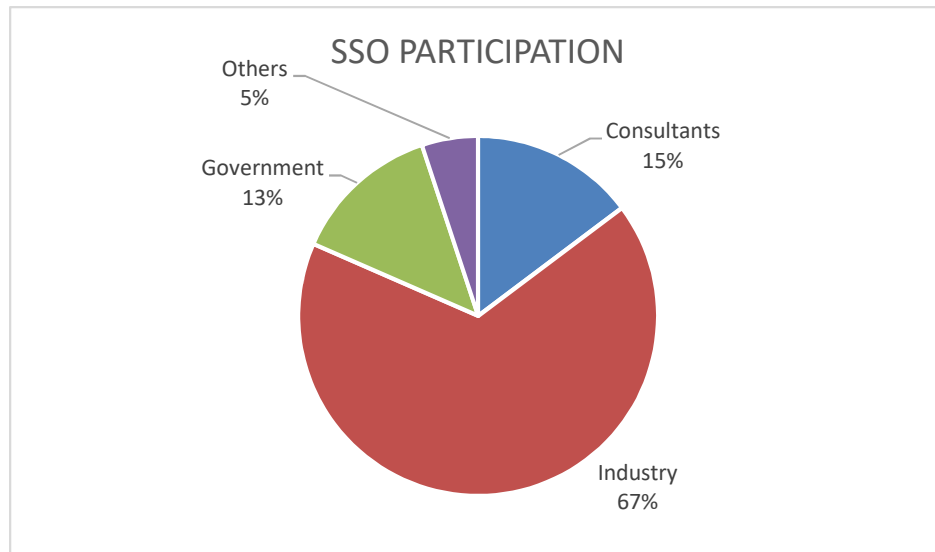


Figure 23: Percentage of SSO participation by sectors

3.2.1.4 Compressed Air Systems Optimization Training (CASO)

As for CASO expert training, a total of 269 participants received the training from UNIDO or local experts. As was the case with the other SO trainings, factory personnel constitute the largest group of training attendees, followed by consultants, government officers and another organisations.

Table 13: CASO Training conducted in 3 years by sectors

Date	Details	CASO Training				
		Consultants	Industry	Government	Consultants	Total
2012	3	34	51	8	5	98
2013	1	4	50	5	0	59
2014	4	20	74	13	5	112
TOTAL		58	175	26	10	269

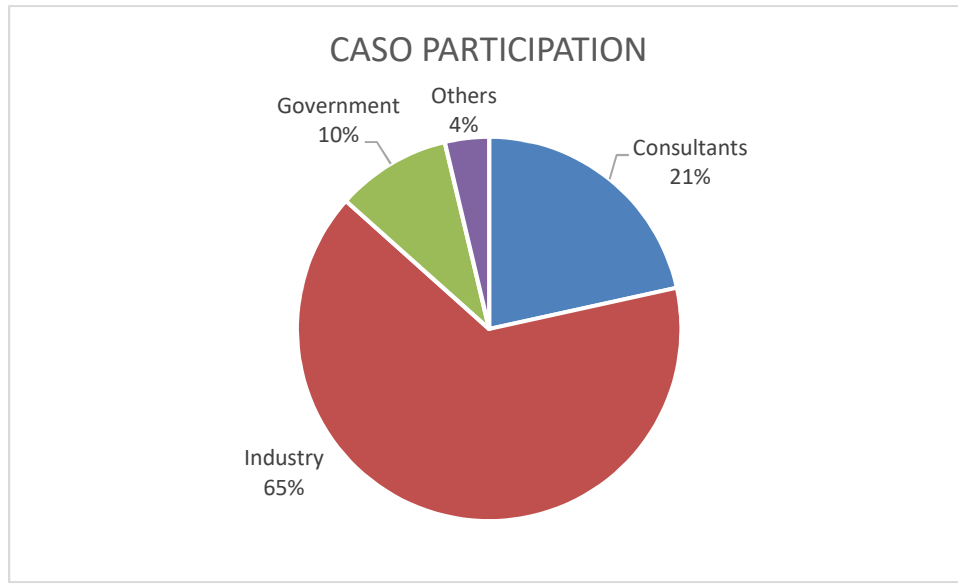


Figure 24: Percentage of CASO participation by sectors

3.2.2 Half-day Vendor Training

The ½ Day Equipment Vendor Trainings were organised for local equipment vendors, suppliers and manufacturers. This training was designed to be supplementary to the 2-Days User Training. The purpose of this training was to introduce key market players to system optimization techniques and service offerings.

At the end of this training, the UNIDO experts were able to prepare manufacturers, vendors and suppliers to participate in reinforcing the system optimization message of the UNIDO project with their industrial customers. At the same time, the UNIDO specialists were able to assist manufacturers, vendors and suppliers in identifying what will be required to reshape their market offerings to reflect a system services approach.

As planned, three system specific training sessions were conducted for vendors of steam, fan and pump systems in 2012 and 2013. Even though the number of participation was small, the 30 vendors who received the training were satisfied. The training was arranged by FMM Kuala Lumpur.

Table 14: Vendor Training conducted in 3 years at FMM KL

Year	Half-day Vendor Training	Location	Total Participants
2012	1/2 Day Vendor Training on Pump Systems Optimization	FMM KL	8
2012	1/2 Day Vendor Training on Fan Systems Optimization		8
2013	1/2 Day Vendor Training on Steam Systems Optimization		14

3.2.3 System Optimization Expert Training

The **Experts training** was an intensive training delivered by leading international Systems Optimization experts to national energy efficiency experts, service providers, equipment vendors and industry engineers. This training provided more in-depth technical information on troubleshooting and making improvements to industrial systems. It introduced basic principles for energy efficiency design of systems how to successfully sell systems improvement projects to management and how to select a system optimization service provider.

The national experts from various organisations were trained through classroom, on-the-job and coaching by international experts and equipped with the expertise, skills and the tools required. The technical assistance to enterprises and coaching facility personnel on system optimization projects development and implementation were provided to well-trained companies.

A range of trainings were offered to the factory personnel including the system optimization expert training for all four systems. UNIDO in collaboration with the host enterprises arranged to have the on-job training at the factories. The experts were invited to the selected factories to apply the knowledge gained from previous trainings. At times, the detailed trainings prolonged to four days for the trainees to understand the actual scenario and the solutions.

3.2.3.1 PSO Expert Training

After the 3-days of full training, the participants were assessed on their understanding on PSO system. Among the 31 participants who sat for the exam, 20 passed the test. A balance of 11 trainees were not able to fulfil the requirement to pass the exam due to a lack of understanding on the system.

Table 15: PSO Expert Training by sectors at different locations

No. of Days	Location	PSO Expert Training				
		Consultants	Industry	Government	Others	Total
Pump Systems Expert Training 2012						
4 days	Factory in Kulim, Kedah	2	1	1	0	4
4 days	Factory in Banting, Selangor	3	1	0	0	4
Pump Systems Expert Training 2015						
2 days	Classroom Training at Seremban Centre	7	17	2	1	27
3 days	On-site training at hotel	4	11	0	0	15
3 days	On-site training at Palm Oil Mill	3	6	2	1	12



Figure 25: PSO Expert Training participation by sectors

3.2.3.2 FSO Expert Training

In the FSO expert training, only 15 participants passed the exam of a total of 31. Almost half of the participants failed to pass the exam and needed further guidance to get familiarised with the FSO system.

Table 16: FSO Expert Training by sectors at different locations

No. of Days	Location	FSO Expert Training				
		Consultants	Industry	Government	Others	Total
Fan Systems Expert Training 2012						
4 days	Factory Ipoh, Perak	3	4	-	1	8
Fan Systems Expert Training 2015						
3 days	UNIDO Training Centre, Seremban	7	11	1	4	23
2 days	Factory in Ipoh	7	11	1	4	23



Figure 26: FSO Expert Training participation by sectors

3.2.3.3 SSO Expert Training

Among the 31 who sat for the examination, 23 were able to identify the SSO system successfully and only 8 of them were still in need of extra guidance from UNIDO trainers to be acquainted with the system well.

Table 17: SSO Expert Training by sectors at different locations

No. of Days	Location	SSO Expert Training				
		Consultants	Industry	Government	Others	Total
Steam System Optimization Expert Module Training 2013						
3 days	Palm Oil Mill in Pasir Gudang, Johor	4	8	3	1	16
Steam System Optimization Expert Module Training 2015						
3 days	On-site training at Factory in Gebeng Ind. Estate Kuantan	8	15	0	1	24



Figure 27: SSO Expert Training participation by sectors

3.2.3.4 CASO Expert Training

The involvement in the CASO trainings shows that factories are highly interested in this subject. A total of 45 participants were trained, out of which 30 managed to reach the goal of becoming experts in this system.

Table 18: CASO Expert Training by sectors at different locations

No. of days	Location	CASO Expert Training				
		Consultants	Industry	Government	Others	Total
Air Compressor System Optimization Expert Module Training 2013						
3 days	Factories in Penang	8	10	4	1	23
Air Compressor System Optimization Expert Module Training 2015						
4 days	On-site at hotel & factory	4	16	1	4	25
2 days	On-site at factory	2	10	1	0	13
2 days	On site at hotel	2	6	0	4	12

After having completed the training, the ‘Systems Optimization Experts’ were recognized as “Qualified Specialists” for the particular system type, in which they received training and passed the respective exam. These new experts received certificates from the organisation providing the training.



Figure 28: CASO Expert Training participation by sectors

3.3 Impact Assessment of IEEMMS Capacity Building Programme

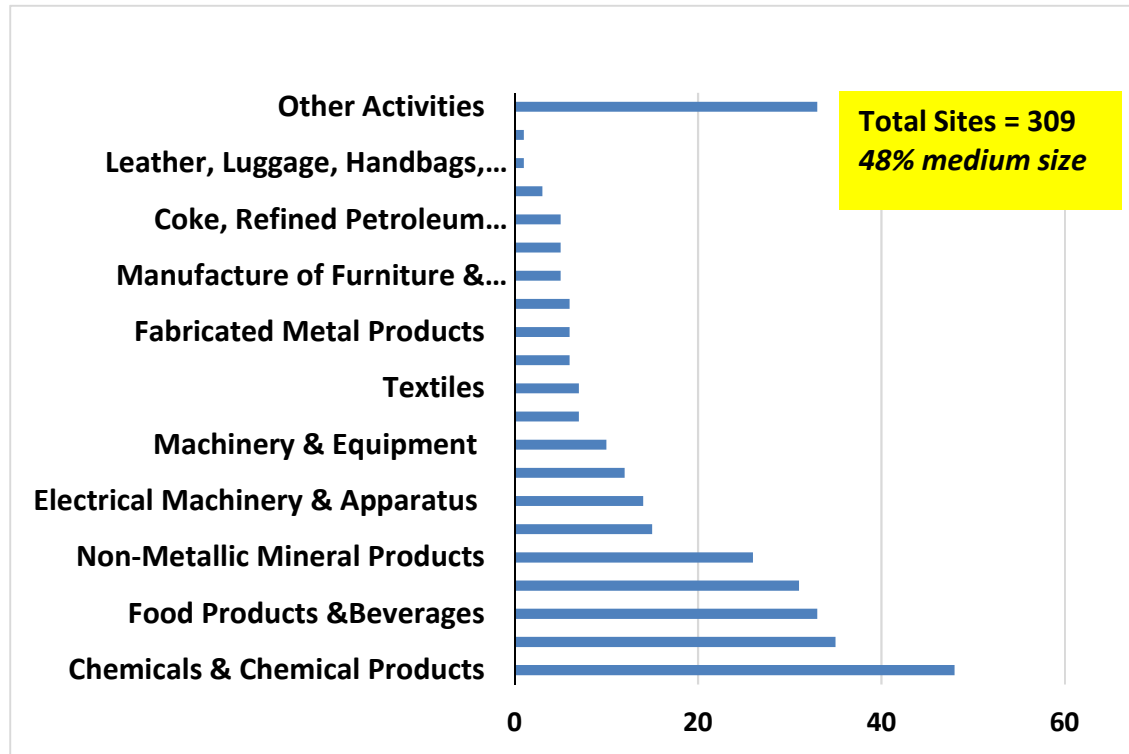


Figure 29: Number and Type of Participating Factories/Organisations

Overall, 309 companies/factories that took part in the capacity building programme. The number of participants from each sector are shown in Figure 29 above.

Among the 309 companies participated, some industries, government agencies and other organisation continue to implement the EE practices in their organisations and the consultants supported the other factories to implement EnMS, SSO, PSO, FSO and CASO.

Referring to the graph above, the highest participation were from companies in the sectors of chemical & chemical products, food & beverage, non-metallic mineral products, electricity machinery & apparatus and machinery equipment factories.

Table 19 below shows the number of factories by sectors who have completed the implementation of EE with positive results and some are in the process of implementing, checking and monitoring efficiency of the new measures.

Table 19: Factories completed and to Implement EE Initiatives

Industries	Completed the EE Implementation	To be implemented
Oil & Gas	1	
Tiles, Limestone, Cement	5	4
Electronic, Panel Board	4	
Foundry, Steel, Copper Wire & Rod, Pewter	5	2
Semiconductor, Plastic Injection Moulding, Automobile Parts, Facility management, Rubber products	10	2
Palm Oil, Flour & Oleochemical mills	3	4
Paper, Printing	4	
Automotive, Car	4	1
Fabric	1	1
Medical Devices	1	
Fatty Acids, Food & Beverage	3	3
Chemical	2	2
Building, Commercial	3	
Resort & Casino	2	
Solar Panels		1
Energy Consultant	1	
TOTAL	49	20

These industries had sent their representatives to the training by choosing the most suitable SO for their factories. Some of them were involved in both EnMS and SO trainings and some in only one particular, which is depicted in the table below. The coaching from the international UNIDO and local experts led the trainees to implement the EE measures successfully in the organisation.

Almost 50% of the industries and medium-sized industries trying to complete the process in the next two years. The involvement of the medium-sized industry is encouraging.

Table 20: Summary of Trainings attended by Large, Medium and Small Scale Factories

Trainings	Completed the EE Implementation			Trainings	To be Implemented	
	Large	Medium	Small		Large	Medium
EnMS	8	12	1			
CASO	2	3		CASO	1	6
PSO	2	1		PSO	1	1
SSO	1	2		SSO	2	2
FSO		1		FSO		3
EnMS, CASO	1	2		CASO, PSO	1	
EnMS, CASO, PSO	2			CASO, FSO		1
EnMS, CASO, SSO	2			CASO, PSO, SSO	1	
EnMS, CASO, SSO, FSO	1			PSO, SSO		1
EnMS, CASO, PSO, SSO	1					
EnMS, SSO	1					
EnMS, SSO, FSO	1					
ENMS, FSO	3	1				
EnMS, PSO		1				
Total	25	23	1	Total	6	14
Grand Total	49			Grand Total	20	

Case Studies

ASSESSMENT OF IEEMMS CAPACITY BUILDING PROGRAMME

Number of trainees implemented IEEMMS learning into their companies energy management plan and the success level of the project in terms of energy savings, carbon reduction and internal rate of return

The training activities were delivered to 309 companies or organisations. Among them, 69 companies have applied the training successfully in their factories or organisation. The number exceeds the target number of 50 that will lead to actions taken by participating factories to implement systems optimization projects and receive assistance to fully implement ISO 50001 in their organisations.

As to date, all the 49 companies have successfully implemented projects, illustrating financially attractive investments in efficiency improvements for steam and electric motor systems, including MS ISO 50001. These case studies show energy and greenhouse gas emissions savings directly attributable to the project. The certified experts trained in this programme are employed by the factories for consultation services to implement the ISO 50001 and system optimisation in their respective organisations. Among these medium

and large industries were included. System assessments and balance of 20 factories are still accounting the energy savings with the new experts' guidance.

Table 21: Summary of Electricity Savings and CO₂ Reduction by Regions

Completed the EE Implementation			
Regions	Electricity Savings		
	Annual Electricity Savings (MWh)	Emission Factor for 2014 (tCO₂/MWh)	CO₂ Emission Reduction (tCO₂)
P.Malaysia	4,834,630	0.694	3,355,233
Sabah	30,226	0.536	16,201
Sarawak	288	0.699	201
Total	4,865,144		3,371,635
EE to be Implemented (On-going)			
Regions	Electricity Savings		
	Annual Electricity Savings (MWh)	Emission Factor for 2014 (tCO₂/MWh)	CO₂ Emission Reduction (tCO₂)
P.Malaysia	12,168	0.694	8,445
Sarawak	1,959	0.699	1,369
Total	14,126		9,814
TOTAL OF CO₂ REDUCTION FROM ELECTRICITY SAVINGS (tCO₂)			
3,381,449			

Referring to the table above, the measures implemented in the 49 factories have achieved electricity savings of about 4,865,144 MWh (since 2014) which is equivalent to 3,371,635 tCO₂ tonnes of CO₂ reduction. The potential reduction from another 20 companies which are still in the process of implementation will account for additional savings accounting to 14,126 MWh or 9,814 tCO₂ reduction. Combined, this would total CO₂ emission reduction from electricity savings equivalent to 3,381,449 tCO₂

The prominent amount of annual energy savings and CO₂ reduction materialized after the factories implemented EE measures such as improvement in compressor room piping, leakage detection, replacement of florescent lighting with LED, switching off the AHUs after office hours, installing heat exchanger and many more relevant measures. Staff

awareness and trainings conducted by IEEMMS experts at their respective office introduced the EE good practices.

Some measures involving steam optimization managed to save the steam production for thermal energy and heat. The improvement in boiler efficiency enabled the reduced usage of fossil fuel such as natural gas consumption. The table below shows the thermal energy savings and the CO₂ reduction.

Table 22: Summary of Thermal Energy Savings and CO₂ Reduction by Source

Completed the EE Implementation				
Source	Thermal Energy Savings			
	Annual Thermal Savings (GJ)	Net Caloric Value (TJ/Gg)*	Emission Factor (kgCO₂/TJ)**	CO₂ Emission Reduction (tCO₂)
Natural Gas	774,269	45.19	56,100	43,454
LPG	781	45.54	63,100	49
Steam	174,652			9,798
Total	949,701			53,302
EE to be Implemented (Potential CO₂ Reduction)				
Source	Thermal Energy Savings			
	Annual Thermal Savings (GJ)	Net Caloric Value (TJ/Gg)*	Emission Factor (kgCO₂/TJ)**	CO₂ Emission Reduction (tCO₂)
Natural Gas	4,186	45.19	56100	227
Steam	188,839			10,594
Total	193,024			10,821
TOTAL OF CO₂ REDUCTION FROM THERMAL SAVINGS (tCO₂)				
64,123				

The annual thermal savings were measured and CO₂ reduction were calculated for all the measures. The total thermal energy savings amount to 949,701 GJ (since 2014). The CO₂ reduction is 53,302 tCO₂ for the 49 companies. The other 20 companies have a potential of 193,024 GJ thermal savings and 10,821 tCO₂ emission reduction. The fuel used in the boiler were natural gas, steam and LPG. The savings of the fuel for thermal energy was reduced with 64,123 tCO₂ annually in total.

The implementation of EE measures has environmental and financial benefits. The electricity savings led to lowered electricity bills of the all factories involved. The total of RM 51.6 million were saved annually by the factories which had implemented the EE measures. The cost of investment for the 49 factories amounted to 27.55 million. The on-

going projects will be able to reduce electricity and CO₂ emission. To date, the total investment for the 20 factories has been 5.8 million with electricity saving of 9,814 MWh.

Overall the total carbon emission from all 49 factories equals 3,445,572 tCO₂ with savings of RM 74 million. The table below shows the environmental and financial benefits of the factories.

Table 23: Summary of Environmental and Financial Benefits Achieved by IEE MMS

Completed the EE Implementation						
Regions	Environmental Benefit			Financial Benefit		
	Carbon Reduction from Electricity Savings (tCO ₂)	Carbon Reduction from Thermal Energy Savings (tCO ₂)	Total CO ₂ Emission Reduction (tCO ₂)	Annual Electricity Cost Savings (MYR)	Cost to Implement (MYR)	Average Payback Period (yrs)
P. Malaysia	3,355,233	53,302	3,408,535	45,570,680	27,227,423	0.6
Sabah	16,201		16,201	5,953,868	260,050	2.2
Sarawak	201		201	57,600	58,392	1.0
Total	3,371,635		3,424,937	51,582,148	27,545,865	3.8
EE to be Implemented (On-Going)						
Regions	Environmental Benefit			Financial Benefit		
	Carbon Reduction from Electricity Savings (tCO ₂)	Carbon Reduction from Thermal Energy Savings (tCO ₂)	Total CO ₂ Emission Reduction (tCO ₂)	Annual Electricity Cost Savings (MYR)	Cost to Implement (MYR)	Average Payback Period (yrs)
P. Malaysia	8,445	10,821	19,266	21,583,838	4,741,110	0.22
Sarawak	1,369		1,369	479,100	1,078,650	2.25
Total	9,814		20,635	22,062,938	5,819,760	2.5
TOTAL OF CO₂ REDUCTION FROM IEE ACTIVITIES (tCO₂)				TOTAL OF ELECTRICITY COST SAVINGS (MYR)		
3,445,572				73,645,086		

Besides energy and cost savings, the factories achieved in-direct benefits such as increased in production rate, reduced buffer time, reduced maintenance cost, improved quality by eliminating unstable facility system and optimised water usage. Adding to that, some companies accepted and invested in potential energy saving/ improvement opportunities proposed in the mechanical and electrical system. The systematic approach and development of staff as registered energy managers are persuasive.

For the better maintenance of system, the awareness among the top management and staff has improved by introducing a well-structured management system to monitor, measure, analyse and verify the energy performance in all factories. Roles and responsibility for the various level of management system were established according to the organisations' needs. Figure 30 shows the experiences shared by the participating companies on the benefit of IEE organised by the UNIDO programme.

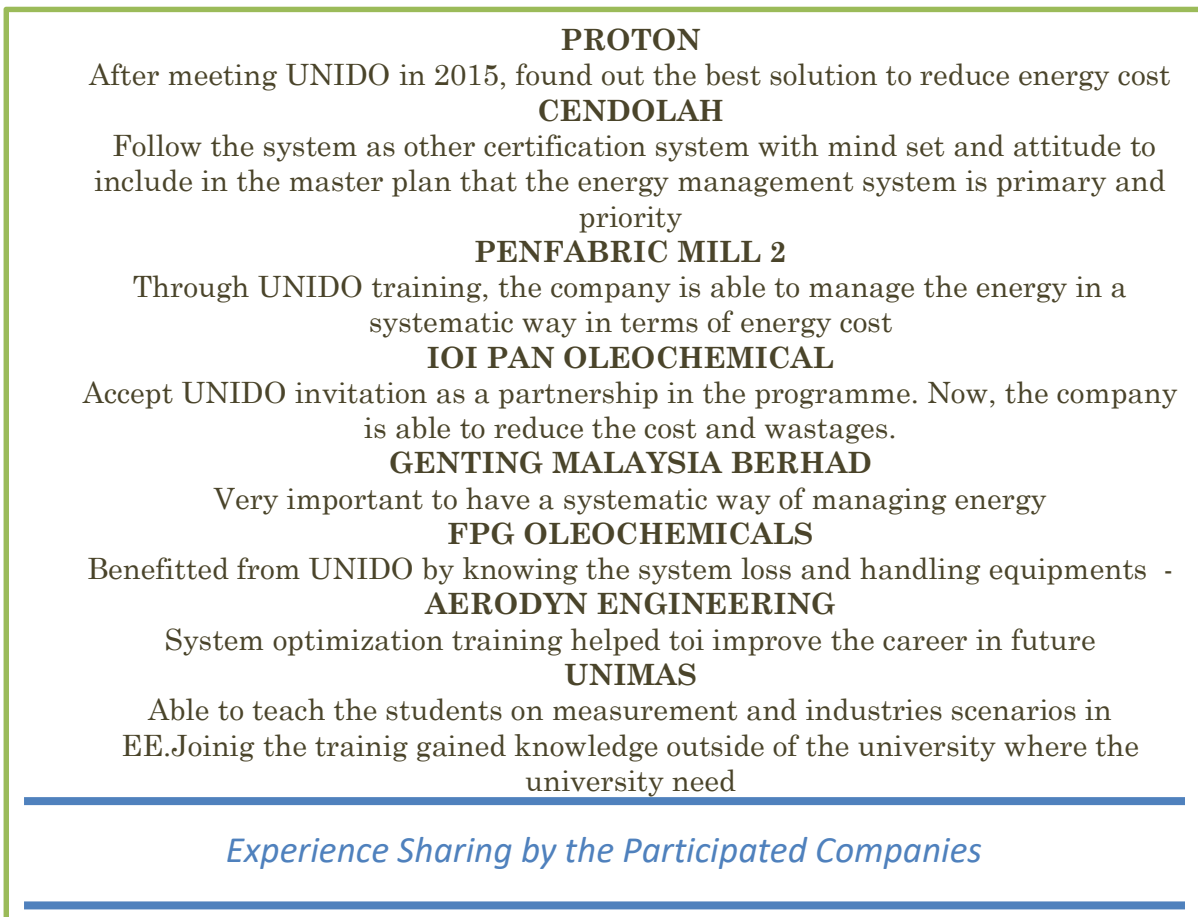


Figure 30: Participants Testimonial on IEEMMS Trainings

About 44 companies were presented with certification during Open Day held in 2014. During the Certification Presentation ceremony in October 2016 at MITI HQ, a video presentation on the project was presented and more than 39 awareness trainings have been carried out including training to municipality personnel.

EnMS training materials have been developed by UNIDO and local experts and adapted to the Malaysian context, with input from PMU and technical advisors. These training materials have been continuously updated and used extensively in the EnMS trainings conducted by UNIDO and also local experts. They have received positive feedback from industry.

Forecast of Implementation of IEEMMS in Industries

Growth in carbon emission reduction from the industrial EE is expected to be increasing annually. Malaysian has pledge to 45% reduction in total GHG emission intensity by 2030. At this time, many mitigations programmes have been implemented to reduce CO₂ emission in Malaysia to achieve the pledge of 45% carbon intensity reduction.

Considering the IEEMMS programmes currently in place, it is projected that the carbon emission reduction activities in industrial Energy Efficiency rise through 2030. The figure below shows the emission reduction level from 2016 till 2030. The total amount of CO₂ emission reduction to be achieved in 2030 is 51,684 ktonCO₂.

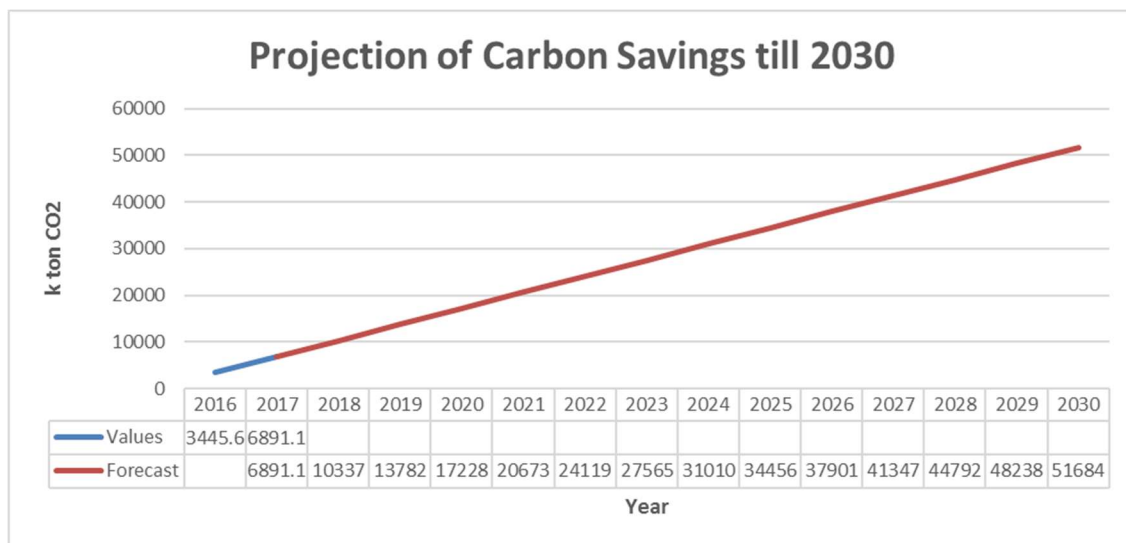


Figure 31: Forecast of Carbon Emission Reduction in 2030 through IEEMMS awareness programme

Even though the figure is too small compared to the total amount of carbon emission to be reduced by Malaysia in 2030, the efforts in industrial EE is peaking and the projection may change significantly as laws and policies aimed at reducing GHG emissions in this country are implemented and enforced in many areas.

3.4 Barriers in Implementation of the Industrial Energy Efficiency

The main barriers to implementation of EE identified at the project development phase. The IEEMMS project has addressed these are mentioned below:

3.4.1 Lack of industrial EE policy formulation

- Lack of a clear and (industrial) energy efficiency policy and action plan with well-defined policy instruments; duty and sales tax exemptions exist for EE equipment (since 2001), however number of applicants have been quite small
- Prices of electricity and fuels do not reflect real costs due to direct and indirect subsidies. The higher the subsidies, the higher the underinvestment in EE.
- Energy intensity benchmarking was initiated by MIEEP within the industrial sectors but remains difficult to implement

Project has addressed this as follows:

- Inputs to EPU on the “11th Malaysia Plan” (2016-20) and to Energy Commission on enhancing the national energy database.
- Visits to Vienna and Copenhagen on ISO energy management for government stakeholders
- ISO 50001 was mentioned in the 11th Malaysia plan as a key tool to developing energy efficiency for industrial as well as the building and residential sectors
- Local Project Management Unit (PMU) coordinated work done by KeTTHA and EPU on long-term demand side management programs

3.4.2 Corporate decision making and management

Energy efficiency is not a core interest mission for most companies and company strategies tend to focus on output growth and production rather than cost management. Most enterprises have a budgetary disconnect between capital projects (equipment purchases) and operating expenses (energy and maintenance, for example). Energy efficiency projects reduce operating expenses, but require capital for implementation. Corporate accounting practices often place capital and operating budgets under separate departments.

3.4.3 Lack of awareness

While the awareness on energy management is fairly high among the large-scale industries, the majority of SMEs do not have the same level of awareness. The SMEs do not have the expertise and know-how to practice energy management. In fact, not many Malaysian industries are inclined towards practising Energy Efficiency (EE). They do not see that it can help reduce their operations costs thereby making their products more competitive.

Project has addressed the above as follows:

An information exchange network has been established through a regularly updated project website (www.ieemms.org), and the set up and use of a “Basecamp, GoTo Training/GoToMeeting, Skype” communication platform. The platform is well used by all project participants where case studies and management plan designs are shared with EE experts on Basecamp.

A national information campaign has been established during the Project including:

- the Project website and newsletters from FMM on awareness raising workshops for EE;
- ongoing information dissemination through user training sessions, pamphlets, brochures and emails
- 39 awareness seminars attended by industry, consultants, energy service providers, academics, local and central government officials. Total number of attendees at the seminars exceeds 1400
- Project participated in the ASEAN SME Showcase and Conference 2015 in Kuala Lumpur
- Project website is constantly being upgraded with ongoing interlinks with other websites including FMM to provide integrated info on EE;
- Project newsletters for awareness raising on EE are regularly posted on Project website and the FMM website

3.4.4 Lack of capacity to design, evaluate and implement EE management and optimization

Lack of familiarity with the range of energy efficiency technologies and processes, and energy conservation investment best practices as well as the under-appreciation of financial benefits from energy conservation investments and lack of technical manpower are primarily responsible for the high risk perception among industrial enterprises.

Industrial energy-consuming equipment purchase decisions tend to focus on individual components, not on systems. When processes and equipment change over time, inefficiencies in term of energy use compound and reoccur. In addition, local suppliers of energy efficiency related finance, equipment and expertise have limited experience and skills in marketing their products to industrial decision-makers.

3.5 The Financial Support for Industrial Energy Efficiency

UNIDO team organised a number of programmes for Industries on EE financing and submitted proposals to SME Corp for the growth of EE in industries. Mostly, the programmes were co-organised with government agencies such as SME Corp Malaysia, MITI and KeTTHA.

1- Day Workshop on Financing Scheme & Options

A workshop was conducted on 28th July 2016 which was attended by 70 personnel from 52 industries, financial institutions, consultants and energy service companies. This workshop was an effort by UNIDO to introduce financing options for implementing energy efficiency projects in manufacturing sector as well as to identify potential projects apply customized the financing options to demonstrate the mechanisms.

The participants were exposed to various financing opportunities. UNIDO presented overall on the IEEMMS project objectives and EE initiatives by facilities. While, SME Corp Malaysia introduced the SCORE (SME Competitiveness Rating for Enhancement) and Business Accelerator Programme (BAP) to the attendees. The SCORE is collaborated with 7 variation model regarding the company's business model. BAP 2.0 is an integrated assistance programme to enhance capabilities of Small and Medium enterprise through business advisory and financial support.

MIDF Financing Scheme is a scheme introduced by MITI, SME Corp, MATRADE and MIDA based on conventional and Islamic financing for SMEs and non-SMEs companies. MIDF will provide soft loan for EE projects and green projects. The soft loans are namely SLSAM (Soft Loan Scheme for Automation & Modernisation) and SLSME (Soft Loan Scheme for Small and Medium Enterprise).

To continue the effort to develop SMEs in line with nation's engine of growth with government's economic agenda, GTFS (Green Technology Financing Scheme) was established to activities related to manufacturing, services and construction. The producers or users of green technology are eligible to obtain the finance by fulfilling certain criteria.

In addition to GTFS, SME is also encouraging to apply for SME Bank Financing scheme which is owned by government (Ministry of Finance and integral with Bank of Negara Malaysia). As of July 2016, 18 companies had received the financing support from SME Bank for commercial projects.

At the end of the workshop, it was observed a demand for financing outside the respective organisations to undertake high cost EE project. The manufacturing sector is ready to finance EE projects and keen to implement them. However, most factories are not aware of the available financing instruments and options suitable for their EE project.

Proposal to SME Corporation Malaysia

A proposal on “Green Technology Financing” has been prepared and submitted to SME Corp to promote energy efficiency in the medium sized facilities. This is to encourage the medium-sized facilities to adopt the Energy Management System MS ISO 50001 as part of their organisation management practices. Using energy efficiently helps organisations save money as well as helping to conserve resources and tackle climate change.

The proposal suggested to

- 1) Offer one off grant per facility for purchasing of meter and sub-meters for energy consumption monitoring
- 2) Matching Grant for purchasing energy efficiency equipment
- 3) Payment cost for training and consultancy for MS ISO 50001 certification
- 4) Payment of certification fees for MS ISO 50001

The suggested grant will support organisations in all sectors to adopt MS ISO 50001 in their existing management system such as ISO 9001 or ISO 14001. This makes it easier for organisations to integrate energy management into their overall efforts to improve quality and environmental management.

Proposal on SCORE for Industrial Energy Efficiency Sub Sector

This proposal is prepared to recommend the establishment of a new SCORE Model, SME Corp UNIDO to promote the implementation of Industrial EE in Malaysia. This proposal outlines the adoption of the current industry based collaboration with SME Corp to establish another SCORE model for Industrial EE.

The SCORE model is a tool to address the industry’s capacity, performance and eligibility to access the financial and fiscal support mechanism. It provides a gauge to measure the competitiveness and capabilities of companies at firm level. SCORE has been used as tool for a business matching purposes for better market access and initial indicator for the access to finance.

The SCORE +UNIDO/FMM Model will play a role in the implementation of EE projects, provision of services (technical financial and commercial) and implementation of EPC. Companies that are SCORE rated will be eligible for the green financing from SME Corp, SME Bank, GTFS, MITI, MIDF and tax initiatives from MIDA. This collaboration between SME Corp and UNIDO is to create new implementation channel of the IEE.

4. CONCLUSION AND RECOMMENDATION

The project has resulted in extensive capacity building and involvement of industries both in the implementation of MS ISO 50001- Energy Management System and System Optimization. The number of participants or industries involved in the capacity building are encouraging.

Approximately total energy saving as a result of the project implementation is 4,865 GWh (mainly through no/low cost measures) derived from 69 companies (both EnMS and Systems Optimization). The total annual cost reduction from energy saving is RM 73.65 million with a GHG reduction of approximately 3.4 million tonnes of CO₂. These companies invested a total of RM 33.4 million on their system improvement at their factories and the average pay back period is 2.2 years.

In addition to that, there are 5 companies certified with MS ISO 50001. The project has purchased measuring/data collection equipment for Compressed Air, Fan, Pump and Steam Systems assessment, a total worth of RM 500,000. Local expert participants are trained by International experts to use the instrument to carry out assessment at various host plants around Malaysia including Sabah and Sarawak.

To ensure sustainability of the training programmes:

- a) A proposal to transfer the project equipment to UNITEN (National Energy University) was accepted by the Project Steering Committee. UNITEN is under the purview of the Ministry of Energy, Green Technology and Water. UNITEN will also be responsible for conducting the System Optimization courses with the local trained experts
- b) It was agreed by the Project Steering Committee that the EnMS course notes will be handed over to MAESCO, the Association of Energy Service Companies who conduct courses in Energy Management. Many of the members of MAESCO have gone through the UNIDO courses and have obtained certificate as local EnMS experts

This move enables beneficial use of the equipment for capacity building at local industries on the energy efficiency topics, in line with the aspiration of UNITEN to be an excellent university in the field of energy and sustainability.

The IEEMMS project objective is to ensure a cadre of highly experts from the public and private sectors are available as a long-term technical resource to industry and the country. The list of national consultants and experts will be provided in the project website as well as in other relevant local agencies. and they can be utilized to provide trainings to the industry representatives. The training programme can be converted into a certification course.

PMU participated in several workshops in drafting the National EE Action Plan (NEEAP) where measures will be taken to identify potential improvements and appropriate approaches to ensure efficient use of energy in buildings, industries and households. The NEEAP has been approved

by the cabinet and the measures to improve EE in industries through Energy Performance Contracting are being implemented.

Due to the good cooperation from government particularly, SME Corp Malaysia, KeTTHA, MITI, EPU, ST and UNIDO, the project was able to obtain the services of international experts for the user and expert training course. On the other side, the slow start was partly due to MS ISO 50001 being introduced just before the project started and the need to raise awareness initially. The demand for the user/expert training came first during year 4 of the project. A few of the expert trainees were not able to fully commit to the training. The expert training took a very long time (18 months) for EnMS and 12 months for SO. Many trainees were delayed in preparing their industry assessment. The financing is always an issue for medium-sized industries although there has been numerous forums and discussions on this.