KeTTHA
KEMENTERIAN TENAGA,
TEKNOLOGI HIJAU DAN AIR

NATIONAL ENERGY EFFICIENCY ACTION PLAN

Table of Contents

List of Figures

List of Tables

Foreword

The proposed NEEAP contained herein incorporates the view of majority of the stakeholders and working group collated at the various stages of deliberations of the original NEEMP documents. This Report therefore only focuses on the final outcome of NEEAP. Invariably, it does not include all the process trails of the previous findings. Notwithstanding that, references of them are made from time to time when the occasion arises.

1. Executive Summary

Malaysia is a developing country where its growing population and expansion of economic activities especially in the manufacturing sector have been the major drivers for the increasing demand for energy supply. Historically, the nation's energy demand growth rates were higher than the growth rates of its Gross Domestic Products (GDP). The energy demand growth, especially the demand growth for electricity, was accelerated by the industrialisation process in the past two decades. The imbalance ratio between energy demand and GDP is indicative of the more energy-intensive economic activities driving the growth. In this regard, the need to promote efficient-use of energy in the country has become clear. However, the effort requires sound energy efficiency policies supported with good strategies and implementable programmes.

Since 2000, Malaysia's energy intensity (energy/GDP) has been rising. This implies that over time Malaysia uses more energy to produce a unit of GDP and this provides a compelling reason for Malaysia to improve its efficiency of energy use. Energy efficiency offers an effective and efficient energy policy instrument to address the energy supply security issue as well as energy-related environmental issue in the country. At the same time, energy efficiency is also one of the ways that will lead the country to a sustainable energy path.

Energy efficiency improvement at demand-side is a crucial parts of the energy sector development as the demand dictates the energy supply and fuel consumption. Savings on the demand side will reduce the energy losses due to distribution and transmission of power, losses in power generation plants, and the energy use associated with extraction and transportation of fuels. In energy terms, saving one unit of energy in the demand side will save 3-4 units of primary fuels. In addition, investments in energy supply facilities such as power plants and grid can be deferred or postponed.

In this regard, the National Energy Efficiency Action Plan, devised for the country, including Sabah and Sarawak, is focused to tackle issues pertaining to energy supply by managing demand efficiently. The Plan prescribes a path towards improving energy efficiency by pursuing the implementation of measures that are considered as "harvesting the low hanging fruits", as they are viable for the nation as well as the end users. The plan is built upon the experiences and knowledge from past programmes and projects, which were implemented by various institutions and agencies, but was lacking in terms of a coherent framework to ensure sustainability in the longer term.

The lessons from the past experiences have given the understanding on the main

barriers that impeded the progress and success of past energy efficiency improvement efforts in Malaysia. The barriers can be categorised as:

- *Low energy prices;*
- *Lack of finance for energy efficiency*;
- *Lack of overall national plan for Energy Efficiency;*
- *Lack of champion to drive Energy Efficiency;* and
- *Lack of consistency in embarking on energy efficiency*.

Therefore, the National Energy Efficiency Action Plan presents the instruments for a successful implementation of energy efficiency strategies in the country for a period of 10 years which will address and mitigate those barriers.

The National 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 National 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."

In meeting the policy direction, the National Energy Efficiency Action Plan will be supported by 4 main thrusts that will drive the nation towards a sustainable energy path:

Thrust 1*: Implementation of Energy Efficiency Action Plan;*

Thrust 2*: Strengthen Institutional Framework, capacity development and training for Implementation of Energy Efficiency initiatives*

Thrust 3*: Establishment of Sustainable Funding Mechanisms to Implement Energy Efficiency Initiatives;*

Thrust 4*: Promotion of Private Sector Investment in Energy Efficiency Initiatives*

The above 4 thrusts will help eliminate the existing barriers and ensure that energy consumers in the targeted sectors will be encouraged to adopt and adapt energy efficiency as a way of life and reap the benefits that energy efficiency could provide.

The National Energy Efficiency Action Plan contains 10 specific energy efficiency programmes covering 3 sectors to be implemented over a 10 years period.

The programmes can be grouped into 5 key initiatives related to the design of the programmes. i.e:-

Initiative 1: Promotion of 5-Star Rated Appliances;
Initiative 2: Minimum Energy Performance Standards (MEPS);
Initiative 3: Energy Audits and Energy Management in Buildings and Industries;
Initiative 4: Promotion of co-generation
Initiative 5: Energy Efficient Building Design.

The target of National Energy Efficiency Action Plan is to save electricity and reduce electricity demand growth. The effective and efficient implementation of the National Energy Efficiency Action Plan supported with sufficient resources will be able to save 52,233 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 8.0%. The electricity savings will eventually lead to a reduction in peak demand and the need to build new power plants in future. In other words, National Energy Efficiency Action Plan's achievement will improve the electricity load profile by better management of peaking load in the power system. A straight-forward calculation of peak demand reduction from the National Energy Efficiency Action Plan implementation will result in a total capacity saving of 2,526 MW. The fuel savings derived from the National Energy Efficiency Action Plan will also lead to less environmental impact and reduction in greenhouse gas emissions. The total reduction of greenhouse gas emission over the plan is projected to be 38 million tonnes $CO_{2\ equivalent}$. A total reduction of 88 million tonnes of $CO_{2\ equivalent}$ will be achieved over the lifetime of the energy-efficient technologies adopted and adapted from the plan implementation.

The effective and efficient implementation of the National Energy Efficiency Action Plan's programmes requires an average governmental budget allocation of RM 54.3 million annually. The budget will cover the cost to administer and incentivise the National Energy Efficiency Action Plan's programmes. The public expenditure on the National Energy Efficiency Action Plan, a total of RM 543 million, will be leveraged by the private sector investments. A total of RM 5,781 million private sector investments will be induced over the plan. From this investment amount, the largest share will be spent on the adaptation of energy-efficient technologies.

The public and private expenditure on National Energy Efficiency Action Plan programmes, amounting to a total of RM 6, 324 million, will result in a total direct monetary saving benefit of RM 18,518 million. The direct monetary benefit is the value of total electricity saved by the National Energy Efficiency Action Plan, calculated based on the current electricity tariff. The other indirect benefits, i.e. capacity savings and greenhouse gas reduction are not included in the direct monetary benefit.

The cost-benefit ratio of the National Energy Efficiency Action Plan, which is calculated by dividing the direct monetary benefit with the public and private cost, is 3.2. In other words, every RM 1 spent on the National Energy Efficiency Action Plan's programmes will result in a saving of RM 34.20, while the cost-benefit ratio based on the lifetime savings of energy-efficient technologies adopted and adapted during the National Energy Efficiency Action Plan is 7.4.

2. Background

Malaysia is a progressive developing country. Its economic and social development has been growing fast with energy as one of the main inputs to drive them. Malaysia's final energy consumption had increased from 13 million toe in 1990 to about 53 million toe in 2013, reflecting an annual average growth rate of 6.3%. The electricity consumption during the period grew at an annual average growth rate of 8.2% to reach 116,087 GWh. At the same time, Malaysia's GDP grew at an annual average growth rate of 5.7%. Malaysia is determined to maintain its economic growth over the next decade, but the growth in its energy consumption must be managed to ensure the productivity and competitiveness of its economy.

In the process to accelerate its economic and social development, supported by its current position as a net energy exporter, Malaysia provides subsidies on energy-use for various levels of users. The energy subsidies amount offered to various energy users in the country has been growing from year to year, corresponding with the volatility of global energy prices and growing demand for energy. The subsidies amount has reached a worrisome level that the government expenditure capacity has been stretched beyond its ability and has taken the share of other developmental budget allocation. This situation has prompted the Malaysian Government to review its policies related to energy subsidies and to take action to manage energy subsidies with proper mitigation actions. In this regard, energy efficiency offers a sound solution to mitigate the effects of the gradual removal of energy subsidies.

The need to drive its economic growth while maintaining productivity and competitiveness and also the compelling need to rationalise its energy subsidies have made energy efficiency as one of the key energy policy instrument for Malaysia. Energy efficiency will benefit the whole society as it encourages reduced overall costs for energy for the consumers and reduced subsidy payments from the government. These savings can be directed to more useful purposes in households, industries and other sectors of the society and increase the welfare of the nation. At the same time, Malaysia also can enhance its security of energy supply through a cost-effective approach by implementing effective energy-efficiency strategies and programs. Energy efficiency will help to reduce the burden of energy costs for the consumers but at the same time will ensure that the energy quality and quantity derived from the energy used are maintained. In addition, energy efficiency will serve as part of the nation's strategy on climate change and the reduction in the emission of greenhouse gasses.

2.1 The Institutional Setup and Regulatory Framework on Energy Efficiency

The key agencies involved to promote energy efficiency in Malaysia are the Economic Planning Unit (EPU) of the Prime Minister's Department, the Ministry of Energy, Green Technology and Water (MEGTW), Ministry of Works, Ministry of Urban Well Being, Housing and Local Government and the Energy Commission (EC). The role of MEGTW is to formulate and implement energy efficiency policy, in coordination with the EPU. The EPU's main role is to allocate sufficient resources for the implementation of energy efficiency programmes. The EC, established under the Energy Commission Act 2001, is the regulatory agency for the electricity and the gas supply industry at the reticulation stage. The Commission's main tasks are to regulate the electricity and gas supply industry at the reticulation stage from the technical, safety and economic aspects. EC also advises the Energy, Green Technology and Water Minister on all matters related to electricity and tariffs including energy efficiency promotion.

In promoting energy efficiency, MEGTW had enacted a number of legal instruments. The main legal instrument on energy efficiency promotion is the Electricity Supply Act (Amendment) 2001 or known as Act A1116. The Act empowers the Energy, Green Technology and Water Minister under the Section 23A, 23B and 23C of the Act to promote efficient use of electricity in the country. Subsequent to this amendment of the Act, MEGTW issued the Efficient Management of Electrical Energy Regulations 2008. Under these regulations, all installations that consume or generate 3 million kWh or more of electricity over a period of six months will be required to engage an electrical energy manager who shall, among others, be responsible to analyse the total consumption of electrical energy, to advise on the development and implementation of measures to ensure efficient management of electrical energy as well as to monitor the effectiveness of the measures taken. The EC is empowered to enforce the Energy Efficiency Regulations.

In 1989, the Ministry of Energy, Telecommunications and Posts, the predecessor of MEGTW introduced the Guidelines for Energy Efficiency in Buildings. The Guidelines was developed as a Malaysian Standard, i.e. MS 1525 – Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-Residential Buildings" in 2001. The code has been used as a guide in designing energy-efficient buildings in the country. The code was revised in 2007 and 2014 to incorporate the latest technological developments. In 2012, the promotion of energy efficiency in new commercial buildings was made mandatory by the amendment of the Uniform Building By-Laws (UBBL). Section 38A of the UBBL requires new or renovated non-residential buildings with air-conditioned space exceeding 4,000 square metres to

be designed to meet the Overall Thermal Transfer Value (OTTV) and the Roof Thermal Transfer Value (RTTV) of MS 1525. The section also requires those buildings to be provided with an Energy Management System (EMS).

The latest regulatory instrument to promote energy efficiency improvement is the Electricity Regulations (Amendment) 2013. The regulations have been amended to allow the implementation of Minimum Energy Performance Standards (MEPS) on selected electrical appliances and lighting. Under the new regulations, refrigerators, air-conditioners, televisions, fans and lamps (Fluorescent, Compact Fluorescent, Light Emitting Diode and Incandescent) that enter the Malaysian market or are sold to consumers must meet the minimum energy performance standards as prescribed in the regulation. Furthermore, information related to MEPS of those products must be made available to consumers by labeling. Labeling of appliances covered by MEPS will became a mandatory requirement. The regulation will pave the way for the phasing- out of inefficient electrical appliances and lighting.

2.2 Past and Current Initiatives on Energy Efficiency

In the past 10 years, a number of energy efficiency initiatives had been undertaken by the Malaysian Government. Some of these initiatives were supported by the United Nations Development Programme (UNDP), Japan External Trade Organisation (JETRO), Energy Conservation Centre Japan (ECCJ) and the Danish International Development Agency (DANIDA). Those initiatives have led to capacity building in various aspects of energy efficiency in the country. It has also increased the awareness on energy efficiency among stakeholders, the private sector and energy users at large. The initiatives also paved the way for the enactment and formulation of energy efficiency regulatory instruments for some selected industries in the country.

Some of those key initiatives are:

1) *Malaysian Green Technology Corporation*, formerly Malaysian Energy Centre. A number of projects have been implemented in the areas of energy efficiency and renewable energy. Some of the most significant are:

    a. *Malaysian Industrial Energy Efficiency Improvement Project* (MIEEIP) – was a cooperative project between the Malaysian Government and UNDP with the aim of promoting energy efficiency within the industrial sector. The project focused on energy auditing of industries, demonstration projects, rating of high efficient equipment and increasing the awareness among industrial consumers on energy efficiency.

b. *Integrated Resource Planning* – was a 4-year DANIDA funded project aimed at providing capacity building on methodologies for effective energy planning and forecasting, taking both supply and demand side initiatives into account.

c. *GEO Building* – the building where the present Greentech Malaysia is located is a demonstration building that had been designed with low energy features. The energy consumption of the building was designed to be 50kWh/m^2/year - significantly lower than the average of 200 kWh/m^2/year of typical office buildings. Furthermore, installation of photovoltaic systems brings the net electricity consumption down to about 35kWh/m^2/year.

2) *Centre for Education and Training in Energy Efficiency and Renewable Energy (CETREE)* is a centre located in the campus of University of Science, Penang. At the initial stage, CETREE's establishment was assisted by DANIDA. CETREE's focus is to increase awareness on energy efficiency and renewable energy among school children and students. The Centre has developed curricula for primary and secondary schools and assisted universities in incorporating energy efficiency in their teaching courses. Furthermore, the centre organises events for schools on energy efficiency and renewable energy and their exhibition busses visits schools all over Peninsular Malaysia. The centre is funded by MEGTW for its operational and developmental expenses.

3) *Fiscal Incentives for Energy Efficiency* was introduced under the government financial budget in 2001. The aim is to promote energy efficiency projects and equipment by providing tax incentives. The tax incentives are in the form of waiver of import duty and sales tax on energy efficient equipment and accelerated capital allowances or pioneer status for investment in energy efficient technologies and projects. These incentives were enhanced over the years.

4) *The Green Technology Finance Scheme* (GTFS) was launched in January 2010, with a fund of RM 1.5 Billion to support investments in green technology projects, which, among others, include energy efficiency. The fund provides a 2% subsidy to the interest rates offered by commercial banks and a credit guarantee support for the loan capital. Under the 2013 budget, the Government increased the amount of interest subsidy by RM2.0 billion, making the total amount of green financing made available by the Government to RM3.5 billion.

5) Sustainability Achieved via Energy Efficiency Program or SAVE was a program designed under the Economic Transformation Program (ETP) of the Malaysian

Government in July 2011. The program was aimed to provide cash rebates for the purchase of energy-efficient refrigerators, air-conditioners and chillers. A total of RM 45 million was allocated under the program for the rebates and its promotional campaign activities throughout the country. The budget had covered the purchases of as many as 100,000 units of refrigerators, 65,000 units of air-conditioners and 72,000RT capacity of energy efficient chillers for eligible domestic consumers and private companies. SAVE has helped to create a market for energy-efficient appliances and market penetration of those products.

6) Energy Performance Contracting (EPC) is an initiative started in Jan 2013 by the Malaysian Government to promote energy efficiency in government buildings. Under the EPC concept, government buildings are allowed to engage energy services companies (ESCO) to improve energy efficiency. The cost of investment to implement energy efficiency improvement will be provided by the ESCO, while the government buildings are allowed to pay the cost of investment by the ESCO from the savings made from the improvement efforts. The initiative will help create an ESCO industry in Malaysia as well as ease the government's monetary burden on building energy bills.

7) Building Sector Energy Efficiency Project (BSEEP) was started in 2010 and will last until end of 2016. It is supported by the Global Environment Facility (GEF) and implemented by United Nations Development Programme (UNDP) and the Malaysia Public Works Department, (Jabatan Kerja Raya-JKR). The Project goal is to reduce the annual growth rate of Green House Gas emissions in the Malaysia building sector. BSEEP's objective is the improvement of the energy utilization efficiency in Malaysian buildings, particularly those in the commercial and government sectors, by promoting the energy conserving design of new buildings and by improving the energy utilization efficiency in the operation of existing buildings through the removal of barriers to the uptake of building energy efficiency technologies, systems, and practices.

8) Industrial Energy Efficiency for the Malaysian Manufacturing Sector (IEEMMS) was launched in April 2012 and will be implemented within 5 years. It is implemented by United Nations Industrial Development Organisation (UNIDO) and SME Corporation Malaysia. The project aims to improve energy efficiency in the Malaysian manufacturing sector through energy efficient optimisation of energy and production systems and through the implementation of energy management system based on the ISO 50001 standard.

The above initiatives have all contributed to create a strong platform for implementation of energy efficiency, as institutions and human resources have been

developed and basic awareness in all parts of society has been spread.

2.3 Identified Barriers to Energy Efficiency

Although various initiatives have been undertaken to promote energy efficiency improvements, the outcome of the initiatives on the nation's energy supply and demand is unclear. The initiatives have been spread and there has been a lack of synergy among the various projects, as well as a proper plan for the continuation of the activities after the project period. In this regard, a number of key barriers have been identified that prevented a wide-spread adoption of energy efficient practices. They are:

1) *Low energy prices* – The electricity and fuel prices have been kept below the actual cost of energy generation due to fuel subsidies. The prices are not reflecting the real cost of production and supply of energy. The low energy prices prevent energy efficiency as the consumers are less concerned about the energy costs. Furthermore, energy efficiency investments are not made as the returns in terms of energy savings are small due to the low energy prices.

2) *Lack of finance for energy efficiency* – dedicated finance for energy efficiency from commercial lending institutions has been difficult to obtain, as the banks have not built sufficient capacity to deal with energy efficiency project evaluation and project finance schemes. Loans for energy efficiency projects are normally given based on collaterals from the applying companies and not based on the project feasibility. Similarly, there are no loan schemes for energy efficiency for individual consumers and the finance institutions will normally recommend traditional loan schemes such as e.g. term loans, credit card loans, if an individual wishes to purchase energy-efficient appliances.

3) *Lack of overall national plan for Energy Efficiency* – Energy efficiency has been a part of the Malaysian Development Plans, but there has not been any underlying road map or action plan for the implementation of energy efficiency. The activities are, therefore, driven by individual short-term projects, without a clear coordination among the activities and a clear medium term and long term objective.

4) *Lack of champion to drive Energy Efficiency* – Energy efficiency has been implemented by various agencies and institutions. But there has not been a clear authority in charge of ensuring that energy efficiency plays a central role in the nation's energy planning. The planning is still very much based on demand forecast and supply planning, without taking into account energy

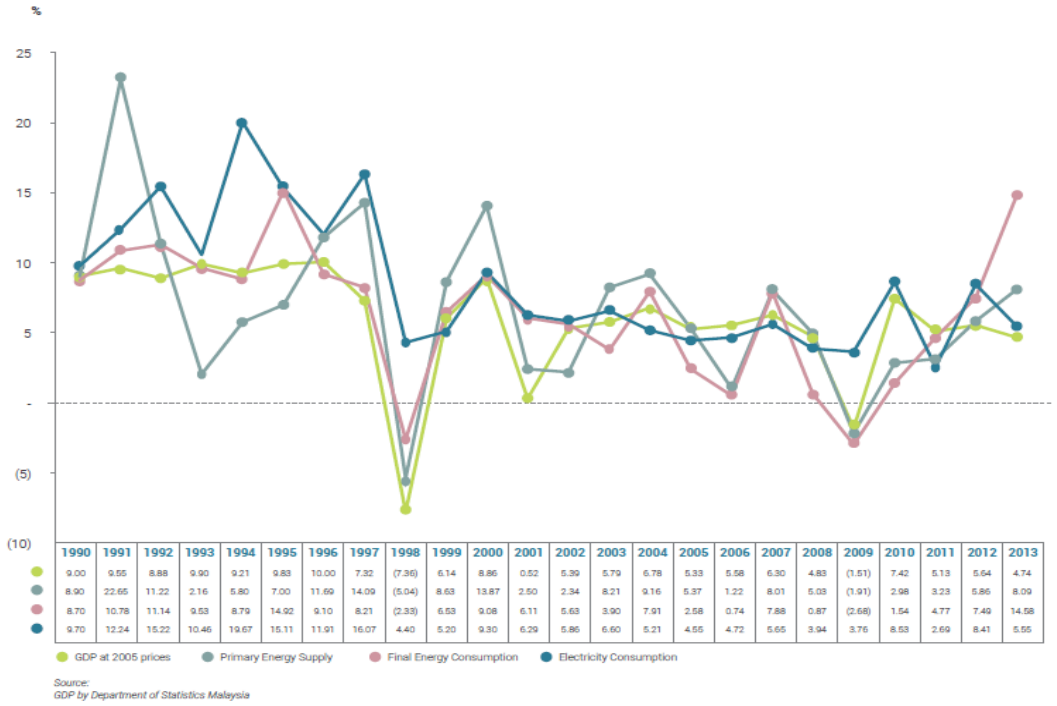
efficiency and demand side management.

5) *Lack of consistency in embarking on the energy efficiency* – most of the effort on promoting energy efficiency has been based on projects with limited time frame. Those projects have contributed to developing capacity in various institutions and a few energy efficiency initiatives have been implemented. But the activities have slowed down or been discontinued after the project funding is ended. The lack of a continuous annual government budget for energy efficiency activities has created a situation where activities are project based which tends to lead to too many starts and stops in the activities.

3. A Plan for Energy Efficiency

3.1 Energy Efficiency Potentials

Energy plays an important role in Malaysia's economic development. In 2013, Malaysia used 53 million toe of energy for its economic development and the well-being of its people. The usage of electricity as one of the final energy components was 123,076 GWh or 10.6 million toe. **Figure 1** shows the economic growth rates pattern versus the energy growth rates patterns which are represented by the final energy demand and electricity demand. The energy demand growth tended to move in tandem with the economic growth rate. The pattern has proved that Malaysia's economic development was depending heavily on energy as one of the important factor inputs.



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
GDP at 2005 prices	9.00	9.55	8.88	9.90	9.21	9.83	10.00	7.32	(7.36)	6.14	8.86	0.52	5.39	5.79	6.78	5.33	5.58	6.30	4.83	(1.51)	7.42	5.13	5.64	4.74
Primary Energy Supply	8.90	22.65	11.22	2.16	5.80	7.00	11.69	14.09	(5.04)	8.63	13.87	2.50	2.34	8.21	9.16	5.37	1.22	8.01	5.03	(1.91)	2.98	3.23	5.86	8.09
Final Energy Consumption	8.70	10.78	11.14	9.53	8.79	14.92	9.10	8.21	(2.33)	6.53	9.08	6.11	5.63	3.90	7.91	2.58	0.74	7.88	0.87	(2.68)	1.54	4.77	7.49	14.58
Electricity Consumption	9.70	12.24	15.22	10.46	19.67	15.11	11.91	16.07	4.40	5.20	9.30	6.29	5.86	6.60	5.21	4.55	4.72	5.65	3.94	3.76	8.53	2.69	8.41	5.55

Figure 1: Economic growth rates and Energy growth rates

According to the National Energy Balance Report 2013, the transport sector of Malaysia was the largest energy user. It accounted for 42% of the final energy demand in 2013. The industrial sector was at the second rank with the share of 25%. The increasing demand for transport energy in Malaysia is driven by passenger transportation sub-sector. Factors such as energy subsidies, rapid urbanisation and growing private vehicle ownership are driving the increase in demand. Malaysia is taking concerted efforts to manage its transport energy demand by improving its mass

transit system, promoting the market penetration of efficient hybrid cars by tax exemption and having continuous awareness dissemination programmes. However, energy efficiency improvement on the transport sector is not covered in this Plan and will be addressed separately by the Government.

Malaysia's economic development is supported strongly by the industrial sector. **Figure 2** shows the relationship between the final energy intensity and industrial energy intensity. The values of both intensities show a strong relationship and they moved in tandem. The reduction in the both intensity values beginning from 2008 was caused by the global financial crisis. The reduction in demand for industrial outputs resulting from the crisis affected the Malaysia's industrial outputs as well. The reduction of energy intensities, which is often related to improvement of energy efficiency, in this case was caused by industrial activity reduction and to some extent by structural changes. The improvement is caused by non-energy components of energy intensity.

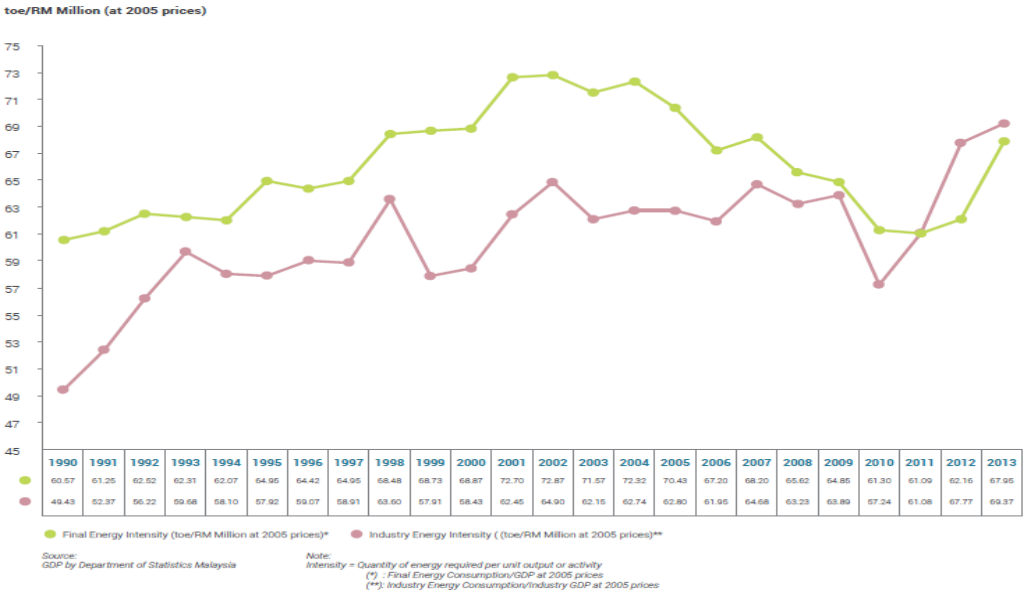


Figure 2: Final energy intensity and Industrial energy intensity.

The potential of energy efficiency in the industrial sector is significant. The energy audits conducted during the Malaysian Industrial Energy Efficiency Improvement Project (MIEEIP) (about 50 audits for the eight industry subsectors) have found that potential energy savings in major industries in Malaysia can be from as low as 2% (for a glass company which was already very efficient) to 52% (for wood companies).

The 2% savings, however, could bring about high savings as the annual energy consumption was high. The highest potential energy saved had been found in the cement industry, which at 32.7% of the annual energy consumption of almost 15 million GJ could yield a savings of 4.9 million GJ. The focus on industrial energy efficiency improvement should be on the adaption of energy-efficient equipment and processes, better management of energy at plant and organisational levels and human capacity development.

The commercial and residential sector's energy use was small when compared to the other two sectors. But the sector has significant contribution to Malaysia's economy. The sector's energy use is mainly in buildings, which is for space cooling and to operate equipment in the buildings. Managing building energy use in Malaysia is relatively easier compared to buildings located in seasonal climates. In this regard, the buildings' energy needs are quite stable and easily predictable. However, the major challenge in promoting energy efficiency in Malaysia is the enforcement of regulatory instrument due to the lack of human capital and relatively low tariffs for commercial buildings to embark on energy efficiency measures.

Malaysia's commercial buildings, other than specific function buildings, on average have a Building Energy Index (BEI) of around 200 to 300 kWh/m^2/year. However, the lesson learned from the showcase office building of the Ministry of Energy, Green Technology and Water (MEGTW) or known as Low Energy Office (LEO) proved that the BEI values for Malaysian office building could be lowered up to 100 kWh/m^2/year, with an additional capital investment of 5% against the total capital cost. The additional capital cost had a pay-back period of 8 years. In this regard, the improvement of energy efficiency in buildings could bring significant savings in electricity consumption and other benefits.

The energy efficiency improvements for the residential sectors will be focused on appliances. The market penetration of the energy-efficient appliances can be enhanced by providing incentives to the buyers. Regulatory measures to ban the importation and sale of inefficient appliances through the Minimum Energy Performance Standards (MEPS), has been introduced. Furthermore information on energy-efficient products to consumers will be widened by mandatory labelling for appliances under the MEPS.

3.2 The Guiding Principles of the Plan

The National Energy Efficiency Policy is based on 4 principles in achieving energy efficiency by ensuring secure and sustainable energy and to achieve sustainable socio-economic growth in the country.These inter-related and mutually supporting principles are:

First
Sustainable Development
It is defined as meeting our current needs in a manner, that the needs of future generation are not compromised. The agenda for development of the society is that, economic growth does not lead to constraints for further growth in the future.

Second
Efficient Use Of Energy
The aim is to increase productivity and the comfort level of the society in a manner where the energy usage is controlled and not higher than necessary while reducing the waste. Waste is defined as both waste of fuel resources, waste products from energy generation such as pollution and greenhouse gasses as well as waste of money, from overspending on electricity and fuels.

Third
Increase Competitiveness And Welfare
Energy efficiency shall lead to an increase in the comfort and productivity for all parts of society. By reducing the use of energy, this will ensure that the expenditure for energy is kept at a low level, which will cushion consumers from any future increases in energy prices.

Fourth
Concerted Participation
Incorporate increase in energy demand consideration at all levels, and increase participation of stakeholders and major groups for effective implementation of Energy Efficiency initiatives.

3.3 The Thrusts of the Plan

3.3.1 Strategic Thrusts

The National Energy Efficiency policy will serve as a guide to integrate the country's energy security issues in planning and implementation of the development programs in addition to promote sustainable economic growth and human capital development as well as environmental conservation. This policy complements other relevant policies and take into account all factors at various levels. Strategic thrusts that have been identified are :

Thrust 1: Implementation of Energy Efficiency Plan

An effective action plan has been identified as an important element to ensure continuous implementation of energy efficiency initiatives in the country. The action plan contains 10 specific programs to reduce energy consumption by consumer groups in the industrial, commercial and domestic (appliances) sector.

Thrust 2: Strenghten Institutional Framework, Capacity Development and Training for Implementation Of Energy Efficiency Initiatives

The thrust outlines the need to strengthen the Energy Commission in managing, monitoring and reporting the implementation of the initiatives designed under the National Energy Efficiency Plan as well as capacity building and training to stakeholders.

Thrust 3: Establishment Of Sustainable Funding Mechanisms To Implement Energy Efficiency Initiatives

To establish a financing mechanism by commercial financial institutions to support the ongoing efforts in promoting and implement energy efficiency activities and initiatives that have been planned.

Thrust 4: Promotion of Private Sector Invesment in Energy Efficiency Initiatives

Private sector cooperation and support is crucial to ensure the success of the energy efficiency initiatives objectives. The private sector plays an important role in the implementation of the energy efficiency projects through Energy Performance Contracting concept.

3.4 Targets and Impact of National Ten-Year Energy Efficiency Action Plan

The focus of the National Energy Efficiency Action Plan strategies and programmes is on electricity use in the industrial, commercial and residential sectors. Therefore, the target of the National Energy Efficiency Action Plan is to save electricity and reduce the electricity demand growth. The effective and efficient implementation of the National Energy Efficiency Action Plan, supported with sufficient resources, will be able to save 52,233 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 8.0%. The National Energy Efficiency Action Plan programmes will continue to produce savings beyond the plan period, owing to the lifetime of the energy efficient technologies adopted and adapted during the plan period. The cumulative lifetime savings of the technologies is estimated at about 122,543 GWh of electricity. Figure 3 shows the electricity savings and percentage of savings by the National Energy Efficiency Action Plan.

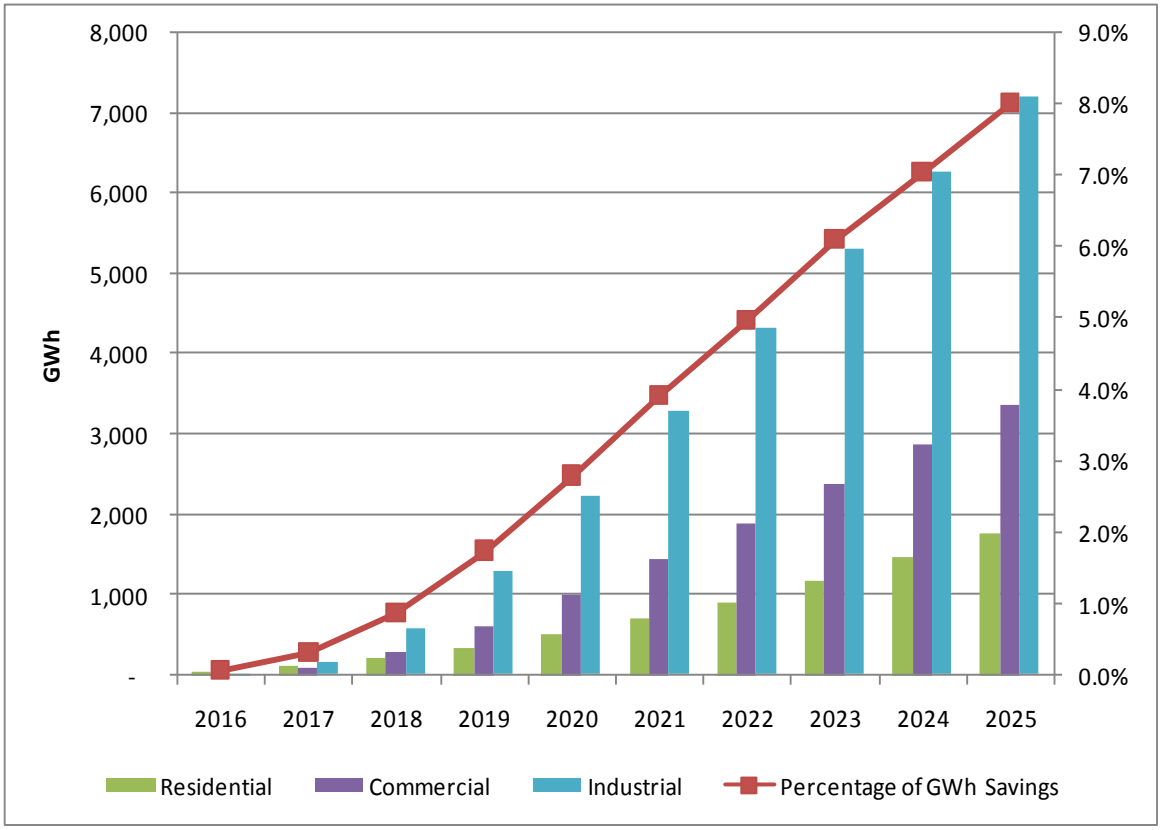


Figure 3: The electricity savings and percentage of savings by the National Energy Efficiency Action Plan

The electricity savings will eventually lead to a reduction in peak demand and the need to build new power plants in the future. In other words, the National Energy Efficiency Action Plan achievement will improve the electricity load profile by better management of peaking load in the power system. A simple calculation of peak demand reduction from the National Energy Efficiency Action Plan implementation indicates a total capacity saving of 2,526 MW at the end of the Plan period.

This translates into savings in capital expenditure and the operating cost needed for the construction of new power plants. At the same, Malaysia's energy supply security position will be enhanced by easing the constraints on the energy supply infrastructure. The fuel savings derived from the National Energy Efficiency Action Plan will also lead to less environmental impact and reduction in greenhouse gas emissions. The total reduction of greenhouse gas emissions over the plan period is projected to be 38 million tonnes of $CO_{2\ equivalent}$. A total reduction of 88 million tonnes of $CO_{2\ equivalent}$ will be achieved over the lifetime of the energy-efficient technologies that are adopted and adapted from the plan implementation. The significant linkages of the target and impact of the National Energy Efficiency Action Plan with major stakeholders is shown in the Figure 4 below.

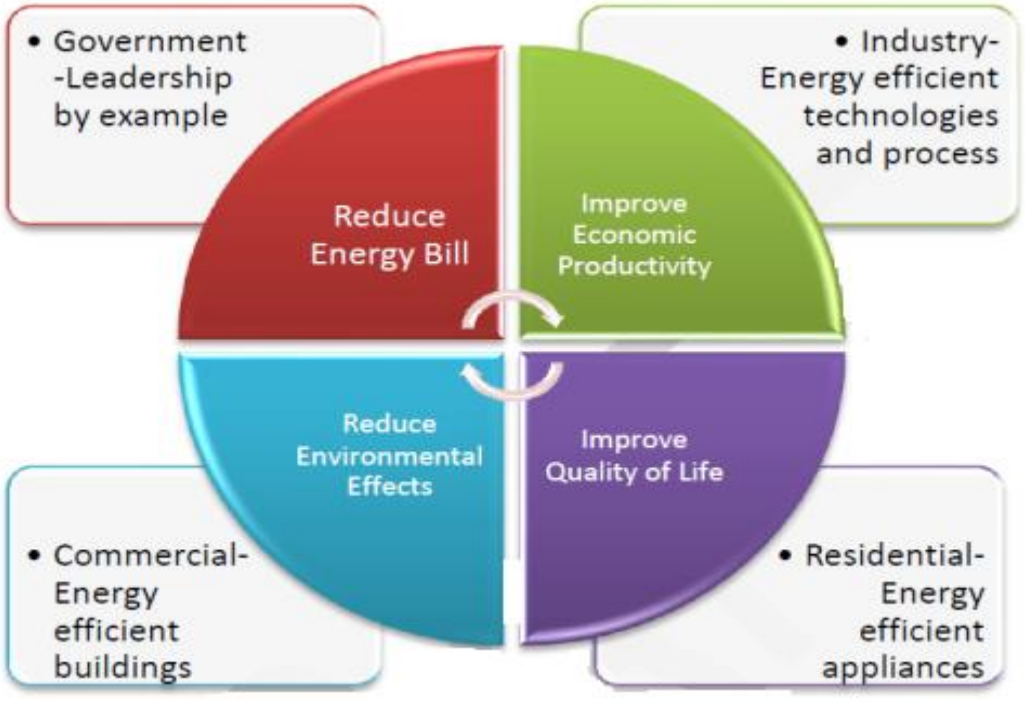


Figure 4: Linkages of target and impact with major stakeholders

3.5 Strengthening EE Legislation

The absence of a comprehensive legislation on EE is a barrier for successful implementation of EE measures in the nation. It is noted that most of the developed nations and even some emerging economies have specific legislation of their own on EE being their ingredient to successful reduction of energy intensity, albeit the extent of success rate varies.

Based on these exemplary measures from other economies, the revision of the Energy Supply Act 1990 should be done to accommodate EE legislations along with the revision of Energy Commission Act 2001, to further empower the EC as the agency responsible EE . The structure of the proposed revision in ESA 1990 shall comprise of key provisions such as measures for equipment, measures for consumers, sanction for breaches and non-compliance and others. The main objective of this action is to tap the potential of EE to be able to contribute to the sound development of national economy through implementing necessary measures for the efficient use of energy in factories, buildings, machinery, equipment and other necessary measures to comprehensively promote the efficient use of energy.

4. Strategic Actions

This chapter outlines the content of the five strategic actions, which form the base for the National Energy Efficiency Action Plan. All of these are crucial for the proper implementation of the key initiatives and in achieving the desired impact of the interventions.

4.1 Action 1: Establish a Dedicated Section for NEEAP in EC

The first action under the National Energy Efficiency Action Plan is to establish a section in the Energy Commission (EC) to act as the project team to administer and implement National Energy Efficiency Action Plan programmes. This recommendation is based on the success factors of other countries and based on the recommendation from the working group, it is proposed that there should be a dedicated section in EC which has the semblance of EE&C system in Japan and India whose structures provide remarkable and continual success in implementation of EE&C measures. This department section can be further empowered by new provisions in the Electricity Supply Act 1990 which can be done over the plan period as the need arises. The section will be instrumental in implementing the energy efficiency programmes under the National Energy Efficiency Action Plan. The section also will play a coordinating role with other relevant agencies on the National Energy Efficiency Action Plan implementation. The main duties of the section are to:

- Carry out effective and efficient implementation of the National Energy Efficiency Action Plan programmes;
- Promote awareness on energy efficiency to various energy users;
- Disseminate information and knowledge through campaigns and programmes on energy efficiency;
- Monitor and evaluate the National Energy Efficiency Action Plan programmes continuously;
- Prepare progress report on the National Energy Efficiency Action Plan periodically; and
- Keep and maintain a database with necessary information and data on energy use and energy efficiency gathered from the National Energy Efficiency Action Plan.

The organisational structure of the National Energy Efficiency Action Plan section is shown in Figure 5. The section will be headed by a Project Leader. The Project Leader will be assisted by 3 sectoral Programme Managers. The Programme Managers' main duty is to manage the activities within their sectors. The corporate functions related to finance and accounting will be managed by a finance officer.

The officer will manage the funds for the operation of the team as well as fund allocations and disbursement to the National Energy Efficiency Action Plan programmes. The data management and monitoring unit function is to compile energy data and provide data analyses. The function includes the monitoring of the progress of the National Energy Efficiency Action Plan with a set of relevant indicators. The effective implementation of the National Energy Efficiency Action Plan is dependent on how well its progress is monitored. Corrective steps on the National Energy Efficiency Action Plan progress will be based on the monitoring report. In this regard, the Unit will report to the Project Team Leader.

A major part of the communication and data management will be using information technology and information should to a great extent be made available on-line. The National Energy Efficiency Action Plan Project will have a web-portal with all relevant information regarding its activities in order to ensure easy access to information and material by the end-users. Internal information shall be made available on an intranet, where all relevant background information as well as budget and fund information is kept up-to-date. The dissemination and sharing of information using information technologies will be done by the Data Management and Monitoring Unit through a Data and information Repository Centre will be established in the section for appropriate statistical data to be systematically collected, compiled, updated and disseminated. This Repository centre will address the grave concern on the lack of current and credible information necessary for energy economists and energy practioners to audit present scenario and forecast future energy economy

Figure 5: The organizational Structure of NEEAP Project Team

4.2 Action 2: Funding for Energy Efficiency

In line with Thrust 3, the National Energy Efficiency Action Plan acknowledges that new Energy Efficiency financing products need to be developed to unlock private sector funding. The success of any project depends on the timeliness and adequacy of the financial resources in meeting the budget requirement. The necessary funding for the implementation of the National Energy Efficiency Action Plan will be limited to seed capital that will enable the private sector to invest in energy efficiency technologies and projects. Funding is budgeted for two main purposes:
a) Administration of the plan including design of programmes and campaigns, and
b) Incentives as catalyst to implement energy efficiency technologies and projects for the private sector.

Equally important is the fact that financial resources have to be managed and monitored by a dedicated department in order to achieve the expected outcomes.

Malaysia is at a critical stage of national development moving from a developing nation status to a high-income economy status, so unless the government and the people take up a tough step now to change towards a sustainable energy consumption, the nation will be facing uncertainty and it cost for energy supply as well as producing more CO2 to the atmosphere. Therefore, NEEAP must be implemented quickly with the financial supports not only from the government but also the private sector, community and NGOS. As long as good governance prevails in the NEEAP implementation process basing on the principles of Environmental economics, the investment by nation and the people will bring long term returns for both present and the future generations.

4.3 Action 3: Government Led Initiatives

Although the major impact from energy efficiency is envisaged to be from the private sector, the role of government institutions and government-linked companies are crucial for the successful introduction of energy efficiency initiatives. The government can, through circulars, direct its institutions to practice energy efficiency in its operations.

The government shall therefore be the pioneer in implementing internal policies for purchase of energy efficient 5-star energy labelled appliances and equipment, conduct energy audits in large facilities and implementation of energy saving measures and also implement energy management practices. This will create a market transformation towards energy-efficient technologies and practices, as suppliers will be encouraged to make energy efficient technologies and services available in the market. This effort by the government will enable the private sector to follow suit in a faster pace as the government will have been the ice-breaker in the market.

4.4 Action 4: Capacity Building

Capacity building of individuals and organisations in energy efficiency will be part of the implementation of the energy efficiency initiatives, whenever training and education in specific areas and practices is required, for example in energy auditing practices and energy management. In addition, it is important that the educational institutions are producing candidates with relevant knowledge and qualifications in energy efficiency such as engineers, economists and technical people. Educational institutions will be encouraged to enhance the resources for energy efficiency training of students to meet the expected demand for such qualified personnel in the future.

Similarly, professional institutions will be encouraged to upgrade and train their faculty members in energy efficiency by introducing courses and workshops for engineers, architects, economists, accountants etc.

In order to "teach the people", the NEEAP unit will need to build the capacity itself to train all segments of people involved directly or indirectly with EE. To a lesser extent, some of the training can be outsourced to other professional bodies and approved training centres of Ministry of human resource, Institution of Engineers Malaysia, SMIDEC, MAESCO and others. It is proposed that the international expertise to be explored to minimize learning curve and fast track-track the preparation of syllabi for a wide spectrum of courses, educational and examination materials and others. The unit will be tasked to increase EE training and professional and semi-professional development. Enhancing the resources and capacity of the unit to deliver and support EE will form an integral part of its skill development needs. Success will depend on the effectiveness of the change management across all levels of the mainstream activities. That being said, EE will not be easy in the Malaysian economy that has been dependent on subsidized fuel and government intervention. Lack of capacity building is one of the few root causes for the limited advancement of EE to date.

4.5 Action 5: Research and Development

Existing research institutions such as universities and private entities e.g. Sirim Berhad, manufacturers etc., will be encouraged to enhance research in the field of energy efficiency. This can be in areas of developing energy-efficient technologies as well as studying the impact of various energy efficiency practices and behaviours. As the energy efficiency initiatives are targeting market transformation towards energy-efficient technologies, it is critical that local manufacturers upgrade and develop their products to meet the highest degree of energy efficiency and play a major role in the market. This will not only enable them to market their products in Malaysia, but also improve the possibilities of exporting their technologies as energy efficiency is an important parameter for buyers in the developing and developed world.

This is also in line with the government's policy on developing a knowledge based economy with the development of more intelligent and advanced, green technologies.

In this context, the government is looking into implementation of smart grid in the long term. It is also planning to have enhanced time of use tariffs. Such tariffs, together with the implementation of smart grids and the use of smart meters, will enable consumers to better understand their own energy needs and help them identify energy saving potentials and implement them in a more effective manner. It will also assist utilities to identify energy saving potentials in the transmission and distribution systems and implement them.

5. Key Initiatives

The identified key energy efficiency initiatives presented in the section 2.4 is further elaborated in this section in terms of programmes to be implemented under the National Energy Efficiency Plan over a period of 10 years. The programmes are designed to ensure attention to the energy efficiency measures that are introduced for the consumers and provide the necessary incentives to kick-start the introduction of new technologies and processes.

The programmes will mainly be funded by the private sector, as the capital investments in energy-efficient measures are to be made by the consumers. The programmes will encourage and enable the consumers to implement the measures by promoting technologies and processes and removing market barriers such as additional costs for energy-efficient technologies. As the market transformation towards new energy efficient technologies takes place and more energy efficient technologies become available the additional costs will be lowered, and this reduces or eliminates the need for incentives.

5.1 Overview of Key Initiatives and Programmes

The key initiatives to be introduced in the plan period are the following:

- **Key initiative 1:** Promotion of 5-Star Rated Appliances
- **Key initiative 2:** Minimum Energy Performance Standards (MEPS)
- **Key initiative 3:** Energy Audits and Energy Management in Buildings and Industries
- **Key initiative 4:** Promotion of cogeneration
- **Key initiative 5:** Energy Efficient Building Design

Table 1 details out the key initiatives and the programmes under each key initiative together with expected electricity savings that each of the measures will result in.

Table 1: Key Initiaves

Key Initiative	Description	Program	Savings in 10 years (GWh)	Public Fund (RM)	Private Fund (RM)
Promotion of 5-Star Rated Appliance	• Star energy rating of appliances and mandatory labelling. • Promotion of 5-star appliance	5-Star Refrigerator Campaign	2,706	2,632,670	1,863,648,930
		5-Star Air Conditioner Campaign	7,014	2,632,670	2,005,537,380
Minimum Energy Performance Standards (MEPS)	• Review of MEPS • Promotion of Efficient Lighting • Development of MEPS for new equipments and appliances	EE lighting Campaign	2,216	2,632,660	378,347,165
		High Efficiency Motors	2,175	0	461,062,525
Energy Audits and Energy Management in Buildings and Industries	• Facilitating energy audits and implementation of energy saving measures and energy management initiatives	Energy Audit and management in Large Commercial Buildings	5,066	40,438,750	32,670,000
		Energy Audit and management in Medium Commercial Buildings	1,916	49,579,750	49,071,000
		Energy Audit and management in Large & Medium Industries	26,969	387,436,500	385,506,000
		Energy Audit Government Facility	881	7,176,400	6,864,000
Cogeneration	• Promotion of cogeneration through the removal of barriers	Cogeneration in Industries and commercial buildings	3,276	0	572,000,000
Energy Efficient Building Design	• Incorporating Energy Efficiency in new building designs and constructions	Energy Efficiency in New Buildings	15	0	26,767,950

5.2 Key initiative 1: Promotion of 5-Star Rated Appliances

Energy rating and labelling has been a key in the market transformation of household appliances towards more energy-efficient models. It has been successfully applied worldwide in Europe, USA, Japan, Australia, Thailand etc. for more than a decade and has resulted in significant improvements in the energy efficiency of the technologies. Energy labels allow the consumer to be informed about the energy consumption of the appliances they wish to purchase. As the purchase decision for electrical decision should be made on the basis of life cycle cost i.e. both the initial purchase cost and the operational cost for electricity, it is necessary to have the electricity consumption displayed on the products, so that the consumer can evaluate the cost and compare both the purchase price and operational cost of various models on display in the shops.

Labelling of the energy performance or energy rating can be applied to all types of energy consuming equipment.

Mandatory labelling has already been introduced for:

- Refrigerators
- Air-conditioners
- Ceiling and stand fans
- Televisions

The labelling can be expanded to more appliances during the plan period, as experiences with the market transformation by labelling the above types of appliances are evaluated.

5.2.1. Programme: 5-star Refrigerators

A programme to promote 5-star refrigerators is proposed. The programme will be based on promoting the existing 5-star rating and label for refrigerators, which was introduced on a voluntary basis in 2005. The 5-star rated refrigerators are available in the market, but their market share is still considered to be low, compared to conventional refrigerators, which are rated as 3-star. The 5-star rated refrigerators are more than 25% more energy-efficient than the average 3-star refrigerators. As nearly all households in Malaysia own a refrigerator and this is often the appliance that consumes the most electricity, if the household is without air-conditioners, then there lies a high potential for energy savings by introducing more energy-efficient refrigerators.

The programme will be targeting the sale of new refrigerators to transform the market into more efficient models.

Title	**5-Star Refrigerator Campaign**
Type	Awareness and enforcement
Design	The campaign is a combination of the following: 1)MEPS and labelling enforcement programmes 2) Review of the current MEPS value 3) Promotion of purchase of 5-star refrigerator through awareness enhancement 4)Awareness on the benefits of smart meter
Total Market	Total market is determined based on all residential consumers having one refrigerator each and this will increase annually with the increase in the number of registered consumers.
Annual Market	The average lifetime of a refrigerator is assumed to be **15 years**, and the annual market is about **700,000**
Savings	An average refrigerator consumes about **420** kWh/year for models between 150-300 L. According to a ST survey this is the most sold size range in Malaysia. A 5-star rated model is min. 25% more efficient than a 3-star rated model. This is 0.25*420=105 kWh savings
Lifetime	The savings are expected to remain the same over the average lifetime of the equipment i.e.**15 years**.
Penetration	Assuming that the campaign can start mid **2016** a penetration of **30%** by active promotion of the rebate is expected. The penetration is expected to increase to 90% of market in 2025 due to consumer demand and suppliers push. Full penetration is about 90% as there will be a demand for certain special purpose models, which are not 5-star.

5.2.2. Programme: 5-Star Air-Conditioners

Air-conditioners are used in mainly residential and commercial sectors. The sale of air-conditioners is growing as the economy grows and more and more consumers can afford to buy air-conditioners. For modern homes it is not unusual to have 3-4 air-conditioners installed. In order to ensure that the consumers are choosing energy-efficient models, it is planned to introduce a mandatory energy label for air-conditioners. The Energy Commission has prepared a star rating scheme for air-conditioners and 5-star air-conditioners are at least 25% more efficient that conventional models. The programme will be designed to promote 5-star air conditioners.

Title	**5-Star Air Conditioner Campaign**
Type	**Awareness enhancement and enforcement**
Design	The campaign is a combination of the following: 1) Mandatory MEPS and labelling of all air conditioners in the market and enforcement 2) Promotion of purchase of 5-star through awareness enhancement programs 3) Improve the standards (wider range of capacity) and the MEPS value 4) Awareness enhancement on the benefit of smart meter
Total Market	Not determined
Annual Market	Based on the survey by SIRIM on 2014, sales is estimated to be 1,200,000 units per year
Savings	Average air conditioners are in the range of 8000-11000 BTU /hr EER is about 2.9 W/W equal to EER 9.9 Btu/hr/W (Malaysian EER), so the consumption is about 1 kW per unit. Assuming an average use of 6 hours per day, 365 days x 6 hours x 1 kW ~ 2200 kWh/yr Savings are determined by the difference between EER=9.5 to EER=11, which is about 15%. So annual savings are estimated to be 330 kWh per unit.
Lifetime	The savings are expected to remain the same over the lifespan of the air conditioner i.e. avg of 7 years
Penetration	Assuming that the campaign can start mid 2016 a penetration of 30% by active promotion. 30% is about 360,000 air conditioners. The penetration is expected to be at maximum of 75% in 2026.

5.3 Key initiative 2: Minimum Energy Performance Standards (MEPS)

5.3.1. Programme: Promotion of Efficient Lighting

Lighting is an important electrical energy consuming appliance in homes. In the commercial sector, lighting account for about 15% to 20% of the total electrical energy used. Thus, improving lighting energy efficiency can result in substantial savings. The campaign will include the promotion energy efficient lighting (e.g: CFL, T5 and LED) through awareness enhancement programmes, the enforcement of Minimum Energy Performance Standards (MEPS) and labelling and the enhancement of awareness on the benefit of using smart meters.

Total Market	**Total market is determined based on 6.7 million consumers in 2014 with the assumption of 10 lamps per household.**
Annual Market	Assuming each year, each household will change at least 1 T8 lamp, annual market is equal to total market i.e. **6,700,000 per year**.
Savings	Average lighting such as T8 is assumed to be 40W. An EE lamp with similar lumen output is 30W. Power saving is therefore 10W. Assuming 2190 hours of use per year, the savings are 17.52 GWh for the 1st year (based on first year market penetration). Market penetration is expected to be 10% for the 1st year with increment of market penetration of 5% for every year.
Lifetime	The annual savings are expected to remain the same over the lifespan of the lamp i.e. about 3 years. (As suggested by BSEEP and AWER)
Penetration	Assuming that the campaign can start in mid-2016, a penetration rate of 10% by intensive promotion is expected. This is about 850,000 lamps. The penetration is expected to increase to 55% in 2025.

5.3.2. Programme: High Efficiency Motors

Motors are widely used in industrial processes and machinery, and can either be purchased as stand-alone motors or integrated in equipment. The Energy Commission has adopted the international CEMEP standard for energy rating of motors, which classifies motors in three classes according to the energy efficiency. The most efficient class is EFF1, followed by EFF2 and EFF3 as the lowest class. The CEMEP scheme is to be changed after the adoption of the latest IEC standard for motor performance classifies the most energy efficient motors as IE3, whereas IE1 is the low efficient class. EU is currently in the process of implementing minimum performance standards for motors, which is expected to be minimum class IE2.

A mandatory minimum energy performance standard for motors will be based on the CEMEP/IEC standard and will define the minimum performance for motors to be minimum IE2/EFF2. This minimum standard is planned to be effective in 2020 and in the period till 2019, awareness and promotion campaigns will be carried out to inform the industries about the benefits of energy efficiency motors (IE2/IE3) motors and the phasing out of low efficient types (IE1). Similarly, importers and manufacturers of motors and equipment with integrated motors will be targeted for promotion and awareness campaigns.

Title	**High Efficiency Motor Campaign**
Type	MEPS
Design	The campaign is a combination of the following: 1) Mandatory labelling of motors in the market 2) MEPS phasing out IE1 motors -In order to regulate the motor equipment in industry sector, the MEPS regulation need to be amended to include industry equipment
Total Market	Not determined
Annual Market	According to a survey conducted by International Copper Association Southeast Asia Ltd in 2014 the average sales of electrical motors is about 115,000 units yearly for year 2010 to 2013 with an annual market increase of roughly around 10%. The current market share of IE1 or EFF2 motors is around 75%. This is the sale of stand-alone motors, not including motors sold as a part of equipment e.g. electrical pumps.
Savings	A typical motor of 7.5 KW is assumed to be used about 3000 hours per year at about 70% load. The consumption is about 15MWh/year. The savings are about 2% by going from **IE 1 to IE2 (High efficiency motor**) so the savings estimated is 300 kWh/year.

Lifetime	The savings are expected to remain the same over the lifespan of the equipment i.e. 10 years. Baseline data will be based on the study conducted by International Copper Association (ICA)
Penetration	As the MEPS is introduced in 2016 it is expected that 25% of the sales of IE1 is phased out in the 1st year. The 2nd year market penetration is expected to be 50% and 90% in the subsequent year.

5.4 Key initiative 3: Energy Audits in Buildings and Industries

Energy audits include the mapping of a facility's energy consumption in order to identify areas where energy efficiency can be implemented.

Often the energy audit will reveal no-cost measures such as energy wastages from equipment that is left on, but not being used or improvements in the processes that leads to energy savings. The outcome of an energy audit is recommendations on energy efficiency measures to be implemented and an evaluation of their costs and benefits. Energy audits are typically done by external consultants with expertise in energy auditing methods and the particular type of facility.

5.4.1. Programmes: Energy Audits and Management in Commercial, Industrial and Government Facilities

The energy audit programmes to be implemented will target the following types of facilities:

- Government Facilities
- Large Commercial Facilities
- Medium sized Commercial Facilities
- Large and medium sized Industrial Facilities

The programmes will offer free energy audits to the facilities on the condition that the facility owner will confirm that recommended energy efficiency measures will be implemented for an amount equal to or higher than the cost of the energy audit.

The number of energy audits to be conducted will depend heavily on the number of trained auditors. There is therefore a need to support the training of energy auditors, so that the resource base can be increased and the number of audits can be intensified. The total requirement for auditors will gradually increase to 500 full-time auditors in 2020 and the work load will be maintained until the end of the plan.

The energy savings that can be expected from energy audits are at least 5% per year for 3 years of the total energy consumption of the installations concerned. Most of these savings are derived from eliminating energy wastages and accelerated change of in-efficient equipment which is beyond their economical and technical lifetime. Larger energy efficiency projects are not considered in the savings calculations but will most likely also take place in many of the facilities which will significantly increase the savings. Energy management is the day-to-day monitoring and management of the energy consumption in a facility. Programmes will be initiated to mandate facilities to implement energy management by appointing an energy manager and prepare energy management reports. The Efficient Management of Electrical Energy Regulations 2008 already prescribes that large facilities need to implement energy management and this will be expanded to cover medium sized facilities. Furthermore, the energy management system requirements will be improved to ensure that energy efficiency measures and practices are being continuously implemented and tracked.

For large government facilities, energy management will be compulsory by circular. This will allow the government to show leadership in energy efficiency as well as in implementing cost reduction measures. A part of the energy management will be procurement procedures ensuring that the government facilities are purchasing 5-star rated equipment.

The campaign for introducing the mandatory energy management will focus on providing guidelines and training to the energy managers to increase awareness of energy efficiency options available to their facilities. The energy management in facilities will also indirectly support other programmes in the national energy-efficiency action plan such as the energy audit programmes and energy rating and labelling programmes as it is expected that the facilities with energy management will demand energy-efficient technologies.

Title	Energy Audit and Management in Large Commercial Buildings
Type	Consultancy and grants
Design	The campaign will offer free energy audits to large commercial buildings, such as offices, hotels, shopping complexes etc. It is required that the building owner accepts to invest in energy savings measures with an amount equal to the cost of the audit. The campaign will be conducted over the period 2016 - 2025. Capacity building for the numbers of auditors required will have to be done. The energy management in large commercial facilities will be conducted during the whole plan period Training courses and material will be prepared to create awareness about energy saving options and reporting will be required from the facilities. It will be marketed as an additional brand value for the facility *EMEER 2008 amendment to impose mandatory saving *Green Technology Financing Scheme (GTFS) and Green Investment Tax Allowance (GITA) will be the funding mechanism for ESCOs to finance and implement the Energy Savings Measures (ESM) based upon the result of the IGA. *ESCOs or In house team could apply for the grant
Total Market	The market is defined as commercial electricity customers with a monthly electricity bill exceeding 500,000 kWh. There are approximately **600 consumers** customers meeting this criteria, with a total consumption of this group to be 9.5TWh per year
Annual Market	The annual market will be determined by the number of audits that is realistic to be performed with the consultancy resources available. One consultant can audit about 10 GWh per year. In the first year it is expected that 475GWh (5% of 9.5 TWh) is audited requiring about 95 auditors. Annual market penetration is expected to be at 10% every year with annual market increment of 1.1%. (NAPIC data)
Savings	The amount of savings achieved from saving measures identified from implementing the Investment Grade Audit (IGA) are expected to be at a minimum of 15%. It will be implemented in a period of 3 years after the IGA. The savings will be spread evenly at 5 % annually accumulating to 15% in the third year (1st year = 5% saving, 2nd year = 5% + 5% = 10% saving, 3rd year = 5% +5% +5% = 15% saving. The 5% savings is equivalent to 800,0000 kWh / year / facility.
Lifetime	The savings are expected to have an average lifetime of 10 years.

Title	Energy Audit and Management in Large & Medium Sized Industries
Type	Consultancy and grant
Design	The campaign will offer free energy audits to large & medium sized industries. It is required that the owner accepts to invest in energy savings measures with an amount equal to the cost of the audit. The campaign will run in the period 2016-2025 1. Low Cost Energy audit encouragement: i. Large and medium sized Industry: Should have Self-funded low cost energy audits 2. Investment Grade Audit (IGA): i. Large and medium sized Industry: Conditional free IGA whereby the installations are obligated to implement an energy efficiency project with an amount equal or more than the funding or grant provided for IGA. ii. Energy Saving Measures (ESM) implementation through EPC concept with the involvement of Energy Service Company (ESCO). iii. Green Technology Financing Scheme (GTFS) and Green Investment Tax Allowance (GITA) will be the funding mechanism for ESCOs to finance and implement the Energy Savings Measures (ESM) based upon the result of the IGA. Sustainable economic development is essential in Malaysia's long-term development plans and green technology has been envisaged as one of the emerging drivers of economic growth not only to ensure sustainable energy growth for the future through energy interdependent and promote efficient utilization, but also the sustainability of the country economically, socially and environmentally. The transformation of the economy to be driven by green technology have been spelled out as the main agenda under the National Green Technology Policy which was launched in July 2009 and various programmes have been implemented to promote the application and development of green technology including the establishment of the Green Technology Financing Scheme in 2010. The purpose of the Scheme that offers a 60% guarantee of the financing amount and a rebate of 2% on the interest/profit rate charged by the financial institutions, is to accelerate the expansion of green investments by providing easier access to financing from the private and commercial financial institutions. The Scheme which is available until 31 December 2015 or upon reaching a total financing approval amount of RM3.5 billion whichever is earlier, facilitates the growth of local green businesses and generates new markets and job creation. 3. Sharing of ESM success stories among the industry players. The energy management in large and medium sized industries will be conducted during the whole plan period. Training courses and material will be prepared to create awareness about energy saving options and reporting will be required from the industries. 1. Include CPD point requirement for board of director to attend training for the public listed company. 2. To suggest to SME Corp to insert additional requirement for SME's who are

	applying for existing funding or financial assistance available from SME Corp to attend energy management training. 3. Introduce Non-monetary Incentives concept: Data sharing for industry for benchmark 4. Introduce Disincentive concept: - Publish name to shame delinquent parties - Increase the penalty for those who do not comply to the EMEER2008 regulations - Introduce surcharge(to be put under EE fund) under EMEER2008 for those who do not achieve the % saving of the Specific Energy Performance Indicator
Total Market	The market is defined as large industrial consumers with a monthly electricity bill exceeding **500,000 kWh *(referring to EMEER 2008)** per month. There are approximately **1500** customers meeting this criterion. The total annual consumption for this group is about 40 TWh/year. As for medium sized industry, market size is approximately **3000** installations and the total annual consumption for this group is about 10 TWh/year, thus total consumption for large and medium sized industry is about 50 TWh

Title	**Energy Audit in Large Government Facilities**
Type	Consultancy
Design	The campaign is to implement energy audits in large government buildings, such as institutions, offices etc. It is required that the owner accepts to invest in energy savings measures with an amount equal to the cost of the audit. The campaign will be be conducted from 2016-2025 *** Investment Grade Audit.** Green Technology Financing Scheme (GTFS) and Green Investment Tax Allowance (GITA) will be the funding mechanism for ESCOs to finance and implement the Energy Savings Measures (ESM) based upon the result of the IGA.
Total Market	The market is defined as government consumers with a monthly electricity bill exceeding **500,000kWh** per month. There are approximately **108 customers (based on EMEER 2008)** meeting this criteria with total consumption of 1800 GWh (Based on TNB Data for large government facilities)
Annual Market	The annual market will be determined by the number of audits that is realistic to be performed with the consultancy resources available. One consultant can audit about 10 GWh per year. In the first year it is expected that 90 GWh (5%) is audited requiring 18 auditors. The annual market penetration starts from 5%, peaks at 12% at the middle of the plan period and achieves saturation at 8% at the end of the plan
Savings	The amount of savings achieved from saving measures identified from implementing the Investment Grade Audit (IGA) are expected to be at a minimum of 15%. It will be implemented in a period of 3 years after IGA. The savings will be spread evenly at 5 % annually accumulating to 15% in the third year (1st year = 5% saving, 2nd year = 5% + 5% = 10% saving, 3rd year = 5% +5% +5% = 15% saving. The 5% savings is equivalent to 800,0000 kWh / year / facility.
Lifetime	The savings are expected to have an average lifetime of 10 years.

5.5 Key initiative 4: Promotion of Co-generations

Generating electricity and thermal energy using cogeneration can achieve thermal conversion efficiencies of over 80% as compared with conversion efficiencies of about over 50% to less than 30% in combined cycle gas turbines and open cycle gas turbines respectively. To promote an uptake of cogeneration, barriers such as the high top up and standby rates and the inadequacies in the natural gas supply for cogeneration will be addressed

Title	**Co-generation in Industries and Commercial Buildings**
Type	Removal of barriers
Design	The cogeneration system's primary function is to meet the heating or cooling demand in the facility and power generation will be secondary. The systems must be fully cogeneration and can include thermal energy storage tanks 1.The programme is to promote cogeneration in industries and buildings. 2. This will be done by reducing barriers, including: a. Standby and top up charges b. Gas tariff pricing (TPA) c. Possible lack of Incentives d. Technical hurdles – lack of capability to locally manufacture some energy supply equipment which leads to higher investments e. Connection to the grid – implication on the reserve margin for the utilities f. Lack of awareness on benefits of cogeneration 3. To overcome the above barriers, a couples of key strategic measures need to be implemented, such as: a. Design of standby, top up and load connected charges that are co-gen friendly - Lowering the amount of charges - Non Firm standby charges (offering daily or monthly as used charges) b. Open bidding for special package of co-gen plants with special gas tariff pricing. c. Promoting the existing incentives such as low cost financing by MGTC and etc. d. Local manufacturers' capacity building e. Regulatory framework for grid-connected co-gen and sales of excess power f. Awareness enhancement on the benefits of co-gen
Total Market	The market is facilities with high demand of heating or cooling. The preliminary market is only considered to be the supported projects in this programme. By the end of the plan period, it is targeted to have 100 operating cogeneration plants.
Annual Market	It is envisaged that with the reduction of barriers and the increase in electricity tariffs in the country, about 12 MWe of cogeneration (about 12 installations) will be installed per year in the country from the year 2017 onwards.

Savings	The savings are in terms of natural gas savings, as cogeneration will utilise the fuel more efficiently. The power generation will save power generation in central power plants. Distribution and transmission lossess are not considered. 1 MWe cogeneration plant is expected to generate 7 GWh/year (at the load factor of 0.8, GWh generated = 1 MW x 24hr x 365 days x 0.8 load factor = 7 GWh / year). Thus the electricity savings are 7 GWh/year for 1 MW capacity. The value of the savings is not the full tariff savings, but the tariff savings minus the additional fuel cost and O&M cost. So the tariff savings is about 50% of the tariff.

5.6 Key initiative 5: Energy Efficient Building Design

The commercial sector consumes about one-third of all electricity in the country and a large share of this is used in buildings for cooling, ventilation, lighting, appliances etc. The future increase in energy consumption in the commercial sector will come from new buildings. Therefore, a programme to ensure that these new buildings are designed and built with consideration of energy efficiency is of high importance. Surveys have shown that new buildings are consuming energy around 200-250 kWh/m^2/year, which could be reduced to about 135 kWh/m^2/year by applying the Code of Practice MS1525:2014 on energy efficiency and use of renewable energy for non-residential buildings.

At present the MS 1525:2014 is a voluntary code of practice and it is therefore purely up to the developers to use it. As many buildings are occupied by tenants or other owners rather than by the developers, the building design often does not take energy efficiency into consideration as this might increase the building cost and the savings will not benefit the developer.

The programme is planned to enforce the provision of MS1525 through the Uniform Building By Law (UBBL) with the cooperation and support from the Ministry of Urban Well Being, Housing and Local Government.

Title	Energy Efficiency in New Buildings
Type	Awareness enhancement & incorporation into UBBL
Design	The programme is to promote energy efficiency in new buildings. By enforcing building regulations on energy efficiency (such as MS1525) the energy consumption of new buildings will be lower than the baseline. Green Technology Financing Scheme (GTFS) and Green Investment Tax Allowance (GITA) will be the funding mechanism for ESCOs to finance and implement the Energy Savings Measures (ESM) based upon the result of the IGA.
Total Market	The market is defined by new commercial buildings including Office buildings, shopping complexes, hotels etc.
Annual Market	The annual market is the annual increase in floor space for commercial buildings. The average annual market as of 2013 is 145,000 m2-year.The annual market growths is about 1% (BSEEP study).
Savings	Based on MS1525 EE building consumes 136kWh/m2 -year and a regular building consumes 200 to 300 kWh/m2 - year, so average savings that can be achieved is (200-150 = 50) 50kWh/m2- year.
Lifetime	The savings are expected to have an average lifetime of 10 years.

6. Costs and Benefits

The effective and efficient implementation of the National Energy Efficiency Action Plan programmes requires an average governmental budget allocation of RM 54.3 million annually. The budget will cover the cost to administer and incentivise the National Energy Efficiency Action Plan programmes. The public expenditure on the National Energy Efficiency Action Plan, a total of RM 543 million, will be leveraged by private sector investments. A total of RM 5,781 million private investments will be induced over the plan. From this investment amount, the largest share will be spent on the adaptation of energy-efficient technologies.

The public and private expenditure on the National Energy Efficiency Action Plan programmes, amounting to a total of RM 6,324 million, will result in a total direct monetary saving of RM 18,538 million over the plan period. The direct monetary benefit is the value of total electricity saved by the National Energy Efficiency Action Plan, calculated based on the current electricity tariff. The other indirect benefits, i.e. capacity savings and greenhouse gas reductions are not included in the direct monetary benefit.

The cost-benefit ratio of the National Energy Efficiency Action Plan, which is calculated by dividing the direct monetary benefit with the public and private cost, is 2.9. In other word, every RM 1 spent on the National Energy Efficiency Action Plan programmes will result in a benefit of RM 2.90. The cost-benefit ratio based on the lifetime savings of energy-efficient technologies adopted and adapted during the National Energy Efficiency Action Plan is 6.7. The overall "cash-flow" during the plan period is summarized in Table 2. The cash-flow shows continuous gain from the sixth year of the National Energy Efficiency Action Plan implementation. The reason for such pattern is because the energy savings from the early years of the plan are accrued in the later years of the plan.

Table 2: The cash-flow of National Energy Efficiency Action Plan

Funding	Unit	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
Public Funding	RM (Million)	24	39	59	60	61	52	53	54	44	45	493
Private Funding	RM (Million)	207	303	493	496	596	628	672	755	791	840	5,781
Administration	RM (Million)	5	5	5	5	5	5	5	5	5	5	50
Total Payments	RM (Million)	236	347	557	562	662	685	730	814	840	890	6,324
Benefits	RM (Million)	28	135	378	799	1,336	1,947	2,552	3,173	3,790	4,401	18,538
Cash Flow	RM (Million)	-208	-212	-180	237	674	1,261	1,821	2,359	2,950	3,511	12,214

At the end of the plan period, the Maximum demand is expected to be 2021 MW. This in turn translates to a reduction of 2526 MW in new generation capacity plant up. This means, the generation cost that can be avoided:

i. If in the case of coal plants, referring to generation cost of a 1000 MW coal power plant, which is RM 6 billion (based on the 2012 cost). Hence for a 2500MW coal plant, the avoided cost of new plant up is RM 15 billion

ii. Or in the case of gas power plants, estimated cost for a 1000 MW plant is RM 2.4 billion (based on 2013 cost). Which equals to RM 6 billion in cost avoided for a 2500 MW gas power plant.

7. Monitoring of the National Energy Efficiency Action Plan Progress

The implementation of the National Energy Efficiency Action Plan requires effective monitoring by the Government. As the EC oversee the implementation of the National Energy Efficiency Action Plan and the National Energy Efficiency Action Plan Project Team executes the plan it is critical that the progress of implementation is monitored periodically by the Data Management and Monitoring Unit of the National Energy Efficiency Action Plan Project Team. In this regard, the annual planning and resources allocation for the National Energy Efficiency Action Plan is prepared with clear indicators for the expected annual implementation target.

One of the key factors to promote energy efficiency improvement successfully is to understand how energy is being used, and ways in which energy can be used more efficiently. By understanding them, not only the energy efficiency improvement can be done with great success but it will also help to monitor and evaluate the performances in terms of energy efficiency improvements. To gain such an insight, an appreciation of the many complexities which make up economic and social activities, and the ways in which these interact is required.

Currently, the method used to monitor Malaysia's energy efficiency status is by judging energy intensity. The energy intensity value is a ratio between energy and economic values. Normally, the energy intensity is calculated by dividing Total Primary Energy Supply (TPES) by Gross Domestic Product (GDP). For Malaysia, our Energy Intensity (EI) in the year 2013 was 67.95 (toe/million, RM at 2005 prices). This implies that Malaysia's energy efficiency status is decreasing despite the continuous efforts undertaken to promote energy efficiency in the country.

Various strategies and actions have been taken to improve the status of energy efficiency in the country. However, the performances of those efforts to improve the state of energy supply and use in the country have remained unknown. The justification of their performances by EI is not accurate because the EI value is not only influenced by energy factors but also by non-energy factors such as economic structure, energy quality and activities.

7.1 Energy Efficiency Monitoring Framework

7.1.1. Energy Efficiency Indicator

One of the main challenges in executing energy efficiency strategies and action plans effectively and efficiently is to quantify the achievements from the available data. To make this happen, one of the useful tools in energy efficiency implementation is the energy efficiency indicators. In general, an energy efficiency indicator is a ratio to measure energy use against a unit of output. In the industrial sector, for example, the measures are normally energy use per Ringgit of production or energy per physical unit of production. In the building sector, energy intensity is expressed in terms of energy per square metre of floor space and in the transport sector; energy intensity is measured in terms of energy use per passenger-km or energy use per ton-km.

7.1.2. Reporting the National Energy Efficiency Action Plan Implementation Progress

The National Energy Efficiency Action Plan Project Team needs to report the progress of the National Energy Efficiency Action Plan implementation as one of the National Energy Efficiency Action Plan's main monitoring tools. In the reporting, the actual progress against the National Energy Efficiency Action Plan targets will be communicated to stakeholders.

8.0 Impact

8.1. Economic Impact

The macro energy model for Malaysia forecasts the Final Electricity Energy demand (FEED) of Malaysia to keep growing. In order to reduce the FEED and subsequently CO2 emissions for the Residential, Commercial and Industry sectors, EE measures of varying targets and actions are recommended above. The reduction in FEED lowers energy intensity and leads to reduced CO_2 emissions and intensity.

The overall impact of the National Energy Efficiency Action Plan is shown in Table 3

8.2. Environmental Impact

8.2.1. Final Electricity Energy Demand (FEED) and CO_2 emission

Final Electricity Energy Demand in the year 2025 is expected to be reduced by 12,391 GWh and the cumulative savings over 10 years from 2016 to 2025 is 52,233 GWh. In the case of CO_2 emission, in the year 2025 the CO_2 emission is reduced by 8,094 ktCO_2eq. The cumulative reduction over 10 years from 2016 to 2025 is 34,886 ktCO_2eq.

8.3. Social Impact

1. Increase awareness and involvement from the public and stakeholders in the development of the country's energy efficiency program;

2. Strengthening regulatory and enforcement on energy efficiency across the country to ensure continuous power supply; and

3. Improve management and human resource development to build human capital and experts in the field of energy efficiency.

Table 3: Impact of the National Energy Efficiency Action Plan

Summary Item	Unit	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total	Lifetime
Annual Savings	GWh	87	386	1,101	2,286	3,783	5,475	7,161	8,909	10,653	12,391	52,233	122,543
Residential	GWh	50	123	219	350	522	712	921	1,184	1,468	1,772	7,320	16,677
Commercial	GWh	28	107	307	626	1,018	1,460	1,908	2,395	2,889	3,391	14,130	31,767
Industrial	GWh	9	156	574	1,310	2,243	3,303	4,332	5,330	6,296	7,228	30,783	74,099
Cumulative Savings	GWh	87	473	1,574	3,859	7,643	13,118	20,279	29,188	39,842	52,233	52,233	122,543
Demand Savings	MW	14	63	179	373	617	893	1,168	1,453	1,737	2,021	2,021	
Capacity Savings	MW	18	79	224	466	771	1,116	1,460	1,816	2,172	2,526	-	
Benefits	RM (Million)	28	135	378	799	1,336	1,947	2,552	3,173	3,790	4,401	18,538	42,548
Public Funding	RM (Million)	24	39	59	60	61	52	53	54	44	45	493	**493**
Private Funding	RM (Million)	207	303	493	496	596	628	672	755	791	840	5,781	**5,781**
Administration	RM (Million)	5	5	5	5	5	5	5	5	5	5	50	50
Total Payments	RM (Million)	236	347	557	562	662	685	730	814	840	890	6,324	6,324
BCR												**2.9**	**6.7**
Cash Flow	RM (Million)	- 208	- 212	- 180	237	674	1,261	1,821	2,359	2,950	3,511	12,214	36,224
Total fuel savings	TJ	964	4,225	11,932	24,534	40,204	57,609	74,600	91,892	108,796	125,289	540,045	1,266,995
Gas Savings	TJ	443	1,943	5,489	11,286	18,494	26,500	34,316	42,271	50,046	57,633	248,421	582,818
Coal Savings	TJ	395	1,732	4,892	10,059	16,484	23,620	30,586	37,676	44,606	51,368	221,418	519,468
GHG savings	ktCO2eq	62	273	771	1,585	2,597	3,721	4,819	5,936	7,028	8,094	34,886	81,847
BAU	GWh	117,110	121,431	125,885	130,474	134,830	139,206	143,326	146,992	150,657	154,142	1,364,053	
NEEAP	GWh	117,023	121,045	124,784	128,188	131,047	133,731	136,165	138,082	140,004	141,751	1,311,820	
Savings	Pct	0.1%	0.3%	0.9%	1.8%	2.8%	3.9%	5.0%	6.1%	7.1%	**8.0%**	3.8%	