MINISTRY OF ENERGY,
GREEN TECHNOLOGY AND WATER
MALAYSIA

GREEN TECHNOLOGY MASTER PLAN MALAYSIA

2017 - 2030

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GREEN TECHNOLOGY MASTER PLAN MALAYSIA 2017 – 2030

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FOREWORD

PRIME MINISTER OF MALAYSIA

Green growth for a greener Malaysia

As Malaysia transforms into a high-income nation, the national development strategy must be in line with the megatrends of the world, especially climate change. As a signatory nation to the Conference of Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC), Malaysia has pledged to reduce its Greenhouse Gas (GHG) emission intensity of Gross Domestic Product (GDP) by up to 45% by 2030 relative to 2005 levels. 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 countries.

The Green Technology Master Plan outlines the strategic plans for green technology development to create a low-carbon and resource efficient economy. This document sets out the immediate course for the country to embark on a green growth journey. It lays the foundation for the cultivation of mindset and behavioural change, to inculcate green lifestyle among the rakyat. This Master Plan is essential to facilitate the Transformasi Nasional 2050, or TN50 which is an initiative to position Malaysia amongst the top countries in the world in economic development, citizen well-being and innovation by the year 2050.

Since independence, the Government had introduced various initiatives to plant the seed of sustainability in key economic sectors to mitigate the negative impact to the environment. Since the past five years, we have seen positive outcomes from some of the initiatives undertaken such as increased renewable mix in power generation, market penetration of resource efficient products, improvement in public modal share, better waste and water management. Moving forward, the Green Technology Master Plan will be the key reference outlining the focus of green technology development in Malaysia. This document anchors on outcome-approach to deliver high socio-economic and environmental impact.

The success of the Green Technology Master Plan draws upon effective cross-sectoral collaboration across various sectors to maximise its potential benefits. The conventional way of driving the green growth agenda shall be replaced by dynamic inter-ministerial cooperation, supported by active involvement of the private sector. Green growth is a shared agenda which belongs to every Malaysian, which shall benefit not only our generation, but more importantly, the many future generations to come.

Dato' Sri Mohd Najib bin Tun Haji Abdul Razak

MINISTER OF ENERGY, GREEN TECHNOLOGY AND WATER

Green Technology – The Preamble for Green Growth

Malaysia is blessed with abundant resources. The rapid development of the country since independence was mainly supported by the use of natural resources. Over the past six decades, Malaysia has evolved from a primary economy dependent on mining, rubber and oil palm plantation, to manufacturing-based secondary economy, morphing into a service-based tertiary economy. Natural resources have served the nation well as the growth engine. For the benefits of the existing, as well as the future generations, it is crucial for the country to embark on green growth.

To support this development strategy, green technology has been identified to catalyse sustainable economic growth. Green technology is cross-sectoral in nature, which presents a solution in balancing the needs for economic development and our responsibility towards the environment. The production and development of green technology offer the opportunity to stimulate economic activities in various sectors, creating jobs and attracting investment. Green technology also offers the capability of mitigating negative environmental impact resulting from economic activities. There is a growing global need to deal with dangers of climate change, in part through the implementation of green technology. Green technology application provides the solution to realise the country's commitment to the world.

It is anticipated that by 2030, green businesses will contribute approximately 1.5% to the nation's Gross Domestic Product (GDP) or equivalent to RM60 billion from RM7.9 billion in 2013. This projection is supported by Government's commitment towards realising the green targets, proper execution of policies and monitoring mechanism to keep track of green business performance, increase of exports as well as cooperation from private sectors. This will also contribute to RM94.3 billion of total investment in green technology. Apart from that, the top 30 public listed companies which contributed about 15% of the national GDP had also committed to sustainability practice in their business operations.

The Green Technology Master Plan outlines the targets of respective key focus areas of green technology applications which can potentially generate the most observable socio-economic and environmental impact. We hope this document is able to provide clearer picture on the Government's commitment in creating conducive ecosystem for green technology development, shifting from technology adoption to technology production.

Datuk Seri Panglima Dr Maximus Johnity Ongkili

SECRETARY GENERAL
Ministry of Energy, Green Technology and Water

The Green Technology Master Plan provides actionable strategic directions to support the National Green Technology Policy. This document is the first of its kind which outlines the national concerted efforts in promoting green technology in key economic sectors to stimulate economic growth in the country. It aligns the existing green technology-related policies and action plans with the strategic direction of the 11th Malaysia Plan.

This Master Plan aims to provide the readers an overview of the Government's commitments in facilitating the development of green technology in the country. It sets out key focus areas where business opportunities could be further explored. The document is informative in nature. It provides the readers the general sectoral profile of each of the key focus areas, achievement, targets, existing initiatives which the Government and/or private sector are undertaking, as well as upcoming initiatives where the relevant Government entities are committed to fulfil their roles.

The Green Technology Master Plan also serves as a guidance to foster inter-ministerial collaboration to address grey areas where overlapping authorities are observed. It identifies five strategic thrusts, in line with the National Green Technology Policy where Government's intervention is essential to drive changes in order to create conducive ecosystems for the development of green technology. It recognises the strengths and weaknesses in the existing system, and provides action points for the relevant Government entities and/or private sector to act on. Most importantly, it explicitly spells out the programme ownership of various initiatives to instil responsibilities among the relevant entities.

Last but not least, I wish to take this opportunity to thank all the stakeholders who have contributed their ideas to develop this Master Plan. Moving forward, I hope we can work together to make this Master Plan a success.

Dato' Seri Ir. Dr. Zaini bin Ujang

EXECUTIVE SUMMARY

The Green Technology Master Plan (GTMP) is fundamentally an outcome of the Eleventh Malaysia Plan (2016-2020) which has earmarked green growth as one of six game changers altering the trajectory of the nation's growth. The GTMP creates a framework which facilitates the mainstreaming of green technology into the planned developments of Malaysia while encompassing the four pillars set in the National Green Technology Policy (NGTP) i.e. energy, environment, economy and social.

This first edition of the GTMP focuses on six key sectors, namely Energy, Manufacturing, Transportation, Building, Waste and Water and attempts to harmonise the policy directions of each sector towards a common goal of sustainable utilisation of natural resources. The green technology goals established for each of these sectors will be progressively realised and fine-tuned in the policies and actions developed in every 5-year National Development Plan period.

Since 2009, several initiatives have shown that green technology could be instrumental in decoupling economic growth from natural capital depletion. This is reflected in the contribution to GDP made by the adoption and use of green technology based practices, systems and products, as shown in Figure A.

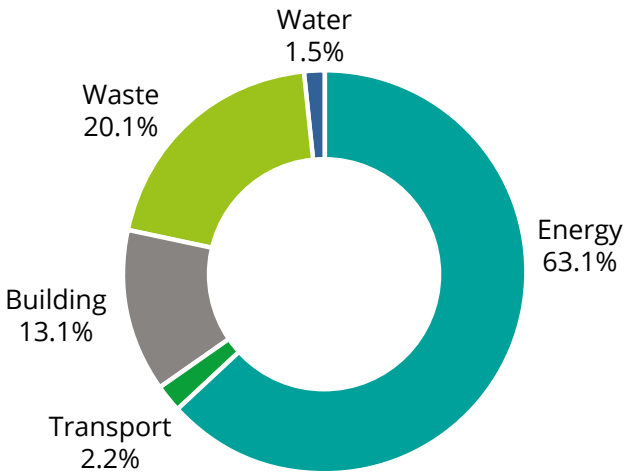


Figure A: Contribution of Green Technology (by sector) to GDP in 2013[1]

[1]This estimation includes manufacturing of related green products in each sector, Malaysian Green Technology Corporation (MGTC) (2014)`

Strategic Direction

The successful implementation of the GTMP will require strategic directions that are practicable and achievable. The strategic directions considered in the GTMP encompass several aspects which will need to work in tandem.

The first strategic direction is for the Government to lead the way in adopting green procurement criteria and to review all aspects of its operations for opportunities to adopt green technology-based practices, systems and products. Because the Government is a major consumer segment, this strategic intervention will resonate throughout the markets and catalyse the change in production and consumption patterns. The reshaping of demand and supply towards sustainably sourced products and services can be further reinforced by strategic fiscal and financial instruments.

The second aspect to the strategic direction looks at mainstreaming green technology into markets through targeted programmes that encourage informed purchasing decisions based on heightened environmental consciousness. This can be achieved through smart partnerships involving the Government, the manufacturers, and the retailers. Such visible and transparent action will be helpful in boosting market confidence in green technology-based products and services.

The third aspect looks at nurturing research, development and commercialisation (R&D&C), which will move Malaysia from adoption and adaptation of non-domestic technologies to creation of its own original intellectual property. It is imperative for Malaysia to move quickly in this area to catch up with the rapid pace of technology innovation around the globe. A consortium of R&D&C entities, industries and consumer groups will be formed to share resources and capabilities to synergise this endeavour.

Finally, progress on the master plan will rely heavily on human capital that is capable of the diligent pursuit of innovation and excellence, and this is reflected in the prominence of human capital development in each of the key sectors.

Key Points from Key Sectors

Key initiatives that are underway and planned, as well as challenges flagged in each of the six sectors are briefly outlined in the GTMP. Each sector has its own unique challenges but there are also common cross-cutting challenges from which strategic areas of intervention have been identified.

The GTMP is cognisant of the fact there is a need to balance the different goals of each sector without diluting the effort towards green growth. However, it has been deemed prudent to focus on the need for technology adaptation and adoption as an immediate outcome. A summary of the key points describing the embedding of green technology in each sector is as follows.

Energy Sector

Efforts have been put into place by the Government to ensure the long-term sustainability of the energy sector through resource diversification, continuous investment in new infrastructure and state-of-the-art technology deployment. The main challenge highlighted was governance in the future energy economy which will be important in setting the tone for harnessing renewable energies and energy storage technologies.

A series of initiatives has also been put into place addressing efficiency in electricity generation and consumption. Funding to buffer the transition to a more market-based approach in energy generation and supply has been provided along with funds for R&D&C. Recommendations include enhancing the energy planning framework to leverage on disruptive technologies such as the massive scale-up of distributed generation, microgrids, independent energy storage, the internet of things, and electric vehicles among others.

The targets for the Energy sector are summarised below:

SECTORS / AREAS	YEAR		
	2020	2025	2030
Renewable Energy (RE)	• 20% • RE mix (installed capacity)	• 23% • RE mix (installed capacity)	• 30% • RE mix (installed capacity)
Energy Efficiency	-	• 10% • Reduction in electricity consumption	• 15% • Reduction in electricity consumption

Table A: Targets in Energy Sector

Manufacturing Sector

Malaysia's manufacturing sector is dominated by the small and medium-sized enterprises (SMEs), making up 95% of the sector, with the remaining 5% comprised of the large enterprises. Initiatives have been put into place to green the industry, with measures promoting energy efficiency and adoption of 'greener' manufacturing processes that reduce water and raw material consumption while minimising air pollution, solid waste and wastewater generation. Challenges highlighted were pegged on the fact that the manufacturing sector covers a diverse range of industrial segments, each with its own unique environmental issues and circumstances requiring tailored solutions. Recommendations include scaling up towards a circular economy, where the industrial system would be more restorative or regenerative and improves resource performance and material savings.

Transport Sector

Initiatives are being looked at to utilise green technology across the land, aviation and maritime transport sectors which will improve energy efficiency and reduce carbon emissions, as well as embed greener operations. An example is the Green Port Policy for the maritime transport sector. Plans are also underway to improve connectivity and infrastructure to make travel more efficient. Governance of the transport sector has been flagged as an issue requiring attention, as there is a lack of coordination in the regulation of the multiple transportation segments. Other issues include the affordability of new transportation technologies such as energy efficient vehicles (EEVs) and the poor market perception and confidence in these new technologies. Recommendations include improving market demand for public transportation as well as providing information on mobility choices to the public.

The targets for the Transport sector are summarised below:

SECTORS / AREAS	YEAR	
	2020	2030
Public transport	• 40% (Greater KL) • 20% (Other cities)	• 40% (All cities)
Private transport	• 85% Energy Efficient Vehicle (EEV)	• 100% Energy Efficient Vehicle (EEV)

Table B: Targets in Transport Sector

Building Sector

The building sector has made great strides in realising the aspirations towards sustainable construction and green buildings. Projects and measures include green building ratings, industrialised building systems, green building designs, green construction materials, and green product directories. The Government has lead the way by implementing initiatives to realise a 5% reduction in energy consumption of ministry buildings in the federal capital by 2020 as well as the adoption of green building rating scheme.

The main challenges highlighted include the high cost of investments in green technology and materials, the absence of regulatory drivers on building energy codes which largely dictate a building's energy intensity (BEI), inadequate sustainability performance standards for building materials, lack of research in sustainable building materials and the need for a more skilled work force in the construction industry. Recommendations include standardisation of rating and audit tools and nudging the construction industry towards a circular economy by enforcing reduction of waste generation at site and increasing the recycled material content in construction materials.

The targets for the Building sector are summarised below:

SECTORS / AREAS	2020	2025	2030
GREEN BUILDING DESIGN			
Active Design - MEPS	• MEPS Law • 11 appliances • Upgrade current MEPS ratings	• 16 appliances • Harmonise MEPS rating to ASEAN SHINE	• All appliances • Universal MEPS rating
Number of Certified Buildings	• 550	-	• 1,750
Passive Design - BEI	• Building Energy Regulation • BEI 120	• Sectoral BEI 90	• Sectoral BEI<60
SUSTAINABLE CONSTRUCTION PRACTICE			
Construction Method - IBS	• Public projects score 70 - 100% • Private projects score 50 –100%	• New Technologies i.e. Automated brick laying etc	
Construction Waste	• To be determined		
GREEN BUILDING MATERIALS			
Raw Materials - Recycle Content	• To be determined. • % recycled content in concrete and other materials		

Table C: Targets in Building Sector

Waste Sector

There are many regulatory measures and policy directions in place for managing waste with multiple goals to reduce waste generation per capita and to turn waste into a source of wealth through waste recovery for material extraction and conversion of waste to energy. The main challenge lies in poor public awareness which must be persistently addressed to change consumption behaviour and lifestyle habits that generate undesirable quantities of waste. Complicating the matter are issues in the jurisdictional scope over treatment of the different types of wastes generated. Recommendations where green technology is concerned have focused on R&D&C, innovations for minimisation of generation and safer disposal technologies, resource recovery, and conversion of waste to energy and reusable materials.

The targets for the Building sector are summarised below:

SECTORS / AREAS	YEAR		
	2020	2025	2030
Waste treatment and disposal	• 22% Recycling rate	• 25% Recycling rate	• 28% Recycling rate
	• 1 Waste to energy thermal plant	-	• 3 Waste-to-energy (WtE) thermal plans
Resource recovery	• 500 palm oil mills with biogas capture facilities	-	-

Table D: Targets in Waste Sector

Water Sector

The Government has put into place several initiatives to address the whole water continuum from resource use to distribution, utilisation, recovery and treatment. Emphasis has been on shifting towards a closed water loop system, water efficient products and services, as well as intensification of R&D&C on water conservation, treatment, distribution and rainwater harvesting.

Some of the challenges highlighted include the lack of funding for R&D&C, slow shifting of the industry and consumers towards water efficient products and services, inadequate use of analytical tools and detection technologies to address issues related to inefficient network distribution and end-user consumption. Recommendations have focused on the adaptation and adoption of suitable technology to facilitate efficiency and optimisation of scarce water resources, improved and cheaper treatment options and migration to a closed water loop system.

The targets for water sector in GTMP are summarised as below:

SECTORS / AREAS	INITIATIVES		
	2020	2025	2030
Integrated river basin management	-	• 10% (freshwater abstraction rate)	• 15% (freshwater abstraction rate)
Water treatment and distribution technology	-	• 25% (NRW)	• 20% (NRW)
Water harvesting technology	• 60% of towns in Malaysia installed with Rainwater Harvesting Systems	-	-
Wastewater treatment	-	-	• 100% (sludges to be recycled) • 33% treated effluent to be recycled

Table E: Targets in Water Sector

Key Interventions

Based on the challenges highlighted and recommendations to facilitate mainstreaming green technology in the six sectors, several key topical areas have been identified as shown in Figure B. These topical areas will serve as the take-off point for action plans to be formulated to structure enabling mechanisms and facilitate funding and or investments in addition to nurturing home-grown talent and fostering smart partnerships.

Figure B: Key areas targeted for the mainstreaming of green technology

The NGTP outlined five (5) strategic thrusts with the aim to:

- Strengthen the institutional framework;
- Provide a conducive environment for green technology development;
- Intensify human capital development in green technology;
- Intensify green technology research and innovations; and
- Promotion and public awareness.

In realising the action plans for each topical area, the GTMP will draw on these five thrusts, adapting them to suit the goal of mainstreaming green technology as shown in Figure C.

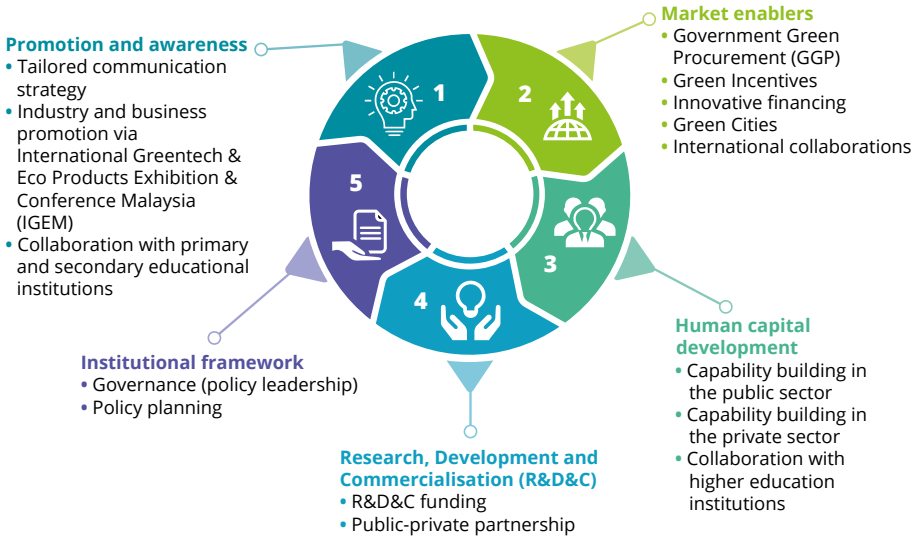


Figure C. Five strategic thrusts for the development of conducive ecosystems for Green Technologies growth[2]

Some examples of enabling mechanisms to raise consumer awareness include:

- Pricing environmental externalities (consequences, costs and risks);
- Providing public access portals which present updated information and tools that allow consumers and producers to calculate the carbon footprint of products and lifestyle choices;
- Providing detailed information on labelling and certification; and
- Awards and reward schemes that raise the visibility of green technology in products and services.

The Government will play a significant role by making a concerted effort to change the Government procurement culture. Programmes will also be introduced to help policy makers become familiarised with emerging innovation concepts to encourage inclusion of technology foresight in policy making.

Improved access to financial resources will be explored to encourage investment in sustainable solutions. Ideally, public sector capital allocations will combine with private sector and community sourced (e.g. crowd sourcing and funding) financing to enlarge the funding pool. Innovative investment instruments such exchange-traded funds (e.g. green sukuk and bonds) will also be considered. Entrepreneurship programmes, to bolster market creation and adaptation will also be looked at.

[2]Kementerian Tenaga, Teknologi Hijau dan Air (KeTTHA), 2016, Malaysian Green Technology Corporation (MGTC), 2016

Human capital development will be done in partnership with industry. This would include exploring new delivery systems of learning and skills training, where engaging instructors and delivering materials can shift beyond classrooms and timetables, where learning becomes on-demand.

The R&D&C direction will be forged through a network of experts and research consortiums ensuring green technology development and application meet the national aspiration to become a regional green technology hub. A strong and close relationship between the research and industry sectors is encouraged to facilitate technology transfer, translate research into viable commercial outcomes, facilitate intellectual property rights arrangements, and most importantly to fuel collaborations resulting in innovations.

1

INTRODUCTION

1.1 The Green Technology Landscape

The history of green technology (GT) dates back to the pre-industrial revolution era in the seventeenth century when windmills were used to power looms and mills. The invention of fossil fuel powered engines displaced the use of green technology (GT) which was deemed inefficient. GT is an initiative which evolves around various methodologies and materials enhancement, from techniques for energy generation to the creation of non-toxic cleaning products. Many scientific studies pertaining to GT had demonstrated the causal effect of greenhouse gases (GHG) to global warming and climate changes. This resulted in an ever increasing societal push for environmental friendly mechanisms to help reduce the impact of energy-intensive economic growth.

The current research projects undertaken by industry groups are pursuing and exploring the alternatives for green energy sources and sustainable production. Governments and the World Energy Council (WEC) are playing key roles in developing and implementing wide-scale GT efforts, aiming to meet the needs of society through indefinite ways into the future without damaging or depleting the natural resources. In short, it is to meet the present needs without compromising the ability of the future generations to meet their own needs, as per Bruntland Report for the World Commission on Environment and Development (1992). Examples of GT supplies include but not limited to renewable energy (RE), green building, green purchasing, green chemistry, green nanotechnology, etc.

Economic growth, industrialisation and growing population in developing countries such as Malaysia, demands acceleration of energy generation to meet the consumption patterns while global environmental problems call for drastic cuts on fossil fuel use. GT applications are the most logical step forward and the Malaysian Government has a pivotal role to accelerate this by introducing and implementing breakthrough policies. GT is the future of any economy due to rising energy costs and the threat of global warming. Businesses are recognising the benefits of using technology to reduce their carbon footprint and minimise waste, which has positive impacts on their businesses.

1.2 National Green Technology Policy (NGTP)

Malaysia has taken the initial step to embrace GT through the National Green Technology Policy (NGTP), which was unveiled by the Prime Minister on 24th July 2009. The Policy focuses on four pillars, namely Energy, Environment, Economy and Social.

The NGTP has identified GT as a key driver to accelerate the national economy and promote sustainable development. Spearheaded by the Ministry of Energy, Green Technology and Water (KeTTHA), Malaysia has constantly introduced various programs and incentives to advocate the use of GT in key economic sectors in the country.

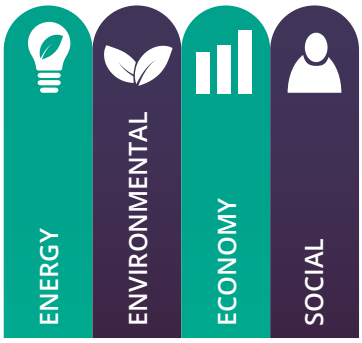


Figure 1.1: Four (4) Pillars of National Green Technology Policy (NGTP)

The GT policy aims to facilitate the growth of GT industry and enhance its contribution to national economy, to increase national capability and capacity for innovation and enhance Malaysia's competitiveness in the global market as well as to conserve the environment and ensure sustainable development for future generation.

1.3 The Eleventh Malaysia Plan (2016 – 2020)

The Eleventh Malaysia Plan (2016-2020) or RMK-11 has outlined inclusiveness and sustainability as the key pillars where the pursuit of green growth for sustainability and resilience will be a game changer, shifting from the old "grow first, clean up later" model. There will be fundamental shifts in the utilisation of natural resources and the environment for socio-economic development. In the next five years, the Government will focus on strengthening the enabling environment, promoting sustainable consumption and production, conserving natural resources, and strengthening resilience against climate change and natural disasters.

The RMK-11 has given due emphasis to GT via a dedicated chapter titled 'Pursuing Green Growth for Sustainability and Resilience'. The three strategies outlined in the Plan to enable green growth include[1]:

- Strengthening governance to drive transformation by enhancing regulatory and institutional framework, coordination, capacity as well as monitoring and evaluation mechanisms;
- Enhancing awareness to create shared responsibility through comprehensive communication, education and awareness programmes and platforms for knowledge sharing; and
- Establishing sustainable financing mechanisms by expanding existing and identifying new economic instruments.

Figure 1.2: Three (3) strategies to enable Green Growth

The targets related to green growth that have been outlined in the RMK-11 are shown in Figure 1.3.

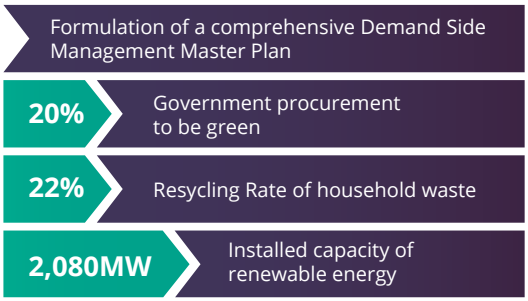


Figure 1.3: Targets of Green Growth in RMK-11

[1]Eleventh Malaysia Plan (2016-2020), RMK-11

The Sustainable Development Goals (SDGs) represent a universal call to act to end poverty, protect the planet and ensure that all people enjoy peace and prosperity. There are 17 SDGs which were built on the successes of the Millennium Development Goals, including new areas such as climate change, economic inequality, innovation and sustainable consumption. The goals are interconnected – often the key to success on one will involve tackling issues more commonly associated with another. The SDGs work in the spirit of partnership and pragmatism to make the right choices now to improve life, in a sustainable way, for future generations. The SDGs provide clear guidelines and targets for all countries to adopt in accordance with their own priorities and the environmental challenges of the world at large. GT plays a vital role towards achieving the extensive goals and indicators of SDGs namely Goal 6 (clean water and sanitation), Goal 7 (affordable and clean energy), Goal 11 (sustainable cities and communities), Goal 12 (responsible consumption and production) and Goal 13 (climate action).

The path-breaking Paris Agreement adopted in December 2015 marked a dramatic turn in the global efforts to mitigate climate change. The establishment of a new framework combining Nationally Determined Contribution (NDC) with new multilateral mechanisms is aimed at ensuring transparency, accountability and promoting greater ambition over time.

Malaysia has pledged to reduce its 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 countries.

Figure 1.4: Sustainable Development Goals (SDGs) related to Green Technology

1.4 Shaping the Future of Green Technology in Malaysia

As GT gains acceptance and grows in popularity across all economic sectors, there remain challenges i.e market, technological, financial and regulatory to overcome. Many of these challenges are similar to those in other countries, while some are specific to Malaysia.

To address these challenges, more than 20 consultations were conducted with relevant stakeholders involving over 300 representatives from the Government, industry, non-governmental organisations, and academia to understand the root causes of the issues and to identify areas where the Government could play a role to address them. The stakeholders had given their full support to the initiative by KeTTHA in drafting the Green Technology Master Plan (GTMP) by sharing their ideas and perspectives about the future of GT development in Malaysia. The stakeholders agreed that the future of GT in Malaysia would be affected by the following factors:

- **Policy direction and synergies among stakeholders**

  Currently there are more than 20 policies related to GT and sustainability under different ministries and agencies. A serious thought for cohesive and synergised policy is crucial in driving the growth of GT. KeTTHA is playing the leading role supported by other ministries such as Ministry of Natural Resources and Environment (NRE) and Ministry of Science, Technology and Innovation (MOSTI). At present, the national GT agenda is being guided by the National Green Technology and Climate Change Council or *Majlis Teknologi Hijau dan Perubahan Iklim* (MTHPI) chaired by the Prime Minister of Malaysia.

- **Economic instruments, infrastructure and facilities**

  Economic instruments are essential to create the market for GT. This includes both physical and non-physical economic instruments. Physical infrastructure support such as charging station, waste transfer station, rail tracks and others are deemed to be provided by the Government. Non-physical economic instruments cover incentives and subsidies such as Feed-in Tariff (FiT), Investment Tax Allowance (ITA), Pioneer Status, carbon trade, technology transfer and others.

- **Cost efficiency and energy prices**

  Currently, the relevant products and services are deemed affordable only to certain income group and those who are well-aware of the climate change and global warming issues. Other opportunity costs (including carbon cost) is not factored into the project economies. Future energy prices are greatly influenced by the global economic performance. The current rate of energy consumption for building operations, the associated GHG emissions, and the uncertainties in future prices of coal, natural gas and electricity can be a cause of concern for policy makers and industry players.

- **Technology advancement and innovation**

  Technology advancement and innovation plays a crucial role in developing a knowledge and innovation based economy. Many countries are also focusing on the development of low carbon economy and intensifying their low carbon technology. However, Malaysia is still at the infancy stage. The Government of Malaysia strives to gradually establish a market-oriented system for technological innovation and commercialisation as well as proliferating basic and applied scientific research.

- **Awareness, education and employment**

  Public empowerment is seen as an important force to move towards green practices. Inculcating public empowerment in the society would enhance people's responsibility where all parties would be involved in environment conservation. Emphasis will be placed on public consultation involving decision makers, industry leaders and the general public. Public consultations aim to engage everyone who is relevant in green practices on various platforms, resulting in the emergence of a green minded society.

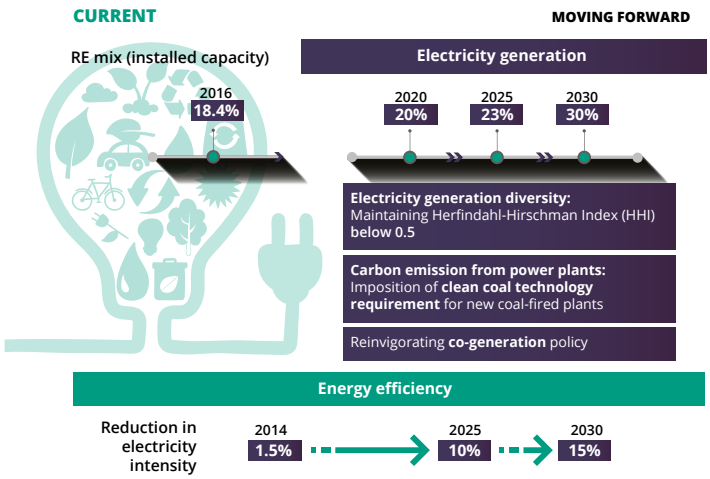
1.5 Summary

The contribution of GT towards the economic growth, cleaner environment, and enhanced well-being is critical. Realising this, the Government of Malaysia aims to build a firm foundation towards low carbon growth to augment the dire reduction of GHG thereby not only fulfilling the 45% carbon intensity reduction pledge but going beyond to join hands with the global community to achieve SDGs. The GTMP is crafted to pave the way to achieve ambitious targets come 2020 and 2030. GTMP positions Malaysia at the forefront of the global movement in climate change mitigation, while fulfilling its needs to leapfrog and becoming a high income nation, driven by green growth.

2

ENERGY

SUMMARY



EXISTING INITIATIVES

Electricity Generation

- National Renewable Energy Policy and Action Plan (NREPAP), Feed-in Tariff (FiT)
- Malaysian Biomass Industry Action Plan 2020 (MBIAP)
- Malaysian Electricity Supply Industries Trust Account (MESITA)
- Capacity Development and Training Programmes
- Incentive Based Regulation (IBR)
- Efficiency in Power Generation
- Net Energy Metering (NEM)
- Large Scale Solar Plant
- Large Hydropower Plant

Energy Efficiency

- Home Energy Report (HER)
- Minimum Energy Performance Standards (MEPS)
- National Energy Efficiency Action Plan (NEEAP)

WAY FORWARD

Electricity Generation

- Energy Planning Framework
- Planting Up Scenario
- Exploration of other RE sources
- Reinvigorating Co-generation Policy
- Long-term plan for electricity tariff rate for higher renewable mix
- New Technologies
- Enhanced cross sectorial collaoration in R&D&C to develop localised technology

Energy Efficiency

- Reinvigorating Demand Side Management (DSM) in electricity thermal and transport
- Smart grid technology (incorporating digital grid etc.)
- Tailored communication strategy to different target audience
- Reinvigorating National Energy Efficiency Action Plan (NEEAP)

2.1 Introduction

Malaysia's energy industry is a critical sector of growth for the entire economy and has accounted for nearly 20% of the country's total gross domestic product in recent years. After gaining independence in 1957, Malaysia started its economic journey as an agriculture- and mining-based country but fast migrated to a middle-income nation by virtue of its rapid industrialisation strategies. The pattern of thinking has been mostly supply-centric and least-cost without giving ample focus on environmental issues. Fossil-fuel resources either indigenous or imported have been conveniently used in large scale and there has been little emphasis on pushing for renewables and more sustainable options. The country took a giant step in putting energy usage in the proper perspective by gazetting the National Energy Policy 1979 by promulgating a more secure, cost-effective use of resources, efficient utilisation of energy and minimisation of impact to the environment. In order to reduce reliance on fossil fuels and efficient use of natural resources, energy policies such as Four-Fuel Diversification Policy (1981) and Five-Fuel Diversification Policy (2001) were introduced to diversify and seek new alternatives in the energy sector.

Beside diversification in the energy supply chain, other countervailing measures include the introduction of energy efficiency (EE) and demand-side management (DSM). The benefits of energy efficiency and associated conservation initiatives starting with behavioural pattern are paramount to the nation's economy and performance in tandem with the management of the environment. The impetus of Malaysian green energy started with the formulation of the National Green Technology Policy (NGTP) in 2009. This means the implementation wave/move by the Government to accelerate the development of RE generation for supply to the national electricity network.

The energy sector has had a prominent effect to the environment in Malaysia similar to other developing countries around the world, where the energy sector was the largest contributor to Greenhouse Gas (GHG) emissions in 2011, amounting to 218.9 $MtCO_2eq$, an increase of 31% since 2000. The energy industries contributed the highest amount of CO_2 emissions at 113.6 $MtCO_2$ within the same year, followed by transport, manufacturing and other industries. Within the energy industries, fossil fuel-based public electricity recorded the highest CO_2 emissions at 87.9 $MtCO_2eq$ (77%) in 2011. This chapter will focus on the electricity sector covering both demand and supply side.

The national Four-Fuel Diversification Policy was introduced to ensure that the nation pursue balance utilisation of oil, gas, hydro and coal. The objective of the policy is to prevent over-dependence on oil as the main energy resource especially for electricity generation. The aim was to ensure reliability and security of energy supply by focusing on four (4) primary energy sources namely oil, gas, hydro and coal in the energy mix. In line with the policy, utilisation of gas in electricity generation increased from 67.80% in 1995 to 78.70% in 2000. On the other hand, the contribution of oil in generation mix declined from 11% in 1995 to 5.3% in 2000.

The Five-Fuel Diversification Policy elevated RE as the fifth fuel in energy supply mix. The policy identified RE sources from biomass, biogas, municipal waste, solar and mini-hydro as additional sources of fuel for electricity generation besides the conventional sources of oil, gas, hydro and coal. It also aimed to encourage efficient utilisation of energy resources as well as reducing over-dependence on conventional or fossil fuel. The enactment of RE Act 2001 and establishment of SEDA has catalysed the growth of RE in the fuel diversification.

2.1.1 Energy Balance

The growth of RE as an alternative energy source was further enhanced to support the continuous increase of energy demand complemented with nominal efforts on energy efficiency (EE) measures. During the Eleventh Malaysia Plan (RMK-11), energy security and RE would continue to be given focus while demand side management (DSM), a major paradigm shift incorporating EE and conservation measures, would be implemented to ensure sustainable management of energy resources. Efforts have also been undertaken to ensure the long-term sustainability of the energy sector through resources diversification, continuous investment in new infrastructure and technology enhancement. Domestic reserves were added to on-going investments, which enhanced energy security. In addition, the improvement in productivity and efficiency as well as the implementation of efficient resource utilisation measures were also undertaken.

The National Energy Balance 2014 by the Energy Commission (ST) reported that the final energy consumption for 2014 recorded a positive growth of 1.2% although marginally 4.6% lower year-on-year (YoY) from 2013. The primary energy supply recorded a 1.9% growth rate in 2014 which was comparatively 4.9% lower YoY. Except for the decline in crude oil prices (1.4% YoY in 2014 as compared to 2013), other types of energy forms anticipated higher total primary energy supply (TPES) for all types of energy except for crude oil. The TPES for crude oil declined by 1.4% YoY due to higher net export with production of crude oil increased by 3.4% YoY (from 28,576 ktoe in 2013 to 29,545 ktoe in 2014. The production of coal in 2014 decreased by 7.1% YoY, which has led to a decrease in the export of coal by 65.0%. TPES from RE recorded an increase from 2013 to 2014 with primary supply of solar registered at 63 ktoe compared to only 38 ktoe in 2013; TPES of biodiesel increased to 300 ktoe from 188 ktoe in 2013 while TPES of hydro had also recorded a positive increase by 13.0% from 2013 level to settle at 3,038 ktoe.

2.1.2 Sustainable Development Goals (SDGs)

The GT agenda resonates well within the purview of SDGs. There are several goals that could pivot energy agenda in SDG, namely Goal 7 (Affordable and Clean Energy), Goal 11 (Sustainable Cities and Communities), Goal 12 (Responsible Consumption and Production) and Goal 13 (Climate Action). In all likelihood, the central theme revolves around better management of resources, optimum harnessing of technologies and behavioural change required in making the right choices for energy use.

2.2 Current Landscape

2.2.1 Energy Supply

In the Tenth Malaysia Plan (2011-2015) or RMK-10 plan period, the security of energy supply was improved to meet the increased energy demand. Efforts were undertaken to ensure the long-term sustainability of the energy sector through resources diversification, continuous investment in new infrastructure and technology enhancement. Domestic reserves were added to on-going investments, which enhanced energy security. In addition, the improvement in productivity and efficiency as well as the implementation of efficient resource utilisation measures were also undertaken.

However, electricity supply industry in Malaysia is still considered over-dependent on fossil fuel with approximately 90% of overall generation mix attributed to coal and natural gas. The inevitable gas price increase for power generation and efforts towards achieving market prices has caused a major shift in the generation mix while coal on the other hand, has been more economically attractive source as least cost option and for base load to ensure the electricity prices are affordable without compromising security aspects.

Over-dependence on fossil fuel could be seen in light of both gas-fired and coal-fired plants being run as base load plants, while RE plants especially large hydro stations are committed during peak load, thus being called peakers. But there are also conundrums: recognition of the inclusive and competing objectives especially energy security versus optimal economic costing in the formulation of installed capacity, as well as environmental concerns being added as another factor for consideration. More often than not, economic objectives outstrip the other two, as generation costs have been based on prevailing commercial contracts with the utilities and gas providers.

Such a scenario may continue to manifest in the future, unless, efforts are taken to enhance other options including the introduction of new resources. It is crucial to reduce dependence on coal in compliance with the GHG emission reduction pledge at the United Nations Framework Convention on Climate Change (UNFCCC) 21st Conference of the Parties (COP21). In the medium term (2016-2020) and long-run (2021-2030), the Government is keen on more sustainable and green energy initiatives. Thus, stakeholders and regulators need to balance options and look for midpoints without losing sight of the energy imperatives particularly available volume of molecules (gas) and tonnage (coal) and economic thresholds that drive the merit order of dispatch for all participating power plants in the national grid.

2.2.2 Electricity Generation

2.2.2.1 Installed Capacity

Malaysia's total installed capacity as of the end of 2014 was 30,875.23 MW, an increase of 3.86% YoY from 29,728.57 MW in 2013. Around 78% of the installed capacity is located in Peninsular Malaysia, 14% in Sarawak and 8% in Sabah.

2.2.2.2 Generation Mix

Gross electricity generation in 2014 recorded a healthy figure of 143,826.58 GWh, an increase of 2.0% YoY as compared to 140,985.01 GWh in 2013. The peak demand for Peninsular Malaysia was recorded at 16,901 MW, Sarawak at 2,306 MW and Sabah Grid at 908 MW. The share of natural gas as energy input in power stations increased from 43.7% in 2013 to 43.8% in 2014.

The oil share of fuel used for generation continued to decline and in 2014, oil accounted for only 2.9% and this was mostly for pockets of power plants in Sabah and Sarawak and mostly for black start operation in Peninsular Malaysia. Such decoupling of oil from generation mix was clearly in line with the Government's strategy in emphasising the use of non-oil indigenous energy sources in the power sector.

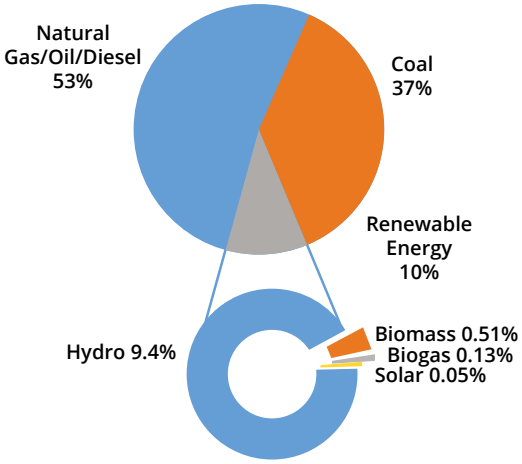


Figure 2.1: RE Generation by Sources (2014)

The generation from RE portion was close to 10% with the large hydro contributing at 9.6% while the remaining were non-hydro renewables at 0.5%

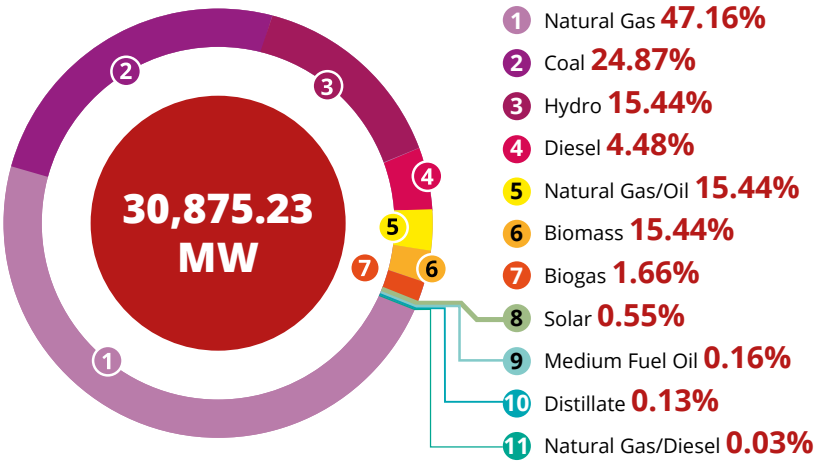


Figure 2.2: Installed Capacity Generation Mix (2014)[1]

[1] 2014 Performance and Statistical Information on Electricity Supply Industry in Malaysia

For the medium-term, coal-fired power plants are expected to continue to be used but there could be opportunities to draw down their numbers. The challenge is to have a transition plan while waiting for existing power plant contracts to expire and new gas and RE plants to come on board.

For coal-fired power plants that are earmarked to come in the RMK-11 window, the Government has indicated that new advanced thermal power generation that are more environment-friendly is required to protect the environment. Utilities and manufacturers could see this as an opportunity to introduce and adopt cutting edge technology.

2.2.2.3 Herfindahl-Hirschman Index (HHI)

In managing the resources efficiently, the Herfindahl-Hirschman Index (HHI) has been adopted with a target to maintain below 0.5 by 2020 for electricity subsector. HHI exceeding 0.5 reflects over-dependence on certain fuel resource and HHI for 2014 is 0.45 which indicates a healthy index.

2.2.2.4 Renewable Energy (RE)

RE resources are diverse and they could come from large hydro, solar photovoltaic, biogas, biomass and small hydro. In the RMK-10, the Government targeted 985 MW from RE generation by 2015. The total approved capacity in year 2014 is 6,285.24 MW.

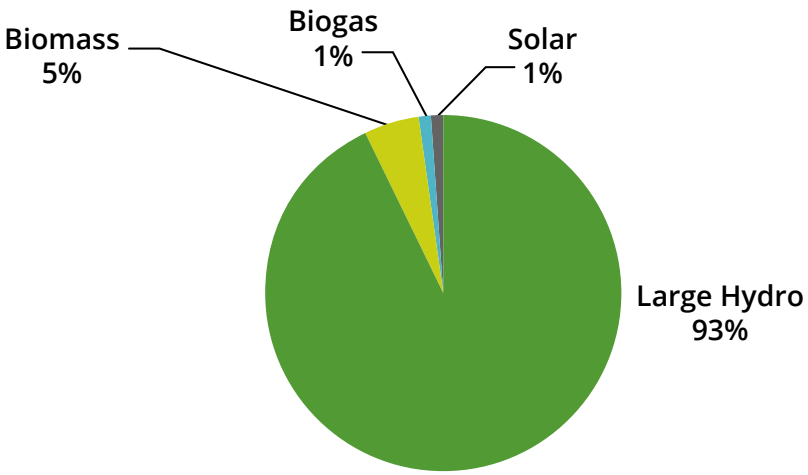


Figure 2.3: RE installed capacity by sources, 2014

With the inclusion of large hydro under definition of RE, it remained as the largest capacity installed as reflected in Figure 2.3.

Besides large hydro, other RE sources (solar, biogas, biomass) showed good progress with the enforcement of the RE Act 2011 paving for the implementation of Feed-in-Tariff (FiT) mechanism in Malaysia in 2011. FiT allows electricity to be produced from RE resources that can be sold to power utilities at a fixed premium price for a specific duration.

Gradual take-off of RE is ideal but with improved technologies and greater efficiency, a bigger take-off could be anticipated. RE is also attractive by virtue of its potential infinite quantum. RE is a practical rebalancing mechanism, able to offset huge swings of conventional (coal-fired and gas-fired) power plant costs, as each RE unit can be a modular set-up.

The aspirational targets for installed RE capacity are set at 20% in 2020, 23% by 2025 and 30% by 2030 as compared with 18.9% in 2016. However, it is conditional on the levelled cost in each RE source is close to conventional resources, with no new major coal-fired power plants established post 2020.

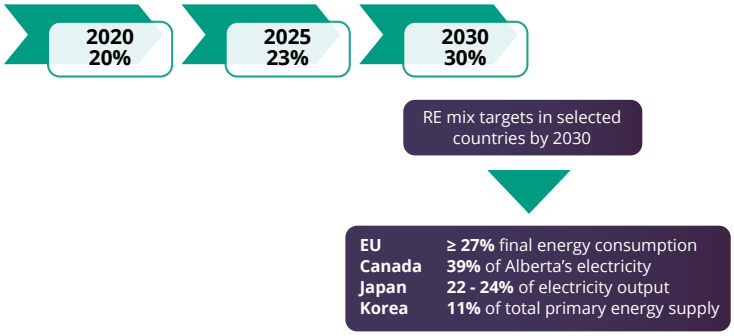


Figure 2.4: RE installed capacity targets of Malaysia

2.2.3 Energy Demand

2.2.3.1 Electricity Consumption

The total electricity consumption for Malaysia recorded a growth of 4.8% YoY from 116,087.51 GWh in 2013 to 121,698 GWh in 2014. The share in electricity consumption was highest for the industrial sector at 44.2%, followed by the commercial sector at 33.0%, domestic sector at 21.2%, public lighting at 1.2% and 0.5% for mining and other sectors.

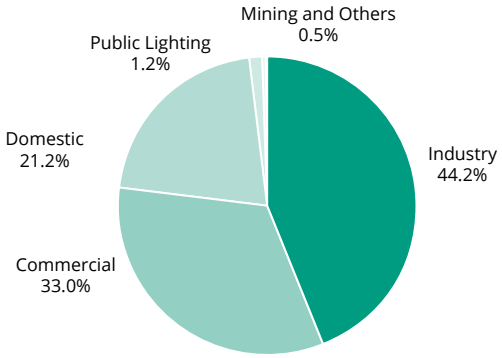


Figure 2.5: Power Consumption by sector, 2014

The Government has shifted focus from increasing supply to meet the demand to reducing consumption by introducing EE and conservation measures. This makes provision for DSM to serve as a countervailing force to the traditional supply side framework or supply-centric. DSM will be a very useful mechanism to trim away the demand spikes, which eventually helps in the reduction of CO_2 and deferment of generation planting up. DSM is also part of a planned initiative under RMK-11 for sustainable production and consumption (SCP) under Focus Area B, Strategy B3.

KeTTHA, ST and SEDA Malaysia have also carried out programmes and projects to implement EE and energy conservation. Among the programmes implemented include, EE measures for buildings, Sustainability Achieved via Energy Efficiency (SAVE) and Minimum Energy Performance Standard (MEPS) as well as equipment labelling programmes.

During RMK-10 period, energy efficient designs were incorporated in new Government buildings while some existing buildings were retrofitted to reduce energy consumption. Four Government buildings located in Putrajaya were retrofitted between 2011 to 2014 and successfully reduced electricity use ranging from 4% to 19% monthly, with an equivalent of RM7,000 to RM130,000 in savings. Other measures promoted include, setting air-conditioner temperature at minimum of 24°C and reducing 5% of electricity bills for all Government buildings. The Uniform Building By-Law (UBBL), 1984 was also revised in 2012 to incorporate the Malaysian Standard: Code of Practice on Energy Efficiency and Renewable Energy for Non-Residential Buildings (MS1525). Currently, Selangor and Terengganu State Governments have incorporated MS1525 into their state UBBL.

In 2011, the SAVE program was implemented to encourage utilisation of energy efficient equipment. A total of RM44.3 million was allocated for the program to offer rebates for any purchase of new energy efficient refrigerators and air conditioners for domestic use as well as chillers for industries. Total energy saved from this equipment for the period from 2011 to 2013 was 306.9 GWh. This has resulted in GHGs avoidance amounting to 208.705 tCO_2eq.

2.2.3.2 Electricity Intensity

In Malaysia, the energy intensity which is a measure of the energy efficiency of a nation's economy, is still high compared to other ASEAN countries. However, marginally lower growth rates have brought some indication that energy shall be decoupled from growth by end of this decade. This could hasten the country's quest to be more energy efficient as EE offers an effective energy policy instrument to address the energy supply security issue as well as energy-related environmental issues in the country. It can lead the country to a sustainable energy path, as energy intensity is anticipated to reduce from a base of 1.5% in 2014 to 10% in 2025 and 15% in 2030.

At the regional level, ASEAN's energy intensity is anticipated to improve over the period of 2013-2035 as its energy demand is expected to increase by only 2.7 times while the GDP grows by 3.7 times. On this score, Malaysia needs to reduce energy intensity by 20% in 2020 based on 2005 level, as part of ASEAN Plan of Action for Energy Cooperation (APAEC 2015-2025) Action Plans.

2.3 Issues and Challenges

2.3.1 Governance

There are various stakeholders entrusted with multiple aspects of governance related to the energy sector, that at times give rise to overlapping roles, authorities, responsibilities and jurisdiction, creating a delicate and complex dynamic system in governing the energy sector. This has resulted in confusion and lack of holistic policies to the industry players and other stakeholders. Among the main issues are inconsistent policies, lack of clarity in demarcation of regulatory oversight as well as dual role of a single entity entrusted to govern, being the industrial player and the regulator at the same time. Strong and effective governance is required to bring stakeholders together, towards a complementary regime of multiple mandates to ensure that the energy sector is managed efficiently.

GT has a significant role to play here, where technology can help bridge the multiple mandates and policy directions. Industry players and the public require coherent signal from cohesive sector to harness full potential of GT. In this regard, the public require a one-stop-centre for information, and airing their suggestion and even grouses on issues related to GT. It is anticipated that as GT continue developing, there are bound to be opportunities to unlock further values along supply and retail chains as in the case of RE.

2.3.2 Accelerating Sustainable Energy

The generation mix for the electricity subsector continues to rely heavily on fossil fuel recording as high as 92.6% and 92.4% in 2006 and 2011. The figure was only marginally reduced to 90.6% in 2013 but has continued hovering around 90% in the past few years.

It is time to make a definitive position to reduce fossil fuel consumption especially coal. The coal-gas combo shall be reduced to manageable quantum (e.g. 80%-85% by 2030), by imposing a HHI of 0.5 on any fuel source and mandate steady stream of RE take-off including large hydro power stations. But this vision needs to be complemented by high availability of base load plants, reliable RE performance, competitive RE pricing and DSM programme. Thus, a transition plan is needed for this to materialise. Similar calls for decarbonisation and eventually carbon-neutral activities are very much in synchronisation with GT milestones.

For RE, there is a huge gap between the target and the achievement, which is attributed to the hesitance of local banks in providing loans to RE players and the difficulty in securing feedstock for long-term agreement. In addition, the collection of RE Fund is limited as it is only based on 1.6% of electricity bill. The amount collected annually is about RM600 million and the accumulated amount might not be sufficient to ensure continuous viability of RE to gain traction in the generation mix portfolio. On a regional collaborative spirit, the national activities shall be aligned with the ASEAN Member States in term of increasing RE and reducing energy intensity.

Paradoxically, low electricity tariff pose a hurdle to improvise/retrofit equipment/connection for greater energy efficiency. This is further compounded by fear of long-term investment returns for each measure taken. A quasi market situation still pivoting on fossil-fuel base load operation with subsidies might impede steps to go for RE. Thus, the Government shall be firm in completely eliminating any form of subsidy although social safety net should still be in place. Slow take-off on energy efficiency initiatives and DSM on grand scale may be attributed to lack of financing mechanism.

In addition, lack of consistency in the initiatives to spur the sector towards energy efficiency and subsequently loss in momentum could be attributed to mixed signals coming from the industry. Lack of awareness, perhaps driven by the fear of long gestation period and long term for price/economic parity for EE/DSM retrofitted equipment, among the public and users has also impeded the implementation of more EE and DSM initiatives. Work to reduce energy intensity may take time, as the industry needs to send a strong message that there is a need to go for quality investment for industrial applications and gradually reducing massive or dirty load. A transitional plan and monitoring system should also be instituted.

2.4 Existing Initiatives

The on-going initiatives introduced by the Government to spur GT growth in the electricity generation and the energy efficiency subsector are:

Electricity Generation

- National Renewable Energy Policy and Action Plan (NREPAP) and Feed-in Tariff (FiT)
- Malaysian Biomass Industry Action Plan 2020 (MBIAP)
- Malaysian Electricity Supply Industries Trust Account (MESITA)
- Capacity development & training programmes
- Incentive Based Regulation (IBR)
- Efficiency in power generation notably via supercritical (SC) or ultra-supercritical (USC)
- Coal-fired power plants
- Large Scale Solar (LSS) and hydro power generations plants
- Net Energy Metering (NEM)

Energy Efficiency

- Efficient Management of Electrical Energy Regulations (EMEER)
- Home Energy Report (HER)
- Minimum Energy Performance Standards (MEPS)
- National Energy Efficiency Action Plan (NEEAP)

The Economic Transformation Programme (ETP) launched in September 2010 and steered by the Government's special vehicle PEMANDU has also outlined several Entry Point Projects (EPP) to spur growth and yield substantial economic returns and creating jobs by 2020 as listed in Table 2.1.

Entry Point Projects (EPP)	2020 GNI (mn)	Jobs	Location
EPP 9 Improving Energy Efficiency	13,900	-	Nationwide
EPP 10 Building Up RE & Solar Power Capacity	457.5	1,906	Nationwide
EPP 12 Tapping Malaysia's Hydroelectricity Potential	5,700	590	Sarawak

Table 2.1: List of relevant Entry Point Projects under PEMANDU [2]

[2] Performance Management And Delivery Unit (PEMANDU), 2010

2.4.1 Electricity Generation

2.4.1.1 National Renewable Energy Efficiency Action Plan (NREPAP) and Feed-in-Tariff (FiT)

The NREPAP 2009 is intended to transform Malaysia into a nation that is:

- Able to sustain its energy consumption through generation from RE sources;
- Independent of fuel imports;
- Able to develop green technologies; and
- Able to conserve the environment.

The NREPAP is also a national effort to mitigate GHG emissions originating from fossil fuel power generation in the long run. With strong efforts driven by the NREPAP, the Renewable Energy Act 2011 and Feed-in Tariff (FiT) act as a catalyst for RE technology adoption. As a result, the RE installed capacity has increased to 18.4% in 2016, with a compounded annual growth rate (CAGR) of 13% from 2010.

Higher projection of RE take-off could be dependent on higher FiT rates than the present 1.6% surcharge on electricity bill but there could be huge opposition to impose higher percentages, which could nullify the objective of getting the *Rakyat* to embrace more RE.

2.4.1.2 Malaysia Biomass Industry Action Plan (MBIAP)

The MBIAP aims to drive Small and Medium Enterprises (SMEs) towards high value-added activities in the biomass industry. Part of the strategy of the MBIAP is to convert organic waste and landscape waste into a source of RE for large-scale biomass power plants. Small-scale biogas generation units could be set up to convert waste into biogas for power plants. As a result, it will reduce landfill waste; reduce the amount of methane released into the environment; and spur business opportunities for SMEs in the biogas industry.

The MBIAP advocated that energy-intensive industries, such as cement and glove industries, to switch from fossil fuels to biomass as the source of electricity generation for their manufacturing plants. The benefits from undertaking the switching activities are carbon credits from GHG emission reduction and a better corporate social responsibility image supported by the Green Investment Tax Allowance (GITA).

The low take-off has not augured well for the biomass subsector, as it needs a clear and distinct signal on the viability of using biomass as energy resource.

2.4.1.3 Malaysian Electricity Supply Industries Trust Account (MESITA)

MESITA plays a crucial role in the R&D of the electricity sector. MESITA was launched in July 1997 and is administered by the Ministry of Energy, Green Technology and Water (KeTTHA) with monetary contribution by the national utility company and independent power producers (IPPs) that are connected to the Peninsular Grid and has since funded various R&D projects and pilot projects in the electricity sector.

The voluntary contribution is 1% of their electricity sale. The fund places high emphasis on EE projects as well as R&D and RE projects as illustrated in Table 2.2 below.

40%	EE projects
25%	R&D programmes and new renewable sources of energy projects
15%	Development and promotion of the electricity supply industry
10%	Human resource development programmes for the industry
10%	Rural electrification programme

Table 2.2: Key focus of MESITA funds

2.4.1.4 Capacity Development and Training Programmes

SEDA is currently providing various professional training courses related to solar PV on topics such as:

- Grid-Connected Photovoltaic (GCPV) Systems Design Course;
- GCPV for Non-Engineers;
- GCPV for Wireman and Chargeman;
- Continuous Development Programme (CDP) for Qualified Persons (QPs);
- Off-Grid Photovoltaic (OGPV) Systems Design Course;
- Solar PV Installation and Maintenance; and
- EE & Energy Management (EM) Training Programme.

As of end 2015, 2,190 participants have benefitted from SEDA's training courses. These training courses, conducted by certified trainers are designed based on stakeholder engagements and feedback from the industry to address the labour gap faced by the RE industry. SEDA assesses its guidelines periodically and reviews its training courses every three years in order to ensure that these guidelines and training courses remain relevant to the industry.

The RE industry is expected to create about 15,300 jobs, comprising skilled and semi-skilled jobs. From 2016 to 2020, the Government aims to provide training to 1,740 personnel through SEDA's various training courses. These trainings will create experts in the field of biomass, biogas, mini hydro and solar PV. The participants will be employees from the industry such as RE project developers, financial institutions and potential service providers. In addition, the private sector will be encouraged to conduct training and increase the number of RE experts. SEDA targets to roll out new training courses for other RE sources, such as biogas, biomass and mini hydro, to raise the competency level of human capital in the RE industry.

Notwithstanding the early successes by the authority, the training calendar and its comprehensiveness still have room for enhancement especially the inclusion of new RE sources.

Training	Biomass	Biogas	Mini Hydro	Solar PV	Total
New training module	1	1	1	-	3
Participants (skilled)	130	100	150	300	680
Participants (semi-skilled)	210	170	250	430	1,060
Number of training	13	10	16	30	69

Table 2.3: Proposed training programmes for RE capacity building, 2016 – 2020

2.4.1.5 Incentive Based Regulations (IBR)

IBR was introduced in early 2014 for the electricity subsector as part of the modernisation of the electricity supply industry. It made way for a structured, transparent and informed way of tariff setting taking into cognisance the huge requirement for capital expenditure (CAPEX) and operational expenditure (OPEX) by the utilities. IBR ensures the utility companies, namely, Tenaga Nasional Berhad (TNB) and Sabah Electricity Sdn. Bhd. (SESB) to continuously enhance their efficiencies and increase transparency in providing electricity supply to customers in full compliance of the projected expenditures. In addition, Energy Commission (ST) continues to audit and review past performances as well as accommodate new requests from the utility companies.

The check and balance focal areas clearly manifest especially by virtue of:

- Determination of financial performance and technical efficiency targets of the utility; and
- Implementation of efficiency sharing mechanism to provide the utility a continuous and sustained incentive to pursue cost efficiencies in every regulatory period.

Through IBR, regulator also has a societal obligation to regulate service quality to ensure:

- Profits are not taken at expense of quality;
- All customers receive a reasonable quality of service (not only those where it is profitable); and
- Acceptable service levels are maintained.

2.4.1.6 Efficiency in Power Generation

By end of 2020, the first generation of IPPs will retire in phases. To replace these plants and their generation capacity (7,626 MW), new tenders will be issued in stages. To ensure CO_2 mitigation, ST has included the minimum requirement of adopting the latest technologies, such as combined cycle gas turbines, ultra-supercritical (USC) and supercritical (SC) technologies coal power plants compared to older machine designs, SC and USC types are using less volume of coal to produce the same amount of energy.

However, the main issue is cost – utilities and IPPs have to construct costlier plants and may have to absorb the additional costs compared to cheaper conventional options. For operation-purpose, the new machines will naturally be dispatched first as base load plants in preference over the older designs and naturally some old plants might not even be used. Such under-utilisation of assets will result in higher than projected tariff to consumers and some might even miscontrue the higher tariff as a way utilities are trying to recover their ROI for such new novelties.

2.4.1.7 Large Scale Solar (LSS) Plants

To drive growth in RE power generation, LSS farms will be promoted. This will increase the overall RE mix in the country and complement the heavy dependence on fossil fuel in horizon years. The targets for LSS farms are elaborated as follows:

- LSS farm - By 2020, Malaysia will have an additional installed capacity of 1,200 MW of LSS farms, of which 200 MW will be in Sabah and 1,000 MW will be in Peninsular Malaysia.

2.4.1.8 Hydro Power Generation Plants

Large hydro power generation plants will be promoted to drive growth in RE power generation to increase the overall RE mix and complement the heavy dependence on fossil fuel. The targets for large hydro powered generation plants are elaborated as follows:

- Large Hydro - By 2025, there will be an additional installed capacity of 1,943MW large hydro dam power plants in Malaysia i.e. in Kelantan (Nenggiri – 300MW), Pahang (Tekai – 168MW), Sabah (Upper Padas – 180MW) and Sarawak (Baleh – 1,295MW).

Following a major flood incident in December 2014, the development of hydro dams will also cater for flood mitigation measures, especially in the east coast of Malaysia.

2.4.1.9 Net Energy Metering (NEM)

To complement the current FiT mechanism in encouraging the take-off of RE, a new instrument termed as NEM has been implemented. The objective of NEM is to promote and encourage more RE generation, by prioritising internal consumption before any excess electricity generated is fed to the grid. NEM is anticipated to encourage manufacturing facilities and the public to generate electricity without any restriction on their generation capacity. This will further assist the Government's effort to increase the contribution of RE in the generation mix. NEM was launched in November 2016. The implementation agency for NEM is SEDA while the regulator is ST.

The introduction of NEM is to achieve the stipulated non-large-hydro RE targets. Unlike FiT, only excess electricity generated from the solar PV system will be sold to the grid. As a result, it will incentivise efficient electricity consumption since the return on investment for the facility is associated with electricity savings (amount of electricity sold to the grid). Under the NEM, the capacity limits for residential are 12 kW (single phase) and 72 kW (three phase), and 1 MW for non-residential (subject to terms and conditions).

In the existing plan, NEM will be applicable to solar PV rooftop installations power generation. It aims to achieve a cumulative solar capacity of 500 MW by 2020, starting with a 100 MW quota per year. NEM is open to all electricity consumers with the following target capacities: industry (45%), commercial (45%) and residential (10%).

2.4.2 Demand Side Management (DSM)

Increasing demand for electricity supply has imminently created issues associated with management of consumption due to rapid expansion of economic activities and growing population.

From 1990 to 2014, electricity consumption grew at an average growth rate of 8%, which is higher than the average growth rate of GDP of 6% in the same period. Such a scenario has forced energy policy planners and implementers to adopt best practices in managing EE in myriad ways. The objective is to inculcate behavioural changes in order to pursue viable retrofitting schemes and innovation that could lead to significant cost savings and thereby improving competitiveness of the energy industry. EE and associated conservation strategies shall also help to conserve the usage and exploitation of the nation's limited natural resources while at the same time reduce the negative environmental impacts.

2.4.2.1 Home Energy Report (HER)

The Home Energy Report (HER) is a pilot programme commenced by TNB in 2015, which has provided home energy reports to 200,000 consumers in the Klang Valley, 1,000 houses (800 in Malacca and 200 in Putrajaya) via mail, email or a web portal. The home energy reports has provided consumers with:

- Detailed information, including analysis of their energy consumption patterns with comparisons to similar houses in the neighbourhood;
- Year-on-year tracking of energy consumption patterns, with monthly household efficiency rankings; and
- Energy saving tips and EE measures.

HER mirrors a similar programme in California to induce behavioural changes among consumers. The benchmarking analysis in the report increases awareness of energy usage and promotes EE measures among consumers. TNB is targeting to roll out HER to 500,000 consumers via hardcopy reports and to all consumers nationwide via web portals in the near term. A total of 4 million smart meters will be installed by 2020 at an estimated cost of RM4 billion by the utility company. As a target, the nationwide implementation of smart grid technology will kick start post-2020.

2.4.2.2 Efficient Management of Electrical Energy Regulations (EMEER, 2008)

Efficient Management of Electrical Energy Regulations 2008 was gazetted on 15th December 2008. Under this regulation, all installation that consume or generate 3 million kWh or more of electricity over a period of 6 months is required to engage an electrical energy manager who shall, among others, be responsible to analyse the total consumption of electrical energy. In addition, the electrical energy manager will also advise on the development and implementation of measures to ensure efficient management of electrical energy as well as to monitor the effectiveness of the measure taken.

The regulations provide description on efficient management of installations for consumers and generators for both existing and new installations through the submission of information, records and documents to the regulator as prescribed. In order to assist each installation becoming energy efficient, the appointment of a Registered Electrical Energy Manager (REEM), having certain competency and experiences in energy management as certified by ST, has been made mandatory.

2.4.2.3 Minimum Energy Performance Standards (MEPS) and Energy Labelling

Minimum Energy Performance Standard (MEPS) initiative was introduced by ST through the enactment of Regulation 101A, 101B and 101C. This was an enhancement to the initially voluntary “Star” labelling programme, which was introduced to promote energy efficient domestic products. The certification by ST is for selected products, which are rated from 1-5 stars as per their EE feature.

MEPS was gazetted in the Electricity Regulation (Amendments) 2013 and implemented by the ST on selected electrical appliances such as refrigerators, air-conditioners, televisions, fans as well as lighting. The regulation requires the said electrical appliances and lighting that enter the Malaysian market or are sold to consumers to meet the minimum energy performance standards as stipulated in the regulation.

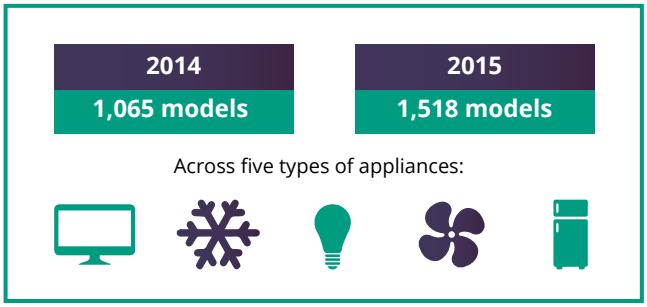


Figure 2.6: Current achievement of MEPS[3]

In addition to this, a few more concurrent activities with different windows have been introduced:

- The Voluntary compliance with MS1525 (Code of Practice on EE and Use of RE for Non- Residential Buildings) made mandatory through its incorporation under the Uniform Building by Law (UBBL) to create awareness on and development of EE buildings;
- Industrial EE for Malaysian Manufacturing Sector - A Global Environment Facility (GEF) and United Nation Industrial Development Organization (UNIDO) supported projects to promote use of MS ISO 50001: Energy Management System (EnMS) to build capacity of SME in managing energy usage and incorporates EnMS to the industrial facilities;
- Building Sector Energy Efficiency Project (BSEEP) - A GEF and United Nation Development Programme (UNDP) supported project and focused on EE for new and existing buildings; and
- Retrofitting of Government Buildings.

[3]Suruhanjaya Tenaga (ST), Kementerian Tenaga, Teknologi Hijau & Air (KeTTHA), 2016

2.4.2.4 National Energy Efficiency Action Plan (NEEAP)

The National Energy Efficiency Action Plan, which was approved by the Cabinet in 2015, is focused to tackle issues pertaining to energy supply by managing demand efficiently. It prescribes a path towards improving energy efficiency by pursuing the implementation of measures that are considered as practically do-able and replicable with measured targets. As energy demand must be managed, the focus will be on securing Malaysia's energy resources and ensure sustainable development for future generation by promulgating productive use of energy and minimising waste. However, NEEAP with a scoping period of 2016-2025 requires a dedicated budget for implementation. It requires commitment from all stakeholders and role-players in the industry, as overarching development in other parallel initiatives could pose a challenge for advocacy of NEEAP activities.

2.4.2.5 Co-Generation

Co-generation or combined heat and power system has been practiced in some of the earliest installations of electrical generation. The result is an optimised use of fuel in generating energy (electrical and heat). Utility standby charges offered by utilities will be reviewed to encourage industries to produce electricity through co-generation. During the RMK-11 period, policy and regulations on future co-generation development will be comprehensively studied and formulated.

Co-generation is a thermodynamically efficient use of fuel. It is the simultaneous generation of electrical or mechanical power and useful thermal energy from a single source of primary energy.

In order to promote an uptake of co-generation, barriers such as the high top-up and standby rates need to be overcome. Key strategic measures ought to be taken to overcome the specific barriers identified covering the design of standby, top-up, load-connected and stand-by charges and revisiting the existing incentives and local manufacturers' capacity building.

Strategies and approaches used by other countries in promoting co-generation systems for their markets should be examined to explore the possible adoption with some changes that will suit our local market.

2.5 Way Forward

Embedding the economy, environmental and social paradigm will be adopted to drive changes in the energy sector. Giving edge to smart and informed usage of energy guided by compelling advantages, the approach strives to be coherent, collective and inclusive, taking into the following considerations:

2.5.1 Electricity Generation

2.5.1.1 Energy Planning Framework

The following are initiatives in improving the energy planning framework:

- Striking a balance between energy security, economic affordability and environmental sustainability with minimal damage to the ecosystem;
- Consider environment-friendly framework in existing planning mode, which has been relying primarily on least cost all this while. A pro-environmental position could also prevent harmful environmental impacts such as emission of GHG and global warming effects;
- Some degree of flexibility is required. Obviously, such policy-making may have to be pursued taking into account of the needs to ensure balanced supply-demand scenario and drawing inspiration from new requirements such as green growth, greater efficiency and other inclusive vantage points in the economy. In many cases, all scenarios have to be considered beyond solely deterministic economic outcomes, and may entail social obligations; and
- A diverse generation mix emphasising on green technology approach and RE as well as comprehensive programmes on EE and DSM could lead to a new norm being adopted.

2.5.1.2 Planting Up Scenario

Revisit our planting up scenarios and consider sustainable approach management:

- New ways will have to be explored, to embed energy planning at the national and macro level and business operations at the micro level more sustainable, by exploring avenues to mitigate environmental risks in supply chains and to minimise carbon footprints;
- A general strategy should be based on drawing down use of gas (including Liquefied Natural Gas - LNG) and coal while stretching further large hydro and non-hydro RE. This could pave the way for conservation of indigenous resources such as natural gas and optimised use of imported resources such as coal. Nevertheless, regulators and utilities should be cautious in crafting this new scenario as there might still be a lack of viable and reliable alternatives to those fossil-fuel options in term of ensuring adequate generation quantum especially for base load purposes;
- In managing the resources efficiently, the Herfindahl-Hirschman Index (HHI) will be adopted with target to maintain below 0.5 in 2020 for electricity subsector. HHI exceeding 0.5 reflects over-dependence on certain fuel resource and HHI for 2014 is 0.45 which indicates a healthy index;
- Institute a two-pronged approach via new initiatives: rebalancing and resizing supply (ensuring diversity) and demand (more EE and DSM initiatives) thresholds and revisiting on-going initiatives;
- Planning must readily advocate more components of EE. Boosting EE will help stretch energy resources and slow down the increase in carbon emissions. It will also create opportunities for businesses and consumers to invest. Setting efficiency standards for appliances and equipment, will encourage higher energy productivity;

- DSM should be on the overdrive as it is a viable option to manage energy profile by curtailing unnecessary energy utilisation by consumers, and thus help shave off high spikes of electricity demand. A comprehensive DSM master plan will pave the way towards a balanced management of the entire energy spectrum;
- Utilisation of RE sources including biomass, biogas, solar PV and mini hydro will be continued as alternative fuel sources for electricity generation. In addition, the potential of geothermal, wind and ocean energy will also be explored. RE capacity is expected to reach 2,080 MW by 2020, contributing to 7.8% of total installed capacity in Peninsular Malaysia and Sabah. RE needs to be enhanced and other avenues such as LSS need to be initiated; and
- Dual track grid-connected and off-grid/distributed generation should be pursued for RE to cater for various needs at grid-level and localised entities.

2.5.1.3 Exploration of Other RE Sources

Studies will be conducted to identify new RE sources to diversify the generation mix. In the RMK-11 plan period, focus will be given in exploring new RE sources, enhancing capacity of RE personnel and implementing NEM to further intensify the development of RE. Looking from strategic standpoint, the same agenda could still be pursued post-2020. New RE sources such as wind, geothermal and ocean energy will be looked at. The national wind mapping will further enable a study on the feasibility of wind energy to be developed. Geothermal potential will also be further explored with the discovery of a 12 km^2 geothermal field in Apas Kiri, Sabah. Viability of ocean energy will be studied to take advantage of Malaysia's geographical position of being surrounded by sea.

2.5.1.4 Revisiting Co-Generation Policy

As of 2015, ST has issued 32 co-generation licences which had an overall capacity of 1,065.7 MW. However, co-generation power plants remain a small component in the total capacity installed. The Government decided in the RMK-11 that policies and regulations on future co-generation development would be comprehensively studied and formulated due to market potential in co-generation. Co-generation or a combined heat and power system can generate substantial savings to end users through more efficient fuel use. In the study, sector specific issues will be plotted out in order to design the strategy in co-generation. Some of the issues, such as the utility standby charges offered, will be proposed for review to encourage industries to improve the attractiveness of co-generation.

2.5.1.5 Long-Term Plan for Electricity Tariff Rate for Higher Renewable Mix

In addition to the current subsidies rationalisation, KeTTHA will take the lead to look into the long-term planning of electricity tariff rates, especially post-2020. This includes the incorporation of cost of emission in energy planning. As the country moves towards becoming a high-income nation by 2020, it is expected that the life style and affordability of the rakyat shall improve over time. The gradual reduction of subsidies and increase in green growth awareness will prepare for the shift towards greater GT adoption and willingness to pay for sustainable growth, especially in terms of higher renewable mix in power generation.

A continuous readiness assessment will be commenced to strategise the long-term plan. In parallel with this planning, the assessment on Malaysia's energy elasticity will be commenced to support the formulation of the electricity rate. This is important to shift Malaysia from energy intensive growth to sustainable growth. In the long term, the aim is to achieve lower energy elasticity whereby there is a smaller percentage change in electricity consumption to achieve one percentage change in national GDP.

2.5.1.6 New Technologies

Prepare for dynamic renewal and disruptive technologies, as there are many things that are constantly changing and may require new ways of thinking. Strive for innovation via imagination i.e. floating solar PV plant;

- New ways could come in the shape of circular economy and minimal change to ecosystems; and
- As it is foreseeable that energy planning may be exogenous in future, rigorous surveillance of global energy events and changes should be enforced and that may include disruptive technologies. An indigenous green technology offering could well insulate Malaysia from such risks and shocks.

2.5.1.7 Enhanced Cross Sectoral Collaboration in Research, Development and Commercialisation (R&D&C) To Develop Localised Technology

Leverage on the availability of relevant funds and grants under MOSTI, KeTTHA (MESITA fund), more cross-sectoral collaboration between KeTTHA, research institutes and other entities will be encouraged to develop localised technology. Some of the focus areas of the collaboration would be technology breakthrough to:

- Enable GT application via distributed generation, tailored to Malaysia's context and environment;
- Enhance efficiency of electricity production; and
- Improve ease of application to address traditional constraints in terms of size and space needed for technology adoption.

Work closer and inculcate greater collaboration with stakeholders, private sector, civil society and public – celebrate EE, RE adherents and advocates such as solar mamas (those Sabahan housewives who learnt about solar PV on their own in India and brought back that knowledge home to propagate to others). We need new energy champions and icons.

2.5.2 Energy Efficiency

The Government plans to reinvigorate DSM and NEEAP, the introduction of smart grid technology and also design communication strategy to its targeted audience to promote efficient use of electricity.

2.5.2.1 Reinvigorating Demand Side Management (DSM) in Electricity Subsector and Harnessing Of Electricity in Thermal and Transport

DSM is a critical shift that enables balanced management of the entire energy spectrum. In 2016, the Economic Planning Unit (EPU) has initiated a preliminary study on DSM. The preliminary study determines the baseline of current DSM initiatives and the scope and boundary setting for an eventual comprehensive study. The eventual comprehensive study will be undertaken to develop a DSM Master Plan with broad horizon to efficiently manage energy demand in the economy especially in the transport, building (residential and commercial) as well as industrial sectors.

With DSM, the return on the utilisation of existing new electricity supply assets (load management) will be maximised. DSM will also play a role in slowing down the nation's electricity demand growth rate, which will result in the deferment of the need to construct new power plants.

2.5.2.2 Energy Efficiency and Conservation (EE&C) Act

Enactment of a comprehensive EE&C Act. The DSM programmes could be accelerated when a comprehensive EE&C Act has been gazetted and duly enforced. With a comprehensive EE&C Act, the gap within the existing EE regulations (EMEER 2008 and MEPS) can be addressed properly and the coverage of the regulations can be widened to thermal energy as well. Thus, streamlining the efforts between the Government and industries.

2.5.2.3 Reinvigorating National Energy Efficiency Action Plan (NEEAP)

In order to maintain energy security and to sustain energy supply, the energy demand must be managed. Hence, the NEEAP was created for the period of 2016 to 2025 and was approved by the Cabinet on 6 January 2016, to drive the national agenda for the country to be efficient in energy consumption especially electricity usage.

Key initiative	Programme related to electricity sector	Programme description	Savings in 10 years (GWh)
Promotion of 5-star rated appliance	5-star refrigerator campaign	Promotion of 5-star rating and label for refrigerators to transform the market into more efficient models	2,706
	5-star air conditioner campaign	Promotion of 5-star rating and label for air-conditioners to transform the market into more efficient models	7,014
Minimum Energy Performance Standards (MEPS)	EE lighting campaign	Promotion of energy efficient lighting through awareness programmes, enforcement of MEPS and labelling	2,216
	High efficiency motors	Promotion and awareness programme that will lead to mandatory MEPS and labelling for motors by 2020	2,175
Energy audits and energy management in buildings and industries	Large and medium commercial buildings	Matching grants where free energy audit will be provided to large and medium sized commercial buildings, industries, large Government facilities provided that the business owner is willing to invest an amount of energy saving measures equal to the cost of the energy audit	5,066
	Large and medium industries		26,969
	Large Government facilities		881
	Medium sized commercial buildings		1,916
Cogen	Cogen in industries and commercial buildings	To promote cogen in industries and commercial buildings by implementing key strategic measures to reduce barriers	3,150

Table 2.4: Key initiatives and programmes under NEEAP

The 10-year NEEAP aims to promote EE by ensuring the productive use of energy and minimising wastage. This will subsequently contribute to sustainable development and increased welfare and competitiveness.

There are 10 specific EE programmes to be implemented in the next 10 years to drive the national EE agenda. These programmes are grouped under five key initiatives as follows:

- Initiative 1: Promotion of 5-star rated appliances;
- Initiative 2: MEPS;
- Initiative 3: Energy audits and energy management in buildings and industries;
- Initiative 4: Promotion of co-generation; and
- Initiative 5: Energy efficient building design

2.5.2.4 Smart Grid Technology

Smart grid is the digital technology that allows for two-way communication between the utility and its customers, and the sensing along the transmission lines is what makes the grid smart. Like the Internet, the smart grid will consist of controls, computers, automation, and new technologies and equipment working together, but in this case, these technologies will work with the electrical grid to respond digitally to changing electric demand. Smart grid technology is timely to prepare the country's infrastructure for greater RE mix in the future, and also efficient management of electricity supply and consumption. This is because smart grids are not only suitably catered for the intermittency nature of RE, but it also increases the efficiency of the entire electrical delivery system.

KeTTHA is expected to undertake a study on smart grid technology in 2017. The outcome of the study will contribute to the strategic plan on smart grid technology in Malaysia. This includes the baseline assessment of the current grid system, as well as the required institutional and infrastructure upgrades, human capital development and also R&D&C on smart grids in Malaysia to realise the benefits of smart grid technology. Extensive public consultation, especially with the utility companies, power producers and technology providers, will commence to gather their inputs and concerns with regard to investment in smart grid technologies. A joint sector lead comprising of the private sector will be identified and established to drive the deployment and development of smart grid technology in Malaysia. This includes collaboration from utilities to micro-grid design, and implementation for remotely located demands. The objective is to empower greater contribution of off-grid or distributed generation in the country, and to pave the way for the structured phasing in of more GT equipment for consumers.

In the next five years, smart grid systems for the electricity industry will be implemented in phases, starting with the introduction of smart meters. Smart meters will provide information on consumers' electricity consumption with real time pricing and assist consumers in managing their own electricity usage. This will in turn minimise electricity costs. As for the utility company, smart meters and smart grid allow for faster outage detection and isolation before they turn into large scale blackouts. These new technologies will also ensure faster restoration of services strategically after an emergency, e.g. to hospitals. As a result, there will be less disruption to customers.

2.5.2.5 Tailored Communication Strategy to All Target Audience

Closer collaboration between various Government agencies (i.e. KeTTHA, the Ministry of Education and the Ministry of Domestic Trade, Co-operatives and Consumerism) and the private sector will be enhanced in designing promotion and awareness programmes. The enhancement will focus on adopting language and logic that is easily understood by the respective target audience from all walks of life. For instance, businesses will be educated with the life cycle cost concepts instead of the lowest cost concepts.

Yayasan Hijau (under KETTHA) has been entrusted to actively engage various groups and communication to promote and create awareness on green technology on continuous basis.

Figure 2.7: Awareness programme on Green Technology by Yayasan Hijau

2.6 Targets

In summary, for Energy Sector, GTMP focuses on two (2) key subsectors - RE and EE. In both these subsectors, significant effort is needed to achieve the desired 2030 target of 30% and 15% for RE and EE respectively.

The key initiatives identified would enable the jump of 11.6% and 13.5% for RE and EE respectively. Continuing the momentum of current initiatives together with developing new ones would make these bold targets achievable.

SECTORS / AREAS	YEAR			INITIATIVES
	2020	2025	2030	
Electricity Generation (Renewable Energy Mix)	• 20% RE mix (installed capacity)	• 23% RE mix (installed capacity)	• 30% RE mix (installed capacity)	• Energy Planning Framework • Planting Up Scenario • Exploration of other RE sources, NEM, LSS plant, Hydro power generation plant • RE new technologies and innovation • Long-term plan for electricity tariff rate for higher renewable mix • Enhanced cross sectoral collaboration in R&D&C to develop localised technology
Energy Efficiency	-	• 10% Reduction in electricity onsumption	• 15% Reduction in electricity consumption	• Reinvigorating DSM in electricity subsector and harnessing of electricity in thermal and transport • Reinvigorating NEEAP • EE&C Act • Reinvigorating co-generation policy • Smart grid technology (incorporating digital grid etc) • Tailored communication strategy to different target audience

Table 2.5: Key outcome and new initiatives to reach the various goals.

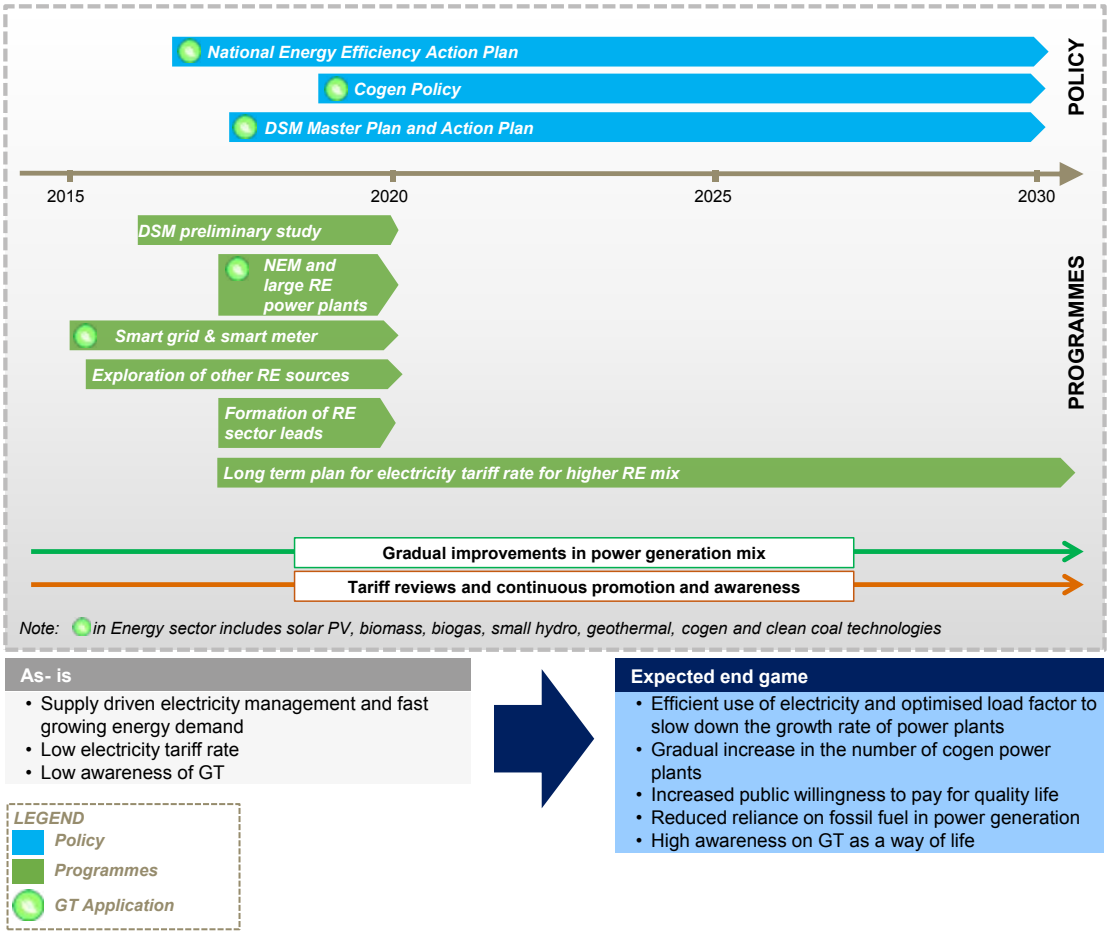
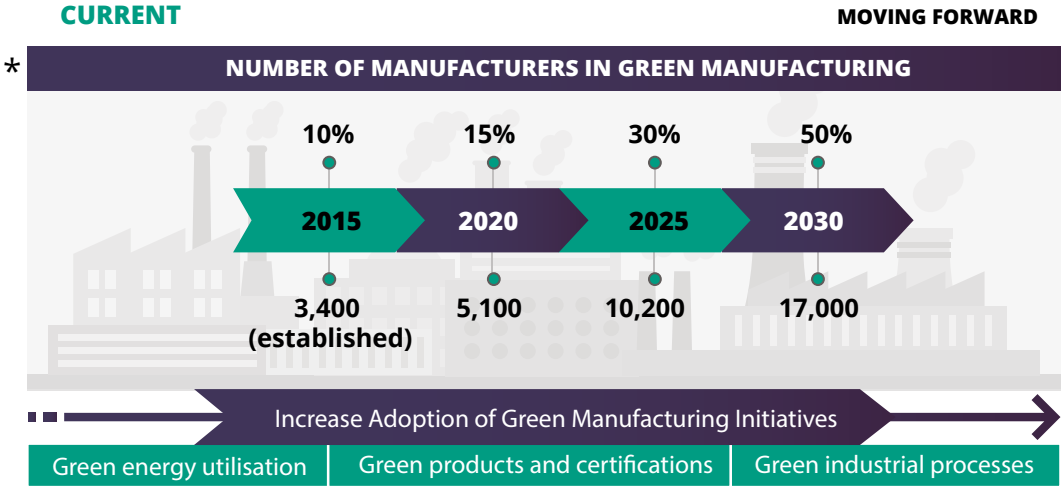


Figure 2.8: Timeline for energy sector

3

MANUFACTURING

SUMMARY



*Aspirational target derived from Economic Census 2011 (SME CORP)

EXISTING INITIATIVES

- ISO 14001
- EMEER 2008
- Industrial Energy Efficiency for Malaysian Manufacturing Sector (IEEMS);
- Environmental Declaration Scheme for Construction and Building Materials
- Malaysia Energy Efficiency and Solar Thermal Application (MAEESTA) Project
- Energy Audit Grant for Industrial sector (Energy Efficiency program under Eleventh Malaysia Plan)
- Energy Management Gold Standard (EMGS);
- MyHIJAU SME & Entrepreneur Development Programme and other green certification schemes;

WAY FORWARD

- Enhanced Time of Use tariff (EToU)
- Information sharing on electricity consumption benchmark analysis to drive behavioural changes
- Promoting the adoption of GT to green the industrial processes
- Establishment of Green Manufacturing Certification which related to Material, Process, Energy utilisation, Recycle, Reuse
- Ecological footprint of the process and product end of life

3.1 Introduction

The manufacturing sector is a major growth driver of Malaysia's economy. In RMK-11, the manufacturing sector is expected to grow at 5.1% per annum, contributing 22.1% to GDP and 18.2% of the total employment by 2020. It contributed about RM232.9 billion or 23% of GDP in 2014, making it the second largest contributor after the services sector. The GDP growth in 2014 at constant 2010 prices by five (5) main sectors are as shown in Figure 3.1.

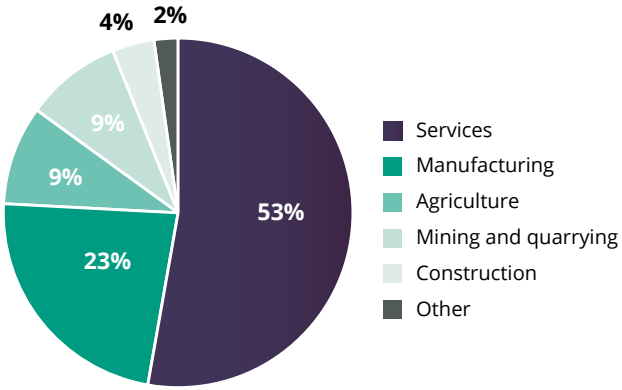


Figure 3.1: GDP 2014 at constant 2010 prices by sector (%)

The growth of the sector was contributed largely by the electrical and electronic (E&E) and chemical sub-sectors. The E&E sub-sector contributed an increase from RM44.2 billion in 2011 to RM53.8 billion in 2015 via new applications for semi-conductors. The chemicals sub-sectors recorded an average growth of 3.4% per annum with an increase in value added from RM24.8 billion in 2011 to RM27.8 billion in 2015 due to growing demands from the automotive, E&E and pharmaceutical and construction industries. Anticipating the growth of the manufacturing sector, the country's environmental concern in manufacturing needs to be mitigated via efficient use of energy and resources as well as minimising generation of waste. These mitigation measures form the core initiatives of the 'Green Manufacturing' concept.

As depicted in Figure 3.2 on the electricity consumption pattern by different sectors of the economy, the Malaysian industrial sector consumes around 45% of electricity generated. Since the Tenth Malaysia Plan period starting in 2011, the Government has been intensifying efforts to reduce GHG emissions from the manufacturing sector, by promoting efficient use of energy, encouraging green processes and utilisation of green products and services. Despite these efforts, the industrial processes in the manufacturing sector have recorded a 46% increase in GHG emissions between 2000 and 2011 as reported in the Malaysia 2016 Biennial Update Report (BUR).

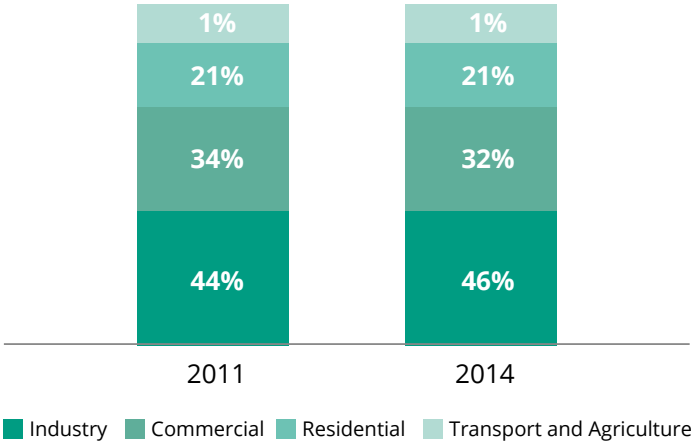


Figure 3.2: Electricity consumption pattern by different sector in Malaysia

A report on Green Manufacturing by the Boston Consulting Group in 2011 identifies transformation towards green manufacturing entails the executions of the following initiatives:

- Utilisation of green energy;
- Developing and production of green products; and
- Deployment of green processes in manufacturing activity.

It should be noted that Green Technology (GT) is the common denominator across all the three areas of green energy, green products and green processes. Manufacturers can adopt green technologies in their business strategy in two different ways – building a new green business, and using technology to "green" an existing one. Energy intensive manufacturing industries can embark on alternative technology that is more energy efficient such as cogeneration to help reduce their energy intensity.

Companies adopting green manufacturing benefit through long term cost savings, brand enhancement with customers and higher investor interest. However, these benefits require a long-term commitment and making trade-offs against short term objectives. Therefore, successful implementation requires adoption of an integrated framework comprising of:

- Planning for green as a core part of business strategy;
- Executing green initiatives across the value chain by shifting towards green energy, green products and green processes; and
- Communicating and promoting green initiatives and their benefits to all stakeholders.

3.2 Current Landscape

According to the 2011 Economic census, there were 645,136 SMEs, representing 97.3% of total business establishments. Out of these, 90.1% of SMEs are in the services sector, with 5.9% in manufacturing, 3% in construction and the rest in agriculture, mining, and quarrying.

The manufacturing sector is dominated by SMEs representing 95% of all establishments while large enterprises constitute the remaining 5%. As of 2015, there are approximately 3,400 green manufacturing SMEs in Malaysia. Collectively, the Government aspires to double the numbers of green manufacturing SMEs by 2030.

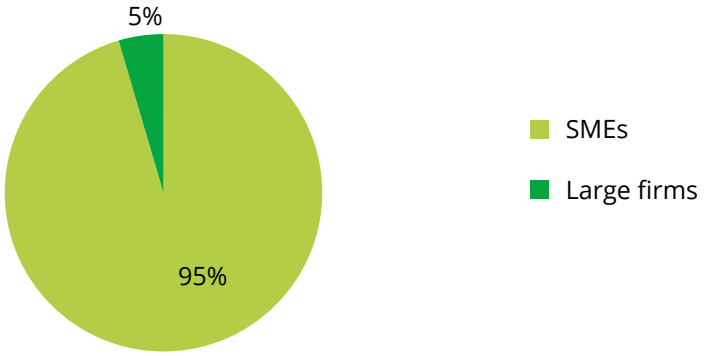


Figure 3.3: Number of companies in the manufacturing sector, 2011

With respect to green products, the paint and cement industries for instance have been certifying their products under SIRIM's Eco-label Scheme. Electrical appliances manufacturers have also introduced a range of energy efficient products that qualify for the energy star labelling from the Energy Commission. The National Water Services Commission (SPAN) has also come out with their own labels for water related equipment. Up to 2015, 73 eco-labels licenses were issued to companies producing green products.

Green manufacturing based on green energy utilisation is already widespread. More than 1000 Energy Managers have been certified under the ASEAN Energy Management Scheme (AEMAS) in the last 5 years which also qualify them to register under the Registered Electrical Energy Manager Scheme administered by ST.

Green process adoption in manufacturing is well underway but its widespread uptake is unsatisfactory. So far only 500 companies registered under FMM have been certified with the prestigious ISO 14001 environmental certifications.

3.3 Issues and Challenges

Overall the adoption of green manufacturing practices is still very low in the manufacturing sector. To aid implementation, manufacturers can focus on three areas:

- **Green Energy**

  Green energy involves production of cleaner energy. Green energy includes both deploying of renewable energy sources and achieving higher energy efficiency in operations.

- **Green Products**

  Developing greener products with lower carbon footprint can often mean higher costs. However, by developing Green products with eco-labels that are sought by consumers, companies can derive additional volumes and price premiums.

- **Green Processes in Business Operations**

  Implementing green processes in operations entails efficient use of key resource, reduce waste generation, reducing carbon and water footprint. Green processes therefore improve operational efficiency and lower costs.

A number of green manufacturing initiatives have been launched for the manufacturing sector as highlighted earlier. However, there is a need to further increase awareness to manufacturers in terms of the importance and benefits arising from the green initiatives. For example, increasing consumer concerns for sustainability and the depletion of natural resources such as oil are the top issues for the automotive industry. In comparison, water shortage, population growth and environmental pollution can be a top issue for the food production industry.

This means that manufacturing companies need to first understand the concerns of their respective industries and then develop specific green strategies to address them in their respective industries.

Therefore, adoption of green manufacturing requires Malaysian manufacturers to embark on a transition from:

- Approaching green as limited, often isolated initiatives with narrow focus to a more holistic approach;
- Meeting regulatory compliance to developing eco-advantage; and
- Viewing initiatives as cost centres to assessing them as business opportunities.

To assist green manufacturing transformation, Malaysian manufacturers need assistance to address the following impediments:

- Manufacturers need to fully understand drivers and issues relevant to them and their industries, and what sustainability means to their business;
- Manufacturers face difficulties in modelling the business case – or even finding a compelling case – for sustainability; and
- Manufacturers need to adopt green initiatives into their core business and integrated as corporate strategy in order to realise its full benefits.

3.4 Existing Initiatives

Various initiatives have been implemented in the manufacturing sector to aid green manufacturing adoption. These initiatives can be classified based on the green manufacturing initiative classifications as follows:

Green Energy

- Efficient Management of Energy Efficiency Regulation 2008 (EMEER);
- Industrial Energy Efficiency for Malaysian Manufacturing Sector (IEEMS);
- Energy Audit Grant for Industrial sector (Energy Efficiency program under 11th Malaysia Plan);
- Energy Management Gold Standard (EMGS); and
- ASEAN Energy Management Scheme (AEMAS).

Green Products

- Environmental Declaration Scheme for Construction and Building Materials;
- Malaysia Energy Efficiency and Solar Thermal Application (MAEESTA) Project; and
- MyHIJAU SME & Entrepreneur Development Programme and other green certification schemes.

Green Processes

- ISO 14001 Certification

3.4.1 ISO 14001 Certification of Manufacturers

ISO 14001 is an international standard focused on environmental management system for organisations. It is designed to introduce environmental improvement on the entire organisation's operation and requires organisations to incorporate environmental issues into their corporate decision-making process.

As such, ISO 14001 certified organisations' will benefit through improvement in environmental performance, minimisation of waste, conservation of energy and water, enhancement of corporate image, reduction in environmental risks and incidents and compliance to legislation.

Companies with ISO 14001 certification are therefore, capable to reduce the negative impact of their activities on the environment via adherence to a prescribed environmental management system framework, which leads towards a sound environmental management.

A survey on ISO 14001 certified manufacturers registered with FMM in 2013 shows that manufacturers with certification were able to reduce the negative impact of their activities on the environment because of their strong environmental management ability. These manufacturing organisations are also capable of implementing environmental management accounting practices as part of their business operations. There are more than 500 ISO 14001 certified companies involving SMEs and big enterprises that are registered with FMM up to 2017.

3.4.2 Efficient Management of Electrical Energy Regulations (EMEER) 2008

The Government gazetted EMEER in 2008 to regulate big energy users. The main objective is to improve energy management practices particularly big manufacturers or industries whose total electrical consumption, equals to or exceeds 3,000,000 kWh as measured at one metering point or more over any period of six consecutive months. These industries need to appoint Electrical Energy Manager to monitor the energy consumption and prepare report to Energy Commission (ST) on the energy efficiency measures undertaken on periodic basis.

Effective 2018 the management of EMEER 2008 will be made more effective via the integration of an energy database tracking and reporting system linking the Energy Commission, the Registered Electrical Manager and end user facility under a common reporting platform known as the Energy Management Information System (EMIS). With EMIS integration, the EC will have better control in enforcing EMEER 2008 across the regulated end-users.

3.4.3 Industrial Energy Efficiency for Malaysian Manufacturing Sector (IEEMMS)

The recently concluded IEEMS project (2011-2017) was implemented by UNIDO and executed by the Ministry of International Trade and Industry (MITI) and SME Corporation Malaysia.

The project has delivered its objective to promote energy efficiency improvements in the manufacturing sector, through the implementation of:

- National Energy Management Standard;
- Application of System Optimisation (SO) for large and SME industries in Malaysia based on the ISO 50001;
- Enhancement of national EE regulatory framework; and
- Widespread awareness of the benefits of EE amongst SMEs and larger industries,

The project has benefitted more than 2,000 organisations in Malaysia from various industries through extensive capacity building and involvement of industries. It has also benefitted collective involvement of the industrial decision-makers (managers), engineers, vendors as well as the Government ministries and agencies, its related subsidiaries and private organisations.

The project has resulted in energy savings of 4,865 GWh and GHG reduction of approximately 3.4 million tCO_2 derived from 69 companies. The annual cost reduction from energy saving was estimated at RM73.65 million.

3.4.4 Environmental Declaration Scheme for Construction and Building Materials

This SWITCH-Asia project (2012-2015) promoted sustainable consumption and production for the construction and

building materials. The project was led by SIRIM in collaboration with Carbon Trust UK, Federation of Malaysian Manufacturers (FMM), Malaysian Green Building Confederation (MGBC) and Building Materials Distributors Association of Malaysia (BMDAM).

Overall, the objective of the project is to drive continuous improvements in the sustainable production, manufacture and use of materials for the construction and building sector within Malaysia and its export markets. The key results of the project were:

- Increased adoption of international best practice and technology by businesses in the Malaysian construction industry;
- Support and encourage the procurement of sustainable products;
- Implementation of a certification and labelling scheme that meets the needs of the local and international business stakeholders; and
- Continued improvement in the environmental performance of construction and building materials produced in Malaysia.

3.4.5 Energy Audit Grant for Industrial sector (Energy Efficiency program under 11th Malaysia Plan)

The energy audit program (2016-2018) provides conditional energy audit grant for large industrial players in Malaysia. It is jointly executed by KeTTHA and ST with the aim to manage and reduce energy consumption in large industries while MGTC has been appointed as implementing agency. All industries including those categorised under the Efficient Management of Electrical Energy Regulation (EMEER 2008) by ST, are eligible to apply.

The objectives of the programme are:

1. To create awareness on the importance of implementing energy audits to understand how and where the energy is being used, to explore on how to manage it and identify the energy savings potential;
2. To provide financing assistance to the eligible applicants through grant, as a catalyst for the implementation of energy audit, so that current energy consumption pattern, baseline and energy savings potential can be identified;
3. To attract financial institutions to provide financing mechanism for energy efficiency projects through energy performance mechanism, to reduce financial burden to the applicants; and
4. To develop capacity building in energy services industry.

It is expected the project will catalyse industries to be more energy efficient in their operations

3.4.6 Energy Management Gold Standard (EMGS)

The EMGS certification system certifies organisations' Energy Management System besides being in compliance with ISO 50001.

The objective of this program is to encourage companies or organisations to practice energy management best practices by managing the energy consumption and ensure the energy is used in efficient and sustainable manner.

The program is executed by MGTC which has been appointed by the ASEAN Centre for Energy (ACE) as certification body for Malaysia.

3.4.7 MyHIJAU SME and Entrepreneur Development Programme

KeTTHA and MGTC to encourage the growth of local SMEs to adopt green practices and produce local green products and services. It supports the Government initiative and direction in the development of SMEs in accordance with the National SME Master Plan (2012-2020). This programme incorporates capacity-building, training and coaching to enable SMEs to obtain green label verification for their products, services and green practices in their operations.

Figure 3.4: Targets of MyHIJAU SME and Entrepreneur Development Program[1]

The MyHjiau SME and Entrepreneur Development Programme partners with 14 prominent green certification or verification bodies in Malaysia. Among the partners are SIRIM Berhad, Energy Commission, National Water Services Commission, Malaysian Timber Certification Council, Green Building Index and Malaysian Palm Oil Berhad. The products and services accredited by these partners are eligible to register for MyHIJAU Mark.

Moving forward the MyHIJAU SME & Entrepreneur Development Programme will focus towards green growth and sustainable activities. SMEs and entrepreneurs will be educated on the Government incentives available. Leveraging on collaboration with other entities such as the Malaysian Global Innovation and Creativity Centre (MAGIC) and Companies Commission of Malaysia, this programme will address the challenges faced by SMEs via:

- Business clinics and advisory sessions with industry leaders;
- Baseline assessment activities to identify areas for improvement considering various elements, such as transport and logistics, energy efficiency, material use, life-cycle cost and business cost needs;
- Strategising actions plans and implementation plans for SMEs to balance adopting green practices and meeting their unique business goals; and
- Engaging big corporations to embark on greening supply chains and green procurement which in-turn will entice many thousands of SMEs to go green.

[1]Malaysian Green Technology Corporation (MGTC), 2016

The programme is also complementing the Government Green Procurement (GGP) initiative. It builds the capacity of SMEs to supply green products and services to Government Ministries and agencies.

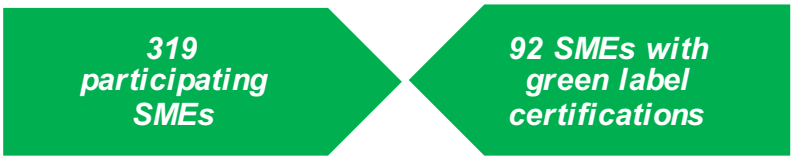


Figure 3.5: Achievements of MyHIJAU SME & Entrepreneur Development Program (December 2016)[2]

3.4.8 Training Related to Energy Management for Industrial Sector

3.4.8.1 ASEAN Energy Manager Accreditation Scheme (AEMAS) training course

The AEMAS training course is one of the initiatives under human resource development programme to build capacity on energy management. This training course is recognised by Energy Commission to produce Registered Electrical Energy Managers (REEM). Energy managers are in demand due to the requirement of EMEER 2008 in which high electrical energy users need to engage energy managers to develop and monitor an EE management plan for the facility.

The AEMAS training aims to provide knowledge and skills to implement the Sustainable Energy Management System that complies to the requirements of ISO 50001 to all energy managers and produce certified energy managers.

[2]Malaysian Green Technology Corporation (MGTC), 2016

3.4.8.2 Certified Professional in Measurement and Verification (CPMV)

CPMV is another training programme to certify practitioners on measurement and verification competency skill. Those practitioners are able to verify savings on energy efficiency programmes by the organisations.

3.5 Way Forward

With increasing global focus on GT, manufacturers should aim for adoption of green manufacturing best practices and technologies. The critical need is to create widespread awareness and adoption of Green Manufacturing practices amongst key growth industries. Incentives, regulatory enforcements and strong political will are essential for success and would be developed according to the following priorities:

- Utilisation of green energy;
- Development and production of green products; and
- Deployment of green processes in manufacturing activity.

A life-cycle approach will integrate pre-production, production and disposal phases in the product life-cycle. To succeed in Green manufacturing, Malaysian manufacturers need assistance to address the following decision-making impediments:

- Lack of understanding on the environmental drivers and issues relevant to their industries, and what sustainability means to their business
- Difficulties in modelling the business case for sustainability; and
- Lack of awareness on on the implication of adopting green initiatives into their core business and integrating a corporate strategy in order to realise its full benefits.

Creating widespread awareness on green manufacturing also requires manufacturers to be made aware of the implementation framework which involve:

- **Planning**

  Green initiatives need to be factored into business strategy, future resource planning and budgeting exercises.

- **Execution**

  Based on robust planning in place and targets clearly defined and monitored, green initiatives need to be integrated across the value chain and as a part of core business as follows:

  ► Green energy: Manufacturers with high energy consumption need to shift towards cleaner energy and plan for efficiency improvements.

- Green products: Manufacturers to conduct evaluation of products parameters based on:
  - How green are the resources and energy being used;
  - How green is the product during the lifecycle of its use; and
  - How green is the manufacturing process.

- Green processes in business operations; Manufacturers need to gradually redesign business processes used in different parts of the value chain. This could include shifting to more sustainable manufacturing options, making changes towards reducing waste, increasing recycling, reusing resources and incentivising suppliers, channels, customers and employees to adopt a common path.

A well formulated promotion campaign and advisory programmes on the implementation framework involving planning and execution of these initiatives will be necessary across the big enterprises and the SMEs in Malaysia.

3.5.1 Future Drivers to Improve Energy Utilisation

3.5.1.1 Enhanced Time of Use tariff (EToU)

By 2020, the EToU will be implemented to replace the Special Incentive Tariff (SIT). Under the SIT scheme, companies with higher electricity usage have benefitted from higher discounts. The total cumulative discounts given from 1997 to 2013 under the SIT were RM5.2 billion. The abolishment of the SIT will encourage electricity-intensive industries to implement EE measures and subsequently reduce their operational energy intensity.

A comprehensive awareness programme on the impacts of EToU will be launched to prepare the industry players in planning to mitigate these impacts, especially those who are particularly sensitive to energy costs. It encourages consumers to use electricity more efficiently by reducing their electricity consumption during peak hours and having more utilisation during off peak hours. The EToU programme will enable electricity consumers to better manage their electrical energy consumption and to explore a different approach in energy cost savings measures.

The new EToU will have three-time zones, which are off-peak, mid-peak and peak. EToU is an option for low and medium voltage commercial users as well as high voltage industrial users. The scheme aims to improve efficiency in load management as well as minimising operational costs of business, ultimately reducing generation cost. In future, the EToU tariff will be extended to domestic users.

3.5.1.2 Information Sharing on Industry Energy-Use Benchmark

Current energy users affected by the EMEER 2008, will soon be assisted in their reporting requirements with an Energy Management Information System (EMIS) currently being implemented under assistance by the UNDP GEF Building Sector Energy Efficiency Programme. The EMIS has the capability to generate data analytics that will be helpful for benchmarking by electricity users.

Manufacturers will be able to compare their performance against the industry benchmark anonymously and this could provide an impetus to reduce energy consumption.

3.5.1.3 Targeted Programmes to Advocate Green Industrial Processes

The existing MyHIJAU SME and Entrepreneur Development Programme will be further leveraged to include awareness and training on green manufacturing implementation framework and provide the readiness for manufacturers to embark on green initiatives.

MyHIJAU SME and Entrepreneur Development Programme will also intensify effort to encourage more manufacturers to embark on ISO14001 certifications and compliance to global environmental management standard. Companies with ISO 14001 certification are able to produce continual reduction in the negative impact of their activities on the environment via adherence to a prescribed environmental management system framework.

3.5.1.4 Cogeneration

Cogeneration is a system of commercially available technologies that decrease total fuel consumption and related GHG emissions by generating both electricity and useful heat from the same fuel input. Cogeneration is often called combined heat and power (CHP), since most cogeneration systems are used to supply electricity and useful heat.

However, the heat energy from electricity production can also be used for cooling and other non-heating purposes, so the term “cogeneration” is more inclusive. Cogeneration is a form of local or distributed generation as heat and power production take place at or near the point of consumption. For the same output of useful energy, cogeneration uses far less fuel than do traditional separate heat and power production, which means lower greenhouse gas (GHG) emissions as fossil fuel use is reduced.

The typical method of separate centralised electricity generation and on-site heat generation has a combined efficiency of about 45% whereas cogeneration systems can reach efficiency levels of 80 percent. Therefore, with cogeneration installation, manufacturers may be able to reduce their energy intensity by as much as 40%.

Up to 2017, there are approximately 1,070 MW of cogeneration plant installations scattered throughout the Peninsular Malaysia. These cogeneration plants are either gas, EFB/Diesel, industrial heat/waste and agriculture waste fired plants. Gas based cogeneration plants constitute the largest share with capacity of 900 MW and with installations scattered throughout the Peninsular Malaysia at location with easy access to natural gas supplies.

3.6 Targets

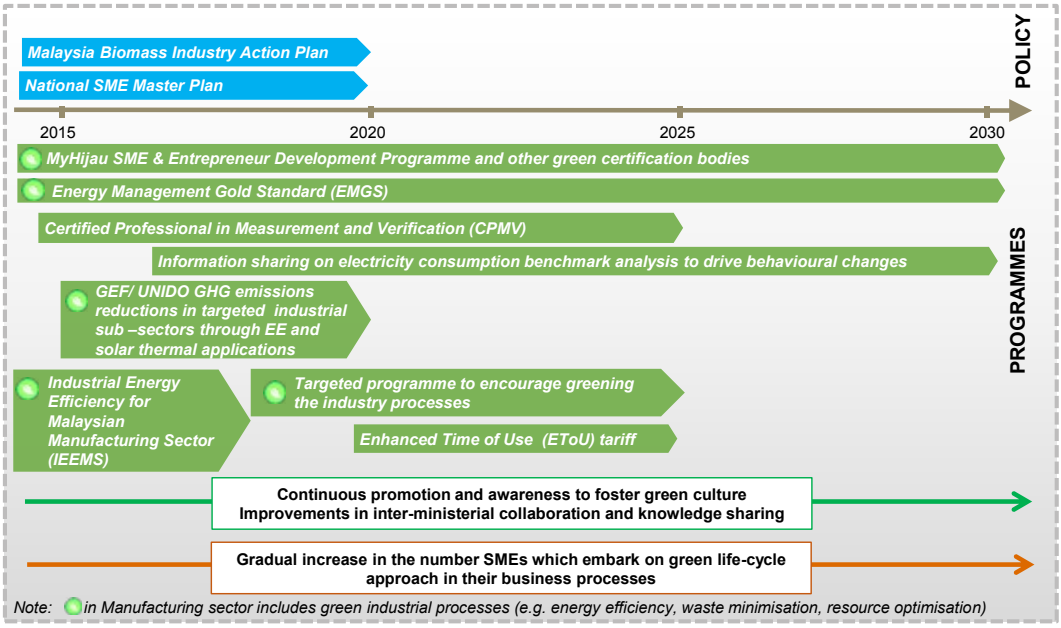
The Government aspire to achieve 17,000 of green manufacturing by 2030 and will continue to support the sector to embark on green manufacturing via multiple initiatives. This is to ensure manufacturers will be equipped with the right tool to meet their varying business requirements.

Under the classifications of green manufacturing; manufacturers can now decide and prioritise their initiatives according to green energy, green products and green processes based on their level of business readiness.

Under this arrangement, manufacturers normally will embark the transformation to green manufacturing in phases. The first phase may involve green energy initiatives, followed by green products and finally a full migration involving green processes.

SECTORS / AREAS	YEAR			INITIATIVES
	2020	2025	2030	
Number of green manufacturing	• 15% (5,100)	• 30% (10,200)	• 50% (17,000)	• MyHIJAU SME & Entrepreneur Development Programme • Energy Audit Grant for Industrial sector • Energy Management Gold Standard (EMGS) • Enhanced Time of Use tariff (EToU) • Information sharing on the energy use Benchmark • Establishment of Green Manufacturing Certification related to Material, Process, Energy utilisation, Recycle, Reuse • Ecological footprint of the process and product end of life • ISO 14001 certifications • Cogeneration application in industrial processes

Table 3.1: Target in Manufacturing Sector



As- is

- Low number of SME manufacturers contributing limited number of GT products in the market
- Large corporations operate at peak hour increasing the peak demand for electricity
- High electricity consumption and demand, driving for more deployment of mega scale coal-fired plants
- High GHG emission from the sector via industrial processes

Expected end game

- High number of SME manufacturers producing GT in the market, and embarking on green life-cycle approach in business processes
- Large corporations being incentivised to operate at non-peak hours to effectively reduce the peak demand for electricity
- EE in electricity-intensive manufacturing sector
- Improved sustainability in industrial processes

LEGEND

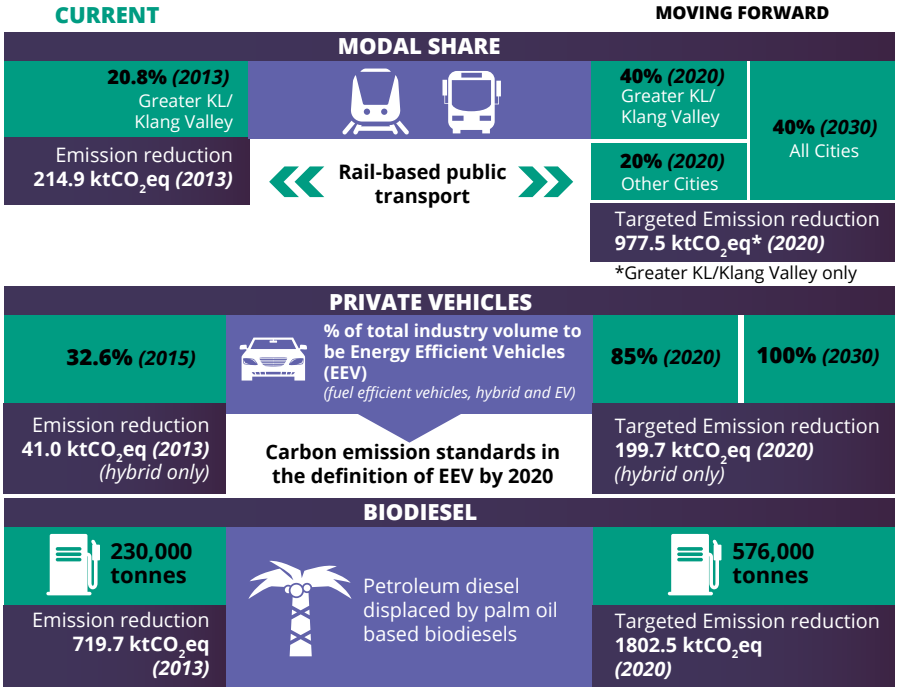
- *Policy*
- *Programmes*
- *GT Application*

Figure 3.6: Timeline for manufacturing sector

4

TRANSPORT

SUMMARY



EXISTING INITIATIVES

Transport Policies

- National Land Public Transport Master Plan (NLPTMP)
- Mega Public Transportation Infrastructure Projects
- National Automotive Policy (NAP)
- National Biofuel Policy (NBP)
- National Logistics and Trade Facilitation Master Plan
- Cleaner Fuel and Improved Fuel Standard
- Green Initiative Programmes by Public Transport Operators
- Market and Technology Assessment
- Human Capital Development

Transport Technology

- Energy Efficient Vehicle (EEV)
- Electric Vehicle (EV) Technology
- Biofuel
- Human Capital Development

WAY FORWARD

Transport Policies

- Implementation of the National Land Public Transport Master Plan (NLPTMP)
- Strengthening the Governance Structure in Green Transportation
- Carbon Emission Standards in the Definition of Energy Efficient Vehicle (EEV)
- Public-Private Partnership in Mega Public Transport Projects
- Partnership with Overseas Entities
- Economic Instruments
- Labelling and Carbon Emission Tax Structure
- Continuation of the National Biofuel Policy (NBP)
- Ride Sharing & E-hailing
- First Mile & Last Mile Connectivity

Transport Technology

- Energy Efficient Vehicle (EEV) Technology
- Electric Vehicle (EV) Technology
- Cycling Lane Infrastructure
- Internet of Vehicle
- Revolutionary Transportation System
- Human Capital Development

4.1 Introduction

Transportation systems form the backbone of social growth and economic expansion of any country. They play a vital role in linking various regions and enabling fast and efficient movement of goods, services and people. One of the strategies outlined in RMK-11 is to encourage low carbon mobility through the utilisation of energy efficient vehicles and public transportation. To achieve this, it is vital that Malaysia aligns its policies, strategies and technologies to drive GT growth in the transport sector.

4.2 Current Landscape

Economic as well as population growth are the two major factors contributing towards the high rates of motorisation in Malaysia:

- The number of registered private motorcycles and cars has increased from 4.7 million in 1990 to 25.7 million in 2016;
- In 2016 there were 578,274 and 464,857 newly registered cars and motorcycles respectively; and
- The number of vehicles is projected to reach 7 million in the Klang Valley (KV) by 2020.

Rapid urbanisation, accompanied by a rise in the number of vehicles on the road has contributed to the increase in energy consumption, carbon emissions as well as traffic congestion problem. Malaysia, as noted in the RMK-11 has put into place strategies that leverage on existing initiatives and makes room for the adoption of new approaches and measures in the transport sector.

4.3 Issues and Challenges

According to the National Energy Balance 2013, transport sector consumed the highest amount of energy at about 43.3% (about 22,357 ktoe) in 2013 compared to 37.0% (about 17,728 ktoe) in 1993. The increasing energy consumption has led to a staggering increase in carbon dioxide (CO_2) emissions, as much as 184.9% over the last 40 years. Malaysia is ranked third after Indonesia and Philippines in terms of CO_2 emission from the transport sector in ASEAN countries. In 2016, out of the total carbon emissions from the land transport sector, 71% originated from cars and 9% from motorcycles. Hence, fuel efficiency and carbon emission levels for individual vehicles will have a significant impact on the environment. In order to mitigate the transport sector's emission and to keep the sector environmentally friendly, the adoptions of a sustainable and green transportation system will have to be made a priority.

A major challenge for the transport sector in Malaysia is governance. Various reform initiatives have been undertaken to streamline and strengthen the institutional structure and governance of the transport sector. These among others include the establishment of Land Public Transport Commission (*Suruhanjaya Pengangkutan Awam Darat* - SPAD) and Malaysian Aviation Commission in 2015. In addition, plans are underway to corporatise the Civil Aviation Department. Despite these various efforts, there are remaining gaps in the governance structure especially in addressing the energy consumption and GHG emission from the transport sector. In order to address the environmental impact of the transport sector, there is a need for a holistic approach from all stakeholders to ensure the sector becomes sustainable.

4.4 Existing Initiatives

4.4.1 Transport Policies

4.4.1.1 National Land Public Transport Master Plan (NLPTMP)

The NLPTMP was launched by the Land Public Transport Commission (SPAD) in 2012. The NLPTMP provides a high level timeline to guide the transformation in the public transportation service up to the year 2020. The NLPTMP aims to improve the land public transportation system in relation to the increase in population, and the demand for accessibility, quality and safety of public transportation. It focuses on urban rail (i.e. MRT, LRT and Monorail), bus and other supporting infrastructure (i.e. Bus Rapid Transit, Park 'n' Ride bays, etc.), covering five (5) main focus areas of improvement:

- Connectivity;
- Accessibility and affordability;
- Service quality and convenience;
- Safety and security; and
- Environmental impact.

The five focus areas of improvement will be supported by:

- Continuous financial support by the Federal Government;
- Development of Regional Land Public Transport Master Plans (RLPTMPs);
- Improving reliability of land public transport sector; and
- Transit-Oriented Development (TOD) to improve accessibility and affordability.

Other supporting programmes being implemented under NLPTMP include:

- The Commuter Bus Improvement Plan (CBIP); and
- The stage bus services transformation programmes.

In order to promote the private-to-public transport modal shift, improvements on the public transportation facilities are necessary. An additional 470 new buses were provided for Rapid KL, Rapid Kuantan, and Rapid Penang. This led to a significant increase in passenger ridership from 10.7 million in 2012 to 17.9 million in 2014.

As of 2013, public transport in the Greater KL/Klang Valley (GKL/KV) region accounted for only 20.8% of the total transport modal share. In the GKL/KV area, there are currently two (2) operating Light Rail Transit (LRT) lines, Mass Rapid Transit (MRT) line and Monorail, as well as a network of public and feeder bus routes. For the LRT, the Kelana Jaya Line and the Ampang Line have achieved 78.7 million and 60.2 million commuters respectively in the year 2013. This is equivalent to taking 109,660 passenger vehicles off the road, therefore achieving a net emission reduction of 214.93 ktCO_2eq in 2013. Extension of the LRT lines from Kelana Jaya station and Sri Petaling station has also been completed with an integrated station at Putra Heights Terminal. For monorail, capacity expansion was done by upgrading of 2-coach to 4-coach trains. For KTM Komuter, the service was expanded in 2015 with the introduction of the Northern and Southern Sectors. Finally, the commencement of Sungai-Buloh-Kajang MRT in 2017 is expected to boost the integration and efficiency of urban public transport in the GKL/KV area.

The track length, number of stations and average ridership of the urban rail in GKL/KV area for the year 2016 are shown in Table 4.1. The modal shift from private to public land transportation (i.e. urban rail and bus) is targeted at 40% public transport modal share for GKL/KV areas and 20% for other cities by 2020. A long-term target of 40% for all urban areas is set by 2030. Annual ridership on urban rail public transportation (i.e. LRT, MRT, Monorail) is targeted to increase by 355% of 2013 levels in 2020, contributing to about 977.5 ktCO_2eq emission reduction.

Rail Service	Track length (km)	No. of Stations	Average Daily Ridership (2016)
LRT Kelana Jaya	46.4	37	215,855
LRT Ampang	44.7	36	161,729
KTM Komuter	217.5	53	108,023
KL Monorail	8.6	11	60,083
KLIA Express	57	3	6,612
KLIA Transit		6	17,719

Table 4.1 Urban rail in GKL/KV area[1]

4.4.1.2 Mega Public Transportation Infrastructure Projects

The Government has implemented several mega public transportation infrastructure projects, especially the urban rail system, to encourage modal shift from private to public transportation and to improve connectivity. Some of the key developments are listed in Table 4.2.

Rail	Progress		Begin Operation	Daily Ridership
MRT Line 1 Sungai Buloh-Kajang	Phase 1	Sungai Buloh-Semantan Completed	January 2017	445,000
	Phase 2	Semantan-Kajang Completed	July 2017	
	Phase 1	Land Acquisition	July 2021	440,000
MRT Line 2 Sungai Buloh-Serdang-Putrajaya	Phase 2	-	July 2022	-
MRT Line 3 North-South Line	Feasibility Study			496,000
Kelana Jaya (Putra) LRT 1	Extension	Completed	June 2016	440,000
Ampang (Star) LRT 2	Extension	Completed	March 2016	352,000
LRT Line 3 Bandar Utama-Klang	-		August 2020	74,000

Table 4.2: Urban Rail Development in GKL/KV

[1]Suruhanjaya Pengangkutan Awam Darat (SPAD)

The LRT 3 project is set to begin operations in August 2020, covering 37 km with 26 planned stations. The project design will incorporate rainwater harvesting technology, a noise reduction system, a better energy management system and natural ventilation system. The project expects to attain a daily ridership of 74,000. The LRT 3 project will connect Bandar Utama and Johan Setia (Klang) to extend connectivity to the Western Corridor of GKL/KV. A feeder bus system will be put in place to facilitate the First and Last Mile initiative that will cover 3 km from a station, with a maximum travel time of 30 minutes. Furthermore, the High Speed Rail (HSR) project that connects Kuala Lumpur and Singapore is expected to provide an efficient alternative mode of transport for the public to travel between the two metropolis as well as the five other cities along the proposed route.

The effective modes of public transport such as the Sunway Bus Rapid Transit (BRT) system has also been implemented, as Transit Oriented Development (TOD) project involving public-private collaboration between the Government and Sunway Group. The elevated system combines the light rail transit system with the usage of dedicated bus lanes serving Bandar Sunway and Subang Jaya, and is aimed to provide a solution to ease the traffic congestion in the area. The alignment is from the intra-city rail station Setia Jaya to Kelana Jaya LRT Line Extension Station in USJ6, connecting seven stations with one Park-n-Ride facility with universal access features.

For bus transportation, Go KL, a free bus service in the Kuala Lumpur Central Business District area was introduced to offer a viable and economical alternative for commuters to travel within the area. The existing bus network has been revamped, where current bus corridors were reorganised into smaller corridors based on the main trunk roads connecting Kuala Lumpur's city centre. In addition, Performance Monitoring Hub System (PMHS) has been implemented to improve public transportation's reliability, journey time, comfort, convenience, accessibility and connectivity by monitoring and tracking the public transport performances beginning with stage bus routes in the GKL/KV.

The automated approach allows SPAD to have real time information for measurement, planning, as well as to assist investigation and implementation of corrective and improvement actions. Besides that, the stage bus service transformation, myBAS, has been rolled out in several key cities in Malaysia, namely Seremban, Ipoh and Kangar. myBAS is designed to help in sustaining stage bus service to ensure connectivity and at the same time provide scheduled trips for local commuters across Malaysia to travel around.

4.4.1.3 National Automotive Policy (NAP)

National Automotive Policy (NAP) was introduced in 2006 with the objective of transforming the domestic automotive industry and integrating it into the increasingly competitive regional and global industry network. The first revision of NAP was done in 2009 to enhance the capability and competitiveness of the automotive industry in Malaysia. The latest revision, NAP 2014 was made to address the need for carbon emission reduction and the promotion of Energy Efficient Vehicles (EEV) and to position Malaysia as ASEAN EEV hub by 2020.

Under the NAP 2014, EEV is defined as vehicles that meet a set of define specifications in terms of carbon emission level (gram/kilometre - g/km) and fuel consumption (l/100km). EEV includes fuel-efficient vehicles, hybrid, electric vehicles (EV) and alternatively fuelled vehicles e.g. Compressed Natural Gas (CNG), Liquefied Petroleum Gas (LPG), biodiesel, ethanol, hydrogen and fuel cell.

NAP 2014 is viewed as an enabler to nurture the local automotive industry and it is formulated based on three (3) main directions:

- Investment;
- Technology and engineering; and
- Market expansion.

NAP also emphasises on three (3) main strategies:

- Supply chain development;
- Human capital development; and
- Safety, security and environment.

In 2013, there were 16,944 units of hybrid vehicles (based on data from JPJ) on the road. The share of EEV by total industry volume has quadrupled from 8.1% (2014) to 32.6% (2015) and 42.8% (2016). It is targeted that 85% of vehicles produced in Malaysia will be EEVs by 2020.The targeted outcome for carbon emission reduction for EEVs is set at 199.7 ktCO_2eq by 2020[2].

4.4.1.4 National Biofuel Policy (NBP)

The NBP was introduced in 2006 to supplement part of the energy demand for transport sector using biodiesel as a source of alternative fuel. The main alternative fuel used in Malaysia is palm-based biodiesel, which is a blend of Palm Methyl Ester (PME) and petroleum diesel. PME is produced from the transesterification process of Crude Palm Oil (CPO) which has a 96% yield factor. Malaysia has implemented biodiesel blending programmes of 5% (B5) and 7% (B7) PME thus far.

[2] Malaysia Biennial Update Report (BUR), 2016

In 2013, palm-based biodiesel displaced 230,000 tonnes of petroleum diesel, resulting in a carbon reduction of 719.7 ktCO_2eq. The current biodiesel blending programme is the B7 which has been implemented since December 2014. In 2015, 382,000 tonnes of petroleum diesel in the transport sector was displaced by PME, contributing to about 1,195.3 ktCO_2eq. The total petroleum diesel displaced by PME from 2011-2015 for both B5 and B7 biodiesel blends is 965,982 tonnes. The upcoming target for the Government is to implement the B10 and B15. Nevertheless, based on the feedback from MPIC, it is expected that B7 programme will remain until 2030.

4.4.1.5 National Logistics and Trade Facilitation Master Plan 2015-2020

Apart from the public and private transportation, some improvements in the freight sector has also been set in place via the National Logistics and Trade Facilitation Master Plan 2015-2020. Under this masterplan, five main strategic shifts have been recommended:

1. Strengthening the institutional and regulatory framework;
2. Enhancing trade facilitation mechanism;
3. Developing infrastructure and freight demand;
4. Strengthening technology and human capital; and
5. Internationalising logistic services.

Various action items and recommendations were proposed under each strategic shifts to improve the freight transport system in Malaysia including greening the logistic ecosystem under the strategic shifts 2, 3 and 4. Some of the proposed action items include creating integrated hub and spoke model to improve logistic efficiency, establishing national freight data program, promote efficient urban logistics, undertake R&D in supply chain innovation and etc. Under the strategic shift 4, it is recommended for the Government to provide green initiative support, including incentives to encourage adoption of green practices and green supply chain initiatives.

4.4.1.6 Cleaner Fuel and Improved Fuel Standard

The existing fuel standard is EURO 4M for RON 97 petrol. EURO 4M standards for RON 97 replaced EURO 2M standards to introduce fuel with lower sulphur content, in turn decreasing the sulphur dioxide output into the atmosphere. The EURO 4M standards also enable the fuel to be less prone to evaporation with better vapour pressure. In addition to lower sulphur content and less vaporisation of fuel, EURO 4M also introduces lower benzene content from 5% (EURO 2M) to 3.5%. The targeted timeline for the introduction of higher EURO standard fuel is as in Figure 4.1.

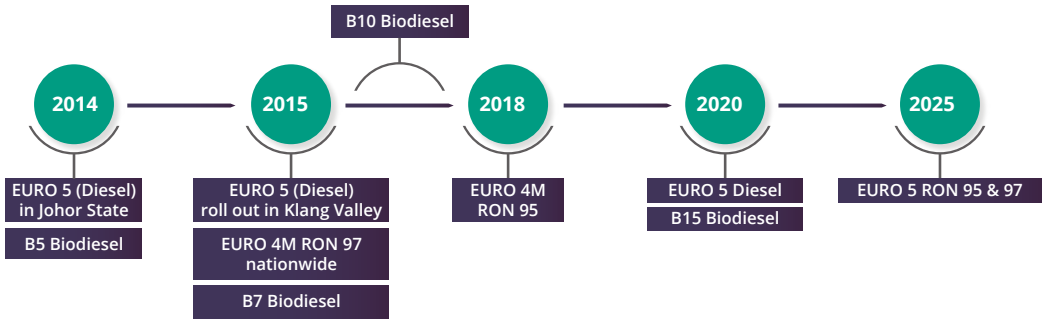


Figure 4.1 Malaysia implementation timeline of fuel standards[3].

Improved fuel standard (EURO standard) will directly improve the emission level. The implementation however will need to be in phases for the vehicle engine specification to be in line with the new fuel standard.

Biodiesel offers as a cleaner option to diesel and thus its utilisation as means to reduce GHGs emission in the transport sector is timely.

Compressed Natural Gas (CNG) is another form of alternative fuel available in the market. It is made by compressing natural gas (mainly methane, CH_4) to less than 1% of the volume it occupies at standard atmospheric pressure. CNG has a higher fuel-to-energy conversion rate than basic petroleum diesel. The use of CNG by vehicles in Malaysia started in the late 1990s and was limited predominantly to taxis and a number of bus fleets in specific areas in Peninsular Malaysia. A total of 839 Natural Gas Vehicles (NGVs), which use CNG, have been registered from 2011 to 2015.

However, the consumption of CNG in Malaysia has dropped from 2013 to 2015 based on the data from National Energy Balance. Nevertheless, RMK-11 has highlighted the encouragement of NGV as part of eco mobility.

[3] Economic Planning Unit (EPU), 2016, Malaysian Biodiesel Association, 2016

4.4.1.7 Green Initiative Programmes by Public Transport Operators

In line with the Government's aspiration to go green and reduce carbon emission, the public transport operators have conducted several green initiative programs. For example, Express Rail Link Sdn Bhd (ERL) has embarked on the Go Lo-CO_2 program (a campaign to raise public awareness on reducing carbon emissions) which is estimated to save 44,800 $ktCO_2eq$ each year when the commuters choose to travel by KLIA express. Meanwhile, MyRapid has launched the Bike N Ride programme, where travellers who cycle and wish to take their bikes with them are welcome to board the trains during off-peak hour, without any additional fare charges. However, the riders have to adhere to the guidelines provided to avoid discomfort to other commuters.

4.4.1.8 Market and Technology Assessment

Malaysia Automotive Institute (MAI) collaborates with other institutions, local or foreign, to help industry stakeholders in market development. For technology development, MAI is in collaboration with Excellerate Australia (formerly known as AutoCRC) to conduct a research known as Market Intelligence and Technology Assessment 2030 (MITA2030). The research will cover the critical roles of vehicle technologies, policies, regulations, standards and energy market in the success of clean vehicle technology in ASEAN and Australian marketplaces. This collaboration involves, among others, a quantitative behavioural econometrics research on consumer preferences in mobility particularly towards EEV technology.

The outcome of this study will provide stakeholder groups with recommendations on relevant econometric outcomes with respect to EEV technologies. These recommendations will address the perspectives of the Government, industry, consumer and fleet management to support Malaysia's EEV strategic vision.

4.4.1.9 Human Capital Development

In support of mainstreaming green technology in the automotive sector, several initiatives have been put in place to enhance human capital development. On the industrial front, MAI has been active in organising technical talks as platform for engaging automotive industry players to keep them updated on the industry's direction matters especially on EEVs including EV. Furthermore, MAI also functions as the Industry Lead Body (ILB) for the training and development of human capital in the automotive industry. MAI is collaborating with Department of Skills Development (DSD) to develop the National Occupational Skill Standard (NOSS).

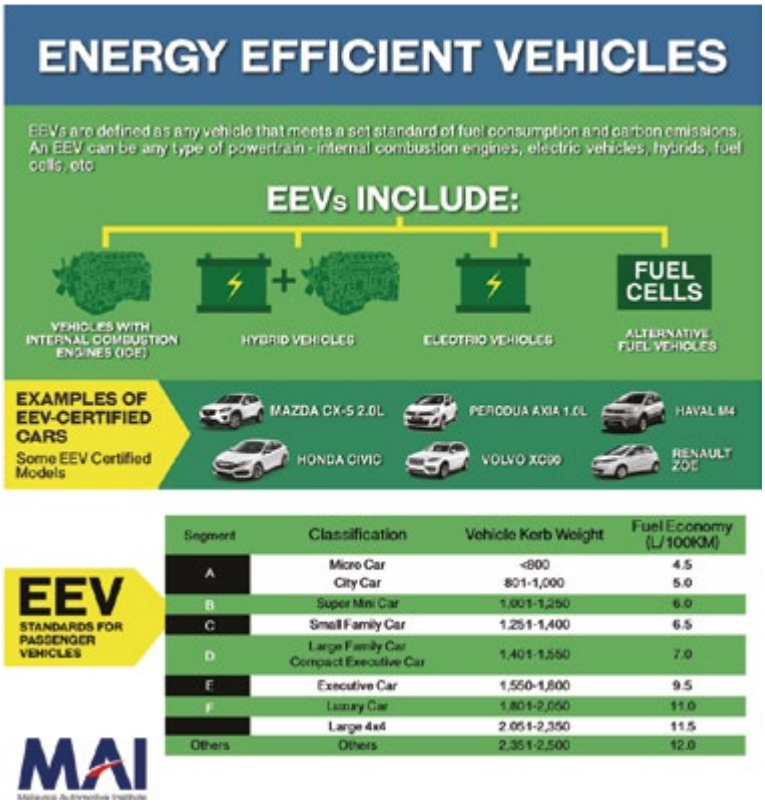
Several research centres in the local universities have also been working on the transport GT research, such as the Proton Future Lab (UTM), UM Power Energy Dedicated Advanced Centre (UMPEDAC, UM), Malaysia Institute of Transport (UiTM) and Research Centre for Applied Electromagnetics (UTHM).

4.4.2 Transport Technology

4.4.2.1 Energy Efficient Vehicle (EEV)

In the National Automotive Policy (NAP) 2014, Malaysian Government has set EEV as the way forward for the national automotive industry. According to NAP 2014, EEV definition is applicable to any vehicle that fits the set of specifications in terms of carbon emission level and fuel consumption, and encompasses fuel-efficient vehicles, hybrid electric vehicles, full electric vehicles, alternative fuel vehicles etc.

Driven by the EEV initiative, local car manufacturers Proton and Perodua have EEV models, such as Ertiga and Axia respectively. R&D&I on EEV should be continued to allow local automotive industry to move up the value chain in transport GT while positioning Malaysia as the local EEV hub.



Segment	Classification	Vehicle Kerb Weight	Fuel Economy (L/100KM)
A	Micro Car	<800	4.5
	City Car	801-1,000	5.0
B	Super Mini Car	1,001-1,250	6.0
C	Small Family Car	1,251-1,400	6.5
D	Large Family Car Compact Executive Car	1,401-1,550	7.0
E	Executive Car	1,550-1,800	9.5
F	Luxury Car	1,801-2,050	11.0
	Large 4x4	2,051-2,350	11.5
Others	Others	2,351-2,500	12.0

Figure 4.2: Energy Efficient Vehicles

4.4.2.2 Electric Vehicle (EV) Technology

KeTTHA and GreenTech Malaysia has initiated the electric mobility effort. Apart from electric bus, the Government also supported private initiative EV car-sharing programme known as Cohesive Mobility Solution (COMOS), to provide rentable EV at selected locations in Klang Valley area.

For personal transport, there are several types of EVs available in the Malaysian market, ranging from Hybrid Electric Vehicle (HEV, which runs on both fossil fuel and battery, without external charging function, such as Toyota Prius and Honda Jazz), Plug-in Hybrid Electric Vehicle (PHEV, which runs on both fossil fuel and battery while allowing the battery to be charged externally, such as BMW 330e), Battery Electric Vehicle (BEV, which runs solely on battery, such as Nissan Leaf and Tesla Roadster) are also in the market.

In terms of electric motorbikes, local company Eclimo Sdn Bhd has been developing electric scooter that can cater local as well as regional markets. Moreover, Eclimo has been working with the Research Centre for Applied Electromagnetics (UTHM) and UM Power Energy Dedicated Advanced Centre (UMPEDAC, UM) to develop electric drive train for its electric scooter, as a move to localise the EV technology.

One of the key drivers for the proliferation of EV is the availability of charging facilities which is critical in alleviating EV drivers' range anxiety. In this aspect, GreenTech Malaysia, through its ChargEV initiative, has been rolling out charging stations throughout Malaysia, particularly in the Klang Valley region, with a target of having 25,000 charging stations by 2020. Nevertheless, the charging station technology is still based on foreign technology.

It is worth noting that EVs will mainly obtain its source of energy from the electrical power grid. Hence, to effectively reduce carbon emission via EVs, the mix of renewable energy in electricity generation needs to be increased accordingly.

4.4.2.3 Biofuel

Even though the car manufacturing industry has moved toward producing EEVs, most of these vehicles are still dependent on fossil based fuel. To further reduce the environmental impact of vehicles on the road, the Government has embarked on the implementation of biofuel and higher fuel standards.

n tandem with the policies set under the National Biofuel Policy, Malaysia has implemented the biodiesel blending programme in the transport sector. In terms of technology, although research of second-generation biofuel from palm biomass and biogas has been ongoing since 2002, product development has been hindered by lack of investment. The second-generation biofuel from palm biomass and biogas production process needs to be implemented.

4.4.2.4 Human Capital Development

One of the crucial elements for the advancement of transport technology is the development of human capital. Currently, there are a number of technical colleges which provide transport related skill development, such as Malaysia Railway Academy and RapidKL Rail Academy. Courses on transport usually focus on logistic and planning rather than technology development. Master of Engineering in Transportation (UTM) and Master in Railway Engineering (UTHM) are a few higher degree courses which are technical oriented.

4.5 Way Forward

4.5.1 Transport Policies

4.5.1.1 Implementation of the National Land Public Transport Master Plan (NLPTMP)

According to the NLPTMP, it is targeted that modal share for public transport in urban areas will reach 40% by 2030. Five strategic objectives have been identified on this target, i.e., physically well connected, affordable and accessible to all, convenient and offer high service levels and quality, safe and secure, and better quality of life.

The implementation of the NLPTMP will be monitored and review mechanisms will be put into place to ensure land public systems adopt green technologies and practices, which include:

- Land public transport vehicles to comply with existing emissions standards set by the Department of Environment (DoE);
- New land public transport development will be required to undergo thorough environmental impact assessments; and
- Close collaboration between SPAD and other Government agencies to assess the reduction in carbon emissions for the public transportation sector. Subsequently, regional plans will be rolled-out to improve inter-connectivity and overall upgrade of the public transport infrastructure.

Several ongoing and future developments on the rail sector, include:

- RT 3 (Bandar Utama to Klang);
- Gemas-Johor Baharu Double Tracking project;
- Mass Rapid Transit line 2 and 3;
- Subang SkyPark Terminal Extension Project;
- Klang Valley Double Tracking (KVDT);
- East Coast Rail Link (ECRL); and
- The Malaysia-Singapore Rapid Transit System (RTS) and the High Speed Rail (HSR).

The timeline for policy implementation for land public transport is shown in Figure 4.3.

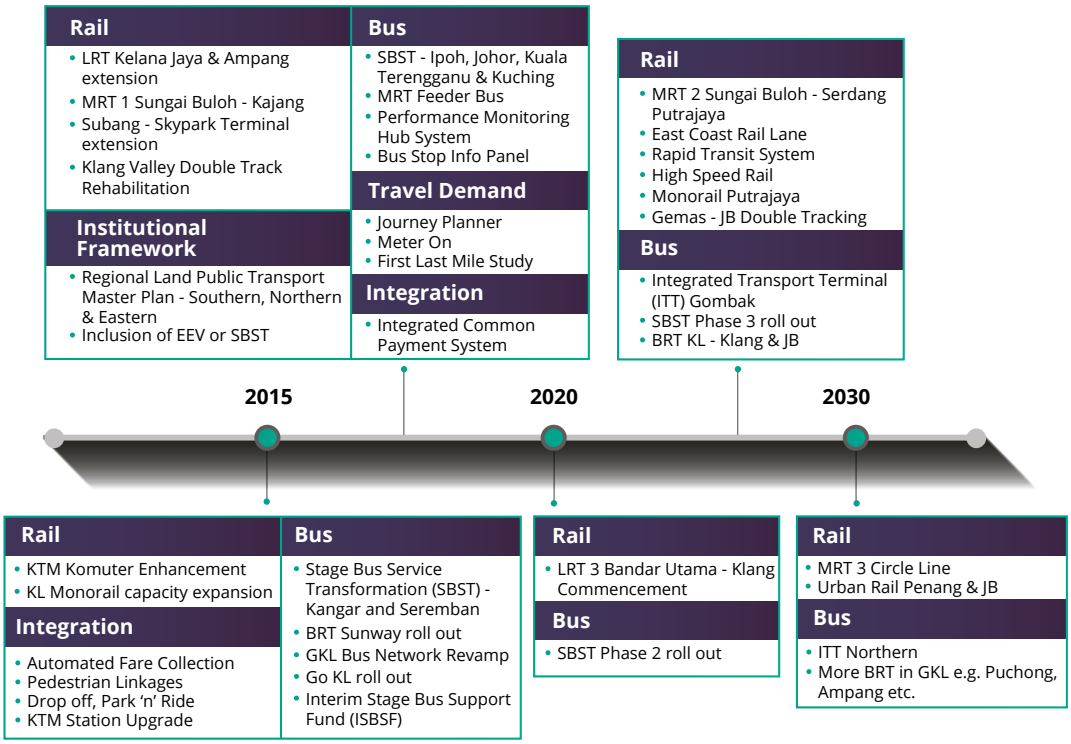


Figure 4.3 Policy implementation time for Land Public Transport.

4.5.1.2 Strengthening the Governance Structure in Green Transportation

The existing governance framework in transportation will be reviewed and enhanced to entrust collaboration of Government agencies to advocate green transportation in the country. These collaborative agencies will establish the baseline of green transportation in Malaysia, including assessment of EE and emission data. The information will be used to facilitate policy planning among the relevant stakeholders. In addition, a mechanism will be established to align transportation planning at the local Government level to the strategic directions set by the federal Government. This will also support the development of green townships and green cities in Malaysia.

Furthermore, attention should go beyond public and private transportation, and also include the freight transport, to provide a more holistic governance for the transport sector. The Government can enter into either compulsory or voluntary energy efficiency agreement with freight companies, and provide incentive to encourage green technology adoption among freight hauliers to improve their energy efficiency and sustainability. Apart from that, the Government can also provide additional support in the form of energy efficiency database that include information on best practices and tools for freight operators to estimate the potential gain for switching to more energy efficient mode of operation for their fleet.

4.5.1.3 Carbon Emission Standards in the Definition of Energy Efficient Vehicle (EEV)

The current classification of EEV is based on curb weight and fuel consumption. Gradually, the car manufacturing industry is shifting towards EEV, as reflected by the aggressive growth in percentage of EEV in total industry volume from 8% (2014) to 32.6% (2015) within one year. Based on the existing framework, the carbon emission standard is yet a criterion in the definition of EEV. As other countries move toward higher fuel standards with lower carbon emission regulations, this will impede the export potential of existing local EEV products. This is because the carbon emission of existing local EEV has yet to meet the international standards. Ironically, the narrow definition of EEV based on fuel consumption has largely improved the affordability on car purchase due to tax incentives, resulting in more cars on the road. Moving forward, MAI has outlined plans to enhance the classification of EEVs using carbon emission standards. The change in classification will seek to raise public awareness of the impact of carbon emissions on the environment. More importantly, the regulatory change will shift the industry towards manufacturing lower emission vehicles.

4.5.1.4 Public-Private Partnership in Mega Public Transport Projects

Green development initiatives in other states and regions, such as Johor, Penang, Malacca, and the East Coast, are geared towards public-private partnership as well as collaboration between local authorities, state and federal Governments for initiatives as follows:

- 2,000 electric buses are set to be on the road by the year 2030, and this initiative aims to reduce the environmental impact further;
- BRTs in other development corridors, such as Iskandar Malaysia, and other states i.e. Penang and Sabah; and
- Participation from private developers includes private-public engagement to provide targeted support, and facilitate industry growth and possibly demand for exports. Some local industry players have already initiated local GT development in the manufacturing of electric buses and monorail trains.

These initiatives seek to get more industry players involved in GT adoption and potentially, production. The public-private partnership initiatives will include the following:

1. Private sector's involvement in the planning phase of the project criteria or agreement with private sector prior to collaboration;
2. Time-based incentives to encourage private involvement;
3. Economic and environmental impact assessment which will estimate GT development impact with the involvement of both public and private sectors; and
4. New development to take into consideration the ease of access to public transportation (e.g. BRT), which shows the concept of transit-oriented development.

4.5.1.5 Partnership with Overseas Entities

MAI has also collaborated with Excellerate Australia (formerly known as AutoCRC) through the Economic and Technical (ECOTECH) platform of Malaysia-Australia Free Trade Agreement (MAFTA). Through the projects in 'Breakthrough Battery' of 'Vehicle Electrification Program', MAI has developed Intellectual Property (IP) in the area of Lithium-ion Battery (LiB) electrodes and electrolyte, LiB packaging and management system as well as LiB material production scale-up. These LiBs can be used for EVs, hybrids, energy storage, etc. The first locally manufactured LiBs are expected to roll out in 2018.

4.5.1.6 Economic Instruments

A revised road tax mechanism has been put in place for hybrid and EVs which charges these vehicles at a lower rate. The Road Transport Department (JPJ) is currently working on enhancing the current road tax system by incorporating a mechanism which considers the Green Engine, carbon emission rate, as well as engine performance and safety. Stakeholders will be engaged by JPJ to design this new road tax mechanism.

The enhanced road tax system will be rolled out in phases based on vehicle type. This initiative seeks to drive the private transportation industry toward lower carbon emission vehicles such as EEVs.

Additionally, MAI has initiated several studies to develop a Scrap Policy to take vehicles off the road in order to control carbon emissions from old vehicles which do not meet the road safety and EEV standards. Besides that, monetary incentives for vehicle end-of-life policy should be considered. To encourage the vehicle owners to comply with the vehicle end-of-life policy, cash/buy back incentives can be provided for the owners to trade-in their old vehicles for new EEVs.

From the Government's procurement aspect, new initiatives will be discussed with Ministry of Finance and existing concessionaires on Government vehicles, as well as methods to incentivise the procurement of EV. One suggestion is to provide electric vehicle (bus) purchase subsidy similar to some other countries (such as China, India and Japan, which give subsidy up to USD81,600, USD 6,000 and USD 19,000 respectively) for the first 2,000 electric buses including the ones that have been purchased before in line with the NKEA target. Furthermore, it also proposed for extension of existing EEV incentives for manufacturers, purchasers and service providers until 2030.

4.5.1.7 Labelling and Carbon Emission Tax Structure

MITI/MAI is in the midst of conducting research on the suitability of introducing EEV Labeling and Carbon Emission Tax Structure in Malaysia. In EU countries, for instance, car manufacturers are required to provide a car's fuel efficiency, CO_2 emissions and other relevant information to consumers.This labelling practice helps consumers to choose cars that use less fuel and hence emit less CO_2. Carbon Emission tax structures, meanwhile, aim to encourage consumers to use low emission models by imposing higher taxes on models that emit higher emissions.

4.5.1.8 Continuation of the National Biofuel Policy (NBP)

To ensure a smooth implementation of the NBP, proper consultation and deliberation with the stakeholders is necessary. For instance, the Association of Malaysian Hauliers (AMH) has expressed their concern on the introduction of B10 diesel in terms of higher costs as well as the lack of clear indication on the implementation date of the B10 programme. Action plans to promote the reliability and sustainability of biofuel for transport and industrial use will be implemented, which includes collaborations among Government bodies such as MPOB, MPIC, NRE, KeTTHA, MOT and MITI to:

- Enhance knowledge sharing among ministries; and
- Explore export markets for biodiesel.

This collaboration will provide a platform to resolve industry issues and promote awareness to increase acceptance of higher biodiesel blends in the industry.

4.5.1.9 Ride Sharing and E-hailing

The rise of ride sharing and e-hailing services, such as Grab and Uber is seen as both disruptive and controversial to the public transport sector in Malaysia. These services have brought a new mode of efficient "public transport" which substantially changed the way urbanites commutes. At the same time, the lack of comprehensive regulations and governance has raised concerns on safety as well as dissatisfactions among other public transport providers, particularly the taxi.

With the recent amendments in the Land Public Transport Act 2010 and the Commercial Vehicles Licensing Board (CVLB) Act 1987, the e-hailing services have been accepted and are expected to transform the landscape of public transport in Malaysia. According to the report "Automotive Revolution – perspective towards 2030" by McKinsey, it is expected that 1 out of 10 cars sold in 2030 will be potentially a shared vehicle, as ride sharing and e-hailing services are seen as the future trend in mobility. It is anticipated that the increase of ride sharing and e-hailing services could potentially increase transport efficiency and mitigate congestion issues. In the light of this, the Government should continue to play an active role in monitoring and encouraging the growth in this sector, to ensure that they can contribute towards achieving greener transportation system in Malaysia.

Figure 4.4: Grab and Uber - ride sharing services in Malaysia.

4.5.1.10 First Mile and Last Mile Connectivity

Several public transport studies are being conducted to further improve the public transport system. A study on regional Land Public Transport Master Plan – Northern, Southern and Eastern is aimed to improve interconnectivity and overall upgrade of the transport demand and infrastructure. Green mobility is one of the main elements to be emphasised in this study.

Apart from that, SPAD has embarked on First Last Miles Study, which entails analysis and recommendation for GKL bus network and GKL urban rail station's first last mile improvements towards higher public transport usage in GKL, commenced in May 2017 and is projected to be completed by April 2018.This study aims to set long term priorities and plans on Greater KL First Last Mile (FLM) accessibility, connectivity and coverage through comprehensive pedestrian, cycling and bus network improvement measures.

The focus in the next 5 years will be centred on the following strategic thrusts:

1. Strengthening the institutional framework in terms of policy implementation, as well as the existing governance structure in green transportation; and
2. Creating market demand for and supply of GT in the public land transportation sector to develop the industry via market enablers, funded by public-private partnership.

4.5.2 Transport Technology

Green technology in transport poses huge economical and societal benefit that should be harnessed by planning ahead the R&D&C activities in the relevant areas. The subsequent section here outlines some key green technologies that Malaysia should look into to develop the transport sector. Figure 4.6 shows the project timeline for a greener transportation sector by 2030.

4.5.2.1 Energy Efficient Vehicle (EEV) Technology

As outlined in the NAP, the effort towards encouraging the development of EEV should be continued. While waiting for the EV ecosystem to mature, technology on improving the efficiency of existing internal combustion engine (ICE) based vehicles should be developed.

Technology such as automated engine shut down, improved vehicle aerodynamics and reduced tyre rolling resistance, can provide improvemens in terms of energy usage of existing vehicles. For freight vehicles, additional efficiency improvement measures such as installation of maximum speed limiter and scrubber (on freight ships) will also be positive steps towards greener transportation.

Moving from gasoline and diesel vehicles to alternative fuel vehicles running on biodiesels and CNG can also be fast solutions in improving the energy efficiency of existing vehicles. Nevertheless, this requires significant effort in the development of relevant technology as well as the preparation of supporting infrastructures, particularly in terms of good coverage of refilling stations and service centres for biofuel and CNG vehicles.

4.5.2.2 Electric Vehicle (EV) Technology

Given the current technological development, electrification of transportation is an inevitable trend. EVs offers zero tailpipe emissions and the highest energy efficiency amongst all other modes. NAP is focusing on local manufacturing and the local manufacturing requires technology acceptance to reach the mass market; hence reaching viable volume for local manufacturing operation.

Figure 4.5: ChargEV as National EV Charging Infrastructure

EV introduction via Completely Built Unit (CBU) importation and various application programs shall be pursued to increase the visibility and acceptance of the technology. To bridge the higher cost of ownership for private purchase or running relevant programs with EV, incentives such tax exemption, purchase subsidy, tax incentive or special program execution fund or grants should be introduced as a catalyst. The program however will have to show clear objectives and great impact on the implementation. As such, the program with high visibility such as e-hailing, electric taxis car sharing, low carbon mobility in campus or green township will be prioritised.

Concurrently, while the market is being primed, development of EV related technology can be embarked upon. To ride on this tide of EV development, it is crucial for Malaysia to embark on electric vehicle technology development. The core technologies in EV include electric motor design, power electronics converters, energy storage systems and battery charging technology.

4.5.2.3 Cycling Lane Infrastructure

To shift from motorised to cycling as an alternative transport mode for people, the Government is planning to build cycling or bikeways infrastructure especially in the cities. This initiative is in line with the Low Carbon Cities program spearheaded by KeTTHA and MGTC in promoting cycling as a healthy and green lifestyle leading to a healthy and cleaner environment.

By having the infrastructure development, it will encourage people to use bicycle which will help to reduce traffic congestion and the need for parking areas as well as to reduce carbon foot print.

4.5.2.4 Internet of Vehicle

As part of the Internet of Things (IoT) development, Internet of Vehicle (IoV) is the future trend of transport system. IoV can be considered as a large scale distribution system where information is exchanged between vehicle, road, human and internet, to achieve better intelligent traffic management,

vehicle control, and dynamic information services, towards the realisation of an intelligent transport system that is more efficient, safe and green. IoV will also be an enabling infrastructure to support the development of autonomous driving, to achieve better transportation efficiency.

The use of IoV concept in freight is also an important direction to improve the energy usage and efficiency in freight industry. With IoV, the activities and conditions of the freight fleet can be monitored in real time, and logistic planning can be improved to reduce travel time as well as unnecessary movements or "empty miles" in order to cut down GHG emissions and energy consumption.

4.5.2.5 Revolutionary Transportation System

Apart from transport technologies that have already demonstrated their feasibility, R&D&C of revolutionary transportation systems that are still at the early stage of their development are also important to Malaysia.

Transportation systems such as the Advanced Transit Networks (ATN) provide alternative solution to a more environmentally sustainable transportation.

ATN embraces various concepts namely personal rapid transit (PRT), group rapid transit (GRT) as well as dual mode systems which ensures green mobility whilst offering door-to-door transit for small group or individuals through interconnecting public transit networks. Another revolutionary transportation idea is the Hyperloop system that allows high speed passenger and freight transportation on land via pod-like vehicle through low-pressure tube.

4.5.2.6 Human Capital Development

In order to support the growth and development in the transport sector, it is crucial to ensure that due attention is given to the development of human capital in the related sectors. In particular, transport related syllabus should be integrated into the existing Technical and Vocational Education and Trainings (TVET) system as well as institutions of higher learnings. On the research front, existing research centres on transportation technology should be empowered to spur the development on research human capital. For example:

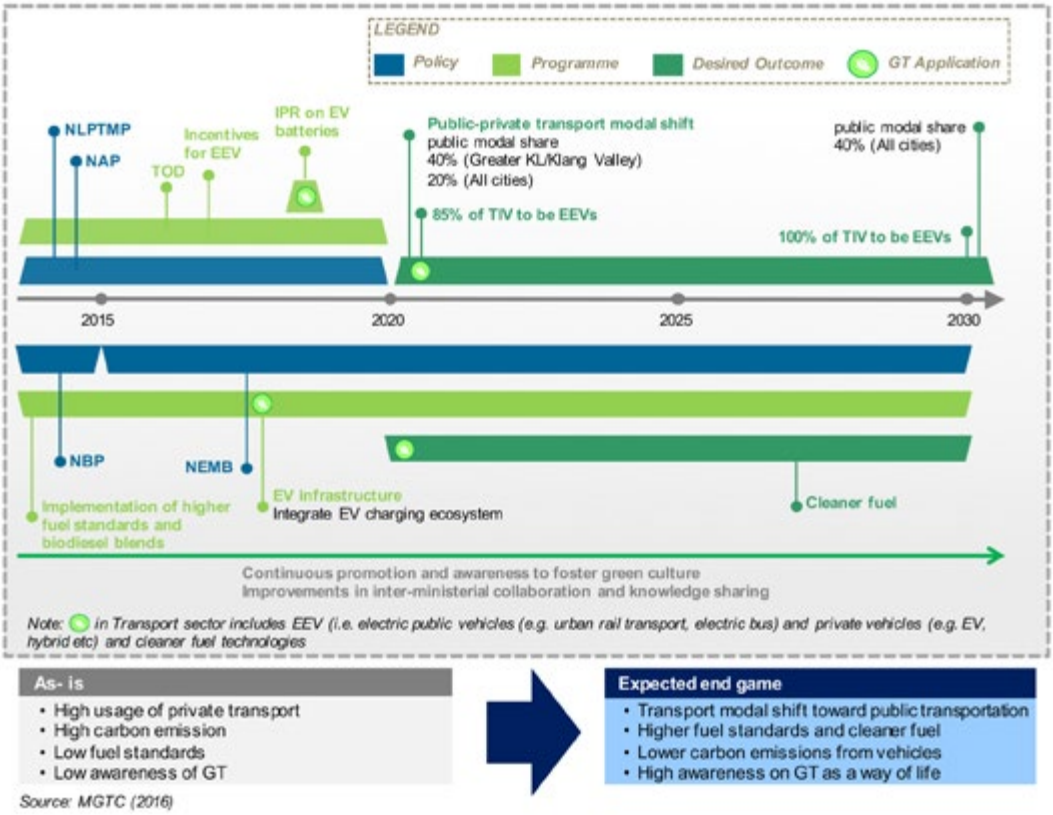
- SELFUEL (UKM) has been specialising in fuel cell technology development;
- Proton Future Lab (UTM);
- UMPEDAC (UM) has developed the technical expertise in motor drive, controller and energy management system; and
- USM and EMC (UTHM) has been working on electric motor designs.

4.6 TARGETS

For Transport sectors, both public and private transportation are the key focus of GTMP. Key targets set related to implementation in cities.

SECTORS / AREAS	2020	2030	INITIATIVES
Public transport	• 40% (Greater KL) • 20% (Other cities)	• 40% (All cities)	• Implementation of the National Land Public Transport Master Plan (NLPTMP) • Strengthening the governance structure in green transportation • Carbon emission standards in the definition of Energy Efficient Vehicle (EEV) • Public-private partnership in mega public transport projects • Partnership with overseas entities • Economic instruments • EEV Labelling and Carbon Emission Tax Structure (CEVS) • Continue with National Biofuel Policy (NBP) • Ride sharing and E-hailing services • First and Last mile Connectivity • Energy Efficient Vehicle (EEV) Technology • Electric Vehicle (EV) Technology • Cycling Lane Infrastructure • Internet of Vehicle • Revolutionary Transportation System • Human Capital Development
Private transport	• 85% Energy Efficient Vehicle (EEV)	• 100% (EEV)	

Table 4.3: Summary of target and initiatives for transport sector.



As- is

- High usage of private transport
- High carbon emission
- Low fuel standards
- Low awareness of GT

Expected end game

- Transport modal shift toward public transportation
- Higher fuel standards and cleaner fuel
- Lower carbon emissions from vehicles
- High awareness on GT as a way of life

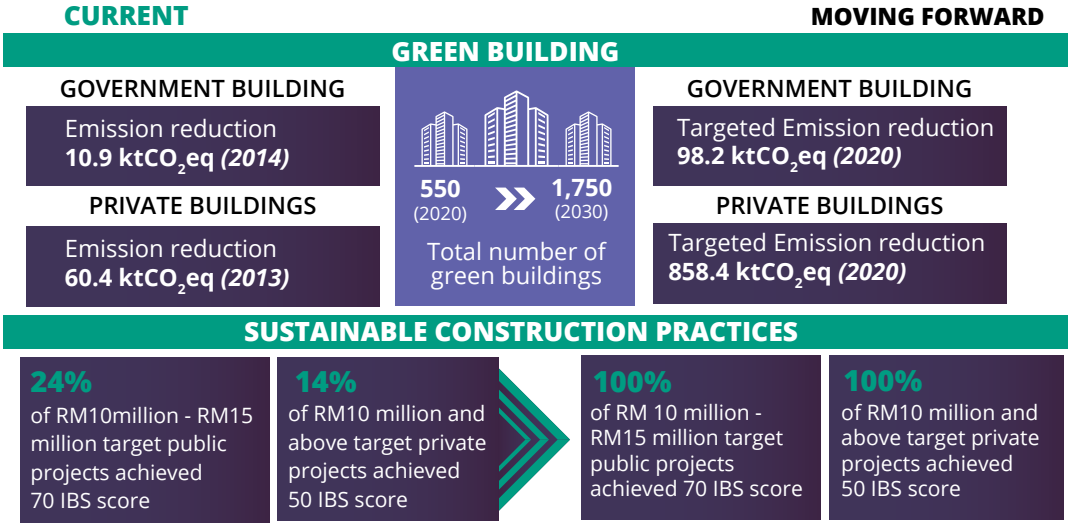
Source: MGTC (2016)

Figure 4.6: Timeline for transport sector

5

BUILDING

SUMMARY



EXISTING INITIATIVES

Green Building Design

- Green building rating tools, e.g. Green Building Index (GBI), Malaysian Carbon Reduction and Environmental Sustainability Tool (MyCREST), Penarafan Hijau (pH);
- Government lead by example;
- Human capital development courses by respective green building rating tool implementers

Sustainable Construction Practice

- Institutional framework to improve adoption rate of Industrialised Building Systems (i.e. Construction Industry Transformation Programme, green building rating tools, and formal public-private collaboration)

Green Building Materials

- Green product directories

WAY FORWARD

Green Building Design

- Energy Audit Conditional Grant
- Near Zero Energy Buildings targets
- Standardisation of green rating tools
- Malaysia Standard for construction specifications
- Centre of Excellence (CoE) by CIDB

Sustainable construction practice

- Continuous implementation of the CITP
- Improving the financial viability of IBS through tax incentives
- Developing competencies via CoE

Green building materials

- Policy framework to be agile to enable recycling of C&D materials

5.1 Introduction

Buildings consume 40% of the world's energy generation, 12% of its water, and contribute 40% of the waste sent to landfills. In Malaysia, residential and commercial buildings consume about 15% of total energy. Based on National Energy Balance 2014, the electricity consumption in Malaysia's buildings is expected to rise due to:

- Rising trend of electricity consumption per capita in the building sector as GDP rises which drives the economic buying power of the population;
- Projected increase in the building stock to cater to population growth and simultaneous growth in the services industry; and
- Absence of mandatory building energy efficiency policies and supporting measures to enforce building energy efficiency.

Meanwhile, the construction industry in Malaysia is likely to experience a growth rate of 10.3% per annum over the next 5 years up to 2020. The GDP contributed by the construction industry is expected to increase from 4% to 5.5% by 2020. The growth rate of commercial buildings is in the range of 3-6% depending on the building typology. The building/construction industry forecast beyond a 5-7 year period is difficult to obtain because it is highly dependent on the economic outlook of the country.

A green building definition covers many aspects such as energy consumption, water consumption, waste generation, and hazard of materials among other issues.

Consideration of the carbon footprint alone of a building is a complex undertaking that covers three distinct scope i.e. Embedded Carbon (construction material type of raw material, manufacturing process and logistics) and construction method (delivery of materials, construction process, waste), Operational Carbon (active design and passive design). A similar accounting for water consumption would follow along the same lines.

Figure 5.1: GreenTech Malaysia's Green Energy Office (GEO) Building

Currently, Malaysia does not have a single holistic approach led by a particular agency that brings together all the actors in the building and construction industry to establish and agree on green building goals for the future. Agreement on a future green building goal will consequently requires these actors to work together to develop the whole ecosystem that can deliver a green building.

This GTMP 2030 will attempt to partially mitigate the holistic framework that is missing by setting out aspirations for specific areas in which GT will be pursued to address the negative environmental impact of buildings without compromising GDP growth.

The discussion for GT in the building sector will primarily focus on the following areas:

- Green building design and operation;
- Sustainable construction practices; and
- Green building materials.

While some of the measures that are presented here may be administrative in scope, they serve as enablers for green technology innovation to take place.

5.2 Current Landscape

5.2.1 Green Building Design and Operation

5.2.1.1 Voluntary Building Energy Codes

Green building design was formally started in 2001 when the voluntary MS1525: Code of Practice for Energy Efficiency in non-Residential Buildings was introduced covering the design specifications of commercial buildings with conditioned floor space of more than 4,000 m^2:

What is MS1525?

MS1525 provides recommended measures and prescribes energy performance standards for different elements of the building (e.g. maximum permissible rates for heat transfer through the building fabric; maximum lighting power densities).

There have been two revisions of MS1525, i.e. 2007 (revision 1) and 2014 (revision 2). MS1525 is a voluntary instrument which has gained very little traction in the building industry. Efforts to incorporate the building envelope energy performance requirements in the Uniform Building By Law has been stymied with only 3 states to date that have gazetted it, i.e Selangor (2012), Terengganu 2013(2013), and Penang (2016)

Another voluntary building energy code, MS2680 - Energy Efficiency and Use of Renewable Energy for Residential Buildings Code of Practice was issued in July 2017.

5.2.1.2 Minimum Energy Performance Standards (MEPS) for Electrical Appliances

The Energy Commission ST has developed the MEPS for a range of electrical appliances and motors. The EC has also imposed the mandatory labelling of MEPS for appliances that are marketed in Malaysia. There are plans to rate additional appliances and electrical motors for MEPS labelling and to harmonise the Malaysian MEPS energy ratings with the future ASEAN-SHINE program for regionally-harmonised MEPS.

5.2.1.3 Voluntary Green Building Rating Tools

The adoption of green building design is largely reflected in the number of buildings (new and retrofitted) that have been certified to green building rating tools such as MyCREST, GBI, and GreenRE, among others.

Malaysian Carbon Reduction and Environmental Sustainability Tool (MyCREST)

MyCREST, is a carbon rating tool used by the CIDB that takes into account a more holistic life-cycle view of the built environment. The Ministry of Works has set a target that all new buildings designed after 2016 with a developmental value of more than RM50 million must be MyCREST certified

Green Building Index (GBI)

The Green Building Index rating tool was established partially in response to encourage the adoption of the building energy specifications in MS1525. The GBI is the first green rating tool that has been customised to the Malaysian climate and legislative requirements. GBI is also recognised and associated with the Malaysian Green Building Confederation (MGBC) and the WGBC

Penarafan Hijau (PH)

The Environment and Energy Branch (CAST) under the Public Works Department (JKR) is responsible for developing, implementing and maintaining JKR's PH scheme. It provides a sustainable development rating that integrate all initiatives undertaken by JKR. The scheme will be undertaken in four phases:

- Phase 1 - New Non-Residential Buildings
- Phase 2 - Existing Non-Residential Buildings
- Phase 3 - Non-Residential Buildings without air conditioning
- Phase 4 - Health Service Buildings

The JKR has set a requirement that all new buildings designed after 2016 with a developmental value of less than RM50 million must be certified to PH

Green Real Estate (GreenRE)

GreenRE is a green rating standard which was established by REHDA. As of 2016, this rating tool has certified 18 projects ranging from residential to commercial properties

As of December 2016, there were about 370 private sector buildings certified to a green building rating tool, an increase of 95% compared to the 190 certified green buildings in 2013.

The total grid electricity savings by the 190 buildings to date is estimated to be 88,824 MWh with expected savings of 1,262.4 GWh by 2020. This is equivalent to a potential emission reduction of 858.40 ktCO_2eq as per Table 5.1.

Sector	Contribution to emission reduction (ktCO_2eq)[1]
Private sector (190 certified buildings)	**60.40** (2013) **858.40** (2020 goal)
Public sector (54 Federal buildings)	**10.94** (2014) **98.21** (2020 goal)

Table 5.1: Contribution of green buildings to carbon emission reduction

[1] Malaysia Biennial Update Report (BUR), 2016

5.2.1.4 Government Lead by Example (GLBE)

The Government has taken the lead in green building initiatives with 54 Government buildings belonging to 25 Ministries in Putrajaya and Kuala Lumpur having embarked on a preliminary retrofitting exercise which resulted in a reduction of 14,758 MWh in electricity consumption, equivalent to an emission reduction of 10.94 ktCO_2eq.

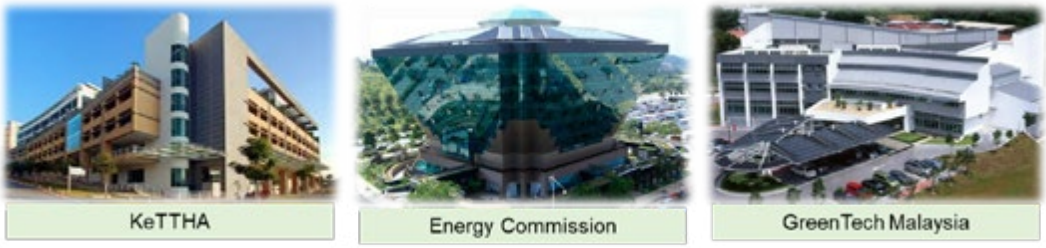


Figure 5.2: Green Energy Office Buildings in Malaysia

5.2.1.5 Government Incentives and Funding

Aside from the Tax Incentives and Tax Allowances that has been provided by MIDA for investments in green technology and services since 2014, KeTTHA has also introduced the Energy Audit Conditional Grant (EACG) scheme initiated in the RMK-11. The grant is open to any existing commercial and industrial building with electrical energy consumption of more than or equal to 100,000 kWh per month.

MGTC was appointed as the Implementing Agency for the EACG for the industrial sector, whilst the commercial sector will be managed by SEDA. To further promote energy efficiency practices and to reduce greenhouse gases (GHG) emissions, KeTTHA has also taken efforts to retrofit Government buildings such as hospitals using the Audit Grants. The EACG intends to:

- Create awareness on the importance of energy auditing as a necessary start to energy efficiency and conservation;
- Provide a fund for industries to conduct energy audits to establish their baseline consumption patterns and to identify opportunities for efficiency; and
- Enhance capacity building in the field of energy auditing.

5.2.1.6 Green Building Proficiency

There has been fairly intensive development of human capital in green building proficiency which is reflected in the variety and absolute number of training courses completed and the number of green building professionals that have been certified. Nearly 1,000 courses have been conducted in the last 5 years by Green Building Index (GBI), Buildings Sector Energy Efficiency Project (BSEEP), Malaysia Association of Energy Service Companies (MAESCO), Malaysian Green Technology Corporation (MGTC), Construction Industry Development Board CIDB, Real Estate And Housing Developers' Association Malaysia (REHDA), Sustainable Energy Development Authority (SEDA) and Suruhanjaya Tenaga (ST) among others.

The GBI has further assessed the market needs for green building specialists and made a projection of the potential numbers of course participants in the future as listed in Table 5.2.

Year	Facilitator	Commissioning Specialist	Pro Series
2016	300	30	500
2020	400	50	600
2025	500	100	700
2030	500	150	800

Table 5.2: GBI courses participant projection[2]

To incentivise the take-up rate, GBI has actively lobbied MIDA to include the GBI Facilitators and Commissioning Specialist courses as a requirement for Income Tax Exemption (ITE).

5.2.1.7 Other Contributing Activities

The recently concluded Building Sector Energy Efficiency Project (BSEEP) funded by JKR-UNDP-GEF explored the scenarios for achieving up to a 60% reduction in energy consumption in the commercial sector by 2040. All scenarios would have required some form of mandatory policy intervention with 60% scenario requiring the most ambitious policies.

The Energy Commission also actively promotes green building adoption by encouraging participation of Malaysian organisations in the ASEAN Energy Awards for Building Category.

5.2.2 Sustainable Construction Practices

5.2.2.1 Industrial Building System

Throughout a building's life-cycle, 15% of its GHG emissions occurs during the construction phase, while the remaining 85% is produced during building occupation. To address the GHG emissions during the construction phase, the Government has championed the adoption of the Industrialised Building Systems (IBS) as a measure to improve sustainability in construction practices which will reduce carbon emission and waste generation. IBS refers to a construction method in which components are manufactured in a controlled environment (either off-site or on-site) and then assembled at-site. The 5 commonly used IBS types in Malaysia are:

- Precast concrete framing, panel and box systems;
- Prefabricated timber framing systems;

[2] Green Building Index (GBI), 2016

- Steel framework systems;
- Steel framing systems; and
- Blockwork systems.

The maximum IBS score is 100. A higher IBS score reflects a better reduction in site labour, lower wastage, better quality construction, neater and safer construction sites, faster project completion as well as lower total construction costs. The IBS system will therefore be important in reducing the amount of construction waste generated, of which little is being recycled at the present moment.

The current adoption rate of IBS is only 24% of targeted public projects valued between RM10 million to RM50 million which have achieved an IBS score of 70, while 14% of the targeted private projects valued at RM10 million and above have achieved an IBS score of 50.

Currently a comprehensive strategy has been formulated in the Construction Industry Transformation Plan (CITP) to improve the adoption rate of IBS.

The strategy aims to first put in place the institutional framework that will drive the subsequent implementation plans for:

- Driving innovation in sustainable construction;
- Driving compliance to environmental sustainability ratings and requirements;
- Focusing on public projects to lead the charge on sustainable practices;
- Facilitating industry adoption of sustainable practices; and
- Reducing irresponsible waste management during construction.

The CITP targets to improve the adoption of IBS through mandating all public projects worth RM10 million and above to achieve a minimum IBS score of 70 in line with the Ministry of Finance's (MOF) circular 1PPL 1/2013. In addition to that, 100% of private projects at RM10 million and above are targeted to achieve an IBS score of 50 by 2020 (Table 5.3).

	Current (2016)	Target (2020)
Public projects between RM10 million and RM50 million with **70 IBS score**	24%	100%
Private projects RM10 million and above with **50 IBS score**	14%	100%

Table 5.3: Targets for IBS adoption by 2020[3]

[3]Construction Industry Development Board (CIDB), 2015

IBS contributed about RM123.3 million to the national GDP in 2013. If the targets are met, the GDP contributed by IBS is likely to increase to RM486.5 million by 2020 and up to RM1 billion by 2030.

5.2.3 Green Building Materials

5.2.3.1 Green Building Materials

Green building materials can be characterised as materials that are environmentally friendly to manufacture and able to reduce energy consumption and environmental impact during the lifetime of its application in the building. In Malaysia, SIRIM Eco-Label has specific requirements that must be met in order for a material to achieve the Eco-Label certification.

Some examples of green building materials that are now available in the market include:

- Cement which incorporate recycled materials such as fly ash;
- Interior building materials which utilise less hazardous materials and/or less raw materials for production such as high-pressure laminates, ceiling boards, partition boards, flooring, paneling, adhesive and sealants products; and
- Paints which use less volatile organic compounds (VOC) and hazardous chemicals and exterior wall paints which are designed to reduce interior building temperatures by about 5-10%.

In 2013, the revenues generated from green building materials were estimated at RM660.6 million The highest contributor to the revenue of green building materials is cement (48.5%), followed by paints (24.6%) and interior building materials (10.6%).

By 2020, the GDP contributed by the subsector is likely to increase to RM2.8 billion, should the growth rate of green building be maintained at 30%, similar to global growth rate for green building. This GDP figure is estimated to reach RM7.9 billion by 2030, should the country continue the efforts in the building sector.

5.2.3.2 Green Product Directories

Currently, there are two product information sources available to encourage green building material procurement, i.e. the MyHijau Directory and GreenPages Malaysia. Products to be listed in these two directories are required to be eco-labeled certified by a recognised certification body, so that it will assist developers, contractors and consumers in making purchasing decisions which takes into consideration the impact of the products to the environment.

Additionally, products that are labelled under the MyHijau directory are eligible for incentives under MIDA's Green Investment Tax Allowance (GITA) introduced in 2014 to shift market preference towards green products and services.

5.3 Issues and Challenges

In general, implementing sustainable practices in the building and construction sector requires significant amount of time and cost investment. The lack of a regulatory push factor and uncertainty in actual costs also contributes to the low interest from developers and contractors to invest in green building technology. The higher cost incurred for importation of the green materials and technology also hinders the shift towards sustainability.

Specific obstacles and barriers are discussed in the following sections.

5.3.1 Green Building Design and Operation

5.3.1.1 Implementation issues of MS1525 and MS2680

Prior to 2012, Malaysia did not have a regulatory instrument to mandate building energy codes. This was only partially mitigated when several parts of the MS1525:2007 pertaining to building envelope thermal performance were incorporated into the Uniform Building By-Laws (UBBL) of only 3 of 13 states in 2012 and 2016. The slow progress in UBBL adoption has stymied the implementation of the building energy code by the more than 154 local authorities. This poses significant carbon lock-in risk from buildings being constructed at the present moment. It is also poorly enforceable for retrofitting of existing buildings.

At the same time, the MS1525 code adopted in the UBBL only addresses buildings with a floor area more than 4000m2 supplied with central air-conditioning. This ignores roughly 90% of the commercial building sector gross floor area. Meanwhile, the implementation of the MS2680 for residential homes is uncertain because it was only just introduced in July 2017. There has been no assessment of how the voluntary MS2680 can be enforced for the design of new residential buildings or influence the retrofits of existing buildings.

5.3.1.2 Slow uptake of Green Building Ratings

Green building certification has progressed mostly for new buildings with limited uptake by existing buildings. Owners of existing building are not sufficiently mandated or incentivised to initiate the retrofits that can help them achieve green building certification, despite the significant cost benefits in reduced electricity bills and maintenance costs accruing from energy efficiency.

5.3.1.3 Financing Energy Efficiency Retrofits

As energy efficiency retrofits is a relatively new and small market, existing building owners and ESCOs find it difficult to access commercial financing for energy retrofit projects due to an insufficient credit and project history. Therefore, the Government has recently established an Energy Performance Contracting (EPC) Fund that will offer a RM200 million credit line and 1% interest rate subsidy. The EPC Fund was financed by the KeTTHA and the BSEEP project which itself was funded by JKR-UNDP-GEF. However, the fund size is small compared to the potential EPC market size which conservatively is estimated to be at least RM500 million to RM1 billion a year.

5.3.1.4 Limited Government Lead By Example (GLBE) Roll-out

While the Government has taken some lead in green building operations within the ministry buildings in Putrajaya, more still needs to be done with all other buildings under the Government's purview including the main State Government administrative buildings. The challenge would be to obtain accurate data quickly to conduct short-term, medium-term, and long-term planning to reduce the Government's energy bill.

5.3.2 Sustainable Construction Practice

5.3.2.1 Low IBS Adoption Rates

The institutional framework to improve the adoption rate of Industrialised Building Systems (IBS) under the Construction Industry Transformation Programme has been developed but the implementation is very slow. While some of the reasons are inherent in the establishment of a new framework, there are other obstacles including a relative lack of guided research and development, disconnected procurement practices, the narrow focus of the construction industry on certain aspects and the continued dependence on outdated methods and materials.

5.3.2.2 Uncontrolled Generation of Construction Waste

The construction industry generates a significant amount of waste which is mostly disposed to landfills or illegal dumps. This is a loss of opportunity to minimise the resource intensive nature of construction by firstly reducing the type and amount of waste generated and secondly to recycle the waste instead of disposing into landfills.

5.3.2.3 Lack of Research into New Construction Methods

There is also a lack of research into new construction practices, apart from the IBS, such as automated brick-laying methods which offer greater flexibility in design particularly for reducing site labor even further in the construction of low-rise to medium-rise buildings.

5.3.2.4 Lack of Integration between Construction Methods and Construction Material

While the IBS solution is commendable in its focus on the reduction of construction waste and site labor, it needs to be more strongly integrated with development of new green building materials that can deliver energy and environmental performance over the lifetime of the building.

5.3.2.5 Slow Up-skilling

There is also an urgent need to up-skill the local construction workforce to keep pace with the modernisation and efficiency gains of the construction industry, and to make the industry attractive to the younger generation to reduce the dependence on foreign labor.

5.3.2.6 Lack of Quantified Data for Environmental Indicators

Quantified data on the reductions in CO_2 emissions, water consumption and waste generation from 100% IBS adoption in Malaysia have yet to be determined. This will hamper the establishment of future goals towards 2030 and beyond as well as limit the options for achieving ambitious sustainability goals.

5.3.3 Green Building Materials

The research and development of new green building materials in Malaysia is still in its infancy. While there are some products that have been showcased at the annual IGEM exhibition and there are a range of products certified to SIRIM's Eco-Label, the variety and quality of innovations is still limited.

The construction material industry lacks specific material standards that can guide investment in the development of new, environmentally friendly construction materials and products.

The development of new construction materials which have a high content of recycled construction waste and demolition waste is also not apparent primarily due to regulatory barriers against the use of recycled materials in building construction.

5.4 Way Forward

5.4.1 Green Building Design and Operation

5.4.1.1 Near Zero Energy Buildings (NZEB) Target and Regulations

It is imperative for Malaysia to accelerate policy and fiscal instruments which will drive building energy consumption to a level of near zero by 2040. The near zero definition itself is arbitrary and will require further analysis in the Malaysian climate context, to define a value for it. Based on existing technology, a building energy intensity (BEI) range of 50 - 100 kWh/m2/year for near zero is achievable for centrally air-conditioned buildings. Observing the rate at which technology is innovating in the energy efficiency, renewable energy and energy storage space, it is entirely possible that the near zero aspiration could be upgraded to zero energy with integration of on-site renewable energy.

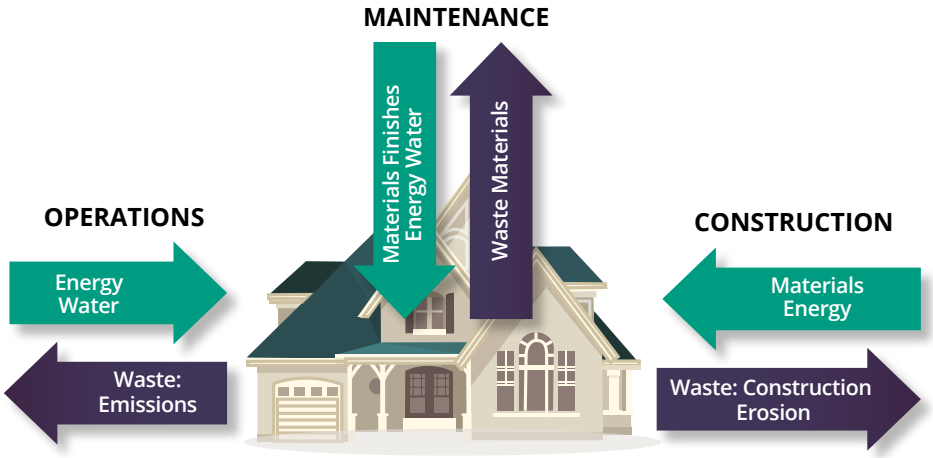


Figure 5.3: Conceptual Model of Near Zero Energy Building

To achieve a Near Zero Energy Building scenario in 2040, the Government intends to draft an Energy Efficiency and Conservation Act (EECA) that regulates requirements for comprehensive building energy codes, building energy labelling and electrical appliance energy performance standards. The regulatory requirements are targeted to come into force in 2019/2020. Subsequently, intermediate BEI targets for 2030 and 2035 can then be established for the various building typologies in Malaysia.

The EECA will ensure that both the residential and commercial buildings are included within its scope. It will also ensure that the MS1525 and MS2680 undergo mandatory revisions to keep pace with the BEI targets that the Government intends to set.

5.4.1.2 Green Building Certification Incentives and Financing

The Government is targeting between 550 and 1,750 buildings to be certified to a green building rating tool by 2020 and 2030 respectively.

In addition to the existing Investment Tax Allowance (ITA) and Income Tax Exemption (ITE), the Government will consider expanding the EACG scheme which started in RMK-11 to encourage building energy retrofits. These retrofits will contribute to the number of buildings that can be certified green as well as it will encourage building owners to take the first step of assessing their energy consumption and identifying energy efficiency opportunities.

Depending on the market progress, the Government could also encourage the growth of the EPC market by enlarging the EPC Fund or encouraging the private sector financial institutions to establish similar fund schemes or Green Sukuk schemes.

The Government is in the process of creating an annual Energy Efficiency Award which will indirectly stimulate more interest in green building ratings. The EE Award will also serve as the springboard to the ASEAN Energy Awards.

5.4.1.3 Government Lead by Example

KeTTHA will continue to coordinate the efforts to achieve the projected 5% increase in the reduction of energy consumption in the Putrajaya federal Government buildings by 2020. KeTTHA also intends to implement building energy disclosure for the ministry buildings in Putrajaya which will provide added impetus and transparency to the Government's efforts in energy efficiency.

The Government plans to collate and analyze building asset data across all ministries in order to understand the energy consumption patterns of these buildings. Once this information has been processed, the Government will be able to set energy efficiency targets for 2020, 2025 and 2030.

5.4.2 Sustainable Construction Practice

The CIDB has developed the Construction Industry Transformation Programme (CITP) to change the way construction is being undertaken. It encourages industry players to adopt proper planning to reduce the impact of construction industries to the environment.

The continuous implementation of the CITP is designed to:

- Improve the financial viability of IBS through various means;
- Reduce the generation of on-site waste;
- Develop competencies via the Center of Excellence (CoE); and
- Develop Malaysia Standards for construction specifications that include green technology requirements.

5.4.2.1 Improving IBS Adoption Rates via Improved Procurement Practices

The public procurement approach will be changed to be less costly and more direct by separating IBS procurement from the main contract. This separation from the main contract will:

- Remove the burden of financial liquidity as payments will be managed by project owners and clients as they can directly procure the IBS components from the suppliers. This may generate competitiveness amongst IBS manufacturers and may eliminate any potential mark-up of prices via main contractors; and
- Reduce cost to the contractor and increase demand certainty for IBS suppliers; Other approaches also include recommending sustainability requirements within procurement processes for public buildings and infrastructure.

5.4.2.2 Improving the Financial Viability of IBS through Tax Incentives

The existing duty on IBS equipment in Malaysia is 40%, which is considerably higher than those of neighboring countries. The relatively small pool of IBS specialists operating in Malaysia has also led to requirements for upfront payment and long delivery lead times, making IBS materials much costlier which slows down the IBS adoption rate. Future Government initiatives to address this will include considerations of the following:

- Tax/levers to improve economics for local IBS manufacturers;
- Tax holiday on IBS component plants;
- Higher plot ratio for IBS compliance; and
- Revolving fund for IBS working capital.

The CIDB plans to undertake a cost-benefit analysis for the adoption of IBS and finalise tax incentive proposals. In addition, the CIDB will also engage stakeholders to facilitate changes in practices and regulations as well as provide input into the design of economic mechanisms to improve the financial viability of IBS machinery and equipment for the manufacturers and suppliers.

5.4.2.3 Other Support Measures for IBS Adoption

CIDB will publish IBS catalogues which are harmonised with IBS suppliers.

- Ensuring IBS adoption in the private sector via inclusion in Development Order and implementing changes to the Uniform Building By-Laws (UBBL) requirements.
- To incorporate IBS and modular coordination into the JKR Pre-Approved Plans (PAP) followed by a requirement for common public building construction and Government-linked projects to use PAP unless exempted by the Director-General of Public Works.

5.4.2.4 Reducing and Recycling Construction Waste

Implementing a circular economy approach to construction waste will see direct benefits of reduced costs due to reductions in the utilisation of raw materials, reductions in disposal costs, cost gains from recycling and cost gains from incorporating waste materials into new construction materials.

Therefore, the CITP actions to achieve this objective of closing the loop on construction waste include:

- Heightening enforcement against illegal dumping;
- Developing and distributing Site Waste Management Plans (SWMP) to industry players, including the concept of "Deconstruction" instead of "Demolition" so that parts of the building can be recycled for other purposes;
- Devising landfill taxation mechanisms as punitive approach to excessive waste generation;

    - Research to identify and determine the baseline data for landfill taxation mechanisms is underway

- Encouraging building of construction-specific recycling centers;

    - CIDB targets to achieve a minimum of 3 recycling centers by 2020

- Facilitating the procurement of recycling product/material or local C&D waste for recycling plants in priority areas.

5.4.2.5 Malaysian Standard for Construction Specifications

Under the CITP, there are initiatives to introduce Malaysian Standards for construction specifications that will encompass quality, material standards, safety, environment, energy and methodology.

The publication of the Malaysian Standards will serve as public reference and guideline for the industry to base practices on. It is foreseen that this will lead to efficient cost reductions and lower wastage.

The Malaysian Standards will be aligned with the building energy codes that will be made as requirement in the proposed Energy Efficiency and Conservation Act (EECA) so that near-zero energy buildings can be achieved.

5.4.2.6 Developing competencies via Center of Excellence

Human capital development initiatives under the CoE of the CIDB include:

- Upskilling the local construction labor force to keep pace with modernisation of the construction industry and to reduce dependence on foreign labor
- Developing and promoting training programs on sustainability topics for the industry
- Partnering with leading local universities with the aim of becoming a hub for research on:

    - sustainable practices in construction;
    - the integration with new green building materials;
    - development of quantified data for environmental indicators; and

- Partnering global and local industry sustainability experts including sustainability advocates, academicians and industry players to develop training modules for members of the CoE
- To increase the number of planners rather than engineers (executors) only

Centre of Excellence (CoE) by CIDB
The CoE under CIDB will focus on the following key initiatives:

- Raising perception of sustainability;
- Promotion of best practices in sustainability;
- Supporting the capability development in sustainability across the industry value chain; and
- Exit policies — Rationalise Government incentives on R&D to create a self-sustaining industry.
- Advanced research in construction methods

5.4.3 Green Building Materials

The CITP has put forward measures to raise the performance of local construction players to meet international standards. This includes the adoption of higher material standards and specifications.

5.4.3.1 Policy Framework to Enable Recycling of C&D Materials

Up until 2022, the CIDB will collaborate with key stakeholders to facilitate equipment procurement for construction and demolition (C&D) waste recycling in priority areas and work to amend policies that will allow the usage of recycled materials in construction.

The private sector will be encouraged to work with the CIDB in setting up supportive policies that recommend or require the use of part-recycled construction materials for some portion of the construction of major projects. A sector lead will be identified to champion this transformation. Government facilitation will be in place to establish relevant studies to support policy development.

5.4.3.2 Research on Green Building Materials with Improved Thermal Properties

The CIDB will establish further research plans on energy efficient building materials as necessary after further consultation with the building material industry. These material standards that are to be developed must also be aligned with future revisions of the MS1525 and MS2680 since the material specifications will contribute to the energy efficiency and environmental performance of the whole building.

5.4.4 Greening the Building Ecosystem

The entire ecosystem of the Building industry must be examined for GT opportunities. This pursuit must have a singular goal of reducing the carbon foot print of a building all the way from its inception to its construction through to its occupation. Not only must the design strive towards nZEB but the materials and electrical equipment must look to be the most sustainable that is available in the market while the construction methodologies become increasingly automated.

This holistic approach requires concrete policies which are progressive and ambitious to provide the market certainty necessary to embark on this course. In addition, the Government needs to bring the entire ecosystem of stakeholders together to explore, produce and coordinate agreed targets and timelines to achieve the nZEB and ZEB goals in the 2020-2030 period as conceptualised in Table 5.5.

5.5 Targets

The national targets for building sector from 2020 to 2030 are specified in the table below:

SECTORS / AREAS	2020	2025	2030	INITIATIVES
GREEN BUILDING DESIGN				
Active Design - MEPS	• MEPS Law • 11 appliances • Upgrade current MEPS ratings	• 16 appliances • Harmonise MEPS rating to ASEAN SHINE	• All appliances • Universal MEPS rating	• Energy Audit Conditional Grant • Near Zero Energy Buildings targets • Standardisation of green rating tools • Malaysia Standard for construction specifications • Centre of Excellence (CoE) by CIDB
No. of Certified Buildings	• 550	-	• 1750	
Passive Design - BEI	• Building Energy Regulation • BEI 120	• Sectoral BEI 90	• Sectoral BEI<60	
SUSTAINABLE CONSTRUCTION PRACTICE				
Construction Method - IBS	• Public projects score 70 - 100% • Private projects score 50 –100%	• New Technologies Automated brick laying, etc		• Continuous implementation of the CITP • Improving the financial viability of IBS through tax incentives • Developing competencies via CoE
Construction Waste	• To be determined			
GREEN BUILDING MATERIALS				
Raw Materials - Recycle Content	• To be determined. • % of recycled content in concrete and other materials			• Policy framework to be agile to enable recycling of C&D materials

Table 5.4: Summary of target and initiatives for Building sector

Target		2020	2025	2030
Raw	Recycled Content	To be determined: % of recycled content in concrete and other materials		
Construction Method	IBS	Public Projects score 70% - 100%	New Technologies: Automated brick laying, etc.	
		Private Projects score 50% - 100		
Passive Design	BEI	• Building Energy Regulation • BEI 120	Sectoral BEI 90	Sectoral BEI <60
Active Design	MEPS	• MEPS Law • 11 Appliances • Upgrade current MEPS rating	• 16 appliances • Harmonise MEPS rating to ASEAN SHINE	• All appliances • Universal MEPS rating
	Certified Green	550		1750
Construction Waste	Recycle Rate	To be determined		

Table 5.5: nZEB and ZEB targets in 2020-2030

Figure 5.4 shows the timeline for building sector until 2030.

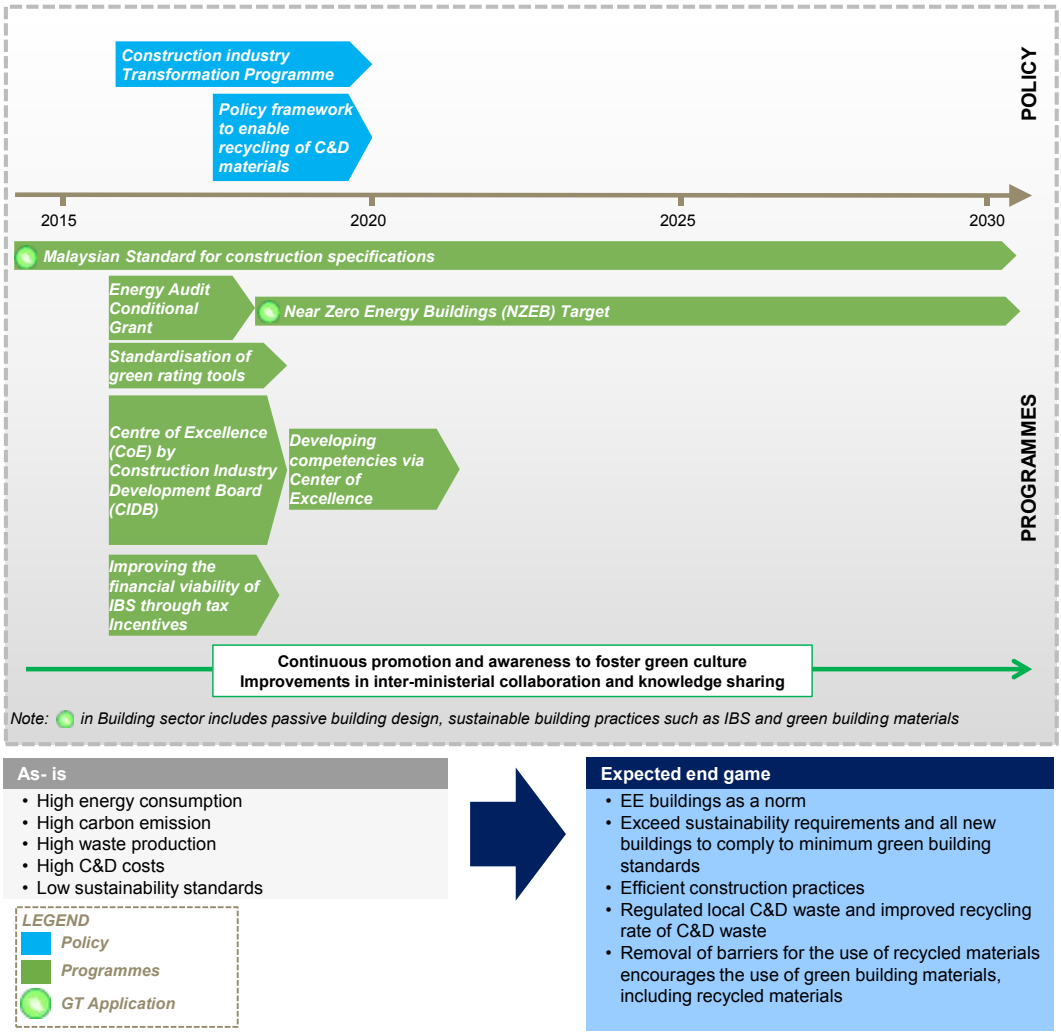


Figure 5.4: Timeline for the building sector

6

WASTE

SUMMARY

CURRENT | **MOVING FORWARD**

WASTE TREATMENT AND DISPOSAL

CURRENT	MOVING FORWARD		
14 sanitary landfills and **147** non-sanitary landfills nationwide as of 2016	**23** sanitary landfills nationwide as of 2020	**80%*** sanitary landfills by 2030	**3** Waste-to-energy thermal plants by 2030

17.5% (2016)

Recycling rate

- **22%** (2020)
- **25%*** (2025)
- **28%*** (2030)

*Expert assumption by the National Solid Waste Management Department (JPSPN) and approved during the meeting on 10th August 2017 on Post 2020 Target Recycling Rates and Solid Waste Management Facilities.

RESOURCE RECOVERY

300		**3,002**
$ktCO_2eq$ biogas capture from palm oil mill effluent treatment		
71	Number of palm oil mills with biogas capture facilities	**500**

EXISTING INITIATIVES

Waste treatment and disposal

- Policies improvement and technology upgrading in landfill operation;
- Introducing policy on food waste management; and
- Introducing market enablers through EPP.

Waste and resource recovery

- Mandating the installation of methane capturing facilities;
- Conducting research to expand the use of biogas as by-product of palm oil mills;
- Establishing a working group to promote biogas capture at all mills;
- Implementing grading and certification mechanism, and talent development initiatives; and
- Implementing tax allowance and import duties.

WAY FORWARD

- Strengthening the institutional framework;
- Enhancing coordination between Federal and State Governments;
- Formulating policy paper on waste separation in non-household areas;
- Strengthening public-private collaboration in R&D&C;
- Developing market enablers through funding mechanism and creating market demand;
- Developing competencies in the public and private sector;
- Designing and implementing targeted awareness programs through education;
- Improving the strategy on the implementation of Waste-to-Energy;
- Extended Producer Responsibility (EPR) in facilitating growth in resource recovery; and
- Moving Towards a Resource Efficient Society: TN50 Green - Waste to Wealth.

6.1 Introduction

Waste generation is often linked to development and industrialisation, and its implication to people and the environment remains a global issue, particularly in developing countries. Population, rapid economic growth and changes in lifestyle have resulted in the complexity of the waste composition being generated and contributed to the ever-increasing waste generation per capita. These, together with inadequate infrastructure, limited budget in managing the waste and land scarcity has made waste management a priority area for the Malaysian Government.

The Eleventh Malaysia Plan (RMK-11) echoes this concern, with strategies being put in place to ensure efficient waste management through formulation of guidelines on resource use and increased measures for effective enforcement. The main strategy is to adopt a waste to wealth approach, where waste is no longer seen as something that is not wanted or needed, but as an economic asset.

At present waste management is largely driven by the public sector, supported by a regulatory framework, which governs the generation, storage, collection, transfer and transport, treatment and disposal of waste. Waste generated in Malaysia can be categorised into 7 types namely: municipal solid waste (MSW), sewage[1], mining waste, construction waste, scheduled and hazardous waste, agriculture waste and radioactive waste. MSW, compared to the other types of waste is the fastest and largest growing waste type in terms of the volume that is generated. The daily MSW generation in Malaysia has shown an increase from 18,180 tonnes (2005) to 33,130 tonnes (2012).

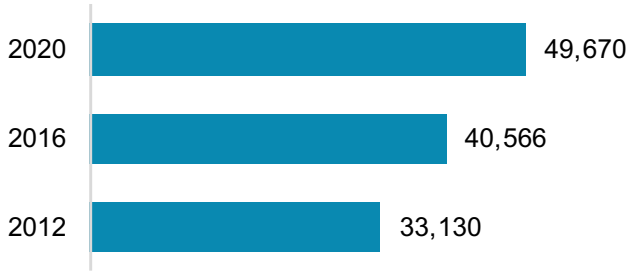


Figure 6.1: Daily MSW Generation in Malaysia[2]

In 2016, the daily MSW generation reached 40,566 tonnes. This surpassed the projected waste generation of 30,000 tonnes by 2020, resulting in a revised estimation of projection of daily MSW to 49,670 tonnes. (Refer to Figure 6.1)

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[1]Management of sewage waste is discussed in the Water Chapter

[2]The National Strategic Plan for Solid Waste Management (August 2005) by the Local Government Department, Ministry of Housing and Local Government, Malaysia.

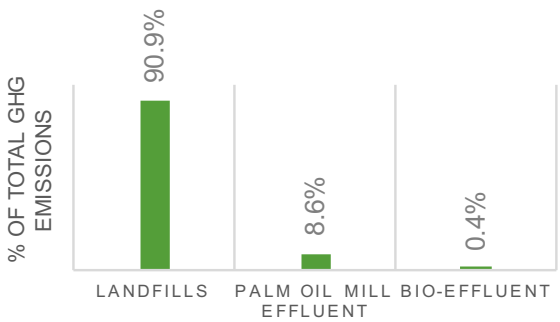
Malaysia's generated waste comprises **biodegradable waste** (food waste, garden waste, wood and husk)

81% disposed at landfills decomposed in anaerobic condition to produce large volumes of methane

Figure 6.2 Statistics on Waste sector in Malaysia[3]

According to a survey conducted on Solid Waste Composition, Characteristics and Existing Practice of Solid Waste Recycling in Malaysia in 2013, 51% of waste generated comprised biodegradable waste, which included food waste, garden waste, wood and husk. 81% of the biodegradable waste disposed at landfills has since decomposed in an anaerobic condition producing large volumes of methane.

Methane is a primary source of GHG emissions in the waste sector, contributing to 23% of the total GHG emissions in Malaysia, of which 90.9% were generated from landfills, 8.6% from palm oil mill effluent (POME) and just under 1% were generated from bio-effluent (Refer Figure 6.3). Despite being an important industry for the country, the processing of palm oil may result in huge environmental impact, if no proper control measures are taken.



Did you know?

Methane has between 21 to 25 times the Global Warming Potential (GWP) relative to other gases, and solid waste disposal sites are major sources of methane emission.

Figure 6.3: Major sources of methane emissions in Malaysia as of 2011[4]

Scheduled and hazardous wastes, generated from industrial activities, form another category of waste that requires proper handling, treatment and disposal. While the industrial sector is a major contributor to national GDP, the industrial processes produced direct or indirect by-products in solid, semi-solid or liquid form, or in the form of gas or vapor which is emitted, discharged or deposited in the environment in volume, composition or manner such as to cause pollution and is harmful to humans and the environment.

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[3] Survey done on Solid Waste Composition, Characteristics and Existing Practice of Solid Waste Recycling in Malaysia, 2013

[4] Malaysia Biennial Update Report (BUR), 2016

These wastes are regulated under the Environmental Quality Act 1974 (Act 127), the Environmental Quality (Scheduled Waste) Regulations 2005.

Construction waste is also another aspect of concern, given that different types of wastes are generated from various types of construction activities, such as building works; road works and infrastructure development; as well as tunnelling. The sector is expected to expand by 10.3% per annum during the RMK-11 period mainly to fulfil the need in the housing/residential sector, which requires a rethink of how to capitalise on the waste that will be generated, and closing the waste life cycle loop.

The RMK-11 is cognisant of the challenges and opportunities to help transform the sector from one that is problematic to one that can contribute to green growth. The idea is to intensify existing initiatives, put in place since the Ninth Malaysia Plan (2001-2005), such as recycling and recovery to improved management of landfills, through innovative approaches where waste can be diverted and recovered, and converting them to resource. Private sector support and partnership will be key to drive innovation and technology adoption.

This Chapter briefly discusses the scenario of waste management in Malaysia, taking into account issues and challenges in existing initiatives, with emphasis on mainstreaming green technology as a means to strengthen waste management measures and capitalise on opportunities to turn waste to wealth.

6.2 Current Landscape

6.2.1 Treatment and Disposal of MSW in Malaysia

MSW management falls under the purview of both the Federal and State Government. At the Federal level, the National Solid Waste Management Department (JPSPN) develops solid waste and public cleansing policies and strategies, action plans and formulate the necessary legislative measures to support management. JPSPN is assisted by the Solid Waste Management and Public Cleansing Corporation (SW Corp). As of 2017, seven (7) states, including Kuala Lumpur, Putrajaya, Melaka, Perlis, Negeri Sembilan, Pahang, Kedah and Johor have adopted the Solid Waste and Public Cleansing Management Act 2007 (Act 672). Under this Act, measures relating to solid waste management and public cleansing across all local authorities are standardised. JPSPN has the national oversight on MSW management in the above- mentioned seven (7) states. While in the other states, MSW management is subject to State Governments' authorities.

In the seven (7) aforementioned states, three concessionaires have been appointed in areas identified by JPSPN, to provide services in relation to waste collection, transportation and disposal services in Peninsular Malaysia. As of 2017, 95% of the collected waste are taken to disposal sites while the remaining 5% goes to waste treatment facilities.

The Government has implemented policies and programmes to reduce waste generation and to divert waste from landfills. Multi-pronged approaches have been taken to address MSW management issues, including waste minimisation through the National Recycling Programme introduced in the year 2000 and the Waste Separation at Source Programme introduced on 1st September 2015. Both programmes were aimed at improving awareness on sustainable waste management and reduce waste generation, which is intended to address the problem of space at landfills and reduce the need to allocate area for landfill siting.

6.2.1.1 Sanitary Landfills and Methane Recovery from Landfills

Various technologies are available to provide efficient MSW management. However, adopting technology that is technically feasible, reliable, economically viable, environmentally sound, and socially acceptable is a challenge in MSW management. Landfilling remains the most common MSW disposal method in Malaysia. As of 2016, there are 161 landfill sites in Malaysia. 14 of the sites are sanitary landfills and 147 are non-sanitary landfills.

Landfilling MSW is an anaerobic process. It produces landfill gases that consist of carbon dioxide, methane, hydrogen sulfide, ammonia and other traces of gas. Besides producing GHGs, landfilling requires huge land space and releases unpleasant odour and leachate that requires treatment. Methane is known to be one of the high Global Warming Potential (GWP). Technology however, has helped to minimise the problem, enabling these gases to be harvested, treated, and applied for electrical generation or direct heating if not flared.

Waste treatment and disposal, which includes sanitary landfills, contributed about RM81.07 million towards Malaysia's GDP in 2012 and 2013. This figure is projected to increase to RM334.0 million and RM489.7 million in 2020 and 2030 respectively, should the volume of waste continue to increase with 95% of the counted waste being taken to disposal sites and the remaining 5% goes to waste treatment facilities[5].

[5] Green Technology Master Plan: Economic Assessment on the Green Business Environment in Malaysia, PwC Consulting Services (M) Sdn Bhd ("PwC"), 2014.

6.2.1.2 Waste-to-Energy (WtE) Thermal Plant

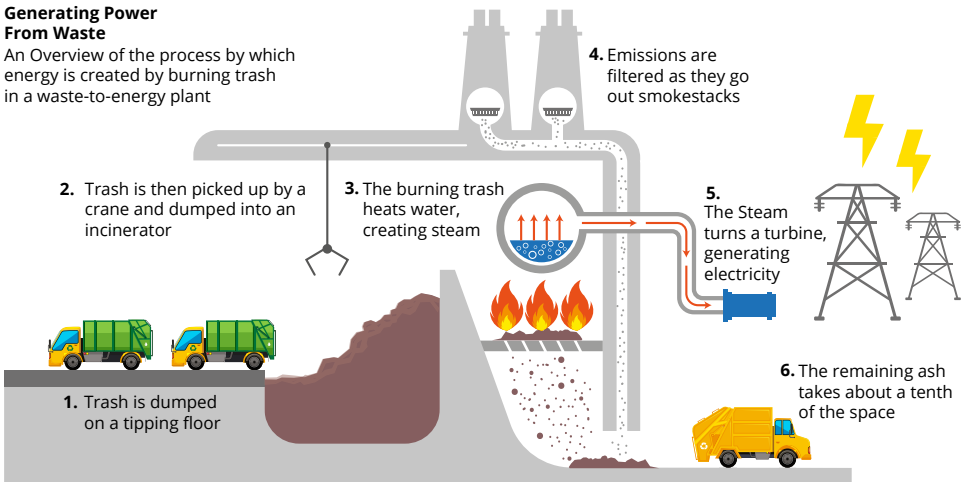

Figure 6.4 Illustration of Waste to Energy process flow

Waste-to-Energy (WtE) thermal plant offer a high technology solution in waste management, in that it reduces waste while producing electricity. Investment in WtE can bring great benefits to the environment. It reduces the waste volume by approximately 90% which leads to reducing the need for land area to site landfills. Studies have also shown that WtE plants produce more energy as compared to landfill gas projects.

The Government's existing initiatives on WtE thermal plants are now focusing on improving the project viability of WtE thermal plants in Malaysia. This strategy considers the maturity of technology, and also the availability of a sustainable funding mechanism, given that it can be expensive to develop and maintain.

A WtE thermal plant project in Kuala Lumpur is underway with the capacity to process 1,000 tonnes of waste per day. It is expected that Malacca will follow suit as the existing landfill capacity in the state is likely to reach its maximum in 8 years, followed by Johor. The WtE thermal plant in Kuala Lumpur is expected to begin operations by 2020. Learning from previous experience on the negative perceptions to incineration technology, the Government has conducted communication programmes to improve the public's awareness and acceptance towards the technology. Prior to the 2014, the WtE thermal plant in Kuala Lumpur, the Government launched public engagements since 2013 to help citizens understand the rationale for implementing the project and how it could impact stakeholders.

6.2.2 Waste and Resource Recovery

Resource recovery from waste, is referring to selective extraction of disposed materials for next use, to extract the maximum benefits from products which will help reduce or delay the consumption of natural resources and reduce the amount of waste generated.

As it is, with the currently recycling rate of MSW being around 17.5% (2016), a lot of valuable materials from the waste sent to landfill are yet to be recovered. It also provides an opportunity to create economic value for these materials while reducing environmental impact. Innovation and green technology adoption will be the key driver to steer waste management towards greater resource efficiency.

Did you know?

Common EU target for recycling of municipal waste by 2030 is 65% whereas packaging waste is 75%. There is a binding landfill target to reduce landfill to maximum of 10% of municipal waste by 2030

6.2.2.1 Methane Capture from Palm Oil Mill Effluent (POME)

Despite being an important industry for the country, the processing of palm oil may result in huge environmental impact, if no proper control measures are taken. Between 2016 and 2020, the average annual production of palm oil in Malaysia is expected to reach 15.4 million tonnes, producing about 100 million tonnes of residue by 2020. Mitigation of environmental impacts of palm mill activities falls under the purview of the Department of Environment Malaysia (DOE). The Malaysian Palm Oil Board (MPOB) supports the DOE's mandate by regulating the activities in the palm oil mills, especially through the implementation of registration and licensing. There are regular engagements between MPOB and NRE to provide GHG data for biogas captured from palm oil mill effluents (POME) under Performance Management and Delivery Unit of the Prime Minister's Department's (PEMANDU) Entry Point Project (EPP) on 'Developing biogas facilities at palm oil mills'. In 2016, 92 palm oil mills are reported to be equipped with biogas capture facilities, showing an increase from 71 in 2013.

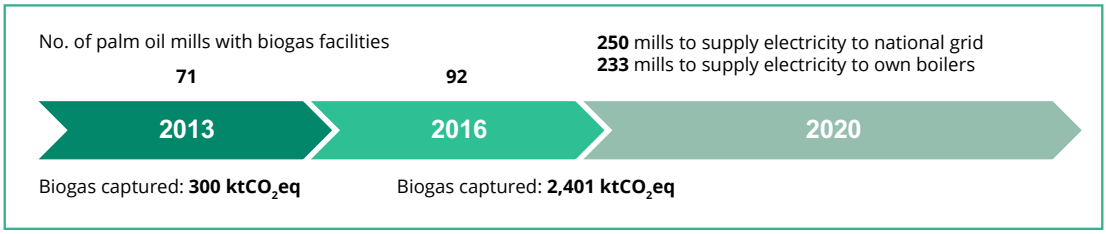

Figure 6.5: Timeline for methane capture from palm oil mill[6]

A Roundtable on Sustainable Palm Oil (RSPO) was established in 2004, supported by a certification process to ensure the credibility of palm oil sustainability claims. Currently, 131 Malaysian companies are RSPO certified.

[6] Performance Management And Delivery Unit (PEMANDU), 2013 & Ministry of Plantation Industries and Commodities (MPIC), 2017

In 2011, 8.6% of methane emission originated from POME. In view of the amount of methane emission originating from POME, the Government aims to achieve the installation of biogas capture facilities in all palm oil mills by 2020. A reduction in emissions of 3,002 $ktCO_2eq$ can be achieved from this initiative; and from this volume of biogas, approximately 1.9 million MWh of electric power can be generated.

6.3 Issues and Challenges

Main issues and challenges in waste management in Malaysia are described below:

6.3.1 Public Awareness

In general, there are low awareness among the people on the needs to reduce waste generation and dispose waste responsibly. The daily MSW generation in Malaysia was reported to increase exponentially. 38,000 tons MSW generated per day and growing at a rate off 0.5% per year with economic growth and population increase[7].

Figure 6.6: Various categories of recycled materials

[7] SWCorp, April 2017 & PEMANDU LAB, June 2015

The 3R (Reduce, Reused and Recycle) campaign is taking place slowly at the rate of 17.5% (2016) and is yet to make significant impact to overall waste reduction. Changing public behaviours and mind set in waste reduction and recycling takes time but efforts need to continue to finally bring change in the life styles of Malaysian.

Open dumping landfill is still being practiced in many areas, resulting in the creation of illegal dumpsites, raw leachate direct discharge and open burning which has affected the water quality of rivers and the air quality. The preference is largely a result of financial constraint and lack of knowledge and understanding on the environmental impact of open dumping.

New sites for waste treatment and disposal facilities often received public protest. Not In My Back Yard (NIMBY) syndrome has been the way public responded to the proposal of waste treatment infrastructure such as landfill, incineration plant or transfer stations. This is mainly due to the nature of its dirty operation. Scarcity of land often creates conflict in land used for waste treatment and disposal facilities.

In Malaysia, there is also strong public protest towards the usage of waste incinerator. The resistance is mainly driven by the experience on waste incinerators where limited public consultations were done; negative perceptions and fear of potential impact to health and environment from the toxic fumes of the incineration process and poor maintenance culture and monitoring system being track records on many facilities built in the country. Although there are some good track records from incineration operations in Malaysia, the lack of confidence in the authority and disasters created by such system elsewhere still lingers in the public mind.

6.3.2 Limited Resources in Waste Management Implementation

Most of the landfills are equipped with minimal facilities. There is a high upfront cost to support the development of new sanitary landfills, upgrading non-sanitary landfills to sanitary landfills and safe closure of dumpsites or non-sanitary landfills. The Government had privatised MSW services but the high cost of investment has required the Government to share a major portion of the investments in the initial stage. This is done via Government's investment for the development and maintenance of waste treatment and disposal facilities.

Such investment is deemed necessary to reduce the impact of high cost recovery from the public, especially when the existing MSW services is funded partly through the assessment tax on the people in the form of tipping fees. The tipping fees in Malaysia is reported to be among the lowest in the world. This limits the attractiveness of the sector to new investment and technology exploration in the country.

6.3.3 Viability on High Technology Waste Treatment Plant

Adopting technologies that are technically feasible, reliable, economically viable, environmentally sound, and socially acceptable pose additional challenges in MSW management for Malaysia. Recycling is preferable but takes time to implement and requires changes in behaviour of people at all levels.

Waste handling by WtE is a good option to start with but it requires high capital and operating expenditure. It is estimated to be 300 times more expensive than the conventional landfilling method. The economic viability of WtE needs to be driven by the Government support on waste volume guarantees, increase in tipping fee and high electricity tariff. In many countries the WtE plant is Government owned or mostly operated by non-profit Government companies. However, there are also limited private WtE plants with moderate returns in operation.

Malaysia has a lot to learn from its past experiences in implementing WtE plant. The first talk on WtE started back in 1998. In 2003, the first project was awarded to a Japanese company. However, the project was cancelled in 2007 due to public protest and cost concern. The Semenyih WtE plant, built and operated by a private company in 2009 was only able to operate partially due to some technical flaws. In 2012 Feed-in-Tariff for solid wastes WtE was introduced by SEDA. Learning from the past, strategies are refined and as the technology gets more matured several proposals on WtE are now on the way.

6.3.4 Inter Agencies Coordination on Waste Management

Waste management is currently implemented independently according to types of waste categories by relevant agencies such as JPSPN, SWCorp and DOE as per their respective jurisdictions. This creates gaps in waste management from four (4) aspects:

- **Jurisdiction:** Electronic waste from industries is regulated under the Environmental Quality Act 1974 whereas electronic waste from households is currently not regulated and being dumped together with other household waste and finally disposed in landfills.

- **Data availability:** JPSPN has the oversight of the implementation of MSW management in the 7 states which have adopted Act 672. However, the department does not have direct access to the information on the remaining states and Federal territories which had not adopted the Act.

- **Knowledge and competencies:** The high turn-over in the relevant Government agencies had posed challenges in ensuring the officials are equipped with the required knowledge on waste management topics and technologies available in the country. Management of diverse types of waste necessitates comprehensive understanding of the sector from all aspects.

- **Governance (implementation and monitoring):** Absence of review and monitoring mechanism which allows the federal Government to monitor the states' implementation and policy planning on waste management. The existing governance and limitations on law enforcement lead to difficulties in aligning the standards of various landfills in states in Malaysia, including the existence of unsafe and illegal dumpsites in which methane emissions are not captured and leachate discharge untreated.

6.4 Existing Initiatives

Existing initiatives on MSW in Malaysia include:

Waste treatment and disposal

- Policies improvement and technology upgrading in landfill operation;
- Introducing policy on food waste management; and
- Introducing market enablers through EPP.

Waste and resource recovery in palm oil sector

- Mandating the installation of methane capturing facilities;
- Conducting research to expand the use of biogas as by-product of palm oil mills;
- Establishing a working group to promote biogas capture at all mills;
- Implementing grading and certification mechanism, and talent development initiatives; and
- Implementing tax allowance and import duties.

6.4.1 Waste Treatment and Disposal

6.4.1.1 Policies Improvement and Technology Upgrading in Landfills Operation

In addressing issues arising from environmental impacts of landfills, the Government has since mandated that landfills built in Malaysia after 2004 to be of sanitary standard with features consisting of liners, leachate collection and treatment, gas harvesting and daily and final covers. Furthermore, to reduce methane emissions, landfills are now required to be equipped with methane capturing systems using semi aerobic systems.

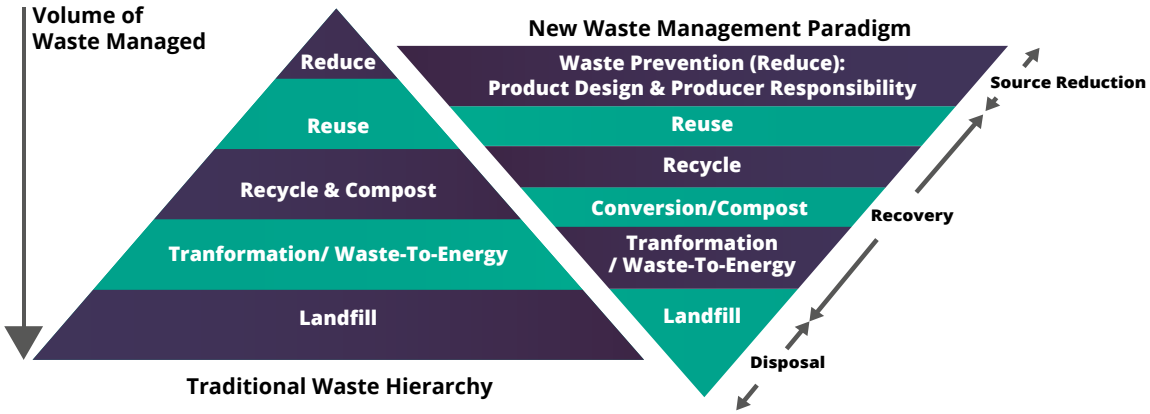

Figure 6.7 Diagram on Modern Methodology on Waste and Landfill Management

On the current operating non-sanitary landfill, KPKT has been conducting scheduled site visits assessment to determine whether those facilities should be rationalised, upgraded or decommissioned. Among the initiatives include:

- Upgrade existing dumpsites to sanitary landfills which incorporate treat leachate before it is discharged into the environment;
- Safe closure of dumpsites or non-sanitary landfills; and
- New land used on landfill land which has been safely closed (e.g. recreational park).

At present, JPSPN is also focusing on developing a new regional sanitary landfill and decommissioning low performing and unsafe landfills. The initiative will be supported by the development of new transfer stations to facilitate waste transportation from sources to landfill sites. The transfer stations also serve as an intermediate step to make waste collection system more efficient and cost effective. This can be achieved by collecting waste from different regions and transporting them to the appropriate disposal sites. There are currently four transfer stations in Malaysia and by 2018, three more will be constructed in phases. Applying green technology that is economically viable, environmentally sound and socially acceptable is vital in the development of the new landfill and transfer stations, especially in the area of waste collection and waste transport.

6.4.1.2 Introducing Policy on Food Waste Management

Application of GT in waste reduction, separation and composting is very relevant in food waste management. Recognising food waste as the key component of MSW and its resulting amount of methane, the Government has developed the National Strategic Plan for Food Waste Management. The plan encourages:

- Diversion and minimisation of food waste from entering the landfill, such as processing food waste to produce compost and aquaculture feed;
- Proper treatment of food waste generated; and
- Effective recovery of landfill gases.

6.4.1.3 Introducing Market Enablers through EPP

EPP 9 on Developing an Efficient Solid Waste Management System under the Economic Transformation Programme (ETP) identified four initiatives that have great bearing on nurturing future clean and green technologies that can enhance:

- product design to facilitate the implementation of the Reduce, Reuse, Recycle (3R) programme;
- waste treatment capacity to reduce reliance on landfills;
- waste collection and transportation such as automatic waste collection and the use of deep bins; and
- waste treatment and disposal technology.

6.4.2 Waste and Resource Recovery in Palm Oil Sector

The Government has supported methane capture from POME through the following initiatives:

6.4.2.1 Mandating the Installation of Methane Capturing Facilities

DOE has been enforcing Environmental Quality Act 1974 and the Environmental Quality (Prescribed Premises) (Crude Palm Oil) Regulations 1977 to regulate POME final discharge standards nationwide. For emission control, DOE has been enforcing the Environmental Quality (Clean Air) Regulation 2014 which imposed a new limit of dust load concentration or particulate level for solid fuel boilers of 150mg/Nm3 as compared to 400mg/Nm3 previously. Palm oil mills are given 5-year grace period till 2019 to fully adhere to the regulatory requirement.

Through MPOB, the Government mandated that new palm oil mills and mills which expand their capacity in 2014 to install methane capturing facilities. The technology has the potential to convert captured methane to electric power, which can be used in the mills or connected to the national grid. To ensure compliance with the mandate, the Government has implemented strict approval and monitoring of biogas trapping facilities in palm oil mills. The monitoring and reporting of biogas capture facilities and the regulations that govern by-product safety at palm oil mills are conducted through the collaboration of MPOB and NRE.

6.4.2.2 Conducting Research to Expand the Use of Biogas as a By-Product of Palm Oil Mills

Addressing technological barriers, it requires greater investment and nurturing of research, development and innovation to minimise and where possible remove the harm of POME discharged to the environment. Currently, this research is funded by the MPOB.

Apart from co-firing biogas in existing mill for on-grid and off-grid electricity production, MPOB is also expanding the use of biogas as a by-product of palm oil mills by utilising the biogas as compressed natural gas for industrial and vehicle use.

6.4.2.3 Promotion and Commercialisation Biogas Capture for Palm Oil Mills

The MPOB National Key Economic Areas Working Group was established to monitor the promotion of biogas capture at all mills. Promotion activities include:

- Regular seminars and conferences by MPOB;
- Biogas capture technology facilitation for industry;
- On-site visits; and
- Roadshows.

Furthermore, a Technology Transfer Seminar is held annually to disseminate and educate the entire industry on potential new technology for industry adoption.

6.4.2.4 Implementing Grading and Certification Mechanism and Talent Development Initiatives

The grading and certification mechanisms currently offered by MPOB include the Malaysian Sustainable Palm Oil (MSPO) certification and Codes of Practice (CoP). MPOB has implemented several talent development initiatives, such as:

- Training courses (e.g. diploma in palm oil milling technology and management, courses on supervising and operating a lab for palm oil processing and courses on palm oil effluent treatment processes);
- Institute of Malaysian Plantation and Commodities (IMPAC);
- Graduate Student Assistantship (GSAS) Programme; and
- Yayasan MPOB scholarship.

MPOB develops its own talent through industry attachment programmes, overseas and local conferences and seminars, annual engagement with experts at the Programme Advisory Committee in April, higher education (PhD-MSc) programme sponsorship and overseas training.

6.4.2.5 Implementing Tax Allowance and Import Duties

According to the 2014 ETP Annual Report, the EPP 5 Key Performance Indicator (KPI) that aimed to progress the construction of two biogas plants to be connected to the grid or external users was achieved by 150%. The Government's assistance in providing financial support had a large role to play in the success of the KPI, namely:

- Pioneer Status (PS) – exemption from income tax on 100% of statutory income for 10 years;
- Investment Tax Allowance – 100% of qualifying capital expenditure incurred within a period of 5 years can be utilised against 100% of the statutory income for each year of the assessment;
- Import Duty;
- Sales Tax Exemption for local products; and
- Exemption of import duty and/ or sales tax.

6.5 Way Forward

Moving forward in the next five years, the Government's efforts should focus on shifting from waste management to resources efficiency. Priority in managing waste should be given to prevent the waste from being generated in the first place. The five steps of waste hierarchy should apply:

- Reduce;
- Reuse;
- Recycling;
- Recovery, e.g. energy recovery; and
- Disposal, e.g. landfill.

Disposal of waste via landfill should be the last resort. More waste is leading to higher cost in waste management. Instead, waste should be reused and treated to recover energy and materials. Producers should take responsibility in their product design in reducing the content of hazardous substances in their product.

6.5.1 Enhancing Policy

6.5.1.1 Strengthening the Institutional Framework

The Government has set up a National committee on Sustainable Waste Management to increase coordination on the management of the 7 types of waste (i.e. solid, agriculture, construction, radioactive, mining, sewage and scheduled waste) based on a life-cycle approach. This committee should streamline the roles and responsibility of various agencies in formulating policies to manage all the 7 categories of waste to work towards waste reduction.

This includes data collection with regards to waste generation, collection, treatment and disposal and organisation from various sources, such as domestic, industrial, commercial and institutions. This will address the data unavailability on different types of waste to enable evidence-based policy planning. The improvement on institutional framework is envisioned to demonstrate the Government's commitment to improving waste management in the country to create more business opportunities for industry, such as WtE or the recycling of waste. Leveraging on the database of different types of waste, relevant Government bodies can facilitate GT growth in the waste sector by identifying and designing market enablers to create market demand. Also, it helps to assess the feasibility of the application of GT and its viability to clearly define the demand creation that is catered to existing markets.

6.5.1.2 Enhancing Coordination between Federal and State Governments

A review and monitoring mechanism will be developed to provide a platform for the federal Government to align the states' implementation and policy planning on waste management with the federal Government's strategic direction. The mechanism will be supported by a panel of cross-ministerial and Government bodies such as NRE, KeTTHA and KPKT, including private sector experts to provide consultancy and advisory services to the states and local authorities.

The National Council for Local Government or *Majlis Negara bagi Kerajaan Tempatan* (MNKT), an annual forum led by the Local Government Department or Jabatan Kerajaan Tempatan (JKT) will be leveraged to achieve this objective.

6.5.1.3 Formulating Policy Paper on Waste Separation in Non-Household Areas

The Government will be advocating the separation of waste in the Industrial, Commercial and Institutional (ICI) sector, after the implementation of waste separation at source in the housing areas. By 2017, the policy paper for an awareness programme on separation of waste in commercial areas will be launched.

A detailed action plan on food waste minimisation at source will be developed. The plan should encourage technology adoption to compact and sort waste, use IOT to manage waste from households, track waste footprint, reward scheme e.g. for those with the smallest footprint based on specified criteria according to household composition and location with the target moving towards zero organic waste to landfill. The detailed action plan will include a clear project timeline, supported by data collected from the National Waste Management Steering Committee. This action plan is envisaged to spur GT development in treating food waste.

6.5.1.4 Strengthening Public-Private Collaboration in R&D&C

Collaboration between the public and private entities on waste-related R&D&C project will be strengthened to drive commercialisation. At present, there is limited information sharing on Government R&D projects among different ministries.

A loose feedback loop between the researcher and the interviewee (often the private industry players) also limits opportunities for the private industry to contribute ideas to commercialise R&D projects. New criteria will be introduced in the assessment of R&D&C projects to encourage the involvement of private industry players in Government funded R&D&C projects, especially those related to solid waste technology. A central repository will be made available for ease of reference, supported by inter-ministry committee participation in the evaluation and monitoring of R&D&C projects.

6.5.1.5 Developing Market Enablers through Funding Mechanism and Creating Market Demand

In addition to the Government's commitment to developing a sustainable funding mechanism for GT, there will be a consistent review of the existing funding mechanism.

KPKT is considering implementing a "pay as you throw" scheme, where households and commercial areas are charged a rate depending on the amount of waste to be disposed. This serves as a method to encourage waste generators to produce less waste. Other methods will be explored further to assess feasibility for implementation in Malaysia.

The Government will consider designing schemes to create market demand in collaboration with relevant Government bodies based on the types of waste. A sector lead will also be appointed to create market demand for solid waste products.

6.5.1.6 Developing Competencies in The Public and Private Sector

Currently, officials in the Government bodies attend local and international conferences to keep abreast of waste management topics. In the private sector, most of the talent is trained through hands-on job experience.

Competencies are recognised through NOSSs developed by the Department of Skills Development (JPK), which is also referenced to facilitate training programmes. The Government will focus on capacity building in the public by:

- Implementing a knowledge sharing platform amongst different ministries, such as KeTTHA, MGTC, KPKT, NRE and the MPOB; and
- Exploring the standard procedures in job hand-over in the Government bodies.

6.5.1.7 Designing and Implementing Targeted Awareness Programs through Education

Planned education programmes on waste management will be implemented in collaboration with the Ministry of Education (MoE). Programmes will be anchored on a practical approach to educate the public on the importance of waste management from a young age.

Promotion and awareness programmes will be designed to target stakeholders from all walks of life, in collaboration with other Government bodies, such as the Ministry of Communication and Multimedia, and the private sector, including non-Governmental organisations. Key topics that will be included, i.e. waste reduction, separation of waste, technology application, service cost and charges imposed on services. More public engagement initiatives will be commenced to collect feedback and to educate the public with regards to waste management in Malaysia.

Communication strategy will be developed to ensure that the implementation is delivered and tailored to its target audience to maximise its impact and effectiveness. The communication strategy will support the long-term planning of improving financial sustainability of waste projects in the country.

Programmes that emphasise practical education on the importance of solid waste diversion, such as composting programmes at school, will be implemented by the Government to inculcate green culture among the youth. The approach will focus on practical experience by the young generation on the benefits of treating food waste.

6.5.1.8 Improving the Strategy on the Implementation of Waste-to-Energy

In preparation for the future, the Government aims to develop one (1) WtE thermal plant in 2020 and three (3) plants by 2030. The Government will focus its efforts on designing targeted:

- **Communication strategy backed by experts:** The Government will endeavour to fine-tune its communication strategy towards raising private awareness of the benefits of WtE thermal plant. For example, international speakers will be engaged to share their experiences and knowledge on WtE thermal plant as an alternative means to dispose of waste

- **Developing alternative funding methods:** High investment cost and low tipping fees have posed great challenges in the financial feasibility of the WtE thermal plant project. The Government is developing alternative funding methods to improve the cost structure to implement WtE thermal plant, including reviewing the existing Feed-in-Tariff mechanism for WtE. This is in line with the Government's commitment to developing sustainable financing mechanisms for green growth, as stated in RMK-11.

6.5.1.9 Extended Producer Responsibility (EPR) in Facilitating Growth in Resource Recovery

The management of waste started with command and control regulation where waste generated at the 'end-of-pipe' needs to be managed either by incinerating or landfilling. As cost for incineration and landfilling increases, focus has shifted to pollution prevention where industries are to implement waste minimisation programmes and adoption of cleaner production.

Today managing of waste is once again undergoing another evolution. Waste is no longer limited to 'end-of-pipe' by product but extended to products development. Industries are responsible to collect back goods they manufactured and ensure they are safely disposed through the extended producer responsibility (EPR) requirement. For instance, the electronic industries are required to collect back the electronic waste at the end of the product life, as part of EPR requirement.

In the field of waste management, EPR is a strategy designed to promote the integration of environmental costs associated with goods throughout their life cycles into the market price of the products[8].

With this shift in environmental control happening globally, industries will have important roles to play in the overall waste management cycle. The authorities and private sectors as important players in waste management need to stay alert on changes that is happening around the world to be ahead of the challenges to come.

6.5.1.10 Moving Towards a Resource-Efficient Society: TN50 Green - Waste to Wealth

Building a resource-efficient society becomes a pre-requisite to support the Government's agenda in shifting from waste management to resource efficiency. Many instruments and measures are required to drive the agenda with the communities. Apart from recycling program, it is also important to continue the development of instruments which help to reduce the consumption of new resources and materials through advocacy and public awareness initiatives.

As a leading Ministry in promoting green technology agenda, KeTTHA has launched TN50 Green - Waste to Wealth to create green businesses of the future and income-earning opportunities for the rakyat by transforming waste into new sources of wealth. The programme was launched under the National Blue Ocean Strategy (NBOS) which will be implemented nationwide. The programme is intended to achieve the followings:

- make recycling easy and convenient for people to increase recycling rates while creating income-earning opportunities;
- accelerate mass adoption of recycling and change mindset of people by making recycling activities fun and entertaining while getting youth involved from an early age; and
- stimulate corporate investment in nationwide Waste to Energy businesses through new Public Private Partnerships (PPPs) that will integrate Government incentives across the chain of waste to energy.

[8] Extended Producer Responsibility: A Guidance Manual for Governments, Paris, France, OECD (2001)

6.0 TARGETS

The national targets for waste sector from 2020 to 2030 are specified in the table below:

SECTORS / AREAS	YEAR			INITIATIVES
	2020	2025	2030	
Waste treatment and disposal	• 22% Recycling rate	• 25% Recycling rate	• 28% Recycling rate	• Establishing the National Waste Management Steering Committee; • Enhancing coordination between Federal and State Governments; • Formulating policy paper on waste separation in non-household areas; • Strengthening public-private collaboration in R&D&C; • Developing market enablers through funding mechanism and creating market demand; • Developing competencies in the public and private sector; • Designing and implementing targeted awareness programs through education; and • Improving the strategy on the implementation of WtE.
	• 1 Waste to energy thermal plant	-	• 3 Waste-to-energy (WtE) thermal plans	
Resource recovery	• 500 palm oil mills with biogas capture facilities	-	-	• Emphasising the efficient use of waste as a resource; • Resource recovery from other sources of organic waste; • Extended Producer Responsibility (EPR) in facilitating growth in resource recovery.

Table 6.1 Targets and initiatives for Waste sector

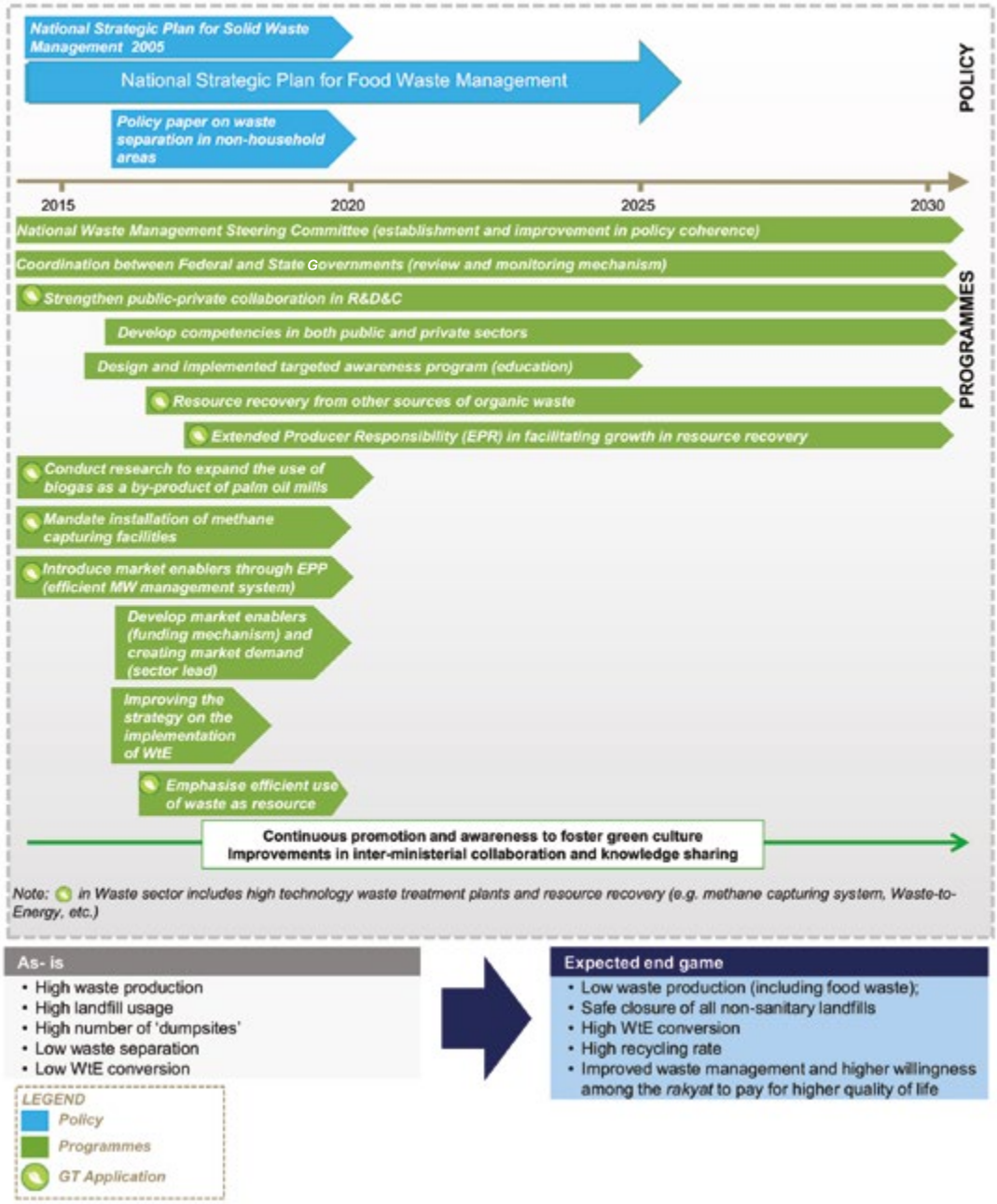

Figure 6.8 Targets and initiatives for Waste sector

7

WATER

SUMMARY

Integrated river basin management

Freshwater abstraction rate

2015	2025	2030
2%	10%	15%

Water harvesting technology

60% of towns in Malaysia will be installed with Rainwater Harvesting Systems by 2020

Water treatment and distribution technology

NRW

35.5% (2015)

25% (2025)

20% (2030)

Water utilisation technology

Increased number of labelled water efficient products

WEPLS will be mandatory by 2019

Wastewater treatment technology

Targets by **2030**

100% sludge to be recycled

33% treated effluent to be recycled

EXISTING INITIATIVES

Integrated river basin management
- One state one river

Water treatment and distribution
- Non-Revenue Water (NRW) (Action Plan and Reduction Programme)

Water utilisation
- Water Efficient Products Labelling Scheme (WEPLS)

Water harvesting
- Promotion and awareness programmes by National Hydraulic Research Institute of Malaysia (NAHRIM)
- Collaboration with industry association to develop technical guidelines, design promotion and awareness programmes, and law enforcement

Wastewater treatment
- Recycling of treated effluent and sludges
- Upgrading of non-compliant wastewater treatment plants
- Rationalisation of small sewage treatment plants (STPs)
- Targeted promotion at local authorities to promote the use of reclaimed water
- On-going R&D&C collaboration with local university

WAY FORWARD

Water treatment and distribution
- National NRW Reduction Program
- Water Demand Management Master Plan

Water utilisation
- Formation of R&D&C fund among private players and strengthening of existing Government funded R&D&C mechanism for water sector
- Educational-based promotion and awareness programmes and enhancement of WEPLS
- Long-term plan in matching water demand and supply at an effective water tariff rate

Water harvesting
- Implementation strategy for rainwater harvesting systems
- Master Plan for urban cities with sustainable water and environment
- Collaboration with industry association to create market enablers for rainwater harvesting system
- Integrated Urban Water Cycle Planning and Management (IUWCM)

Wastewater treatment
- National Sewerage Master Plan
- National Sewerage Catchment Plan
- Receiving of trade effluent into public STPs
- Integrated Resource Recovery Centre

Strengthening Regulatory Framework
- Amendments of Act 655 & 654
- Tariff setting mechanism
- Water Services restructuring

7.1 Introduction

Water is vital to human lives and fundamental to all development. Access to clean water has become a major concern as water is a necessity for all socio economic activities. Water underpins all socio economic activities and will have direct linkages with long term prospect of economic growth. With rapid economic growth and accelerated urbanisation, the demand for water also increases and huge pressure is placed on the supply of water. Green growth is a new paradigm to sustain economic growth by investing in eco systems and natural resources including water. In fact, water is one of the critical components of the visible structures of the economy. By linking green growth with water resource management, the country can sustain the long term economic growth prospect, support rapid urbanisation and drive agricultural and industrial development while improving the resilience to water related disasters as well as be prepared for water shortage and drought and improve sanitation.

Climate change will affect the natural ecosystem and people through water related issues. Water security, access to water supply for domestic and economic activities, pollution of water, floods, cyclones and droughts are among the myriad of issues currently faced. The Government needs to urgently and strategically address these to advertise the negative repercussions on social, environmental and economic development of the country.

7.2 Current Landscape

The predominant focus of the Malaysian Government in the water sector is to improve water efficiency and savings through integrated water management, monitoring of water usage, reducing losses and non-revenue water, and boosting overall water availability and reliability. The provision of quality and efficient water and sewerage services is essential in ensuring a high quality of life and facilitating economic development. The Government has started several initiatives that have been adopted such as applying water efficient system and appliances such as rainwater harvesting systems, smart monitoring and metering equipment, advanced leak detection equipment, non-revenue water control software, low-loss distribution equipment and storage equipment.

The existing water supply sector is heavily dependent on the country's freshwater reserves and tapping on surface water (especially rivers and dams) from rainfall. However, rainfall is unevenly distributed throughout the country. This, accompanied by the supply driven management of water, and a growing population, put tremendous pressure on existing water resources. In recent years, the country has experienced the effects of unprecedented climate change such as drought and El Nino, which further increased the pressure on water resources. These issues have resulted in certain states in Malaysia reaching their practical limit of surface water resource.

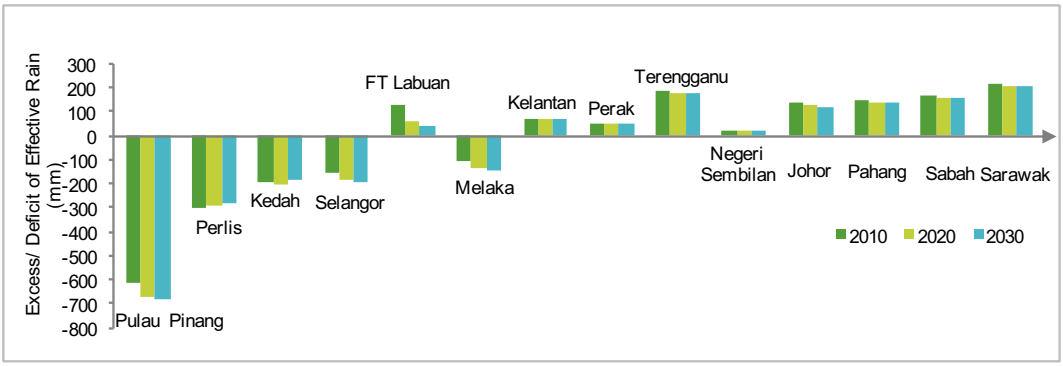

Figure 7.1: Review of the National Water Resources Study (2000-2050)[1]

Towards becoming a sustainable high income nation, the Government has recognised the need to be more efficient in its water management. Figure 7.1 illustrates the Review of the National Water Resources Study (2000-2050). To address the rising pressure on water resources, and improve water conservation and efficiency, the Government's efforts have been focused on the following strategic areas:

- Integrated river basin management;
- Water treatment and distribution technology, especially on Non-Revenue Water (NRW) management;
- Water utilisation technology, i.e. the introduction of water efficient products; and
- Water harvesting technology, specifically on Rainwater Harvesting Systems (RHS).

7.3 Issues and Challenges

Due to urbanisation and rapid economic development, the provision of quality water and sewerage services has become more challenging to the Government. Different issues and challenges are identified in the water supply industry and wastewater treatment industry:

7.3.1 Water Supply Industry

7.3.1.1 Reliability of Water Supply

Since more than 90% of water supply in Malaysia is from rivers, optimisation of the yields from unregulated flows of rivers is crucial in water supply management. Some states have also faced deficit of unregulated river flows. Pollution of rivers, changing of rainfall patterns and rising sea levels have also impacted water sources. Besides that, development of new areas and expansion of economic activities have also increased the demand of water supply.

[1]Department of Irrigation and Drainage Malaysia, 2011

7.3.1.2 Non-Revenue Water (NRW)

In 2015, NRW was recorded at 35.5% and the main factors contributed to the higher NRW were physical losses due to old network of pipes and poor workmanship by contractors especially in new development areas, commercial losses and also lack of knowledge and expertise in NRW.

7.3.1.3 Limited Coverage of Clean and Treated Water

Water supply coverage in the rural areas of Kelantan, Sabah and Sarawak is lower than the national average of 92.5%. For Sabah and Sarawak the scenario is due to their remoteness locations, low population density, difficult terrain and poor infrastructure access, which require high cost in providing water supply. Even though there is accessibility for water supply in Kelantan, the premises with connected services is low as there are other alternative sources, i.e groundwater to be used.

The water services industry is not self sustaining due to two (2) main issues which are high cost of operation and low tariff. This resulted in the industry not being sustainable.

7.3.2 Wastewater Treatment Industry

7.3.2.1 High Operational and Maintenance Cost

The service operators of sewage treatment plants are faced with high operational and maintenance costs while revenue from sewage tariffs are below the costs. Furthermore, higher costs are needed to upgrade the old sewage treatment plants.

7.3.2.2 Environmental Threats from Non-Connected Systems

The non-connected systems such as septic tank and pour flush systems mostly found in suburban and rural areas, discharge untreated effluent and sludge directly into water bodies.

7.4 Existing Initiatives

There are a lot of KeTTHA initiatives which have been implemented by the key stakeholders in the Malaysian water sector such as Suruhanjaya Perkhidmatan Air Negara (SPAN), Department of Irrigation and Drainage (DID), Indah Water Konsortium (IWK) and Jabatan Perkhidmatan Pembetungan (JPP). Among others, the initiatives include:

- **Integrated river basin management**
- **Water treatment and distribution**
  - Non-Revenue Water (NRW) Action Plan and Reduction Programme
- **Water utilisation**
  - Water Efficient Products Labelling Scheme (WEPLS)

- **Water harvesting**
  - Promotion and awareness programmes;
  - Collaboration with industry associations to develop technical guidelines, design promotion and awareness programmes, and law enforcement;

- **Wastewater treatment**
  - Recycling treated effluent and sludge;
  - Technical standards for recycling of treated effluent and composting of sludge;
  - Upgrading of non-compliant wastewater treatment plants;
  - Rationalisation of small STPs;
  - Targeted promotion at local authorities to promote the use of reclaimed water;
  - On-going R&D&C collaboration with local universities;

7.4.1 Integrated River Basin Management (IRBM)

Rivers are key source of water supply to the country. According to the Department of Irrigation and Drainage (DID), there are about 150 river systems in Peninsular Malaysia and 50 river systems in Sabah and Sarawak. (Table 7.1)

Area	No. of basin	Main basin (>80km^2)	Small basin
Peninsular Malaysia	1,235	74	1,161
Sabah	1,468	75	1,393
Sarawak	283	40	243
Total	2,986	189	2,797
Total area	327,897.03	312,863.71	15,033.86
% of total area	-	95%	5%

Table 7.1: River basins in Malaysia

Despite being endowed with an abundance of natural resources, water supply shortage is still experienced in certain states. Seasonal distribution of rainfall together with rapid economic growth, as well as urbanisation and migration in certain regions have rendered a higher ratio of population to the capacity of river basin which can support the demand for fresh water supply in some regions. Some of the challenges facing the country include:

- Flooding, especially flash flood in urban areas;
- River and water pollution;
- River sedimentation; and
- Presence of squatters within river reserves.

[2] Department of Irrigation and Drainage (DID), 2016

To manage the water resources in the country, the Government has introduced Integrated River Basin Management (IRBM), which is defined as the coordinated management of resources in natural environment (air, water, land, flora, fauna) based on river basin as a geographical unit, with the objective of balancing man's need with necessity of conserving resources to ensure their sustainability.

There are 8 components under IRBM namely: Enforcement; Institution; Legislation; Public awareness; Preventive; Curative; Planning; and Finance. To support IRBM, One State One River Programme was introduced in 2002. The programme required each state to select, with the agreement of State Government one polluted river to be rehabilitated. The rehabilitation programme is to be carried out over a 10 to 15 years' time frame with several short-term programmes. Key areas for GT application is as follows:

CURATIVE

Flood mitigation, river maintenance and rehabilitation, water quality improvement, biomediation, effective microorganisms, activated carbon, etc

PREVENTIVE

River conservancy, stormwater management manual, erosion and sediment control plan, gross pollutant trap, food, oil & grease trap, guidelines, gazetting of river reserves.

Figure 7.2: Two of the Components under IRBM

As of 2016, IRBM had covered a total area of 68,474km^2 throughout Peninsular Malaysia. By 2020, an additional 46,257.63km^2 areas will be covered, primarily in Penang, Kedah, Greater KL, Melaka, Johor, Pahang Terengganu, Sabah and Sarawak.

7.4.2 Water Treatment and Distribution

Several water operators are reported to be innovative in improving cost efficiency of water treatment at their plants. Amongst the initiatives is the use of energy efficient water pump, and by addressing the high non-revenue water (NRW). The Government has allocated a substantial amount of budget for the NRW Programme. NRW is critical to be addressed, especially in urban areas such as Kuala Lumpur as it reflects inefficiency in demand management. The National Water Resource Study forecasted the total water demand in Kuala Lumpur in 2015 is about 943 MLD, of which NRW constitutes about 270 MLD.

In line with the GT's definition, decreasing wastage of treated water by reducing NRW helps to manage resources efficiently. Maintaining the quality of piping used in distribution channels and controlling leakage are among the areas where GT could play a role. Managing NRW helps to shift towards a closed loop system by preventing clean water from being wasted.

7.4.2.1 Non-Revenue Water (NRW) Action Plan and Reduction Program

Since 2008, SPAN has been managing NRW, and in 2011 had organised an NRW national workshop to raise awareness of the issue. Following the workshop, a Special Task Force was formed to provide expertise on NRW and monitor NRW implementation issues. A comprehensive Action Plan, a policy framework and a reduction programme to decrease NRW was developed.

The NRW initiatives put in place include:

- Implementing NRW as Key Performance Indicators (KPIs) imposed on all water distribution operators;
- All operators are required to submit a quarterly report on NRW volumes;
- NRW controls are monitored on a quarterly basis; and
- NRW audits by SPAN are continuously carried out.

The priority for the Government in the next three (3) years is for all water distribution operators to address to the physical and commercial losses in the Water Balance, and the development of Action Plans. To do so, the Government has finalised the NRW Action Plan in 2013, which focuses on improving the NRW policy framework in the country. The Action Plan[3] comprises of eight strategies:

- Holistic NRW management;
- Management concept of "Preventive Compared to Reactive";
- Sustainable funding;
- Effective mechanism for monitoring of NRW management;
- Development of effective organisation structure;
- Human capacity building in managing NRW;
- Improvement of Research, Development and Innovation in managing NRW; and
- Public Education and Awareness Programme on NRW management.

Did you know?

The level of NRW in Putrajaya is 11%. The level of NRW in developed countries is estimated at 15%.
Source: SPAN (2015) World Bank (2006)

NRW level in Denmark is less than 10%. Many decentralised Danish water supplies have almost eliminated NRW.
Source: International Water Association (2015)

7.4.3 Water Utilisation

RMK11 focuses on improving efficiency of the water services industry towards achieving long-term financial sustainability and continuous renewal of water as a resource. Aside from conservation efforts, water savings by the end-user is also being encouraged through water utilisation technology. Implementing water-efficient products is a way to reduce water wastage.

[3] Suruhanjaya Perkhidmatan Air Negara (SPAN), 2012 & 2013

7.4.3.1 Water Efficient Products Labelling Scheme (WEPLS)

The Government has introduced WEPLS to enhance consumers' awareness on the importance of reducing water consumption. In 2013, water efficient products contributed about RM111.1 million towards Malaysia's GDP. The enforcement of mandatory usage of water efficient product for sanitary ware will increase the GDP contribution to about RM464.3 million by 2020 and RM965.9 million by 2030[4].

Products that can be registered under WEPLS are:

- Water tap;
- Water closet;
- Urinal;
- Washing machine; and
- Showerhead.

The existing initiatives in advocating water efficiency are primarily on institutional framework through WEPLS. The scheme was initiated by SPAN in Jan 2013 as voluntary programme but it will be mandatory by 2019 to register and label water-efficient products. The WEPLS label informs consumers of the product's water efficiency rating, which helps to increase consumers' understanding of the product and allows them to factor this information into their purchasing decisions. The Scheme aims to raise awareness of the availability of water-efficient products in Malaysia whilst encouraging suppliers to participate in the development of the water-efficient technology in Malaysia.

Products to be registered under WEPLS must be tested for their water efficiency according to the WEPLS Guidelines published by SPAN. The testing is carried out by independent testing laboratories that are recognised by SPAN, and accredited under the National Laboratory Accreditation Scheme.

More about WEPLS:

- Registered products are given a WEPLS label displaying key information, e.g. star rating, water efficiency, registration number and product-specific information, including brand and model; and
- Products are rated according to their nominal flow rates. The higher the water efficiency grade, the more stars they are awarded. Ratings are between one to three stars, and products with an automated shut-off device receive an extra star.

7.4.4 Water Harvesting

Water harvesting technology refers to the optimisation of available water resources, encompassing water collection, storage, treatment and harvesting techniques. The water resources include rainwater, surface water (such as runoffs), groundwater, treated effluent or grey water.

Malaysia receives 1 trillion cubic metres of annual rainfall, of which 93% is not collected for resource optimisation, especially for non-potable use. Freshwater abstraction is only 2% in the country.

[4] Economic Assessment on the Green Business Environment in Malaysia, PwC Consulting Services (M) Sdn Bhd ("PwC"), 2014.

Capturing rainwater and using it for non-potable purposes strengthens the closed loop system by preventing wastage of clean water and maximising usage of resources. (Table 7.2)

Annual rainfall		%	Usage	%
1 Trillion cubic meter	Rainfall lost	93%	Surface runoff	93%
			Evaporation	
	Rainfall used	1%	Agriculture	76%
			Industry	13%
			Domestic	11%

Table 7.2: Average annual rainfall in Malaysia[5]

The Government has been active in encouraging the adoption of rainwater harvesting systems (RHSs) in Malaysia since 1998. In 1999, the Cabinet discussed and approved the RHS Guideline. The Rainwater Harvesting Guidebook was published in 2009. In 2012, the Government amended the 1984 UBBL, which requires newly-built buildings with a roof area of 100 square meters and above to be equipped with RHSs. In 2013, RHS is estimated to contribute about RM5.6 million to Malaysia's GDP. Training course programme for RHSs in buildings was released in 2014. The Government aims to increase the freshwater abstraction rate to 10% by 2025 and 15% by 2030. This includes the target of implementing RHSs in 60% of towns nationwide by 2020. RHS's GDP contribution is likely to increase to RM364.8 million (2020) and RM758.9 million (2030) if the UBBL on RHS is enforced on all new properties in Malaysia.

The Government has been implementing promotion and awareness programmes in the country on RHS specifically. Collaboration with the private sector is also fostered to strengthen the institutional framework for the industry. NAHRIM facilitated the establishment of the Malaysia Rainwater Harvesting Systems Association (PERSPAH).

7.4.4.1 Promotion and Awareness Programmes

NAHRIM initiated six programmes to raise awareness among the public, private players and Non-Governmental Organisations (NGOs) on the benefits of installing RHSs.
These include:

- Raising awareness at primary and secondary schools through collaboration with the NGO Treat Every Environment Special Sdn. Bhd. (TrEES);
- Hosting technical and academic site visits by the public and educational institutions at several RHS locations, such as Zoo Negara, the Selangor State Government Office, Paya Indah Wetlands and Incubator NAHRIM;

[5] National Hydraulic Research Institute of Malaysia (NAHRIM), 2012

- Seminars and workshops on RHSs regarding the Design Guide for residential RHS, RHS pilot projects and Tangki NAHRIM;
- Collaboration with universities, learning agencies and technical entities, on a RHS pilot project. NAHRIM has also undertaken 10 RHS projects since 2001. These include residential buildings, religious sites, public spaces, Government headquarters and traditional infrastructures; and
- Providing consultancy and technical advisory on RHS for the public, private players and Government agencies that are required to install or construct RHSs on their premises.

7.4.4.2 Collaboration with Industry Associations

NAHRIM has been in active discussion with PERSPAH on several RHS issues, including the limited common standards and guidelines on design, materials, pumps, filtration systems, storage systems, tank sizing, and maintenance schedule and water quality. Action plans that have been developed through these discussions include:

- Promoting rainwater harvesting as a solution to water scarcity, which aims to increase the take up rate for RHSs and reduce water demand for treated water;
- Producing a comprehensive technical guideline on RHS, including design, materials, pumps, filtration systems, storage systems, tank sizing, maintenance scheduling and water quality; and
- Collaboration amongst several stakeholders, including the Government, private sector, the public and NGOs to enforce related laws and knowledge transfer of RHS technologies from Germany and Australia.

7.4.5 Wastewater Treatment

7.4.5.1 Recycling Treated Effluent and Sludge

In 2016, there are more than 9,700 sewage treatment plants in Malaysia. About 6,500 consists of public Sewage Treatment Plants (STPs). Among the public sewage treatment plants, 90 STPs are identified as potential STPs capable of producing treated effluent and sludge.

Instead of releasing the treated effluent to the environment, treated effluent should be further treated as reclaimed water for non-potable application to reduce the pressure on existing potable water supply. Reclaimed water is recommended for application of non-food related field i.e. non-food crop agriculture and non-food related industry application. It can be delivered to the end user via a closed loop system or by tankers.

Sludge from STPs can be recycled as biosolids which is recommended for application as fertiliser for non-food crop agriculture, energy production and raw materials for other green technology products.

Key success factors for this initiative include conducting various awareness and communication programs, setting up incentives and establishing the necessary policy and regulatory support.

As of 2015, there were 3.4 million accounts for connected sewerage services with a handling capacity of 26.1 million population equivalent (PE). Seven states (7) registered more than the national average handling capacity, with the Federal Territory of Putrajaya achieving 100% coverage of connected sewerage services. The extensive coverage of sewage treatment in some states indicates the immense potential for treated effluent and sludge recycling program at regional or central treatment plants.

The Government is aiming to recycle one third of treated effluent by 2030. The use of recycled sludge as fertilisers for municipal landscape plants reduces CO_2 emissions by 3 $MTCO_2eq$, compared to disposal at municipal landfill sites. By 2030, the Government targets to maximise the potential of sewage by increasing the recycling rate of sludge to 100%. The sludge shall also be tapped for RE purposes to generate electricity for the usage at the sewage treatment plants.

7.4.5.2 Technical Standards for the Recycling of Treated Effluent and Composting of Sludge

SPAN is developing the technical standards for the recycling of treated effluent and sludge. Inputs from the industries are retrieved to ensure that all technical aspects of treated effluent and sludge recycling are sound.

Did you know?

There are important nutrients such as sulphur, phosphorus, organic matters in sewage sludge which are valuable resources. In 2013, Denmark recycled 50 – 55% of sludge through exploiting the phosphorus in the ash from incinerating sludge as fertiliser or by spreading it on agricultural soil. Denmark aspires to recycle 80% of the phosphorus in the sludge by 2018.
Source: The Danish Government (2013)

The new Pantai 2 Sewage Treatment Plant is designed to reuse treated effluent and generating electricity from biogas captured through the sludge treatment.
Source: Sewerage Service Department (Accessed and retrieved in March 2017)

7.4.5.3 Targeted Promotion of Reclaimed Water and Biosolids

Promotion and awareness programs have been conducted to increase acceptance of reclaimed water and biosolids. Participation from various stakeholders have shown positive uptake on the utilisation of reclaimed water and biosolids. Some Malaysian local authorities have been using reclaimed water and biosolids for landscaping. In addition to that, the private sector has utilised reclaimed water at construction sites.

7.4.5.4 On-Going Research, Development and Commercialisation (R&D&C) Collaboration with Local Universities

Various R&D projects have been initiated to improve both the quantity and quality of reclaimed water and biosolids. These include:

- Sewage sludge as a fertiliser for various crops;
- Sludge as soil amendment;
- Co-composting of sewage sludge;
- Effectiveness of sludge lagoons in Malaysia;
- Application of sewage sludge in forest rehabilitation and regeneration;
- Dewatering of waste sludge by two stage integrated technique;
- Sludge thickening and dewatering using natural local polymer; and
- Drying of sludge for building material application.

Among the R&D projects carried out, selective success outcomes have been identified as potential commercial products to targeted industries.

7.5 Way Forward

In its transition towards becoming a high income nation, the Government of Malaysia has adopted a demand driven approach to manage water resources in the country. The primary target of the Government is to ensure accessibility to clean water for 99% of the population by 2020. The following are the initiatives which will be prioritised in the coming years:

Water treatment and distribution

- National NRW Reduction Program;
- Water Demand Management Master Plan;

Water utilisation

- Formation of R&D&C fund among private players and strengthening of existing Government funded R&D&C mechanism on water sector;
- Educational-based promotion and awareness programme and enhancement of WEPLS;
- Long-term plan in matching water demand and supply at an effective water tariff rate;

Water harvesting

- Implementation strategy for rainwater harvesting systems;
- Master Plan for urban cities with sustainable water and environment;
- Collaboration with industry associations to create market enablers for rainwater harvesting system;
- Integrated Urban Water Cycle Planning and Management (IUWCM);

Wastewater treatment

- National Sewerage Catchment Plan;
- Integrated Resource Recovery Centre;

Strengthening regulatory framework

- Amendment of Act 655 & 654;
- Tariff setting mechanism (TSM);
- Water Services Restructuring;

7.5.1 Water Treatment and Distribution

The upcoming initiatives will be focused on strengthening the institutional framework via policy development:

7.5.1.1 National NRW Reduction Program

The Government has outlined National NRW Reduction Program for all NRW actions in the next three years (2017-2020), which consist of valuing short-term projects, quick wins and higher impact programmes. The Government is targeting to reduce national NRW levels to 25% by 2025, and 15% by 2030.

7.5.1.2 Master Plan on Water Demand Management

The Government will develop a Master Plan on water demand management, which aims to provide tools to forecast water demand. Priority will be given to reduce the use of treated water for non-potable uses and revision of tariffs. In addition, promotional and educational programmes will be intensified to promote the efficient and prudent use of water in all related economic sectors, especially the agriculture sector, which comprises 68% of total water consumption in Malaysia but also contributes about 10% to Malaysian GDP.

Long-term plan on the following will also be developed:

- Increase efficient use of treated water for industrial purposes;
- Address the water demand in water-stressed states, especially in urban areas, and also improving the irrigation efficiency for the agriculture sector using an integrated water management approach;
- Improve awareness on the importance of conserving water as a resource; and
- Implement tariff setting mechanism that reflects the true cost of water, including the environmental costs.

Stakeholder engagement with the State Government will be initiated to understand the concerns and challenges in each state, in order to design specific strategies to monitor and encourage collaboration at state and local authority levels. Some of the initiatives for GT applications include:

- Increase usage of recycle water for industrial & non-potable usage towards minimum discharge with the application of green technology; and
- The construction of wetlands to avoid direct discharge to water bodies.

7.5.2 Water Utilisation

Given the challenges Malaysia face with water deficiency in some states, the Government has prioritised water-efficient products and encouraged a demand-driven market for these products. In particular, the Government has implemented the following initiatives:

7.5.2.1 Strengthening Existing Research, Development and Commercialisation (R&D&C) Management Mechanism

The existing cross-ministerial mechanism in the management of the Government's R&D&C fund, that is the Public Funds Investment Committee or Jawatankuasa Pengurusan Dana Awam (JKPDA), will be strengthened to facilitate public-private R&D projects on water security.

A working group consisting of NRE, MOSTI, the Ministry of Higher Education (MOHE), KeTTHA (including SPAN and the Sewerage Services Department), water operators and technology providers will be established. This serves as a platform to enable knowledge exchange on various R&D efforts currently undertaken by the Government among different ministries.

At present, there are limited platforms for knowledge sharing on R&D efforts which are undertaken by different ministries. The establishment of a knowledge sharing mechanism is essential to facilitate the identification of opportunities for more collaboration and effective resource utilisation.

Leveraging on the incentives in place for R&D, existing private players will be encouraged to establish an industry fund to finance R&D projects in the water sector. This will ensure that the projects are outcome-driven and targeted for commercialisation. In collaboration with State Governments, SPAN will encourage the water and sewerage operators to:

- Explore their readiness in contributing to the R&D&C fund;
- Understand their needs in terms of technological support;
- Identify and create enablers to encourage their participation;
- Determine clearly the objectives and the use of the fund;

7.5.2.2 Promotion and Awareness

A fact-based educational approach is under planning to improve the effectiveness of promotion and awareness programmes. SPAN plans to conduct a water consumption study in collaboration with KeTTHA at five academic institutions. These studies will analyse the use of water amongst students. Subsequently, educational programmes will be conducted to increase students' awareness of the importance of saving water.

7.5.2.3 Enhancement of Water Efficient Product Labelling Scheme (WEPLS)

The Government is developing a comprehensive strategic plan to enhance the effectiveness of the WEPLS and target promotional campaigns at suppliers and consumers. Apart from this, the Government is also planning to implement the WEPLS as mandatory legislation, which will be applied to both local and imported products by 2019.

7.5.2.4 Long-Term Plan in Matching Water Demand and Supply at an Effective Water Tariff Rate

The existing water tariff rate is unable to incentivise water savings at the consumers' end. A long term plan in matching water demand and supply at an effective water tariff rate will be developed to prepare for the transition towards sustainable development.

The long term plan will consider the following aspects:

- Improved access to quality water supply and reduced supply interruption;
- Gradual increase in the water tariff rate based on water consumption and income growth rate, supported by incentives; and
- Strategic pilot projects will be studied and formulated to encourage water savings at targeted communities.

7.5.3 Water Harvesting

7.5.3.1 Implementation Strategy for Rainwater Harvesting System

The Government's strategy to further implement RHSs includes:

- Developing and upgrading RHS infrastructure to improve storm water management;
- Incorporate requirements for selected public institutions (such as schools, hospitals and military camps) to install RHSs as determined by the Government;
- Promoting harvested rainwater as an alternative source of water; and
- Enhancing stakeholder participation and awareness of RHSs, especially collaboration with MIDA to leverage on GITA to encourage existing buildings to adopt RHSs.

7.5.3.2 Master Plan for Urban Cities with Sustainable Water and Environment

Currently, NAHRIM has been entrusted by the National Water Resources Council and the Ministry of Federal Territories to conduct a study titled "Urban Conjunctive Water Resources for Kuala Lumpur Independent Water Supply", which is a 2016 to 2018 Master Plan for urban cities with sustainable water and environment.

7.5.3.3 Public-Private Collaboration to create Market Enablers

Moving forward, NAHRIM will collaborate with PERSPAH and other Government bodies to support:

- Producing local products with more variety of RHSs;
- Setting relatively competitive prices for local products compared to imported products;
- Providing tax exemption on R&D developments of local RHS products; and
- Offering attractive funds for the development of RHS technologies and products.

7.5.3.4 Integrated Urban Water Cycle Planning and Management (IUWCM)

Apart from rainwater, there is a need to explore the use of water harvesting technologies on other type of water resources, especially in water-stressed states which receive less rainfall but have high water demand. In particular, the State Government of water-stressed states such as Penang, Perlis, Kedah, Selangor and Melaka will need to take the lead in this exercise since the jurisdiction of water supply and distribution overlaps between the state and federal Government.

Mapping of water demand and supply (resources) will be commissioned to identify the most cost-effective alternative water resource option. Existing Government Research Institutes such as NAHRIM will be leveraged to embark on its existing research to improve efficiency in water management. Collaboration among various Government entities such as KeTTHA and NRE (Department of Irrigation and Drainage) will be strengthened to explore water harvesting and storage technology and also its application in urban areas facing water scarcity issues.

The Integrated Urban Water Management (IUWM) represents the managed hydrological cycles and systems of a Water Sensitive City. In short, IUWCM offers 'broader solutions' that satisfy the water-sensitive urban design and 'liveable cities and towns' objectives.

IUWCM is one of the pioneer research projects conducted in Malaysia by NAHRIM with selected pilot study in the KL City. This project has been approved in RMK 11 with the implementation study's duration of 3 years starting from 2017 till 2019. The Integrated Urban Water Cycle (IUWC) practices propose water conservation and efficient use of water.

It is believed that the IUWCM in the KL region can potentially provide at least 40% independence in relation to the existing treated water supply. Under this project, the KL region is demarcated into 10 zones, involving approximately 1.5 million people. This project will identify alternative water resources which are highly available to function as supplementary water supply. Subsequently, this will reduce the dependence on treated water supply for non-potable uses. As a result, the decentralised water supply will also reduce NRW in the system.

To support IUWCM, the following initiatives are put in place:

- Promotion and awareness programme led by NRE and KeTTHA, as well as NAHRIM, The programme will focus on strengthening the implementation of GT in water related infrastructure and facility for water sustainable development and climate resilience;

- Human capital development via knowledge and technology transfer – a series of technical capability building, on job training on modelling and design, water management exposure and involvement in international or local conference, seminar, forum and workshop will be rolled out;

- R&D&C – Higher involvement of key players in the water and water supply industry to look into localised technologies, such as water treatment system (nano technology), filtration (membrane technology), modernised water treatment plant and decentralised treatment plant with GT application;

- Market enablers – IUWCM will be included in Government projects and premises through the Government green procurement;

Integrated with other types of technologies, the various sources of water can be optimised for its intended use. In other words, the value of various sources of water is optimised to address the water demand for different purposes. Consequently, the cost of treating water (which is also associated with the energy needs), will be reduced. Water resources are better conserved to ensure the sustainable supply of freshwater while minimising the impact to the environment.

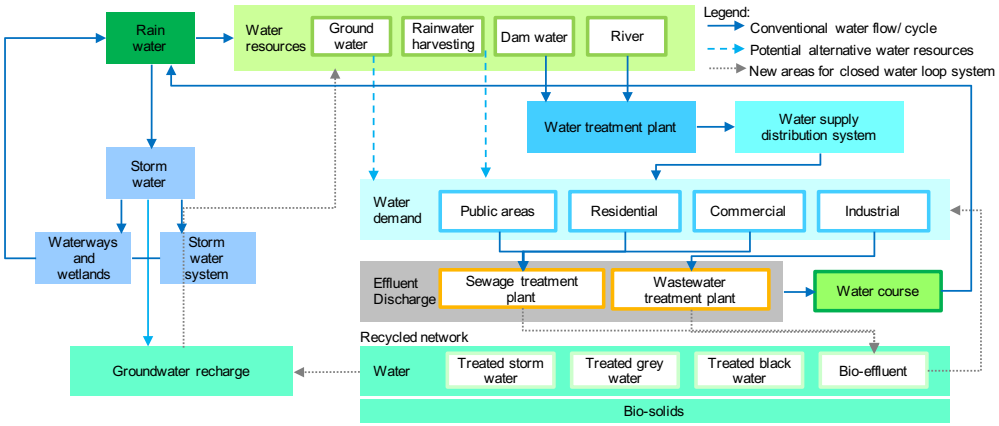

Figure 7.3 IUWCM and closed water loop system[6]

7.5.4 Wastewater Treatment

The Government's focus to drive industry growth is as follows:

- Policy support for the commercialisation of treated effluent and sludge technologies; and
- Promotion and awareness to change the mindset of water consumers on the safe usage of reclaimed water.

7.5.4.1 National Sewerage Catchment Plan (NSCP)

The NSCP is being formulated by SPAN in accordance to the provisions in Suruhanjaya Perkhidmatan Air Negara Act 2006 (Act 654). This document will encompass sewerage planning policy and strategies that will cover the planning needs of the nation. This document will be used as a guide to prepare a sewerage development plan that is appropriate for the needs of the area, to determine the investment required for sewerage infrastructure that will consider the whole life cycle cost, to encourage resource recovery from point source up to by-products of sewage treatment and to facilitate inter agency coordination. The NSCP will also include strategic plans on the identification of catchment areas and the rationalisation of treatment plants. Last but not least, it is also to be used as a guide to promote participation amongst stakeholders in order to create awareness within the sewerage sector.

7.5.4.2 Receiving of Trade Effluent into Public STP

Public sewage treatment plant is aiming to receive trade effluent from industry in view of reducing pollution at point source to the environment. It is not only intended to reduce the enforcement and monitoring cost from the Government but also to integrate treatment plants.

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[6] National Hydraulic Research Institute of Malaysia (NAHRIM) ,2016, Suruhanjaya Perkhidmatan Air Negara (SPAN Malaysia), 2016, Malaysian Green Technology Corporation (MGTC), 2016

Currently the stakeholders are in the middle of developing the necessary policy, legislation and guideline on trade effluent. A feasibility study and a pilot study on receiving trade effluent are also in the pipeline.

7.5.4.3 Integrated Resources Recovery Center (IRRC)

All organic water in terms of liquid and solids will be treated in the IRRC to leverage on the facilities for the wastewater treatment plant and the digester. This will help to promote the production of reclaimed water and the generation of more gases for electricity or biomethane as fuel. Several locations have been identified as potential sites for future development of IRRC.

7.5.5 Strengthening Regulatory Framework

7.5.5.1 Amendment of Act 655 & 654

The Water Services Commission Act 2006 (Act 654) and Water Services Industry Act 2006 (Act 655) came into effect in year 2008. In the past 9 years, SPAN noticed that there were various policy changes and unclear interpretation leading to weak implementation and enforcement activities. Therefore, SPAN proposed 51 amendments to Act 655 and 4 amendments to Act 654 to address the limitations of existing provisions in order to improve effective implementation and enforcement of these acts.

7.5.5.2 Tariff Setting Mechanism (TSM)

Tariff setting mechanism (TSM) is a robust, fair and transparent tariff setting process to ensure full cost recovery of the water industry. It is conceptualised from the Regulatory Water Accounting (RWA) framework in promoting the transparency of financial information and performance of water operators where information on costs and performance levels will be disclosed to consumers who will then know what they are paying for and what they are getting in return. In the short and medium term, the increasing block tariff model is adopted under TSM, where moderate to heavy users will be charged at full supply costs. Whereas in the long term, tariff model for domestic and non-domestic should be based on Uniform Volumetric Charge, where users pay a flat rate for the cost of water services.

In setting the base for the implementation of TSM, SPAN has conducted a few related studies on RWA and cost benchmarking for the water services industry. KeTTHA and SPAN plan to implement TSM in stages, starting off with a tariff structure harmonisation, followed by a gradual increase in tariff rate. Moving forward, SPAN will conduct stakeholders' engagement to solicit feedback and to get buy-in prior to nationwide implementation.

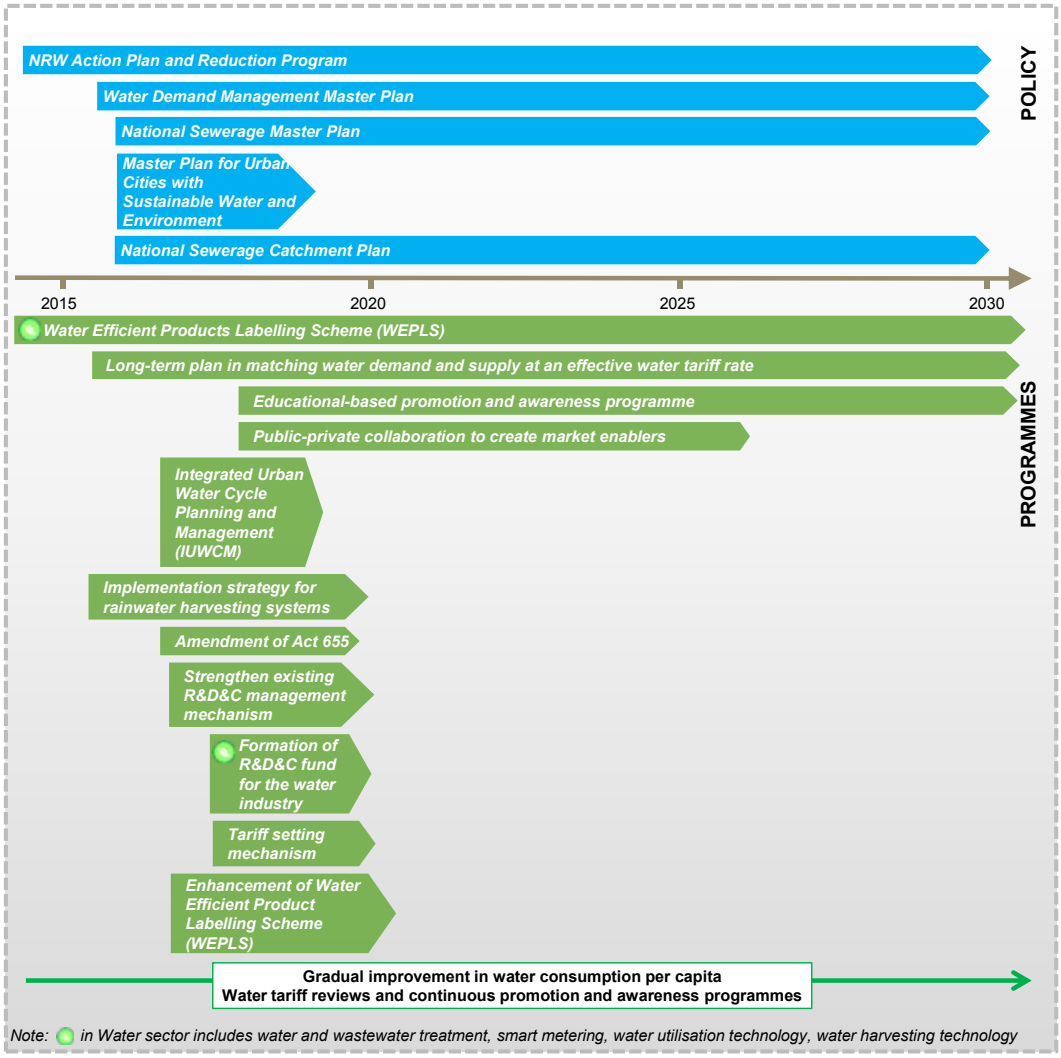
7.6 Targets

SECTORS / AREAS	2020	2025	2030	INITIATIVES
Integrated river basin management (IRBM)	-	10% (freshwater abstraction rate)	15% (freshwater abstraction rate)	Widening area covered by IRBM
Water utilisation technology	WEPLS will be mandatory by 2019	-	-	• Formation of R&D&C fund among private players and strengthening of existing Government funded R&D&C mechanism for water sector • Educational-based promotion and awareness programmes and enhancement of WEPLS • Long-term plan in matching water demand and supply at an effective water tariff rate
Water treatment and distribution technology	-	25% (NRW)	20% (NRW)	• National NRW Reduction Program • Water Demand Management Master Plan

SECTORS / AREAS	2020	2025	2030	INITIATIVES
Water harvesting technology	• 60% of towns in Malaysia installed with Rainwater Harvesting Systems	-	-	• Implementation strategy for rainwater harvesting systems • Master Plan for urban cities with sustainable water and environment • Collaboration with industry association to create market enablers for rainwater harvesting system • Integrated Urban Water Cycle Planning and Management (IUWCM)
Wastewater treatment	-	-	100% (sludge to be recycled) 33% treated effluent to be recycled	• National Sewerage Master Plan • National Sewerage Catchment Plan • Receiving of trade effluent into public STPs • Integrated Resource Recovery Centre

Table 7.3: Targets in Water Sector

Figure 7.4 below shows the Project timeline for water sector until year 2030.



As- is

- High water consumption per capita, especially using clean water for non-potable purpose
- Low water tariff rates which leads to wastage
- Open water loop system, High NRW and Low RHS

Expected end game

- Energy efficient at water and wastewater treatment plants
- Public willingness to pay for high quality of water
- Reduced reliance on treated clean water for non-potable use
- Closed water loop system for sustainable water cycle management
- High application of GT as a way of life

LEGEND

- *Policy*
- *Programmes*
- *GT Application*

Figure 7.4: Timeline for water sector

8

STRATEGIC THRUSTS

8.1 Conducive Ecosystems are Essential to Pave the Way for Green Technology Development

To shift into GT development mode, the Government has outlined its plans in creating conducive ecosystems for GT growth. Five strategic thrusts were identified in the NGTP, in line with RMK-11. The GTMP outlines the key areas for improvement identified under each strategic thrust in the next five years. To complement the NGTP, each strategic thrust will outline specific outcomes to be achieved, providing the fundamentals to establishing conducive ecosystems for GT development.

Efforts need to be intensified, especially to inculcate a green culture and lifestyle which creates the essential market demand for driving GT innovation and growth. The aspiration is to transform Malaysia into a GT hub post-2020.

Figure 8.1: GTMP Strategic Thrusts[1]

STRATEGIC THRUST	KEY AREAS	OUTCOMES
Promotion and awareness	• Tailored communication strategy • Industry and business promotion via International Greentech & Eco Products Exhibition & other platforms. • Collaboration with primary & secondary educational institutions	• Improved awareness & receptiveness towards GT • Increase in business transaction, entrepreneurship & global value chain integration • Improved knowledge on GT among the younger generation to drive behavioural change
Market enablers	• Government Green Procurement (GGP) • Green incentives • Innovative financing • Green cities • International collaborations	• Strengthened industry readiness in the production of green products & services • Improved financial feasibility of green projects & affordability of green products and services • Improved infrastructure readiness for green adoption; • Creation of export opportunities through regional collaborations
Human capital development	• Capability building in the public sector • Capability building in the private sector • Collaboration with higher education institutions	• Improved knowledge of Government officials • Increase in recognition of skills and competencies • Improved workforce readiness of fresh graduates

[1] Malaysian Green Technology Corporation (MGTC), 2016

STRATEGIC THRUST	KEY AREAS	OUTCOMES
R&D&C	• R&D&C funding • Public-private partnership	• Demand-driven, market and result oriented R&D&C projects, • Stronger collaboration among Government bodies & research institutes in information sharing to enable efficient strategic planning and resource deployment
Institutional framework	• Governance (policy leadership) • Policy planning • Policy implementation	• Strengthened governance to facilitate cross-sectoral cooperation among Government bodies to improve the ease of doing business

Table 8.1: GTMP Strategic Thrusts and Targeted Outcomes[2]

8.2 Strategic Thrust 1: Promotion and Awareness

8.2.1 Changing the Mindset of the Rakyat to Embark on a Green Lifestyle

Exposure to technological advancements and their benefits help the public understand the importance of GT, subsequently improving their receptiveness and willingness to adopt GT.

At present, GT promotion and awareness programmes are executed via three key platforms:

- Website portals, roadshows, advertisement, social platforms and flyers;
- International Greentech & Eco Products Exhibitions & Conference Malaysia (IGEM); and
- Awareness programmes via education.

In recent years, there has been a shift to more innovative ways of promotion that leverage on information communication technology, demonstrated in the increasing use of social platforms and website portals.

8.2.2 Moving Forward

There will be increased public consultations and communications with four target audiences (Figure 8.2) which will be well-thought out and prioritised based on the desired outcomes that the respective agencies aim to achieve.

The communication strategies employed will be focused on advocating a green lifestyle and the mode of communication will be differentiated according to the needs of the specific target audience.

[2] Malaysian Green Technology Corporation (MGTC), 2016

Figure 8.2: Target Audience of Promotional Awareness Programs[3]

Promotion and awareness in cultivating a green lifestyle will require cross-sectoral collaboration among KeTTHA, NRE, MOSTI, MOE, MOHE and other stakeholders. In addition, proactive engagement with the NGOs will also be fostered to increase the coverage of the promotional programmes on green lifestyle to civil society.

8.2.3 Preparing the Future Generation for Green Lifestyle

8.2.3.1 Awareness Programmes via Education

To inculcate the green culture in local communities, it is important to start the awareness at a young age. This will equip the future generation with relevant GT knowledge, helping them to understand the benefits of GT to drive behavioural change. As a consequence, the larger community will be impacted through their interaction with the family and community. At present, promotion and awareness programmes for the younger generation is undertaken by:

- Yayasan Hijau Malaysia (YaHijau); and
- Centre for Education, Training, and Research in Renewable Energy and Energy Efficiency (CETREE).

[3] Malaysian Green Technology Corporation (MGTC), 2016

8.2.3.2 Yayasan Hijau Malaysia (YaHijau)

YaHijau was launched in 2014 with the objective of promoting and educating the public, especially the youth, on the importance of GT and sustainable living. YaHijau adopts an integrated approach in its initiatives with both students and communities to transform the mindset towards GT.

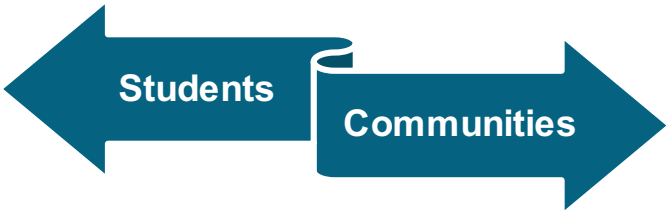


Figure 8.3: YaHijau's two pronged approach[4]

YaHijau has conducted corporate social responsibility initiatives, activities and sponsorships that have been important in encouraging corporations, communities and the public in adopting green practices. Examples of these are through their YaHijau Carnival, Green Youth and Green Education programs.

8.2.3.3 Centre for Education, Training and Research in Renewable Energy and Energy Efficiency (CETREE)

The inception of CETREE in 2000 marked the Government's commitment in establishing a centre to provide education and training, especially in renewable energy and energy efficiency, for professionals, schools, tertiary institutions and the public in Malaysia.

Over the years, the role of CETREE has evolved, increasingly focusing on equipping students with GT knowledge which can be practically applied in their daily routine. The existing target audience of CETREE are primarily secondary school children throughout the country.

8.2.3.4 Cross Curriculum Education Modules

The shared objectives have brought YaHijau and CETREE together, in collaboration with Universiti Sains Malaysia and MOE to develop the GT Cross Curriculum Education Modules for secondary schools. The implementing agency of the project is CETREE, with the following objectives:

- Training teachers in GT methodologies and implementation; and
- Educating secondary school children on GT.

The project is also augmented with school competitions on GT at the state and national levels which create and sustain interest in GT. The Modules will be extended to primary schools, with a target roll out by 2020, benefitting 7,769 primary schools. Besides the six sectors in the GTMP, the modules also cover agriculture and forestry to provide a holistic concept of GHG emissions.

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[4] Yayasan Hijau Malaysia (YaHijau), 2016

8.2.4 Creating a multiplier effect, reaching out to larger communities

Further outreach which blends the youth activities into the community is achieved through the YaHijau Carnivals and eco-youth camps.

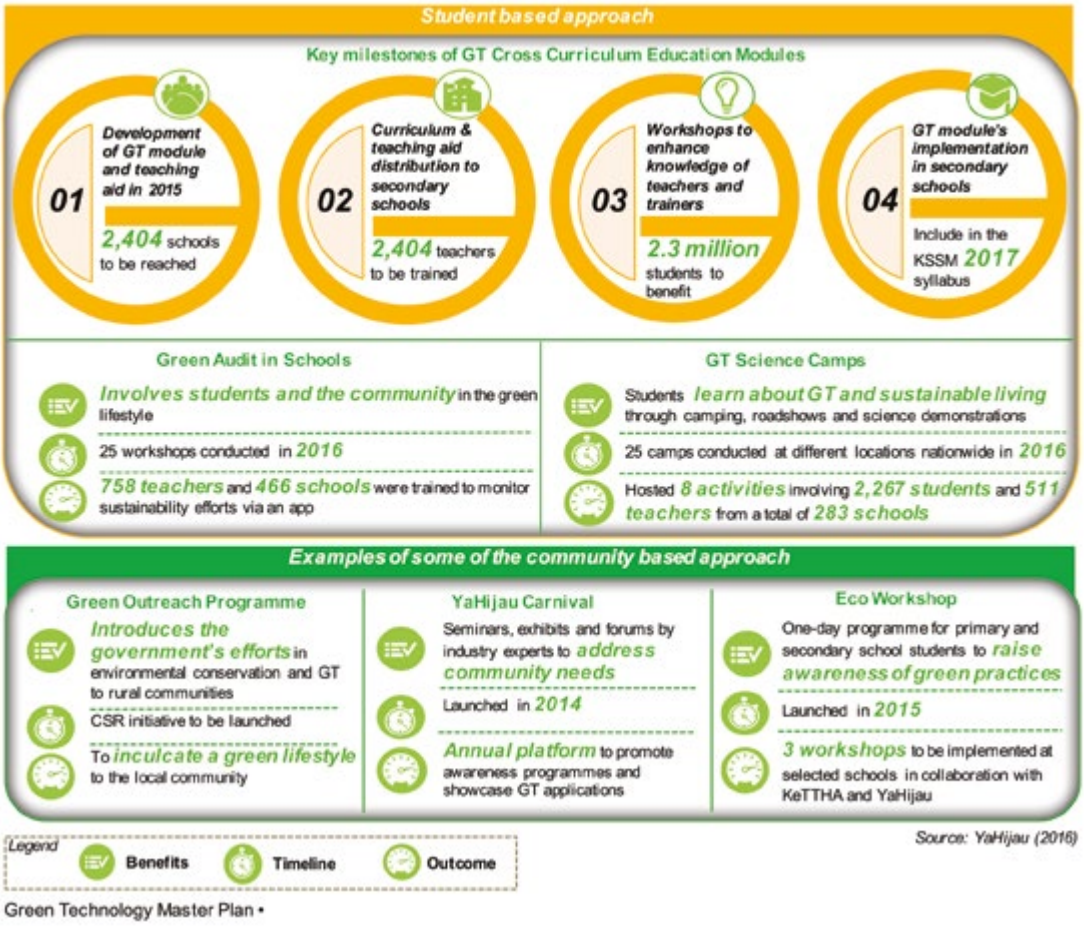

Figure 8.4: GT Cross Curriculum Education Modules[5]

Figure 8.4 shows the different types of green education modules, the topics they cover and how widespread their reach has been.

8.2.4.1 Moving Forward

The target audience of the GT programmes will encompass people from all walks of life, starting from a wider outreach to school communities followed by communities at grassroots level.

Besides the existing initiatives, YaHijau proactively looks for other platforms to convey the green lifestyle message (Figure 8.5). It is exploring the possibility of inserting its initiatives into universities and the healthcare industry.

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[5] Yayasan Hijau Malaysia (YaHijau), 2016

For rural areas, YaHijau awareness programmes will target indigenous communities, who depend on the environment for their livelihood. YaHijau's campaigns will be designed to communicate the benefits that GT can bring to these remote communities in preserving the environment.

Prototype Eco Schools	By 2020, prototype eco schools will be set up in every state to serve as a model of sustainability.
Mobile GT learning	YaHijau plans to make GT learning accessible to schools by initiating mobile learning facilities. This would benefit schools in remote rural areas.
University Platforms	University platform for youth to collaborate and exchange ideas and innovations, such as an annual programme in ASEAN Green Youth Summit.

Figure 8.5: Programmes under YaHijau's exploration and planning[6]

CETREE will continue to collaborate with MOE to accumulate knowledge and increase awareness of Green Technology among school children.

8.3 Strategic Thrust 2: Market Enablers

8.3.1 Creating the market demand and supply for GT

Since the introduction of the NGTP, the Government has initiated various programmes to facilitate industry growth in the GT domain. The key market enablers include:

- FiT;
- Eco-labelling mechanism;
- Tax incentives and duty exemptions; and
- GTFS.

In the next 5 years, resources will be focused on the following market enablers, not only to stimulate GT adoption, but also to shift economic development towards green growth:

- Government Green Procurement (GGP);
- Green financing;
- Green incentives;
- Green cities; and
- International collaboration.

[6] Yayasan Hijau Malaysia (YaHijau), 2016

8.3.1.1 Government Green Procurement (GGP)

Government procurement in Malaysia is a significant socioeconomic catalyst as it represents about 13.2% of GDP and public expenditure is expected to grow.

By assuming a leadership role in encouraging green purchasing, the Government will encourage businesses to realign their products and services to the new "green' demands of the market.

Therefore, in the RMK-11 period, a target has been set for 20% of Government procurement to be green by 2020. One of the benefits of the GGP is the anticipated cumulative savings of about RM390 million in electricity bills during this period with an associated reduction of 0.7 $MtCO_2eq$.

Currently, the number of green products and services which qualify for GGP is limited. The Government has mandated MGTC to strategise the direction of GGP programmes, assessing their implementation across ministries, undertaking lifecycle cost trainings and reporting on progress and impact. To prepare for GGP, MGTC launched the MyHIJAU Programme with its two-pronged approach in 2012.

The MyHIJAU Programme includes a labelling scheme (MyHIJAU Mark) and a long-term programme for industry (MyHIJAU SME & Entrepreneur Development Programme). While the MyHIJAU Mark facilitates green purchasing, the SME & Entrepreneur Development Programme focuses on a long-term shift of business operations towards sustainability.

8.3.1.2 MyHIJAU Mark

Rapid growth in GT globally has led to the proliferation of numerous labels for green and eco-products. To reduce confusion, The MyHIJAU Mark is the integrated mark that brings together various eco-labels and environmental certifications under one common mark for GGP reference and are compiled in a single reference i.e. the MyHIJAU Directory.

Figure 8.6: Achievements of MyHijau Programme as of 2016[7]

Figure 8.6 shows the number of products, services and companies registered under the MyHijau Programme. Both local and foreign certification partners have collaborated in the programme.

[7] Malaysian Green Technology Corporation (MGTC), 2017

8.3.1.3 Encouraging business transactions via GGP

Figure 8.7: Number of products targeted by MyHIJAU Mark[8]

The MyHIJAU Mark is in line with the Government's shift to sustainable procurement practices which subsequently incentivises entrepreneurs and businesses to explore green growth opportunities. To achieve this, the MyHIJAU Mark plans to implement the following actions:

- Market research to study the readiness of suppliers and determine the availability of selected product groups in meeting these demands. The identified gaps would be addressed to formulate a more targeted approach in industry development; and
- An awareness campaign to create a strong user base will be rolled out to increase the public's understanding on the significance of the MyHIJAU Mark and to familiarise them with the MyHIJAU Directory.

To support the roll out of the GGP, an online monitoring and tracking system will be developed to provide data to improve GGP policies as well as to provide market intelligence on emerging demand and supply gaps.

Figure 8.7 shows the number of products targeted to have the MyHijau Mark. Efforts need to be implemented to increase the number of registered products throughout the years to support the GGP initiative.

8.3.2 Funding GT project development

8.3.2.1 Green Financing

Financing is one of the biggest challenges facing GT development, not only in Malaysia but also in other countries. The Government, together with financial institutions, has collaborated to provide financing to both GT producers and users via the Green Technology Financing Scheme (GTFS). The GTFS was introduced in 2010, and is the key channel for the disbursement of green finance in Malaysia.

8.3.2.2 Green Technology Financing Scheme (GTFS)

The GTFS offers a 60% guarantee of the financing amount and a rebate of 2% on the interest rate charged by financial institutions with the aim to ease access to financing from private and commercial financial institutions. The GTFS is available until 31 December 2017 or upon reaching a total financing amount of RM3.5 billion, whichever is earlier. Figure 8.8 shows the number of projects financed under GTFS as of December 2016.

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[8] Malaysian Green Technology Corporation (MGTC), 2016

These projects are projected to contribute positively to GHG emissions reductions, employment levels and investments opportunities.

Figure 8.8: Achievements of GTFS as of December 2016[9]

As of December 2016, 576 projects have been certified by GTFS, and 272 of these have successfully received financing from financial institutions in Malaysia. Although projects have been GTFS certified, they face barriers in obtaining financing from private financial institutions and banks.

Some of the challenges faced in accessing green financing in Malaysia are as follows:

- The lack of knowledge about new technologies and the profitability of GT makes private investors apprehensive about financing GT projects;
- GT projects are unable to fulfil the same standards as conventional projects when applying for financing because of the nascent nature of the GT market;
- The GTFS' financing limit of RM50 million per project discourages high capital projects that could yield larger benefits to the nation; and
- The GTFS may not be attractive to private investors as it only covers 60% of the green component cost of the project and does not cover the investor's whole risk exposure.

To address some of its key challenges, the following are improvements made to the GTFS:

- Government guarantee will be granted on the overall cost of the green component compared to only 60%, provided the cost of green component exceeds 60% of the total cost of the project;
- The maximum financing facility under the GTFS has increased from RM50 million to RM100 million for GT producers; and
- A different set of guidelines in the Credit Administration Rules to be adopted by financial institutions. The new assessment criteria for GTFS applications would consider factors such as collateral, due diligence and sectorial exposure specific to the green sector only.

[9] Malaysian Green Technology Corporation (MGTC), 2017

8.3.3 Exploring Alternative GT Financing Ecosystem

8.3.3.1 Moving Forward

Now, the GT industry in Malaysia relies on conventional funding from banks and other financial institutions through Government assistance, such as the GTFS which is set to expire in 2017.

As Malaysia moves towards the status of a high-income nation, the need to accommodate the accelerating demand for green financing is rising. MGTC projects that by 2030, the demand for green investment funds is likely to increase from RM6.7 billion in 2013 to RM76.2 billion. This will drive the need to consider innovative financing instruments to develop a self-reliant GT industry.

Some possible financing mechanisms are outlined below.

- A green energy special-purpose vehicle (SPV) that would allow companies to access soft interest rates and long grace periods for loan repayment;
- A green bank concept such as the Green Investment Bank (GIB) in the United Kingdom that has been used to finance GT ventures;
- Financing opportunities available through international organisations such as the Asian Development Bank (ADB), the Asian Infrastructure Investment Bank (AIIB), and the United Nations agencies;
- The capital market and community-driven crowd-funding platforms;
- GT innovators can set up infrastructure project companies to access the capital market through initial public offerings (IPOs); and
- Socially responsible Islamic Bonds such as Green Sukuk that finance sustainable projects.

In the long-run, for GT to become a sustainable component of the Malaysian economy, there must be an increased public willingness to pay for a better future.

This will involve the revision of existing utility tariffs that provide subsidised energy, water and waste management to the rakyat. While there has been subtle pull back in energy tariffs, future revisions will need to be more substantive to reflect the actual cost and environmental cost of providing the utility services. The Government will review the best cost transition plan that will minimise hardship for the average person. It will certainly require concerted efforts to educate the public on these issues to gain acceptance.

8.3.4 GT Incentives

8.3.4.1 Green Incentives

Incentives are critical economic instruments to encourage GT adoption and development, especially when the environmental impact is an opportunity cost which is difficult to be quantified. At present, tax incentives are leveraged to cultivate investor interest in the GT sector while other non-tax incentives are yet to be explored and introduced to the market.

Previous tax incentives under the Promotion of Investment Act (PIA), 1986 were largely related to RE and EE projects. These incentives expired on or before 31 December 2015.

The incentives were aimed at supporting local industries and service providers to invest in RE and EE via:

- Pioneer Status (PS);
- Investment Tax Allowance (ITA); and
- Tax & Stamp duty exemption for GBI certified property.

These tax incentives lacked an organised and systematic framework in assessing green incentive applications on both a technical and non-technical level. Furthermore, the absence of a legislative framework resulted in challenges in safeguarding the incentives and monitoring the results.

To address the challenges in green incentives, new tax incentives were announced in Budget 2014 and will be implemented until 2020. This is accompanied by an improved process of obtaining the incentive approval according to compliance with the MyHijau criterion. The revised green incentives (Figure 8.9) cover an extensive scope of GT activities in EE, RE, transportation, building, integrated waste management and supporting service activities.

Figure 8.9: New Tax Incentive Mechanisms (2016-2020)[10]

The revised tax incentives supervised by MIDA and MGTC will be gazetted to safeguard their implementation and will follow a similar route to the Income Tax Act. This will outline a systematic process of reviewing and monitoring the application process to enable tracking of quantifiable results that can be used as a basis for refining the existing policy and its implementation process.

8.3.4.2 Moving Forward

As GT is at the stage of market formation, the Government will undertake studies to assess the expansion of the new incentives framework to cover other types of business entities which are not registered under the Companies Act. Tax relief for individual consumption of green products and services may also be considered although this may be limited to certain products of substantial value.

[10] Malaysian Green Technology Corporation (MGTC), 2016 & Kementerian Tenaga, Teknologi Hijau dan Air (KeTTHA), 2016

As the market develops, the incentives framework can be further fine-tuned to promote investment in GT production. For instance, raising the requirement or tightening the criteria in the definition of GT for a product or service to be qualified for green incentives.

While incentives are justified as a means to building up a nascent market, these benefits must be compared to the financial costs of maintaining the incentives. In the long run, green incentives are an unsustainable form of Government assistance. Gradually, an exit policy of such incentives will be developed to reduce the Government's fiscal burden in financing sustainable economic growth.

Further on, the Government will explore the feasibility of implementing a carbon tax or green tax and its effectiveness in embedding sustainability as a business norm in Malaysia.

A green or carbon tax primarily taxes the consumption of products and services at a cost that reflects the negative environmental impact of the use of the product or services. This allows the Government to attach a quantifiable cost to carbon emissions and change energy consumption behaviours of households and industries. A similar pricing can also be placed on water pollution and waste generation.

The RMK-11 already references the need for a taxation system that incorporates a carbon tax. However, the introduction of such a tax must be cautiously calibrated with the subsidy withdrawals that are mentioned in the earlier section. This will require a cost-benefit analysis and intensive public consultations with the relevant key stakeholders, to assist the Government in making an informed decision.

A detailed long-term plan with a realistic timeline will only be developed when the feasibility of implementing a carbon tax or green tax is proven and public acceptance is gauged at a reasonable level. In respect of the latter, a persistent communication strategy which presents the issues transparently will be key in preparing the *rakyat*.

8.3.5 Greening Cities for the Transition towards a Green Lifestyle

8.3.5.1 Green Cities

Malaysia's urban population currently stands at 72.8% of the total population, growing at a rate of 2.5% per year. The absence of sustainable strategies, accompanied by rapid urbanisation would lead to severe environmental and health issues. To protect the ecosystem, there must be concentrated efforts to develop green cities. Green cities are communities that proactively incorporate sustainable technologies and adopt green practices to lower carbon emissions and improve quality of life for their populations.

To spearhead the development of green cities, KeTTHA and MGTC launched the Low Carbon Cities Framework and Assessment System (LCCF) in 2011. LCCF is a national framework and assessment system to assist local municipalities and developers to achieve low carbon city status.

The LCCF has two components:

1. Low Carbon Cities Framework: This framework identifies potential areas that can be targeted to reduce carbon emissions via a systematic review; and
2. Low Carbon Cities Assessment System: Carbon emissions are periodically assessed using a carbon calculator.

The LCCF has already been put to the test with several pilot projects and local councils adopting the framework and commencing initial baseline studies. MGTC is targeting 52 cities for implementation (Figure 8.10).

The implementation of the LCCF leverages on existing legislations and policies under the KPKT. In its Housing Planning Guidelines, KPKT rolled out a circular in 2014 on Environmentally Sensitive Areas to ensure environmental conservation.

4 themes of the LCCF that represent the main contributors to carbon emissions are:

- **Urban Environment**: A centralised and well-defined city plan to reduce energy consumption from all activities and inculcate a greener lifestyle.
- **Urban Transportation:** The adoption of public transportation and walking to reduce traffic congestion and single occupancy vehicle usage.
- **Urban Infrastructure**: Effective urban planning and provision of infrastructure to reduce carbon emissions.
- **Buildings:** The efficient use of energy and water in buildings to reduce operational emissions and wastage.

Figure 8.10: Number of cities targeted under LCCF[11]

[11] Malaysian Green Technology Corporation (MGTC), 2017 & Kementerian Tenaga, Teknologi Hijau dan Air (KeTTHA), 2017

8.3.6 Introducing Roll-Out Plans Comprising Human Capital Development and Public-Private Collaboration to Green the Cities

8.3.6.1 Moving forward

A major challenge in rolling out the LCCF is to ensure its compatibility with the unique requirements of each municipality. Local authorities have the best understanding of the needs of their municipalities and the gaps in achieving a green transformation.

To enable local authorities to address the challenges they face, MGTC with the support of its key stakeholders, will deploy qualified and skilled personnel to assist in the implementation of the LCCF across all municipalities.

At the same time, training programmes will be developed and implemented to enhance competencies of the personnel involved at the federal, state and municipal level.

To ensure the success of green cities and township planning, the coordination between MGTC and the Federal Department of Town and Country Planning Peninsular Malaysia (PLANMalaysia) will be strengthened. This is critical to ensure that the green cities agenda is cascaded appropriately from the federal level to the state and local authorities.

Constant communication will be established among the relevant agencies and PLANMalaysia to foster the successful development of green cities. A systematic monitoring system will be designed and put in place to measure and report progress towards the LCCF themes.

Feedback from the Local and State Governments will be assessed and reflected to the federal level for better policy coordination. Besides direct public efforts, MGTC will encourage private sector participation in the greening of cities by leveraging on existing policies and tax incentives such as GITA and GITE.

Ultimately, green cities are an important step towards creating a greener and more sustainable Malaysia, improving the quality of life for its residents as well as future generations.

8.3.7 International Collaborations

International collaborations provide the opportunities for industry players to develop capability and obtain experience in doing GT related business in the region. This helps to prepare the industry players to export their products and services in the future.

Malaysia is a member of the International Renewable Energy Agency (IRENA) and the Energy Working Group (EWG) under the Asia-Pacific Economic Cooperation (APEC).

As part of the EWG under APEC, Malaysia works with other APEC members to:

- Strengthen energy security;
- Promote energy security;
- Develop cleaner energy sources; and
- Enhance trade and investment in all energy sources to promote economic prosperity.

Malaysia has also hosted the ASEAN Ministers on Energy Meeting (AMEM). The 21st AMEM that was held in Langkawi in July 2003, called for intensified cooperation in the development and exploitation of the energy resource potentials in the ASEAN region, as well as in attracting private sector participation and investment in the ASEAN energy sector.

Malaysia has participated in various programmes under the purview of the ASEAN Centre for Energy (ACE). Apart from the energy efficiency and conservation programmes such as ASEAN Energy Management System (AEMAS) and clean coal technology, Malaysia is especially active in the ASEAN Power Grid programme.

ASEAN Power Grid

- A flagship energy connectivity programme to ensure regional energy security while promoting the efficient utilisation and sharing of resources
- The programme is undertaken by the Heads of ASEAN Power Utilities/ Authorities which also acts as the Specialised Energy Body
- The construction of the ASEAN Power Grid is first done on cross-border bilateral terms, then expanded to a sub-regional basis, and finally to a total integrated regional system
- Laos-Thailand-Malaysia-Singapore Power Integration Project (100 MW) is among the prioritised pilot projects

"One of the ASEAN Economic Community objectives is to integrate energy market in the framework of ASEAN Electricity Exchange and to enhance the implementation of ASEAN Power Grid, with the objective to achieve regional energy security from the availability to quality of energy supply, to optimise regional resources especially new and renewable energy, and to have accessible energy to all ASEAN people."

-Head of ASEAN Power Utilities / Authorities-

Since January 2016, Malaysia has successfully commissioned the export of 70MW of hydroelectricity power per day from Sarawak to West Kalimantan via a 275kV transmission line, the project was funded by the Asian Development Bank.
Other projects currently under planning include:

- Malacca-Sumatra interconnection via submarine cable; and
- Nunukan (East Kalimantan) – Sabah (Tawau) link.

8.3.7.1 Moving Forward

Malaysia has signed a MoU with the Government of Cambodia to establish a framework for cooperation in the field of GT between the two countries. The MoU seeks to promote the development of technologies, products, services, trade and market. The Government-to-Government collaboration offers business opportunities for GT in various sectors, especially in renewable energy and energy efficiency, electric mobility, integrated waste management and the promotion of green buildings.

Recently, Malaysia has also signed three other MoUs of which the first is for multilateral power trading of up to 100 MW between Malaysia and Laos through Thailand. The MoU will pave the way for Malaysia to purchase hydro power from Laos through Thailand by 2018.

The second MoU was signed in October 2016 between Malaysia and Brunei to take necessary steps to encourage and promote technical cooperation in GT.

The third MoU was signed in November 2016 between Malaysia and South Korea to collaborate in developing the soft landing/co-incubation programmes for vitalising the industry clusters of ICT, biotechnology and life sciences, advanced engineering and GT.

Other international collaborations which Malaysia will leverage on include:

- *ASEAN + 3 (China, Japan, Korea): Mitigation Cooperation Programme* – a programme funded by the Government of Korea through the Ministry of Knowledge Economy to cooperate on Clean Development Mechanism in energy, to help reduce GHG emission and promote sustainable development in the region through capacity building activities;
- *ASEAN – European Union: ASEAN Standards Harmonisation Initiative for Energy Efficiency* – a programme funded under the EU SWITCH-Asia affiliated programme to increase the market share of higher efficient air conditioners through harmonisation of test methods and energy efficiency standards, adoption of common MEPS and changing consumer purchasing attitudes;
- *ASEAN – Germany:* ASEAN Renewable Energy Support Programme to carry out activities of direct relevance to the development of RE sector in the ASEAN region;
- *ASEAN – Japan:* Energy Efficiency Partnership, Energy Conservation Workshop; Energy Efficiency Market Transformation with Information Provision Scheme; and
- *ASEAN – USA: 5-year Energy Cooperation Work Plan* in priority areas related to Energy Efficiency and Conservation, Renewable Energy, Power Sector, and Natural Gas and Petroleum.

8.4 Strategic Thrust 3: Human Capital Development

8.4.1 Enhancing national capabilities for innovation in GT development

Human capital development is a strategic thrust that aims to increase the national capability and capacity for innovation in GT development and enhance Malaysia's competitiveness in the global arena. There have been consistent efforts in strengthening the competencies and skillsets through the introduction of sector-specific trainings and informal approaches such as industry dialogues.

In line with RMK-11, the Government's efforts in human capital development will focus on 3 key areas, covering the existing workforce in the public and private sector, and the future workforce in the education system, as shown in Figure 8.11.

Figure 8.11: Key Areas in Human Capital Development[12]

8.4.1.1 Capacity Building for The Public Sector

At present, public officials broaden their knowledge through attendance at topical seminars and conferences. Opportunities for formal education to acquire specialist skills are subject to invitation and approval by budget availability and other factors.

To cope with the dynamic nature of GT and its technology advancement, a more structured approach to prepare public officials in their field will be established. This includes:

- A knowledge-sharing platform led by a coordinator supported by GT specialist agencies in various sectors. The agencies will:
  - keep track of seminars, conferences and other training opportunities available; and
  - recommend the appropriate event to the relevant Government bodies
- All attendees will be required to prepare and circulate a short report on information gleaned from the event and propose suitable applications for Government bodies; and
- Periodic newsletters on GT updates from respective Government bodies are to be made available to the public. These materials will be kept in a central depository for reference.

8.4.1.2 Capacity Building for the Private Sector

Malaysia targets to have 40% of its workforce classified as highly-skilled workers to become a high-income nation. This target will be realised through local capacity building and attracting global talent, subsequently reducing dependency on foreign experts. Currently, 28% of the workforce are classified as highly-skilled and the RMK-11 targets to increase the proportion of highly-skilled worker to 35% by 2020.

[12] Malaysian Green Technology Corporation (MGTC), 2016

In addition to the various sector-specific trainings and accreditation, which both the Government and private sectors introduced to the market, the Government has been facilitating the process by appointing an Industry Lead Body (ILB) in the various industry sectors.

There are 22 ILBs in Malaysia representing various sectors established under the Department of Skills Standard (DSD) of the Ministry of Human Resource (MOHR).

As the ILB for the GT sector, MGTC will align the Technical Vocational Education and Training (TVET) curriculum with industry requirements and develop the National Occupational Skill Standard (NOSS) relevant to the industry.

What are NOSS?

- NOSS is an internationally recognised specification of competencies expected of a skilled worker for an occupational area, level and pathway. NOSSs can be developed by an ILB or any agency engaged by JPK. All NOSS is approved by JPK before they are submitted to MOHR for final review and approval
- NOSS is reviewed every three years, where the match between skills standards and candidates in the defined positions will be checked and updated for accuracy.
- NOSS is supported by Occupational Structures, which are produced from Occupational Analysis (OA). OA is the process of identifying the work scope of the occupational sub-area in terms of competencies. In other words, it is used to analyse skilled human resource competency requirements for industries.

Approximately 2,000 NOSSs have been developed to date, of which 61 are recognised under the GT sector for reference by TVET institutions. The scope of the NOSS developed under the GT sector covers Renewable Energy, Green Building, Water Treatment, Solid Wastes, Scheduled Wastes and Electric Vehicle.

ILBs also identify existing skilled workers, define their competency level and certify them using a mechanism termed as Prior Experience Achievement or *Pengiktirafan Pencapaian Terdahulu* (PPT) which recognises the value of work experience in lieu of higher education qualifications.

Starting in 2016, the Government has, via DSD and the ILBs, developed incentive programmes such as sponsoring application fees for experienced skilled workers who are eligible to apply for PPT certification. These incentives include allowing for application fees to be paid from the Human Resources Development Fund (HRDF).

In addition, a high-skilled person who has more than 10 years' experience in the GT sectors is eligible to apply for country expert database registration or Daftar Pakar Industri Negara (DPIN) in categories that match the existing 61 GT NOSS. This facilitates the private sector in adopting NOSS as part of their employment strategy and move towards an industry-driven NOSS labour development model.

8.4.1.3 Moving Forward

The Government plans to develop nine NOSSs per year until 2020. The Government also plans to uplift the NOSSs on RE and biomass energy generation plant and landfill gas plant from Level 2 to 5 by 2016; and more NOSS on waste, transportation and green building sector NOSSs will be produced by 2017.

By 2020, MGTC aims to identify the types of jobs and sectors that exist in Malaysia's green technology space. With a better understanding of the landscape, the OA can be revised to suit the demand and supply of talent more efficiently. The process for the PTT certification will be improved to allow the ILB to identify skilled persons who have significant experience in GT projects conducted during the RMK-9, RMK-10 and RMK-11 period with final approval of the certifications by MOHR, as shown in Table 8.2 below.

NOSSs by Sector	
Electrical and Electronic, Telecommunication and Broadcasting	Business Management
Information and Communication Technology	Textile and Apparel
Machinery and Equipment	Agriculture and Agrobased
Mechanical and Electrical Service and Maintenance	Resource Based
Transportation	Biotechnology
Materials	Education and Training Services
Packaging	Oil and Gas
Printing	Halal Industry
Chemical	Integrated Logistics Services Industry
Medical and Pharmaceuticals	Distributive Trade
Hospitality and Tourism	Defence and Security Services
Souvenir and Small Enterprise	Care and Community Services
Building and Construction	Art and Culture
Landscaping and Environmental	Mining Industry
Interior Decor	-

Table 8.2: NOSSs by sector as of 2016[13]

[13] Malaysian Green Technology Corporation (MGTC), 2016

8.4.2 Greater Collaboration with Tertiary Institutions for Upskilling of Graduates

8.4.2.1 Voluntary Programmes by Universities

Currently, certain university programs require the student to complete a short work stint in industry as a requirement to graduate. The intention is to provide a minimal level of work skills before graduates begin their careers. However, the short period of 4-6 weeks and curriculum which is less than relevant to the industry means that the work experience rarely achieves its intent.

Recognising this, selected universities have reached out to Government bodies such as MGTC, to obtain advice on the relevance of their syllabus to actual marketplace needs.

The integration of the NOSS into tertiary institution syllabus will help align their curricula with the most updated requirements of workforce demand in the GT spectrum and allow a more enriching experience during the student's outplacement in the industry. The result would be graduates who have high employability ratings.

Apart from integrating NOSSs in the curricula, the ILBs can offer guidance at seminars or lectures to provide candidates with a different perspective on job requirements, and therefore increase the candidates' awareness of the skills required for their desired careers.

Further support is provided for collaboration between NOSS developers and educational institutions, such as private and polytechnic universities, with funding by the HRDF and Universiti Teknologi Malaysia (UTM).

MGTC also plans to implement an industry-oriented national dual training system that combines workplace and institutional training.

The Government hopes to develop human capacity in the GT sector by facilitating close collaboration between industries and the private-public sectors. This can be achieved by creating GT knowledge sharing through the implementation of a common platform which is continually updated.

8.5 Strategic Thrust 4: R&D&C

8.5.1 A key stepping stone towards an innovative GT hub

Malaysia aspires to become a high income nation by 2020. One of the key drivers in this regard is the creation of a knowledge-based economy, where R&D&C plays a key role in spawning innovations which benefit the society. In 2012, the National Science and Research Council (NSRC) identified 9 National Research and Development Priority Areas (NRPAs), setting a common vision for the use of Science, Technology and Innovation (STI) towards advancing socio-economic development. GT is subsumed in all of the NRPAs, especially in energy security, the environment and climate change, water security as well as transport and urbanisation. The main aggregate measure of R&D expenditure is Gross Domestic Expenditure on R&D (GERD).

Malaysia's GERD amounted to RM10.6 billion in 2012, equivalent to 1.1% of the nation's GDP. Public sector expenditure on R&D accounted for 36% of GERD in 2012 while the private sector funded the remaining 64%.

NO.	NRPAS	TARGETED GOALS
1.	Biodiversity	• Sustainable exploitation of Malaysian biodiversity
2.	Cyber security	• Development of national autonomous and secure systems to reduce foreign dependency on systems of strategic importance
3.	Energy security	• Harnessing alternative resources and improving the efficient use of energy, especially in the areas of RE, to reduce dependency on fossil fuels and imported fuel
4.	Environment and climate change	• Supporting ecosystem management, protection and improvement to mitigate floods, droughts and air pollution as well as promoting eco-tourism
5.	Food security	• Improvement of food crops, livestock, fisheries and animal feedstock, focusing on post-harvest technology to reduce dependency on staple food imports and increase self-sufficiency
6.	Medical and healthcare	• Improving health, well-being and longevity through diagnosis, prevention and treatment of lifestyle diseases as well as new and emerging diseases
7.	Plantation crops and commodities	• Creating a sustainable sector for plantation crops and commodities by increasing productivity and utilisation, focusing on oil palm, timber, rubber, cocoa and pepper
8.	Transport and urbanisation	• Reducing dependency on fossil fuels and enhancing EE by focusing on the use of alternative energy and design engineering • Ensuring sustainable urbanisation via efficient urban waste management
9.	Water security	• Ensuring sustainable water supply and optimising water usage, focusing on creating sustainable sources and improving the processing, treatment and distribution of water

Table 8.3: National Research Priority Areas[14]

[14] National Science and Research Council, 2012

8.5.1.1 R&D&C Projects

At the national level, publicly funded R&D&C projects are conducted by research universities and GRIs, which are funded by:

- Research university block grants;
- Cess funds of GRIs; or
- Competitive grants, including development expenditure funding offered by the JKPDA, MOHE and MOSTI.

A secretariat - *Jawatankuasa Pelaburan Dana Awam* (JKPDA) - was established in 2012 to drive the restructuring, streamlining and strengthening of public innovation funding mechanism for R&D&C. It operates under the Agensi Inovasi Malaysia (AIM) and is driven by a co-secretariat partnership between AIM and MOSTI.

One of the objectives of AIM is to drive the country to achieve a minimum GERD of at least 2% for R&D&C while one of the JKPDA missions is to ensure R&D&C adherence to Malaysia's growth priority areas and sectoral focus. However, there is very little coordination between JKPDA and KeTTHA in the GT sector to assess and approve projects due to KeTTHA's absence from JKPDA's subject matter panel.

This limits KeTTHA's ability to influence and collate information on R&D&C projects related to GT in the six key sectors – Energy, Manufacturing, Transport, Building, Waste and Water. This limitation hampers KeTTHA's role in setting policy directions and plans for GT development as well as KeTTHA's ability to facilitate public-private partnerships both locally and across borders.

KeTTHA itself has R&D&C funding capabilities via the MESITA fund which it manages. The fund is contributed by IPPs and is allowed to be utilised to fund electricity related pilot projects and commercialisation projects. However, the fund's approach to the provision of grants is reactive in nature with poorly defined focus areas for driving GT in the electricity sector.

Meanwhile private sector R&D&C initiatives for GT, especially in the five other key GT sectors, need to be tracked and coordinated.

8.5.1.2 R&D&C Projects

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Meanwhile private sector R&D&C initiatives for GT, especially in the five other key GT sectors, need to be tracked and coordinated.

8.5.1.3 Moving Forward

To further reduce duplication of resources, KeTTHA will seek to work with the JKPDA to influence the direction and funding of R&D&C initiatives towards GT development. As KeTTHA and its agencies have technical knowledge of GT, namely in the six key sectors of the GTMP, KeTTHA would be able to provide valuable insights and inputs on the latest technological advancements.

Coordination with JKPDA and engagement with stakeholders would also allow for better definition of focus areas for the deployment of the MESITA fund and a more active solicitation of applications to the MESITA fund.

The RMA and JKPDA could provide the platform to facilitate greater public-private partnerships by integrating private participation as assessment criteria in proposal assessment.

8.5.2 Encouraging more localised and demand driven R&D&C

Malaysia is targeting to be the GT hub in Southeast Asia and is planning to move from GT adoption to GT development post-2020. To achieve this, the Government will engage in industry facilitation and promotion of localised GT solutions instead of relying on direct adoption of GT solutions that may not always be suited to the climate conditions of Malaysia.

It is therefore important for KeTTHA to be represented on the JKPDA to ensure that resources for R&D&C projects will be channelled towards the development of GT solutions suited to the tropical conditions of Malaysia.

The feedback loop of the evaluation and monitoring process enables effective information sharing that plays an important role in KeTTHA's policy planning with regards to R&D&C on GT.

8.6 Strategic Thrust 5: Institutional Framework

8.6.1 Strengthening governance to advance national green agenda for sustainable economic development

Malaysia is among the first countries in the Southeast Asian region to establish a dedicated Ministry to undertake policy advocacy on green technology. Having recognised the need to strengthen the institutional framework in the NGTP, Malaysia has undertaken some initiatives to address 3 key areas in the governance of the country's GT agenda, namely:

- Policy leadership;
- Policy planning; and
- Policy implementation.

8.6.1.1 Policy Leadership

In 2009, the Government of Malaysia established the Green Technology and Climate Change Council (MTHPI) to formulate policies and identify strategic issues in the NGTP development and climate change. This Council is chaired by the Prime Minister and the secretariats are NRE and KeTTHA. The MTHPI was entrusted. It also coordinates, monitors and evaluates the effectiveness of the NGTP and GT programmes and climate change at the national level.

The MTHPI is supported by a Steering Committee and 8 Working Committees (WCs) in specific focus areas, involving both public and private stakeholders. Each WC comprises of members from various ministries and Government agencies, including private industry players to create synergies and spin-offs.

Figure 8.12: Eight working committees under MTHPI[15]

[15] Kementerian Tenaga, Teknologi Hijau dan Air (KeTTHA), 2016

The MTHPI institutionalises an inter-ministerial communication mechanism, recognising the cross-sectoral nature of the green agenda. This communication mechanism is critical to ensure the strategic direction of the green national agenda is a well-communicated decision, which is being set objectively based on consultative views.

Moving forward, efforts will be focused on improving the effectiveness of the MTHPI and its working committees. Most of the existing terms of reference in the 8 working committees shall continue to be pursued by the respective Government bodies.

The existing governance structure of the MTHPI, especially its working committees will be reviewed to identify and prioritise key areas which require urgent attention.

The MTHPI will be leveraged to maximise the benefits of the inter-ministerial communication mechanism, to solve issues in GT development requiring collective efforts from all the key stakeholders. Key improvements to be made to the Working Committees are as follows:

- Regular meetings with clear agenda;
- Shared targets among various stakeholders and long-term planning supported by clear project timeline to deliver the GT targets in the six sectors;
- Proactive feedback loop to be formed between the WCs and Secretariat to the MTHPI to ensure that the WCs are aligned to national green agenda; and
- The Secretariat to the MTHPI to undertake analysis on the policy papers put forward by the WCs to facilitate policy planning instead of solely handling administrative matters.

8.6.2 Enhancing capacity and capability in policy planning

8.6.2.1 Policy Planning

The cross-sectoral nature of GT poses challenges in aligning policy development and implementation. While most of the ministries have included the green agenda in their strategic policy development, nevertheless, KeTTHA is the mandated ministry in developing the NGTP and advancing the national green agenda.

KeTTHA's mandate to influence the GT agenda in other ministries needs to be better embedded in the MTHPI structure. Therefore, key improvements will be made in the following areas:

- Addressing inter-ministerial coordination issues to drive the green technology agenda.
- Adoption of structured framework in policy planning, starting with:
  - Value chain analysis for all key sectors;
  - Clear portfolio (e.g. GT sectoral focus, strategic thrusts);
  - Stakeholder engagement to understand sectors and technology updates; and
  - Systematic process in policy development, especially involving other agencies such as MiGHT.

The 8 WCs in MTHPI will be leveraged as the platform for GT policy development with the anchor ministries consulting with KeTTHA on the application of GT in greening the sectors under their respective purviews.

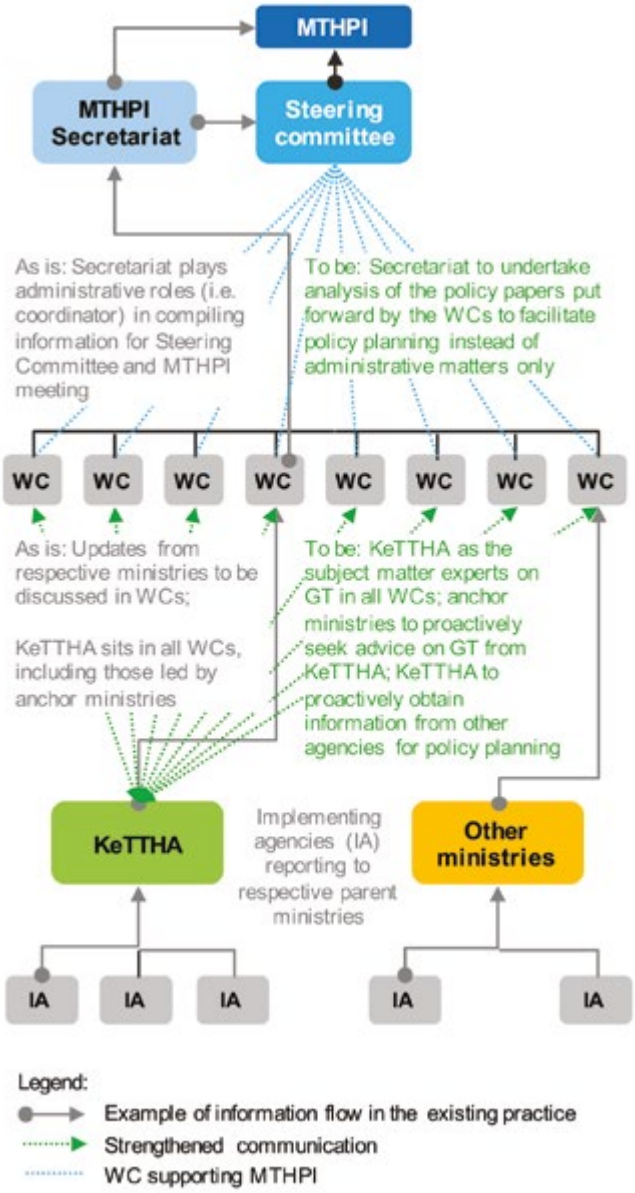

Figure 8.13: Improved feedback loop in policy governance[16]

[16] Kementerian Tenaga, Teknologi Hijau dan Air (KeTTHA), 2016

8.6.3 Strengthened collaboration in policy planning and implementation

8.6.3.1 Policy Implementation

The implementing agency (IA) of a policy usually reports directly to the parent ministry. However, the reporting of GT developments from policy implementers that are under other ministries will also be reported in parallel to KeTTHA. This is critical to ensure access to data and information, which are crucial for KeTTHA to perform analyses for policy planning purposes.

To enhance the effectiveness of policy implementation, the following improvements are need to be undertaken:

- Clear demarcation of roles and responsibilities as implementing agencies;
- Shared KPIs to be created to facilitate outcome-driven results of the WCs in MTHPI, including at the IA level; and
- Updates on progress of policy implementation to be shared consistently on a regular basis by the WCs in the MTHPI to facilitate policy planning.

In summary, the five strategic thrusts i.e. promotion and awareness, market enablers, human capital development, R&D&C and institutional framework have been identified to facilitate the growth of GT in Malaysia in its journey towards becoming a GT Hub post 2020. These holistic strategies provide a platform for the implementation and monitoring of green initiatives that will expand Malaysia's GT development and help achieve the country's long term aim to shift from GT adoption to GT development.

9

IMPLEMENTATION PLAN

9.1 Priority Setting

The key criteria in setting priorities for implementation are mainly driven by the relative contribution of each sector's GT to economic growth and specific factors unique to the respective sectors.

9.1.1 Contribution of GT to National Economic Growth

Figure 9.1 below demonstrates the economic contribution and projection for five (5) sectors by 2020 and 2030 under two scenarios; business as usual and meeting the green targets.

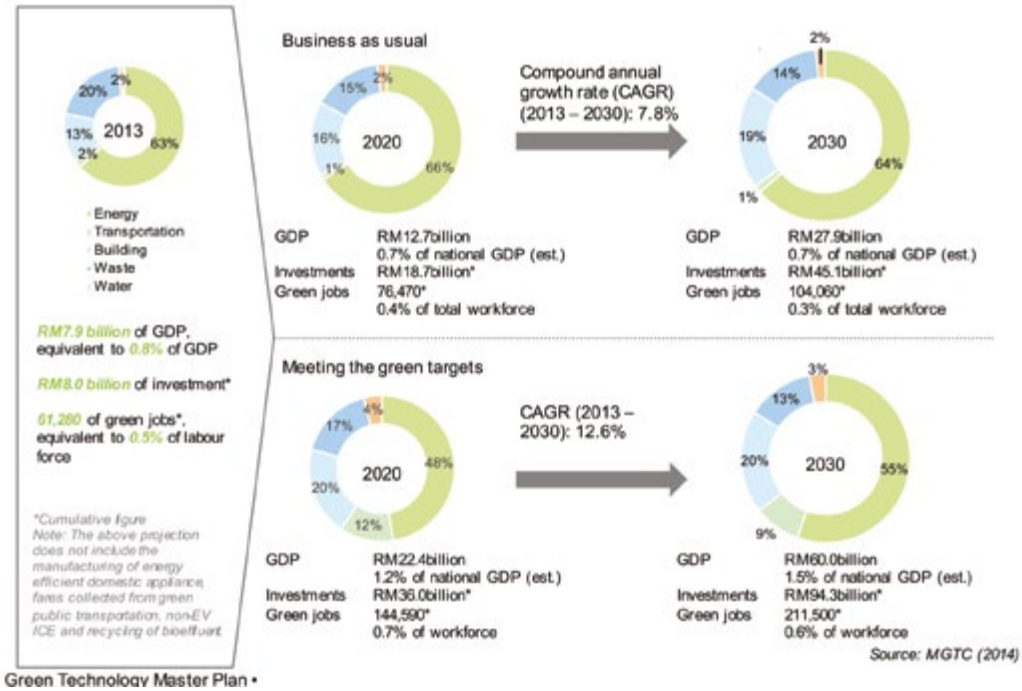

Figure 9.1: Green Technology economic contribution and projection by 2020 and 2030[1]

Business as usual (BAU) - By 2020 GT adoption in the five sectors are expected to contribute around GDP RM12.7 billion which is 0.7% of national GDP while the green investment and green jobs are estimated at about RM18.7 billion and 76,470 jobs respectively. Towards 2030, if BAU continues , Green Technology is expected to contribute around GDP RM27.9 billion which is still 0.7% of national GDP and the green investment and green jobs are estimated at about RM45.17 billion and 104,060 jobs respectively.

[1] Economic Assessment on the Green Business Environment in Malaysia, PwC Consulting Services (M) Sdn Bhd ("PwC"), 2014.

Under the BAU scenario, the fastest growth is expected by the building sector, attributed to the strong growth in green building materials and EE for building. The growth is mainly driven by local market demand as green buildings seem to offer higher return values in terms of rental returns (additional RM0.50-RM2.25/sqft), occupancy rates, as well as lower building maintenance cost.

The Energy sector ranked second under this scenario. The growth is likely to be driven by:

- Consistent local demand to establish RE power plant (non-solar) supported by FiT; and
- Export-oriented businesses (solar and energy efficient products).

Meeting the Green Targets by 2020 more exciting figures emerge as the GT contribution is estimated at around GDP RM22.4 billion which is 1.2% of national GDP while the green investment and green jobs are estimated at about RM36 billion and 144,590 jobs respectively. Towards 2030, Green Technology is expected to contribute nearly three times as much to the GDP with an estimated value of RM60 billion, i.e. 1.5% of national GDP. Green investment and green jobs will by then be at about RM94.3 billion and 221,500 jobs respectively.

9.1.2 Growth Potential by Sector

The following sections highlight existing GT presence in key industrial sectors.

9.1.2.1 Energy

The GDP contribution from GT is estimated to grow from RM5.0 billion in 2013 to about RM33.3 billion in 2030. However, the percentage of overall GDP of the energy sector is likely to shrink from 63% to 55%. This is mainly due to the diversification of green technology products and services in the country. The energy sector is estimated to grow at 12% CAGR from 2013 to 2030, attracting at least RM35.2 billion of cumulative investment. The industry is likely to be driven by:

- Realisation of 2,080MW of RE installed capacity in the country;
- Export of solar photovoltaic panels; and
- Energy efficient products and appliances.

The economic potential of green energy could be higher should there be wider adoption of renewable technology in the system, wider adoption of co-generation, as well as the application of energy efficient equipment and processes by various industries. In addition, local industries could also tap on the growing renewable markets in the Southeast Asian region. It was estimated that the renewable capacity in this region is likely to rise from 43GW (2012) to 130GW (2035), which is 32.5 times higher than the Malaysian targets. The well-established electrical sector in Malaysia could also leverage on its capability in supplying high-end electrical products and components to both domestic and international markets for the production of energy efficient electronic appliances.

9.1.2.2 Transport

The fastest growth is expected by the transport sector, especially in the private transport subsector, mainly driven by:

- Appropriate pricing regime for car and fuel subsidies;
- Increase in the number of EEV manufacturers in the country;
- Improved technology used in hybrid cars and EVs which strengthen market confidence towards these products;
- Presence of supporting infrastructure for EV such as a comprehensive network of charging stations; and
- The deployment of first miles and last miles solution such as car sharing or e-hailing services.

The transport sector is estimated to grow at 22% CAGR from 2013 to 2030, attracting at least RM14.5 billion of cumulative investment. The GDP contribution of the green transportation is estimated to increase from RM0.2 million in 2013 to RM5.4 billion by 2030. At present, only Thailand and Malaysia have the capability to assemble hybrid vehicles in the region. This presents an excellent prospect for Malaysia to becoming a hybrid car leader in the automotive industry.

9.1.2.3 Building

The building sector is likely to be the third fastest growing sector, whereby its GDP share is projected to increase from 13% (2013) to 20% (2030) with values of RM1.0 billion and RM11.8 billion respectively. The industry is likely to be driven by:

- Growth in private green buildings (both new and existing);
- Export-oriented businesses for green building materials;
- Energy efficient building system (particularly heating, ventilation and air conditioning, as well as solar hot water system);
- IBS growing in tandem with the growth in the green building construction; and
- Strong local demand growth due to full enforcement of UBBL on energy efficient building system in Malaysia.

The building sector is estimated to grow at 16% CAGR, attracting at least RM13.8 billion of cumulative investment.

9.1.2.4 Waste

Assuming that waste recycling rates increase and more waste goes into sanitary landfills instead of uncontrolled dumpsites, the GDP contribution of the waste sector will increase from RM1.6 billion (2013) to RM7.6 billion (2030). However, the percentage of overall GDP contribution of the waste sector is likely to shrink from 20% to 13%. This is mainly because the growth rate of other sectors are significantly higher than the waste sector and also assuming that the existing tipping fees remain unchanged. Nevertheless, the increase in waste generation per capita is likely to result in the increase of the absolute GDP contribution of the waste sector.

The waste sector is expected to grow at 10% CAGR from 2013 to 2030, attracting at least RM19.9 billion of cumulative investment. The economic potential of a green waste sector could be higher should there be wider adoption of GT through Waste-to-Energy (WtE), biogas capture from POME, and other facilities such as transfer station, materials recovery facilities to green the entire waste management process from collection and transfer to final disposal.

9.1.2.5 Water

The GDP contribution of the water sector is estimated to increase from RM0.1 billion in 2013 to RM1.9 billion (2030) which is a marginal increase from 2% to 3%. This assumes that:

- All the sanitary ware products are water efficient as all manufacturers have phased out conventional sanitary ware;
- Regulations are also in place to hinder the import of non-water-efficient sanitary ware; and
- All states are assumed to have gazetted and enforced the Rain Water Harvesting System to all types of landed properties.

The water sector is expected to grow at 17% CAGR from 2013 to 2030, attracting at least RM2.9 billion of cumulative investment. The economic potential of a green water sector could be higher should there be wider adoption of GT through in the following areas, including:

- Integrated river basin management;
- Efficient water treatment and water distribution system;
- Water harvesting system (including ground water and storm water); and
- Wastewater treatment.

9.2 Implementation Framework

The implementation framework for GTMP is demonstrated in Figure 9.2 below.

Figure 9.2: Six Key Sectors and Strategic Thrust

9.3 Governance Model

Figure 9.3 outlines the Governance Model proposed for the implementation of the GTMP towards its goals. For effective implementation, it is critical to structure the governance model to enable a smooth operational roll-out, performance monitoring, accountability and funding access.

The governance structure of GTMP will leverage on the existing National Green Technology and Climate Change Council (MTHPI) a high-level platform to report the progress of the implementation plan. MTHPI which is chaired by the Prime Minister shall provide strategic directions and thought leadership towards achieving the green growth and sustainability agenda.

KeTTHA will be the lead ministry for the overall implementation of GTMP and MGTC, as the technical arm for KeTTHA, will assist to coordinate the implementation strategies. MGTC will facilitate and monitor the implementing agencies which are entrusted to execute the initiatives identified in the respective sectors and strategic thrusts. A GTMP Advisory Committee comprising experts and key players from all the six sectors will be established to provide advice, propose initiatives, review/assess strategies/programmes and provide technical expertise.

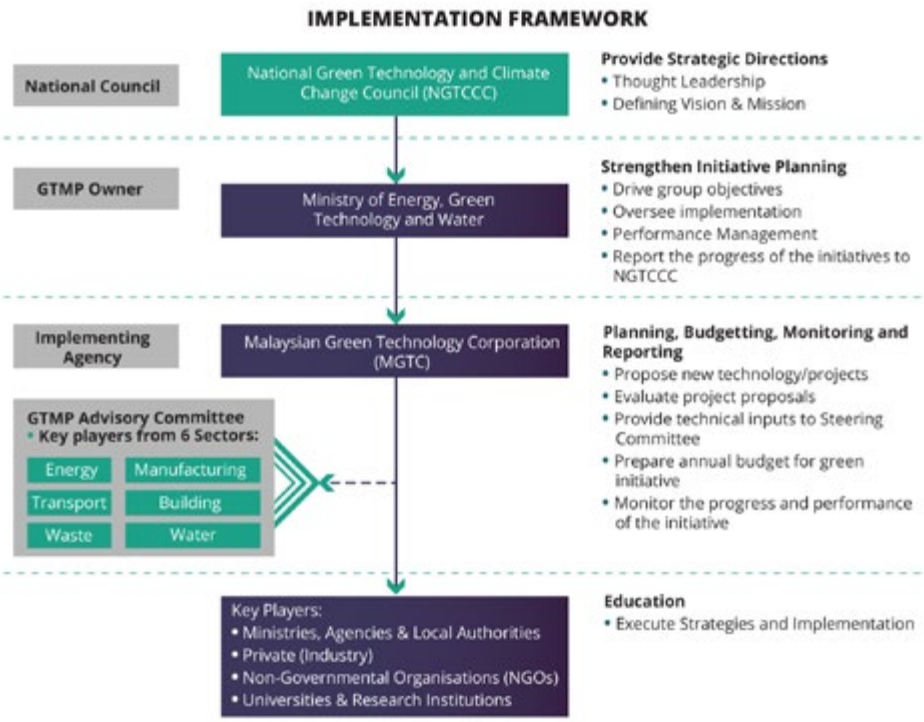

Figure 9.3: Governance Model

9.3.1 Roles and Responsibilities

Table 9.1 lists the roles and responsibilities of key committees and entities.

Body/Entities	Roles and Responsibilities
1. **Green Technology & Climate Change Council**	• Provide national direction on green growth and sustainability agenda • Address the strategic issues in the GTMP implementation and decide on matters pertaining to green technology and climate change • To identify and provide necessary funding access
2. **Ministry of Energy, Green Technology & Water**	• Chair the Steering Committee • Coordinate the policy decision, issues and implementation strategies • Monitor the progress and performance of the initiatives • Report the progress of the initiatives to MTHPI
3. **Malaysian Green Technology Corporation**	• Prepare annual plan and budget for the implementation strategies • Propose and prioritise new technologies and projects to be implemented • Plan and facilitates projects, programmes and manages fund

Body/Entities	Roles and Responsibilities
	• Provide technical expertise in the implementing strategies • Provide technical inputs and report to Steering Committee • Monitor and evaluate the effectiveness the GTMP implementation strategies
4. **GTMP Advisory Committee**	• Provide advice or feedbacks on the implementation of strategies identified under 6 sectors (Energy, Manufacturing, Transport, Building, Waste and Water).

Table 9.1: Roles and Responsibilities of Key Committee and Entities

9.3.2 Programme Implementation

GTMP emphasises the effective implementation of strategies to solve immediate industry issues to enable market creation. Proper planning and a systematic approach needs to be done to ensure the smooth implementation of the key strategies. Table 9.2 summarises the proposed key initiatives as outlined in earlier chapters. The projects and programmes shall be implemented via a mix of Government funding, international funding or public private partnership.

The immediate action is to set up the Steering Committee chaired by KeTTHA and to establish the GTMP Advisory Committee. Members of the Steering Committee will be appointed from various ministries and key industry players. While for the GTMP Advisory Committee, MGTC will identify the main stakeholders from Government agencies and key industrial players of each sector. The GTMP Advisory Committee of each sector shall deliberate and formulate action plans to address industry issues. MGTC with the assistance from the Advisory Committee will prioritise and propose to KeTTHA the technology types as well as projects and programmes to be implemented.

Meanwhile, for the strategic thrusts, there are existing mechanisms which will require finetuning to enhance its effectiveness to facilitate GT growth and to deliver progressive improvement. A detailed action plan with shared KPIs will follow suit, accompanied with project milestone to enable KeTTHA to monitor the implementation of initiatives which have been identified in the respective strategic thrusts. Table 9.3 shows the key areas based on the five (5) strategic thrusts.

No.	KEY SECTORS & SUB SECTORS	KEY INITIATIVES
1.	**ENERGY SECTOR**	
	• **Electricity generation** • **Energy efficiency (residential and commercial**	• Energy Planning Framework • Planting Up Scenario • Exploration of other RE sources, NEM, LSS plant, Hydro power generation plant • RE new technologies and innovation • Long-term plan for electricity tariff rate for higher renewable mix • Enhanced cross sectoral collaboration in R&D&C to develop localised technology • Reinvigorating DSM in electricity subsector and harnessing of electricity in thermal and transport • Reinvigorating NEEAP • EE&C Act • Reinvigorating co-generation policy • Smart grid technology (incorporating digital grid etc) • Tailored communication strategy to different target audience
2.	**MANUFACTURING SECTOR**	
	• **Percentage and number of manufacturers on green manufacturing**	• MyHIJAU SME & Entrepreneur Development Programme • Energy Audit Grant for Industrial sector • Energy Management Gold Standard (EMGS) • Enhanced Time of Use tariff (EToU) • Information sharing on the energy use Benchmark • Establishment of Green Manufacturing Certification related to Material, Process, Energy utilisation, Recycle, Reuse • Ecological footprint of the process and product end of life • ISO 14001 certifications • Cogeneration application in industrial processes
3.	**TRANPORT SECTOR**	
	• **Public transport** • **Private transport**	• Implementation of the National Land Public Transport Master Plan (NLPTMP) • Strengthening the governance structure in green transportation • Carbon emission standards in the definition of Energy Efficient Vehicle (EEV)

No.	KEY SECTORS & SUB SECTORS	KEY INITIATIVES
		• Public-private partnership in mega public transport projects • Partnership with overseas entities • Economic instruments • EEV Labelling and Carbon Emission Tax Structure (CEVS) • Continue with National Biofuel Policy (NBP) • Ride sharing and E-hailing services • First and Last mile Connectivity • Energy Efficient Vehicle (EEV) Technology • Electric Vehicle (EV) Technology • Cycling Lane Infrastructure • Internet of Vehicle • Revolutionary Transportation System • Human Capital Development
4.	**BUILDING SECTOR**	
	• **Green building** • **Green building materials** • **Sustainable construction practices**	• Energy Audit Conditional Grant • Near Zero Energy Buildings targets • Standardisation of green rating tools • Malaysia Standard for construction specifications • Centre of Excellence (CoE) by CIDB • Continuous implementation of the CITP • Improving the financial viability of IBS through tax incentives • Developing competencies via CoE • Policy framework to be agile to enable recycling of C&D materials
5.	**WASTE SECTOR**	
	• **Waste treatment and disposal method** • **Resource recovery**	• Establishing the National Waste Management Steering Committee • Enhancing coordination between Federal and State Governments • Formulating policy paper on waste separation in non-household areas • Strengthening public-private collaboration in R&D&C • Developing market enablers through funding mechanism and creating market demand • Developing competencies in the public and private sector • Designing and implementing targeted awareness programs through education

No.	KEY SECTORS & SUB SECTORS	KEY INITIATIVES
		• Improving the strategy on the implementation of WtE • Emphasising the efficient use of waste as a resource • Resource recovery from other sources of organic waste • Extended Producer Responsibility (EPR) in facilitating growth in resource recovery
6.	**WATER SECTOR**	
	• **Water treatment and distribution technology** • **Water utilisation technology** • **Water harvesting technology** • **Wastewater treatment technology**	• Implementation strategy for rainwater harvesting systems • Master Plan for urban cities with sustainable water and environment • Collaboration with industry association to create market enablers for rainwater harvesting system • Integrated Urban Water Cycle Planning and Management (IUWCM) • National Sewerage Master Plan • National Sewerage Catchment Plan • Receiving of trade effluent into public STPs • Integrated Resource Recovery Centre

Table 9.2: Key Initiatives of Sectors & Sub Sectors

9.3.3 Project Ownership

In most of the strategic thrusts, there are existing mechanisms which require finetuning in order to enhance its effectiveness to facilitate Green Technologies growth. Instead of transformative changes, progressive improvement will be made by initiating a comprehensive review on the existing mechanism. A detailed action plan with shared KPIs will follow suit, accompanied with project milestone to enable KeTTHA to monitor the implementation of initiatives which have been identified in the respective strategic thrusts. Table 9.3 below shows the key areas based on the five (5) strategic thrusts.

Strategic Thrust	Key Areas
Promotion and awareness	• Tailored communication strategy • Industry and business promotion via International Greentech & Eco Products Exhibition & Conference Malaysia (IGEM) • Collaboration with primary and secondary educational institutions
Market enablers	• Government green procurement (GGP) • Green incentives • Innovative financing • Green cities • International collaborations
Human capital development	• Capability building in the public sector • Capability building in the private sector • Collaboration with higher education institutions
R&D&C	• R&D&C funding • Public-private partnership
Institutional framework	• Governance (policy leadership) • Policy planning

Table 9.3: Strategic Thrust Approach

9.4 Implementation and Performance Monitoring

9.4.1 Reporting and Performance Monitoring

All the programme and project owners will be required to share a progress report which contains their workplans, project milestone and achievement by the second quarter of 2019. KeTTHA will initiate reviews on the programmes, and also stakeholder engagements to validate the report, as well as to identify next key steps on the specific programme.

9.4.2 Communication to Public

The latest updates on the relevant workplans and its achievement will be reported to increase the public's understanding of the Government initiatives to drive GT growth in the country.

9.4.3 Document Review (GTMP 2.0)

The GTMP will be updated to incorporate valuable lessons of what has worked best in earlier programmes. Reviews on GTMP will be done periodically to ensure that the Master Plan considers the latest market megatrends of green technology which are related to Malaysia and suitable to be implemented domestically.

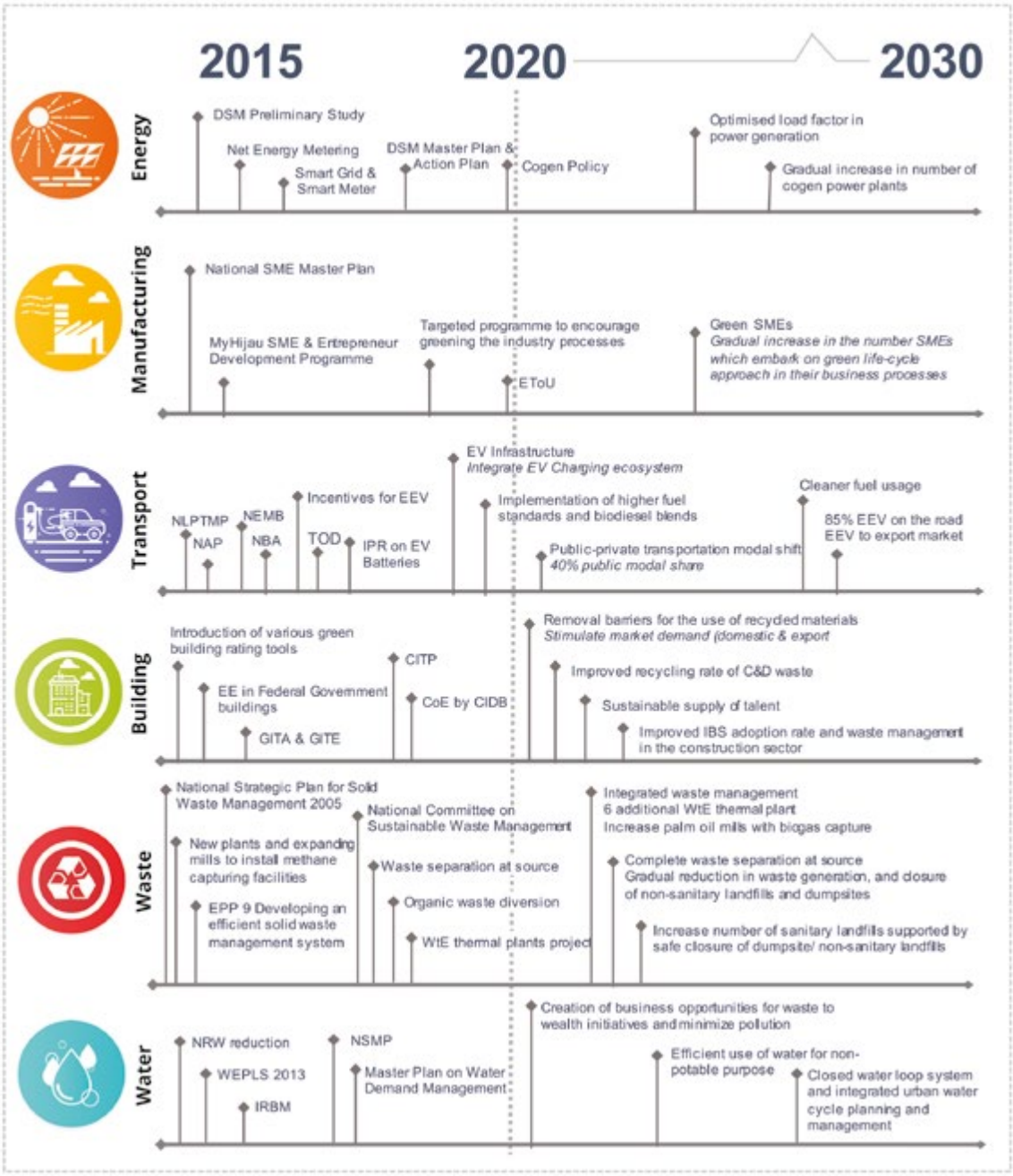

Figure 9.4: Implementation Timeline

CONCLUSION

Conclusion

Malaysia's shift towards a low-carbon economy is a strategic and bold move that will leverage on green technology as the enabler to undergo this transition. However, since green technology applies to all spheres of life, it is a complex challenge to embed it in a coordinated manner across all sectors in the economic plans of the country. The approach therefore must be multi-phased and increasingly expansive in sectoral coverage, underpinned by an increasingly deep grasp of the underlying carbon emissions data.

To this end, the GTMP has been developed as a strategic roadmap that informs the intentions for the future development of green technology strategies and programmes in Malaysia. In this first iteration, the GTMP has targeted six key sectors that are the primary contributors to carbon emissions in the country i.e. Energy Production and Supply, Buildings, Manufacturing, Transport, Waste Management and Water Supply. The initiatives that are described in these key areas, of which some are already underway, will be expanded as more data is amassed that can be interrogated for greater specificity in setting targets.

A significant lesson learnt in the development of the GTMP is that a sectoral target does not only produce a single isolated outcome within the sector but also has concurrent outcomes in other sectors. This high degree of interdependence makes it imperative for ministries to work together in producing targets which can be aggregated towards a national aspiration for a zero-carbon economy. As an interim measure, Malaysia established an intermediate goal of reducing GHG emission intensity of Gross Domestic Product (GDP) by up to 45% by 2030 relative to 2005 levels.

Future economic plans for the country will therefore be more wholistic and produce a more sustainable economy with shared goals and coordinated policy instruments. In addition, Malaysia will eventually need to graduate from a phase of technology adaptation and adoption towards greater home-grown innovations in green technology. This will require the persistent application of the five strategic thrusts that have been described in this GTMP.

Decoupling economic growth from carbon emission has the added benefit of ensuring that Malaysia remains competitive as an investment destination as it keeps pace with other economies that are pursuing it aggressively. GTMP shall pave the way for Malaysia's *Transformasi Nasional 2050* (TN50) to be amongst the leading global economies. Many of the 17 Sustainable Development Goals (SDGs) formulated by the United Nations can also be achieved through the GTMP. Realistically, it will require an informed rakyat and committed stakeholders to work out the bold targets in the GTMP which will create a greener and more sustainable Malaysia for the future generation.

GLOSSARY

Glossary of Terms used in this Document

- ACE – ASEAN Centre for Energy
- ADB – Asian Development Bank
- AEMAS – ASEAN Energy Management Scheme
- AIIB – Asian Infrastructure Investment Bank
- AMEM – ASEAN Ministers on Energy Meeting
- APEC – Asia Pacific Economic Cooperation
- ASEAN – Association of Southeast Asian Nations
- BAU – Business as Usual
- BEI – Building Energy Intensity
- BEV – Battery Electric Vehicle
- BMDAM – Building Materials Distributors Association of Malaysia
- BRT – Bus Rapid Transit
- BSEEP – Buildings Sector Energy Efficiency Project
- BUR – Biennial Update Report
- C&D – Construction and Demolition
- CAGR – Compounded Annual Growth Rate
- CAPEX – Capital Expenditure
- CAST – The Environment and Energy Branch
- CBU – Completely Built Unit
- CETREE – Centre for Education, Training, and Research in Renewable Energy and Energy Efficiency
- CEVS – Carbon Emission Tax Structure
- CHP – Combined Heat and Power
- CIDB – Construction Industry Development Board
- CITP – Construction Industry Transformation Programme
- CNG – Compressed Natural Gas
- CO_2 – Carbon Dioxide
- CoE – Centre of Excellence
- CPMV – Certified Professional in Measurement and Verification
- CPO – Crude Palm Oil
- CVLB – Commercial Vehicle Licensing Board
- DID – Department of Irrigation and Drainage
- DoE – Department of Environment
- DPIN – Direktori Pakar Industri Negara
- DSD – Department of Skills Development
- DSM – Demand Side Management
- E&E – Electrical and Electronics
- EACG – Energy Audit Conditional Grant
- EE – Energy Efficiency
- EE&C – Energy Efficiency and Conservation
- EEV – Energy Efficient Vehicle
- EMEER – Efficient Management of Electrical Energy Regulations
- EMGS – Energy Management Gold Standard
- EMIS – Energy Management Information System
- EnMS – Energy Management System

- EPC – Energy Performance Contracting
- EPP – Entry Point Projects
- EPR – Extended Producer Responsiblity
- EPU – Economic Planning Unit
- EToU – Enhanced Time of Use
- ETP – Economic Transformation Programme
- EV – Electric Vehicle
- EWG – Energy Working Group
- FiT – Feed-in Tariff
- FMM – Federation of Malaysian Manufacturers
- GBI – Green Building Index
- GCPV – Grid Connected Photovoltaic
- GDP – Gross Domestic Product
- GEF – Global Environment Facility
- GERD – Gross Domestic Expenditure on R&D
- GGP – Government Green Procurement
- GHG – Greenhouse gases
- GIB – Green Investment Bank
- GITA – Green Investment Tax Allowances
- GITE – Green Income Tax Exemption
- GKL/KV – Greater Kuala Lumpur and Klang Valley
- GLBE – Government Lead by Example
- GreenRE – Green Real Estate
- GT – Green Technology
- $GtCO_2eq$ – Gigatonnes carbon dioxide equivalent
- GTFS – Green Technology Financing Scheme
- GTMP – Green Technology Master Plan
- GWP – Global Warming Potential
- HER – Home Energy Report
- HHI – Herfindahl-Hirschman Index
- HRDF – Human Resources Development Fund
- HSR – High Speed Rail
- IA – Implementing Agency
- IBR – Incentive Based Regulation
- IBS – Industrialised Building Systems
- ICE – Internal Combustion Engine
- ICT – Information and Communications Technology
- IEEMMS – Industrial Energy Efficiency for Malaysian Manufacturing Sector
- IGEM – International Greentech & Eco Products Exhibition & Conference Malaysia
- ILB – Industry Lead Body
- INDC – Intended Nationally Determined Contribution
- IPPs – Independent Power Producers
- IRBM – Integrated River Basin Management
- IRENA – International Renewable Energy Agency
- IRRC – Integrated Resources Recovery Centre
- ITA – Investment Tax Allowance
- ITE – Income Tax Exemption
- IUWCM – Integrated Urban Water Cycle Planning and Management

- IUWM – Integrated Urban Water Management
- JKPDA – Public Funds Investment Committee *(Jawatankuasa Pelaburan Dana Awam)*
- JKR – Public Works Department *(Jabatan Kerja Raya)*
- JPP – Sewerage Services Department *(Jabatan Perkhidmatan Pembetungan)*
- JPSPN – National Solid Waste Management Department *(Jabatan Pengurusan Sisa Pepejal Negara)*
- KeTTHA – Ministry of Energy, Green Technology and Water *(Kementerian Tenaga, Teknologi Hijau dan Air)*
- KPIs – Key Performance Index
- KPKT – Ministry of Urban Wellbeing, Housing and Local Government *(Kementerian Kesejahteraan Bandar, Perumahan dan Kerajaan Tempatan)*
- $ktCO_2eq$ – Kilo tonnes carbon dioxide equivalent
- kV – kilovolt
- kWh – Kilowatt hour
- LCCF – Low Carbon Cities Framework and Assessment System
- LiB – Lithium-ion Battery
- LNG – Liquefied Natural Gas
- LRT – Light Rail Transit
- LSS – Large Scale Solar
- MAEESTA – Malaysia Energy Efficiency and Solar Thermal Application
- MAESCO – Malaysia Association of Energy Service Companies
- MAGIC – Malaysian Global Innovation & Creativity Centre
- MAI – Malaysia Automotive Institute
- MBIAP – Malaysian Biomass Industry Action Plan
- MEPS – Minimum Energy Performance Standards
- MESITA – Malaysian Electricity Supply Industries Trust Account
- MGBC – Malaysian Green Building Confederation
- MGTC – Malaysian Green Technology Corporation
- MIDA – Malaysian Investment Development Authority
- MiGHT – Malaysian Industry-Government Group for High Technology
- MOE – Ministry of Education
- MOHE – Ministry of Higher Education
- MOHR – Ministry of Human Resources
- MOSTI – Ministry of Science, Technology and Innovation
- MOT – Ministry of Transport
- MoU – Memorandum of Understanding
- MPIC – Ministry of Plantation Industries & Commodities
- MPOB – Malaysian Palm Oil Board
- MRT – Mass Rapid Transit
- MSW – Municipal Solid Waste
- $MtCO_2eq$ – Million tonnes carbon dioxide equivalent
- MTHPI – National Green Technology and Climate Change Council (Majlis Teknologi Hijau dan Perubahan Iklim)
- MW – Megawatt
- MyCREST – Malaysian Carbon Reduction and Environmental Sustainability Tool
- NAHRIM – National Hydraulic Research Institute of Malaysia
- NAP – National Automotive Policy

- NBP – National Biofuel Policy
- NEEAP – National Energy Efficiency Action Plan
- NEM – Net Energy Metering
- NEMB – National Electric Mobility Blueprint
- NGO – Non-governmental Organisations
- NGTCCC – National Green Technology and Climate Change Council
- NGTP – National Green Technology Policy
- NGV – Natural Gas Vehicle
- NKEA – National Key Economic Area
- NLPTMP – National Land Public Transport Master Plan
- NOSSs – National Occupational Skills Standards
- NRE – Ministry of Natural Resources and Environment
- NREPAP – National Renewable Energy Policy and Action Plan
- NRPA – National Research and Development Priority Area
- NRW – Non Revenue Water
- NSCP – National Sewage Catchment Plan
- NSRC – National Science and Research Council
- nZEB – Near Zero Energy Building
- OPEX – Operational Expenditure
- PAP – Pre-Approved Plans
- PEMANDU – Prime Minister's Department
- PERSPAH – Malaysia Rainwater Harvesting Systems Association
- pH – Penarafan Hijau
- PHEV – Plug-in Hybrid Electric Vehicle
- PLANMalaysia – Federal Department of Town and Country Planning
- PME – Palm Methyl Ester
- PMHS – Performance Monitoring Hub System
- POME – Palm Oil Mill Effluent
- PPP – Public Private Partnership
- PV – Photovoltaic
- R&D&C – Research, Development and Commercialisation
- RE – Renewable Energy
- REDHA – Real Estate and Housing Developers' Association Malaysia
- REEM – Registered Electrical Energy Manager
- RHS – Rainwater Harvesting System
- RLPTMP – Regional Land Public Transport Master Plan
- RMK-9 – Ninth Malaysia Plan
- RMK-10 – Tenth Malaysia Plan
- RMK-11 – Eleventh Malaysia Plan
- RSPO – Roundtable on Sustainable Palm Oil
- SAVE – Sustainability Achieved via Energy Efficiency
- SCP – Sustainable Consumption and Production
- SDGs – Sustainable Development Goals
- SEDA – Sustainable Energy Development Authority
- SESB – Sabah Electricity Sdn Bhd
- SIT – Special Incentive Tariff

- SME – Small and Medium Enterprise
- SO – System Optimisation
- SPAD – Land Public Transport Commission (*Suruhanjaya Pengangkutan Awam Darat)*
- SPAN – National Water Services Commission (*Suruhanjaya Perkhidmatan Air Negara)*
- SPV – Special Purpose Vehicle
- ST – Energy Commission *(Suruhanjaya Tenaga)*
- STI – Science, Technology and Innovation
- STP – Sewage Treatment Plan
- SWMP – Site Waste Management Plans
- TIV – Total Industry Volume
- TNB – Tenaga Nasional Berhad
- TOD – Transit Oriented Development
- TPES – Total primary energy supply
- TSM – Tariff Setting Mechanism
- TVET – Technical Vocational Education and Training
- UBBL – Uniform Building By-Laws
- UiTM – Universiti Teknologi Mara
- UM – Universiti of Malaya
- UMPEDAC – UM Power Energy Dedicated Advanced Centre
- UNDP – United Nations Development Programme
- UNFCCC – United Nations Framework Convention on Climate Change
- UNIDO – United Nations Industrial Development Organisation
- USC – Ultra-supercritical
- UTHM – Universiti Tun Hussein Onn Malaysia
- UTM – Universiti Teknologi Malaysia
- VOC – Volatile Organic Compounds
- WEC – World Energy Council
- WELPS – Water Efficient Products Labelling Scheme
- WtE – Waste to Energy
- YaHijau – Yayasan Hijau Malaysia
- YoY – Year-on-year
- ZEB – Zero Energy Building

SUMMARY

GREEN TECHNOLOGY MASTER PLAN MALAYSIA (2017 – 2030)

The GTMP puts into place a framework that facilitates the mainstreaming of green technology in Malaysia.

The goal of GTMP is to strengthen the role of the green economy and green technology as a catalyst to drive Malaysia's aspirations for sustainable growth.

Six key sectors focused in GTMP are Energy, Manufacturing, Transport, Building, Waste and Water.

Energy

Manufacturing

Transport

Building

Waste

Water

ENERGY:

CURRENT

RE mix (installed capacity)

2016
18.4%

MOVING FORWARD

Electricity generation

2020 **20%** → 2025 **23%** → 2030 **30%**

Electricity generation diversity:
Maintaining Herfindahl-Hirschman Index (HHI) **below 0.5**

Carbon emission from power plants:
Imposition of **clean coal technology requirement** for new coal-fired plants

Reinvigorating **co-generation** policy

Energy efficiency

Reduction in electricity intensity

2014 **1.5%** → 2025 **10%** → 2030 **15%**

MANUFACTURING:

CURRENT

MOVING FORWARD

NUMBER OF MANUFACTURERS IN GREEN MANUFACTURING

2015	2020	2025	2030
10%	15%	30%	50%
3,400 (established)	5,100	10,200	17,000

Increase Adoption of Green Manufacturing Initiatives

- Green energy utilisation
- Green products and certifications
- Green industrial processes

TRANSPORT:

CURRENT | **MOVING FORWARD**

MODAL SHARE

20.8% *(2013)* Greater KL/ Klang Valley

Emission reduction **214.9 $ktCO_2eq$ *(2013)***

Rail-based public transport

40% *(2020)* Greater KL/ Klang Valley

20% *(2020)* Other Cities

40% *(2030)* All Cities

Targeted Emission reduction **977.5 $ktCO_2eq$* *(2020)***

*Greater KL/Klang Valley only

PRIVATE VEHICLES

32.6% *(2015)*

% of total industry volume to be Energy Efficient Vehicles (EEV) *(fuel efficient vehicles, hybrid and EV)*

85% *(2020)*

100% *(2030)*

Emission reduction **41.0 $ktCO_2eq$ *(2013)*** *(hybrid only)*

Carbon emission standards in the definition of EEV by 2020

Targeted Emission reduction **199.7 $ktCO_2eq$ *(2020)*** *(hybrid only)*

BIODIESEL

230,000 tonnes

Emission reduction **719.7 $ktCO_2eq$ *(2013)***

Petroleum diesel displaced by palm oil based biodiesels

576,000 tonnes

Targeted Emission reduction **1802.5 $ktCO_2eq$ *(2020)***

WASTE:

CURRENT | **MOVING FORWARD**

WASTE TREATMENT AND DISPOSAL

14 sanitary landfills and **147** non-sanitary landfills nationwide as of 2016

23 sanitary landfills nationwide as of 2020

80%* sanitary landfills by 2030

3 Waste-to-energy thermal plants by 2030

17.5% (2016)

Recycling rate

22% (2020)
25%* (2025)
28%* (2030)

*Expert assumption by the National Solid Waste Management Department (JPSPN) and approved during the meeting on 10th August 2017 on Post 2020 Target Recycling Rates and Solid Waste Management Facilities.

RESOURCE RECOVERY

300

3,002

$ktCO_2eq$ biogas capture from palm oil mill effluent treatment

71	Number of palm oil mills with biogas capture facilities	**500**

BUILDING:

CURRENT | **MOVING FORWARD**

GREEN BUILDING

GOVERNMENT BUILDING

Emission reduction **10.9 $ktCO_2eq$ *(2014)***

PRIVATE BUILDINGS

Emission reduction **60.4 $ktCO_2eq$ *(2013)***

550 (2020) » **1,750** (2030)

Total number of green buildings

GOVERNMENT BUILDING

Targeted Emission reduction **98.2 $ktCO_2eq$ *(2020)***

PRIVATE BUILDINGS

Targeted Emission reduction **858.4 $ktCO_2eq$ *(2020)***

SUSTAINABLE CONSTRUCTION PRACTICES

24% of RM10million - RM15 million target public projects achieved 70 IBS score

14% of RM10 million and above target private projects achieved 50 IBS score

100% of RM 10 million - RM15 million target public projects achieved 70 IBS score

100% of RM10 million and above target private projects achieved 50 IBS score

WATER:

Integrated river basin management

Freshwater abstraction rate

2015	2025	2030
2%	10%	15%

Water harvesting technology

60% of towns in Malaysia will be installed with Rainwater Harvesting Systems by 2020

Water treatment and distribution technology

NRW

35.5% (2015)

25% (2025)

20% (2030)

Water utilisation technology

Increased number of labelled water efficient products

WEPLS will be mandatory by 2019

Wastewater treatment technology

Targets by **2030**

100% sludge to be recycled

33% treated effluent to be recycled

IMPLEMENTATION FRAMEWORK

National Council

National Green Technology and Climate Change Council (NGTCCC)

Provide Strategic Directions
- Thought Leadership
- Defining Vision & Mission

GTMP Owner

Ministry of Energy, Green Technology and Water

Strengthen Initiative Planning
- Drive group objectives
- Oversee implementation
- Performance Management
- Report the progress of the initiatives to NGTCCC

Implementing Agency

Malaysian Green Technology Corporation (MGTC)

Planning, Budgetting, Monitoring and Reporting
- Propose new technology/projects
- Evaluate project proposals
- Provide technical inputs to Steering Committee
- Prepare annual budget for green initiative
- Monitor the progress and performance of the initiative

GTMP Advisory Committee
- **Key players from 6 Sectors:**

Energy	Manufacturing
Transport	Building
Waste	Water

Key Players:
- Ministries, Agencies & Local Authorities
- Private (Industry)
- Non-Governmental Organisations (NGOs)
- Universities & Research Institutions

Education
- Execute Strategies and Implementation

1 Promotion and awareness
- Tailored communication strategy
- Industry and business promotion via International Greentech & Eco Products Exhibition & Conference Malaysia (IGEM)
- Collaboration with primary and secondary educational institutions

2 Market enablers
- Government Green Procurement (GGP)
- Green Incentives
- Innovative financing
- Green Cities
- International collaborations

3 Human capital development
- Capability building in the public sector
- Capability building in the private sector
- Collaboration with higher education institutions

4 Research, Development and Commercialisation (R&D&C)
- R&D&C funding
- Public-private partnership

5 Institutional framework
- Governance (policy leadership)
- Policy planning

**MINISTRY OF ENERGY,
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MALAYSIA**

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