Asia-Pacific
Economic Cooperation

Peer Review on

Low Carbon Energy Policies in Malaysia

Final Report

22 May 2014

Endorsed by the APEC Energy Working Group

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PREFACE

The APEC Peer Review on Low Carbon Energy Policies (PRLCE) was endorsed by the APEC Energy Ministers at the 2010 Energy Ministers Meeting. The review is an extension of APEC Peer Review on Energy Efficiency (PREE) and follows its guidelines. The PRLCE seeks to achieve the following objectives:

- Share information on low carbon energy performance as well as on policies and measures for improving and promoting low carbon energy in respective economies;
- Provide opportunities for learning from the experiences of other economies and for broadening the network among low carbon policy experts;
- Explore how low carbon goals on an overall and/or sectoral basis and action plans could be effectively formulated in each economy under review, taking into account the range of possible strategies that could be used, according to the circumstance of each economy;
- Monitor progress on attaining low carbon energy goals on an overall and/or sectoral basis and implementing action plans, if such goal and action plans have been already formulated at the time of the review; and
- Provide recommendations for voluntary implementation on how implementation of action plans could be improved with a view to achieving low carbon energy goals.

Malaysia volunteered to undertake the fourth low carbon energy peer review after Thailand, the Philippines and Indonesia. This report presents the results of the peer review of low carbon energy policies conducted in Kuala Lumpur and Putrajaya, Malaysia.

The primary accountability for each peer review is shared by the economy being reviewed and the PRLCE Review Team. The peer review in Malaysia was conducted by a team of nine experts (see Appendix A) who visited Malaysia from 9 – 13 December 2013.

During the visit, the PRLCE Review Team had comprehensive discussions on low carbon energy policies with representatives and experts from the government ministries and agencies, private companies and other stakeholders (see Appendix B).

The PRLCE Review Team wishes to thank all the presenters and others that spent time with the team for discussions, especially the representatives of the Ministry for Energy, Green Technology and Water (KeTTHA) and Sustainable Energy Development Authority (SEDA) who organised the event.

EXECUTIVE SUMMARY

Malaysia began incorporating Renewable Energy (RE) into its energy supply mix in the 1980s with the introduction of stand-alone solar photovoltaic systems for rural electrification. In April 2001, the importance of renewable energy was formally recognized with adaptation of the Five-Fuel Policy under the Eighth Malaysia Plan which defined renewable energy as the fifth fuel in the national energy supply mix alongside natural gas, oil, hydro and coal. Ten years later, the National Renewable Energy Policy and Action Plan (NREPAP) was established to provide a more comprehensive and effective renewable energy policy to accelerate renewable energy contribution into the national power generation mix. The NREPAP enabled the formulation of two acts, the Renewable Energy Act 2011 and the Sustainable Energy Development Authority Act 2011, which forms the basis for the feed-in tariff (FIT) mechanism implementation in Malaysia.

The APEC PRLCE Review Team were pleased to note that since the introduction of FIT mechanism in Peninsular Malaysia in December 2011, about 119.47 MW of renewable energy power generation capacity is already in operation as of October 2013. This is more than double the 53 MW of renewable energy power capacity installed in the previous decade. The PRLCE Review Team were also impressed with the biomass and biofuel strategies in place in the economy. Malaysia is currently on track to implement the nationwide mandatory requirement for 5% biodiesel (B5) by July 2014.

In terms of the institutional framework, the structure for the Malaysian energy industry is quite unique compared to most of the other APEC members, whereby the formulation and implementation of energy policies is not centralized under the Energy Ministry. While a more streamlined structure is usually preferable to eliminate problems of overlapping roles or gaps in responsibility sharing, the current structure does not pose serious problems as long as responsibilities and jurisdiction of the different authorities are clearly defined. The PRLCE Review Team also strongly encourages the establishment of stakeholder associations that can provide valuable insight to policymakers on emerging issues in their fields of expertise, and furthermore collaborate with the Malaysian Government to foster RE development in the economy.

Malaysia already has ambitious renewable energy targets for power generation. The PRLCE Review Team believes that to further encourage diversification of energy resources, there is a need to include sub-targets for other types of renewable energy applications, for instance commercial water heating, industrial process heating as well as biofuel for transportation in agricultural or industrial sectors are areas where RE can be utilised. These sub-targets can be used to formulate action plans that can be easily implemented and monitored to ensure the economy is on-track to meet its set targets. These action plans and targets can then be integrated into a comprehensive update of the NREPAP and national energy policy to provide a unified, clear direction for renewable energy development in Malaysia for the long-term.

A critical component for sustainable low-carbon energy promotion is the financial framework as renewable energy investment can be expensive. To help mitigate this challenge, Malaysia has several financial incentives and strategies in place to encourage investment in renewable energy applications.

This includes the FIT mechanism, the Incentives for End Users, the Green Technology Financing Scheme (GTFS) and the Clean Development Mechanism (CDM).

The PRLCE Review Team applauds these initiatives, and believes that on-going monitoring should be done to continuously evaluate the effectiveness and usefulness of each incentive implementation. Continuous evaluation would also enable the economy to determine whether an incentive should be continued, expanded or even terminated if the market is able to operate independently without government support. At the same time, the PRLCE Review Team also recognizes the importance of local authorities and local communities in renewable energy development in Malaysia and strongly urges the economy to develop incentives (both fiscal and non-fiscal incentives) to boost local participation and support.

Two challenges that cropped up many times during discussions with the Malaysian renewable energy stakeholders are the matching of potential resources with local demand and the lengthy approval processes for renewable energy projects. Usually, the supply-demand matching problem is related to the remote location of renewable energy resources which makes it economically difficult to be connected to the power grid while low local demands in remote areas may cause instabilities in the power network. The time-consuming approval processes are also usually related to the stationary and statutory nature of renewable energy resources which necessitates the involvement of local authorities for requirements. This involves land conversion approvals, water abstraction rights and permissions, planning permissions, access to reserve lands and environmental impact assessments. Both these challenges are very much related to the local authorities and local communities. Therefore cultivating local expertise and support to facilitate processes and grow local demand is highly important to meet these two challenges.

Renewable energy resources that are currently prioritized in Malaysia are biomass, biogas, small-scale hydro and solar photovoltaic (PV). There are many specific programs and incentives in place to promote the development of these resources like the National Biomass Strategy 2020 and Solar PV Rooftop Programme. While some of these initiatives are being successfully implemented, some needs further action and attention which has drawn a number of recommendations from the PRLCE Review Team.

In terms of resource potential, there is a definite need for a detailed and reliable potential mapping that provides information not only on the technical potential but also on other key enabling factors or constraints, such as the reach of transmission and road networks, protected areas and potential cumulative impacts on local flora and fauna. In terms of resource utilization, there is strong potential for diversification of renewable energy applications in Malaysia which will require innovative research and development activities and robust policy framework to bring into fruition. In terms of local content, Malaysia is encouraged to leverage on its existing educational and training system to further strengthen and improve local talent that is capable of growing a sustainable industry value chain, especially for solar PV manufacturing and biomass products and services.

For this PRLCE in Malaysia, two sectors were reviewed at the request of the Malaysian Government; the power sector (which includes the FIT mechanism implementation) and the transport sector. Combined together, these two sectors account for about two-thirds of the total carbon emissions in Malaysia.

For the power sector, the main challenge is to defer the need for new fossil-fuel capacity build-up. This can likely be achieved by gradually rationalizing electricity subsidies as well as expediting electricity efficiency and conservation measures in tandem with renewable energy solutions. At the same time, the Malaysian Government is encouraged to accelerate the development of smart grid solutions and low carbon cities to maximize renewable energy utilization in the economy and at the same time improve sustainability. APEC has several initiatives for knowledge sharing on both the smart grid and low carbon cities. Therefore, Malaysia is strongly urged to take advantage of the opportunities available for building local capacity and technology transfer.

The FIT mechanism, introduced in December 2011, has shown much progress and the PRLCE Review Team are pleased to observe that the implementing agency continuously monitors the system for weaknesses and holds regular dialogues with stakeholders to improve the system as required. On the other hand, there are still some improvements that can be made based on lessons learned from other FIT schemes worldwide, such as staggering quota release time and introducing a consistent mechanism for degression and one-stop information centres at the local level. The PRLCE Review Team believes that these improvements may help ease administrative burden and shorten project development time.

Recommendations for the transport sector can be roughly divided into two categories, the private and public transportations. For private transportation, Malaysia is encouraged to continue diversifying the transportation fuel sources by incentivizing alternative options like higher blend biodiesels, bioethanol, biogas and electricity. At the same time, given the considerable variation between vehicle fuel consumption even for vehicles with similar sizes and engine cc rating, Malaysia should consider introducing vehicle fuel economy labelling that would provide buyers with information on energy running costs which will enable buyers to determine the total cost of ownership rather than vehicle purchase price alone.

Fuel switching to low-carbon alternatives is also recommended for public transportation, particularly for urban busses. Malaysia has a number of significant public transport infrastructure and service projects in the pipeline for implementation. The PRLCE Review Team strongly urges that these be implemented without delay. To further encourage consumer modal shift from private to public transportation, improving the commuting experience should be a priority, especially for the first and last mile journeys.

In summary, Malaysia already has several initiatives, programs and policies in place to introduce low-carbon energy utilization, particularly renewable energy, into the economy's energy supply mix. The PRLCE Review Team believes that these policies can be further improved to accelerate low-carbon energy utilization in the economy and reduce carbon emissions. The recommendations in this report are designed based on this need for acceleration and to address the issues observed. Generally, the PRLCE Review Team strongly encourages that Malaysia diversify its renewable energy applications; streamlines its process and procedures especially at the local level; and encourage public and private participation; as well as grow and strengthen local capacity to meet the many needs for sustainable energy development. Malaysia has strong potential for renewable energy development, and it is hoped that the recommendations in this report will help the economy to realize this potential and achieve its low-carbon energy aspirations.

RECOMMENDATIONS

Institutional Context

Recommendation 1:
It is desirable for all government entities to continue close cooperation in implementing renewable energy policies. However, a more streamlined structure would improve accountability and coordination as well as help mitigate problems with overlapping roles.

Recommendation 2:
Encourage state authorities to streamline and standardize renewable energy approval processes and procedures across different departments.

Recommendation 3:
Create an official forum for regular dialogue sessions between RE stakeholders and the authorities.

Recommendation 4:
Encourage RE stakeholders to establish associations that fosters RE development in the economy.

Renewable Energy Goals, Targets and Strategies

Recommendation 5:
As the current National Renewable Energy Policy and Action Plan (NREPAP) was endorsed by the Malaysian Cabinet in 2010, it is highly recommended that Malaysia updates the NREPAP targets and action plans to adapt to the changes in global and local circumstances and to take into account the two renewable energy laws and funding available for RE development.

Recommendation 6:
Consider expanding definition of national renewable energy targets to include sub-targets for Sarawak state and renewable energy applications in different sectors like power generation (off-grid and on-grid), heat generation (process and water heating), transportation and others.

Recommendation 7:
In order to maximize the uptake of renewable energy technologies, consider integrating the deployment of smart networks (including advanced metering infrastructure (AMI) and smart grid) into the upcoming New National Energy Policy Study.

Recommendation 8:
Enhance international cooperation to help lift barriers (like market and technology barriers) for renewable energy applications.

Energy Regulation and Infrastructure

Recommendation 9:
It is worthwhile to consider the introduction of an RE development plan based upon a law in which goals and targets are legally binding in order to strongly promote RE development.

Recommendation 10:
It is recommended that the authorities continue to develop human capital, improve information sharing and increase public awareness raising activities.

Recommendation 11:
State-level approval processes for RE projects should be reviewed and where necessary, standardized or even streamlined.

Recommendation 12:
There should be a feedback mechanism to monitor the achievements of RE policy and other action plans in terms of actual performance of RE facilities installed and other indicators (jobs created, CO_2 savings and others).

Sustainable Development

Recommendation 13:
Monitor and evaluate the progress of the Green Technology Financing Scheme (GTFS) in light of recent changes to the scheme.

Recommendation 14:
Consider another extension to Incentives for End-Users, pending evaluation of the success of the current implementation.

Recommendation 15:
Expand the Incentives for End-users to include:

- *Import duty and sales tax exemption for imported spare parts (currently only applies to large equipment such as gas engines).*
- *Sales tax exemption and investment tax allowance for individual (residential) projects that purchase from local manufacturers (currently only available to commercial projects).*

Recommendation 16:
Investigate the possibility of fiscal incentives in the form of tax payments for local communities to encourage social acceptance and build support for local renewable energy projects.

Recommendation 17:
Malaysia should encourage the development of renewable technologies that are less established; including wind, geothermal and tidal energy.

Recommendation 18:
Encourage renewable energy projects by giving these projects preferential treatment.

Recommendation 19:
It is recommended that the Government of Malaysia accelerate the design and implementation of its NAMAs through the Mitigation Action Implementation Network (MAIN) and Low Emission Capacity Building (LECB) program.

Recommendation 20:
The Government of Malaysia should consider establishing its own registry or database of domestic mitigation actions.

Biomass and Biogas

Recommendation 21:
Identify mechanisms to incentivize isolated plants such as easing transmission costs for long-distance connections or exploring other sustainable applications for biogas like biofuel for on-site transport utilization.

Recommendation 22:
Regulate environmental laws to enhance biomass/biogas production and incentivize plants to achieve excellent environmental performance.

Recommendation 23:
Stimulate the co-firing of biogas/biomass in boilers of new and upgraded facilities.

Recommendation 24:
Promote local content to improve technological self-dependency.

Recommendation 25:
Provide research funding and incentivize commercial pioneering for second generation technologies.

Recommendation 26:
Distribute benefits of RE to the local community to ensure continued public support.

Recommendation 27:
Explore potentials of other forms of organics.

Small-scale Hydro and Solar

Recommendation 28:
Re-evaluate the potential of hydro resources (especially in Sarawak) by conducting a comprehensive study on hydro potential, taking into account new technologies (like low-head and ultra-low-head technologies), accessibility and proximity to load demand centres. Based on the findings of this study, formulate a long-term plan for small-scale hydropower development.

Recommendation 29:
Micro-grids powered by small-scale hydro should be investigated and incentivized to supply rural communities.

Recommendation 30:
Investigate appropriate incentives to encourage more building-integrated PV (BIPV) installations for public and commercial buildings.

Recommendation 31:
State and local authorities may consider developing additional incentives to attract public participation in solar PV development.

Recommendation 32:
Analyse instruments for promoting and incentivizing solar applications beyond solar rooftop PV to include solar thermal applications in commercial (solar water heating) and agricultural sectors (solar-assisted drying systems, solar-assisted dehumidification systems) as well solar PV applications integration with agricultural activities.

Recommendation 33:
Improve local capacity and capability to build-up a sustainable and competitive solar PV industry value chain.

Low-Carbon Power Supply

Recommendation 34:
Continue to explore and implement high-efficiency, low-emissions technologies for new and existing thermal generation capacities.

Recommendation 35:
Accelerate and increase electricity efficiency and conservation measures in tandem with renewable energy solutions to decouple electricity consumption from economic growth and defer the need for building-up new thermal power capacity.

Recommendation 36:
Continue to gradually rationalize electricity subsidies on schedule and consider transferring a portion of the savings benefit from the fossil-fuel subsidies rationalisation to promoting low-carbon technologies.

Recommendation 37:
Accelerate resource mapping for new renewable energy potentials (wind, geothermal, biomass, small-hydro) to diversify resources for renewable energy power generation.

Recommendation 38:
Accelerate the development and implementation of smart grid and low carbon cities to maximize renewable energy potential.

Recommendation 39:
Local authorities should be encouraged to play a wider role in promoting RE development in their respective jurisdictions.

Recommendation 40:
Encourage wider public participation by providing easily accessible information on where electricity supply is needed, what renewable energy resources and technologies are available and what benefits can be achieved.

Recommendation 41:
Coordination between renewable energy development and grid infrastructure perspectives should be secured at an early stage to accommodate future expansion of renewable energy.

Recommendation 42:
Consider applying degression on solar PV tariffs more frequently and based on a pre-determined mechanism or formula.

Recommendation 43:
Consider staggering the time and amount of quota released throughout the year as this would help ease the burden of administrative processing and provide accessibility for the developers.

Recommendation 44:
Continued efforts for capacity building in various stages of renewable energy from planning, construction, operation and decommissioning stages would benefit the increase and expansion of feasible renewable energy projects.

Recommendation 45:
Promote the formation of energy service companies (ESCOs) focused on renewable energy.

Low-Carbon Transport

Recommendation 46:
Gradually rationalize petroleum products price subsidies.

Recommendation 47:
Continue implementing the B5 biodiesel blending mandate and investigating potential for B7 or B10.

Recommendation 48:
Investigate other biofuel options including bioethanol and biogas for transportation.

Recommendation 49:
Consider introducing vehicle fuel economy labelling which includes information on energy running costs.

Recommendation 50:
Projects for developing and improving public transport infrastructure should be implemented without delay.

Recommendation 51:
Continue efforts to attain targets for public transport infrastructure and ridership by improving the commuting experience, especially for the "first and last mile" journey.

Recommendation 52:
Continue coordination with local authorities for integrating transport and land-use policies.

APEC PEER REVIEW

ON LOW-CARBON POLICIES (PRLCE)

PART I: BACKGROUND INFORMATION

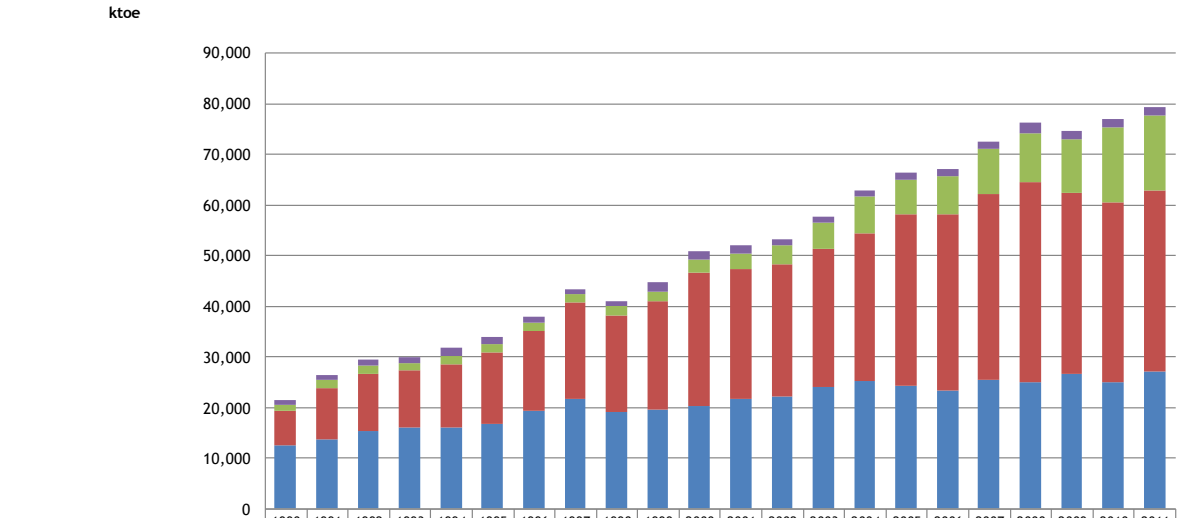
This part of the report was contributed by Malaysia and includes basic information on renewable energy and the main institution associated with energy in the economy. The main purpose of this part is to provide the reader with the context within which the PRLCE Review Team based its recommendations.

The report shows the aspect of low-carbon energy including the current policy and objectives as well as low-carbon energy activities. The data provided is the latest data available at the time of the PRLCE Review Team visit in December 2013.

1. ENERGY SITUATION IN MALAYSIA

1.1 PRIMARY ENERGY SUPPLY

The Malaysian total primary energy supply in 2011 was recorded at 79,289 ktoe, a 3.2 percent growth from the previous year (2010: 3.0 percent). The growth was attributed to the higher imports of energy in order to meet local demand. The highest increase of imports was observed for natural gas as it recorded an increase of 26.3 percent to settle at 6,979 ktoe. The total increase of primary energy supply was attributed to the lower total exports of energy, as it declined by 6.6 percent to settle at 49,142 ktoe. This high drop was due to the lower export of crude oil which declined by 33.4 percent in 2011 compared to that in the previous year to register at 11,404 ktoe.



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Hydropower	915	1,053	997	1,262	1,652	1,540	1,243	790	1,113	1,668	1,612	1,687	1,329	1,056	1,329	1,313	1,567	1,522	1,964	1,627	1,577	1,850
Coal and Coke	1,326	1,564	1,640	1,352	1,563	1,612	1,677	1,622	1,731	1,940	2,486	2,970	3,642	5,316	7,109	6,889	7,299	8,848	9,782	10,623	14,777	14,772
Natural Gas	6,801	10,112	11,381	11,360	12,392	13,960	15,567	19,041	19,101	21,476	26,370	25,649	26,101	27,257	29,145	33,913	34,917	36,639	39,289	35,851	35,447	35,740
Crude Oil, Petroleum Products and Others	12,429	13,606	15,273	15,951	16,055	16,767	19,353	21,720	19,051	19,450	20,242	21,673	22,124	23,936	25,253	24,096	23,240	25,381	24,996	26,482	25,008	26,927

Source: National Energy Balance

Figure 1: Primary Energy Supply

In 2011, the total crude oil and condensates production posted a decrease of 1.8 percent from that of 2010 to 28,325 ktoe or 569.8 thousand barrels per day. This was due to major scheduled maintenance and shutdown programmes that were carried out during this period, involving over 70 fields and 10 pipelines. These shutdowns were planned to coincide with tie-in work for new field development facilities that are expected to come on-stream in the next few years.

Table 1: Production and Reserves of Oil as of 1st January 2011

Region	Reserves in billion barrels			Production in thousand barrels per day		
	Crude Oil	Condensates	Total	Crude Oil	Condensates	Total
Peninsular Malaysia	2.048	0.326	2.374	207.7	35.8	243.5
Sabah	1.874	0.118	1.992	134.0	0.0	134.0
Sarawak	1.007	0.485	1.492	119.3	73.0	192.3
Total	4.929	0.929	5.858	461.0	108.8	569.8

Source: National Energy Balance

As of 1st January 2011, Malaysia's crude oil reserves stood at 5.858 billion barrels compared to 5.799 billion barrels in the previous year. This increase was due mainly from Peninsular Malaysia totalling 2.374 billion barrels compared to that in the previous year at 2.061 billion barrels.

Natural gas production remained stable, averaging at 7,299 million standard cubic feet per day (mmscfd) compared to 7,476 mmscfd in the previous year. A slight decrease was recorded for Peninsular Malaysia and Sabah with 13.2 percent and 3.2 percent negative growth rates respectively. Overall, the production of oil and gas was maintained by the addition of three new gas fields (Cilipadi, F9 and Melor & Laho) and three new oil fields (Dana, East Piatu and Sepat) that were brought on-stream in 2011. This increased the total number of producing fields in Malaysia to 124, comprising 76 oil fields and 48 gas fields.

The primary supply of crude oil was at 24,679 ktoe in 2011, an increase of 9.7 percent from 22,487 ktoe in 2010. The increase was mainly due to higher imports and lower exports during the 2011 period. The primary supply of natural gas which stood at 35,740 ktoe in 2011 is an increase of 0.8 percent from the 2010 level of 35,447 ktoe. The increase was mainly due to higher imports of natural gas in 2011.

Table 2: Reserves and Production of Natural Gas as of 1st January 2011

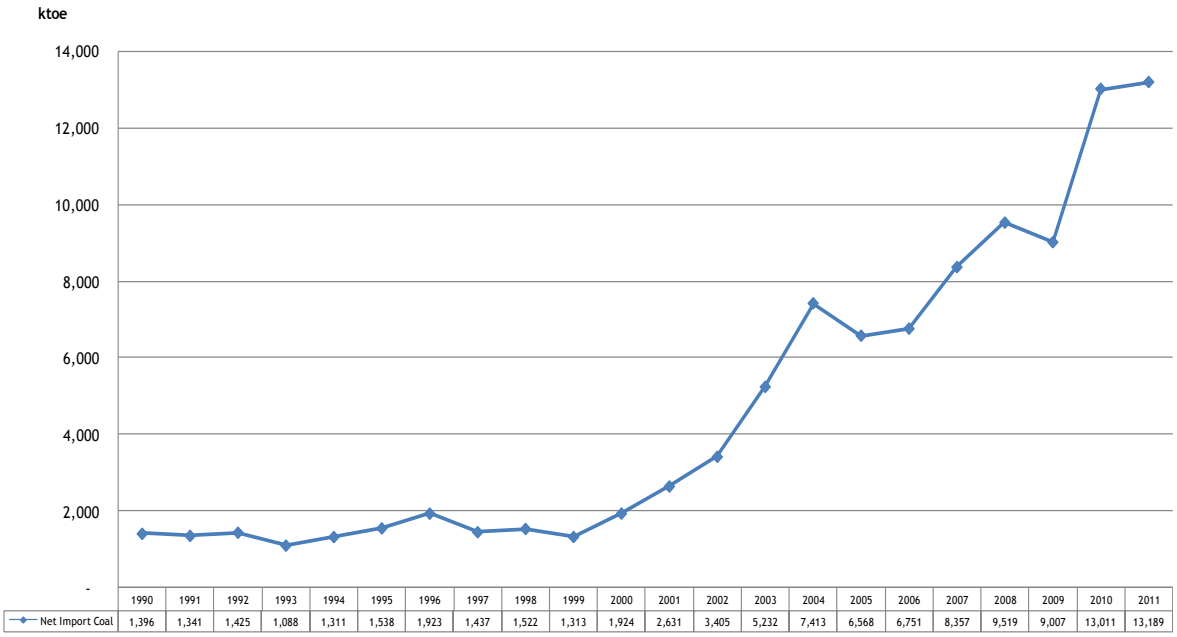
Region	Reserves			Production
	Trillion standard cubic feet (Tscf)			Million standard cubic feet per day (mmscfd)
	Associated	Non-Associated	Total	
Peninsular Malaysia	9.797	25.337	35.134	2,385.73
Sabah	3.327	8.638	11.965	433.61
Sarawak	3.033	39.856	42.889	4,479.49*
Total	16.157	73.831	89.988	7,298.84

Notes (*): *Refers to the amount of gas produced/generated from associated fields*
1 cubic feet = 0.028317 cubic metre
Associated Gas: Natural gas produced in association with oil
Non-Associated Gas: Natural gas produced from a gas reservoir not associated with oil

Source: National Energy Balance

Meanwhile, as of 1st January 2011, Malaysia's natural gas reserves increased to 89.988 trillion standard cubic feet (tscf), from the 2010 level of 8.587 tscf. PETRONAS made two gas discoveries in the shallow water areas offshore of the west coast of Sabah. The first discovery was via the Zuhal East-1 well, which is located in the Samarang Asam Paya Block about 130 km southwest of Kota Kinabalu. The well was spudded in at a water depth of 38 m and reached a total depth of 2,336 m to confirm the presence of significant gas-bearing reservoirs. The current estimate of gas-initially-in-place is about 550 billion standard cubic feet (bscf).

The primary supply of coal and coke in the country was stable at 14,772 ktoe in 2011 compared to 14,777 ktoe in 2010. Higher imports of coal and coke in 2011, which increased by 5.5 percent, was recorded in line with the increase in local demand especially from the power sector. In 2011, the primary supply of hydropower energy recorded an increase of 17.3 percent to 1,850 ktoe. This was due to the commissioning of Bakun Hydro that generated 300 MW in 3Q 2011 and 750 MW in 4Q 2011.



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Net Import Coal	1,396	1,341	1,425	1,088	1,311	1,538	1,923	1,437	1,522	1,313	1,924	2,631	3,405	5,232	7,413	6,568	6,751	8,357	9,519	9,007	13,011	13,189

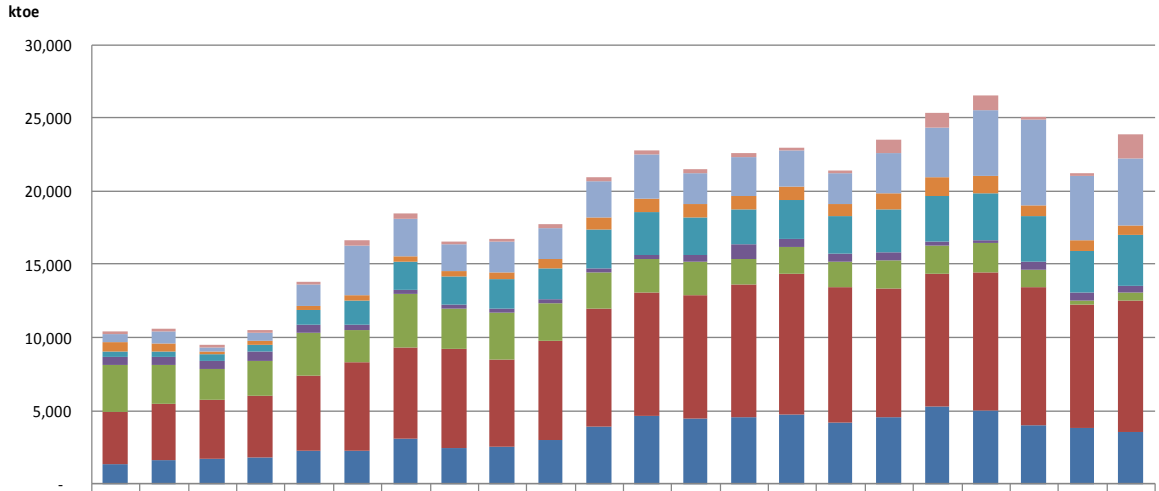
Source: National Energy Balance

Figure 2: Net Import of Coal

1.2 ENERGY TRANSFORMATION

The total oil refineries production in 2011 was recorded at 23,867 ktoe, an increase of 12.5 percent compared to the previous year (2010: 21,207 ktoe). All major petroleum products showed an upward trend except for Petrol, LPG and Kerosene. Of the total production, diesel took up the highest share (37.4 percent), followed by Non-Energy (19.1 percent), Petrol (15.1 percent), ATF and AVGAS (14.5 percent), Refinery Gas (6.9 percent), LPG (2.8 percent), Fuel Oil (2.4 percent) and Kerosene (1.8 percent). Malaysia's total refinery capacity currently is 492 thousand barrels per day, excluding the condensates splitter capacity of 74.3 thousand barrels per day.

Liquefied Petroleum Gas (LPG) production from the Gas Processing Plant (GPP) increased to 2,434 ktoe compared to the previous level of 2,299 ktoe. The LPG production from the Liquefied Natural Gas (LNG) plants recorded a more than double drop to 214 ktoe in 2011 compared to the previous year's level of 451 ktoe. The Middle Distillate Synthesis (MDS) plant output also showed a downward trend of 20.9 percent to settle at 359 ktoe compared to the previous year's level of 454 ktoe. The petroleum products from MDS plant consisted of 70.2 percent Non-energy products, 20.6 percent Diesel and 9.2 percent Kerosene.



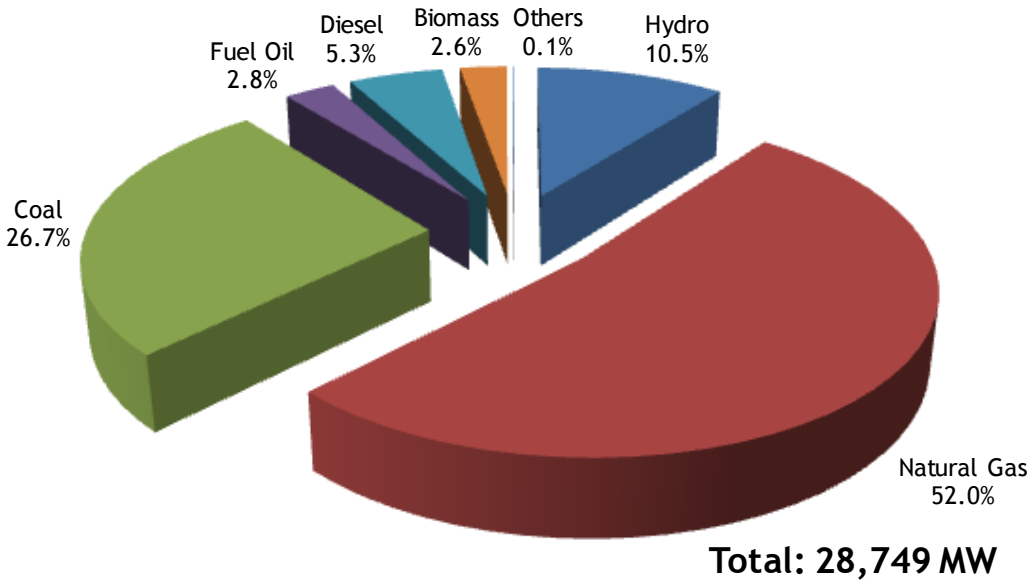
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Refinery Gas	158	174	143	106	162	385	331	203	192	230	241	331	294	262	215	202	849	938	991	195	209	1,659
Non-Energy	585	798	324	600	1,468	3,380	2,554	1,783	2,117	2,159	2,492	3,020	2,127	2,623	2,455	2,157	2,750	3,461	4,475	5,905	4,357	4,572
ATF & AVGAS	640	567	200	244	319	431	371	371	449	617	838	875	897	932	897	822	1,118	1,228	1,208	732	697	665
Kerosene	376	403	412	517	980	1,587	1,899	2,000	1,985	2,140	2,660	2,954	2,570	2,367	2,693	2,553	2,938	3,138	3,139	3,085	2,891	3,457
LPG	512	544	541	576	563	360	292	265	285	210	239	283	414	983	591	521	537	234	245	565	483	419
Fuel Oil	3,241	2,633	2,110	2,375	2,887	2,212	3,696	2,716	3,233	2,603	2,532	2,269	2,332	1,763	1,813	1,777	1,933	1,990	1,994	1,144	327	571
Diesel	3,496	3,805	4,048	4,249	5,108	6,011	6,174	6,744	5,926	6,712	8,059	8,462	8,401	9,062	9,611	9,161	8,752	9,033	9,364	9,415	8,369	8,925
Petrol	1,406	1,665	1,724	1,816	2,316	2,320	3,134	2,491	2,545	3,056	3,893	4,623	4,460	4,584	4,724	4,245	4,607	5,285	5,066	4,052	3,873	3,599

Source: National Energy Balance

Figure 3: Production of Petroleum Products from Refineries

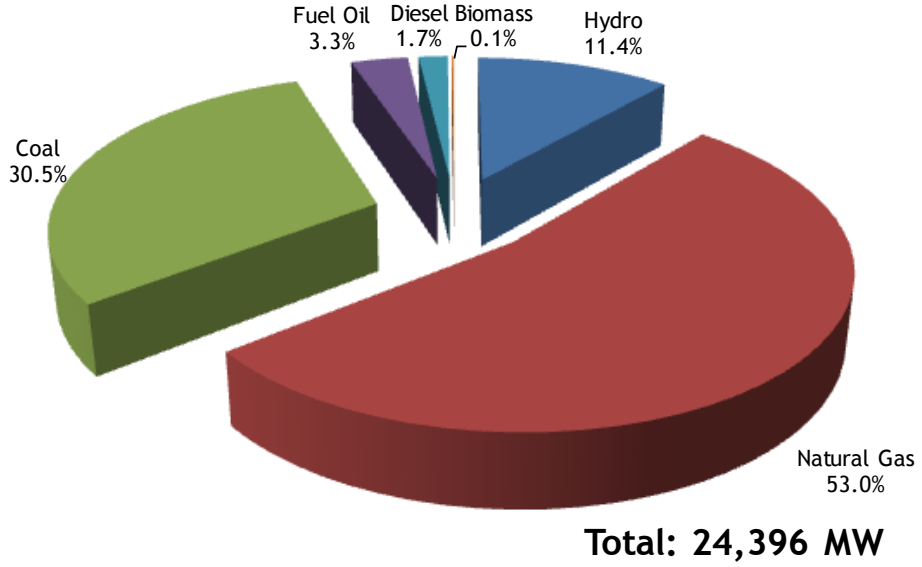
1.2.1 Electricity

Malaysia's total installed electricity generation capacity as of 31st December 2011 was at 28,749 MW. Peninsular Malaysia had about 84.3 percent of the total, followed by Sarawak at 9.0 percent and Sabah at 6.7 percent. An additional 750 MW of major hydro capacities were recorded for 2011 in Sarawak. Gross electricity generation registered 123,561 GWh, an increase of 14.2 percent from the previous year (2010: 108,175 GWh). The electricity consumption was 107,330 GWh, an increase of 2.7 percent from the previous year (2010: 104,521 GWh). The peak demand for Peninsular Malaysia of 15,476 MW was recorded in the second quarter of the year (2Q 2011), while in Sarawak it was at 1,214 MW (in 3Q 2011) and in Sabah it was at 830 MW (2Q 2011). The calculated reserve margin for Peninsular Malaysia was 37.0 percent, 66.8 percent for Sarawak and 40.7 percent for Sabah.



Source: National Energy Balance

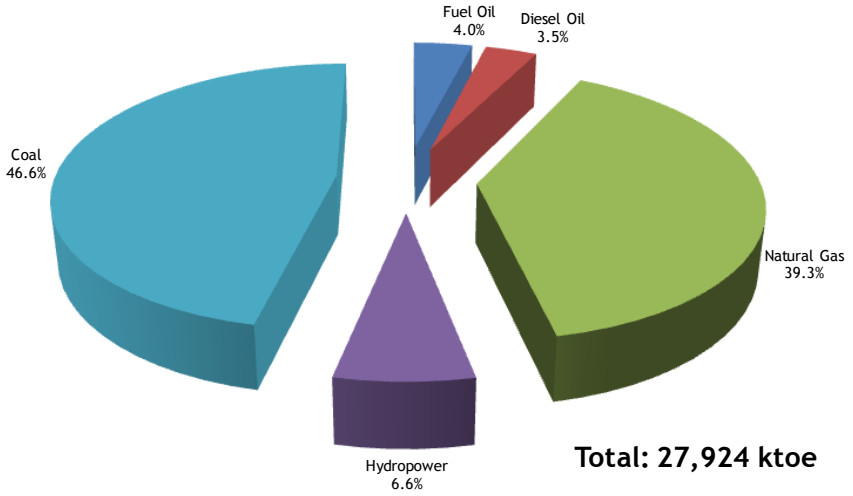
Figure 4: Installed Capacity as of 31st December 2011



Source: National Energy Balance

Figure 5: Available Capacity as of 31st December 2011

In 2011, the total energy or fuel input to power stations increased by 0.8 percent to 27,924 ktoe. The biggest drop was observed for natural gas, as it decreased by 13.1 percent from the 2010 level at 12,628 ktoe to 10,977 ktoe in 2011. In order to meet the local demand, the power industry shifted to diesel and fuel oil. As a result, the fuel oil and diesel inputs in power station increased significantly by 782.4 percent and 136.4 percent respectively. Analysis by fuel share showed that coal and coke is the main fuel source for electricity generation with 46.6 percent of the total fuel inputs, followed by natural gas at 39.3 percent, hydropower at 6.6 percent, fuel oil at 4.0 percent and diesel at 3.5 percent.

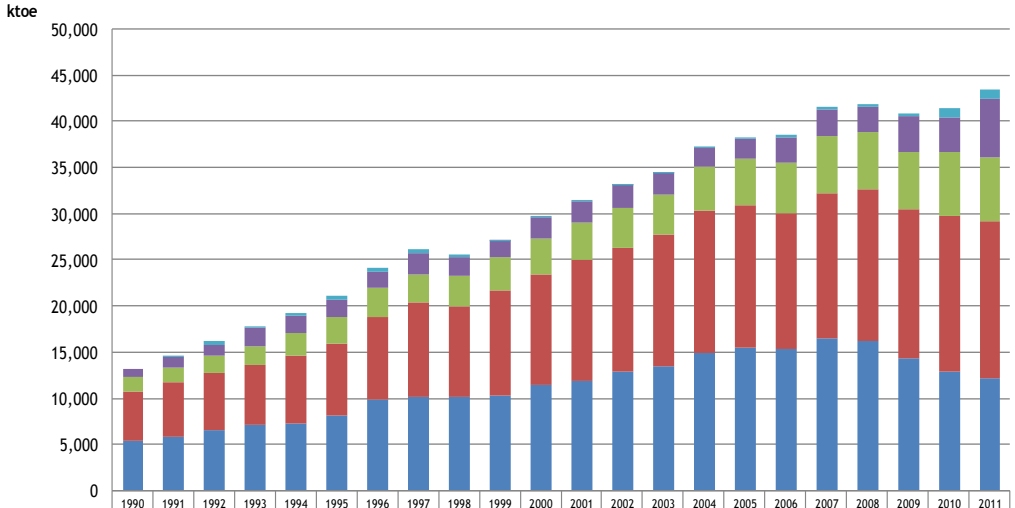


Source: National Energy Balance

Figure 6: Energy Input in Power Stations, 2011

1.3 TOTAL FINAL ENERGY CONSUMPTION

Total final energy consumption in 2011 experienced an increase of 4.8 percent from the previous year to register at 43,455 ktoe. The increase was attributed to the high demand from the non-energy sector which grew 72.5 percent to settle at 6,377 ktoe. This was followed by the residential sector's demand growth of 4.2 percent. Demand from the transport sector also increased in 2011 by 1.4 percent to 17,070 ktoe. Analysis showed that the transport sector was still the main consumer of energy in the country with a share of 39.3 percent. This was followed by the industrial sector at 27.8 percent, non-energy sector at 14.7 percent, commercial sector at 9.7 percent, residential sector at 6.4 percent and the agriculture sector at 2.1 percent.

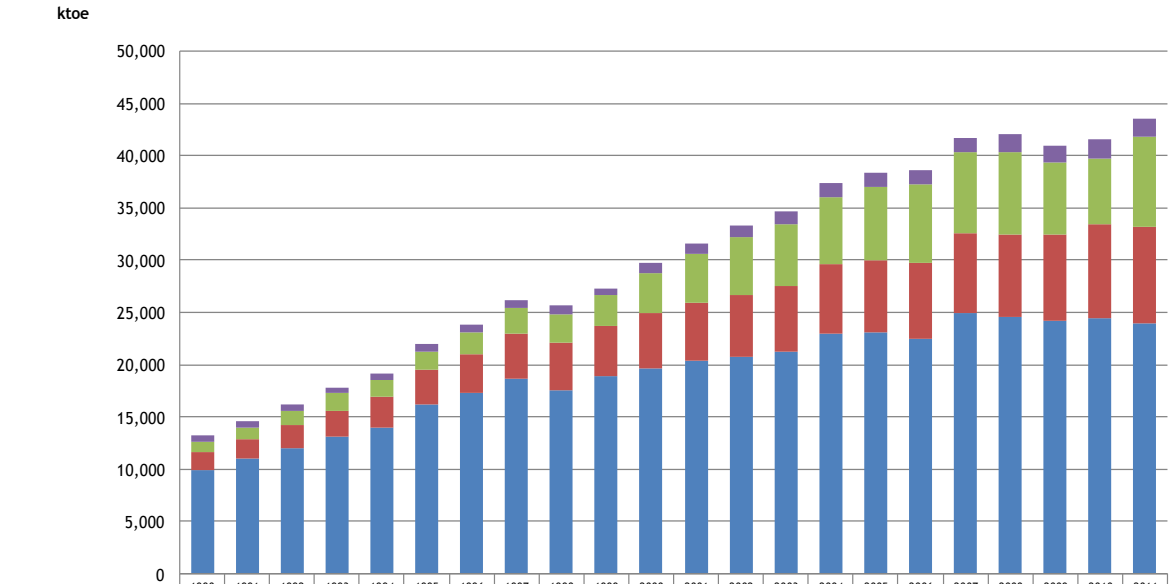


	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Agriculture	0	130	391	62	422	446	486	490	307	106	104	98	96	98	87	101	253	265	287	211	1,074	916
Non-Energy Use	838	1,071	1,222	2,027	1,817	1,994	1,744	2,298	2,023	1,799	2,250	2,378	2,511	2,345	2,183	2,173	2,819	2,958	2,876	3,868	3,696	6,377
Residential and Commercial	1,622	1,721	1,891	2,069	2,502	2,837	3,162	3,073	3,314	3,653	3,868	4,048	4,387	4,399	4,754	5,134	5,430	6,212	6,205	6,336	6,951	6,993
Transport	5,386	5,806	6,226	6,558	7,262	7,827	8,951	10,201	9,793	11,393	12,071	13,137	13,442	14,271	15,385	15,384	14,819	15,717	16,395	16,119	16,828	17,070
Industrial	5,300	5,835	6,455	7,012	7,283	8,060	9,838	10,106	10,121	10,277	11,406	11,852	12,854	13,472	14,914	15,492	15,248	16,454	16,205	14,312	12,928	12,100

Source: National Energy Balance

Figure 7: Final Energy Consumption by Sectors

In 2011, the industrial GDP of Malaysia registered a positive growth of 2.7 percent compared to the previous year, with growth mainly coming from the manufacturing and construction sectors. In terms of energy efficiency, Malaysia's industrial energy intensity for 2011 was 61.3 toe/RM million, an increase of 6.7 percent from the previous year's intensity.



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Coal and Coke	513	599	672	487	598	712	727	740	767	608	991	977	1,086	1,212	1,305	1,348	1,335	1,361	1,713	1,613	1,826	1,759
Natural Gas	1,069	1,099	1,344	1,701	1,660	1,654	2,079	2,465	2,726	3,023	3,862	4,620	5,642	5,886	6,490	6,981	7,562	7,709	7,818	6,802	6,254	8,515
Electricity	1,715	1,925	2,218	2,450	2,932	3,375	3,777	4,384	4,577	4,815	5,263	5,594	5,922	6,313	6,642	6,944	7,272	7,683	7,986	8,286	8,993	9,241
Petroleum Products and Others	9,825	10,914	11,927	13,075	13,894	16,142	17,203	18,578	17,488	18,782	19,582	20,323	20,638	21,175	22,886	23,012	22,394	24,852	24,451	24,145	24,403	23,946

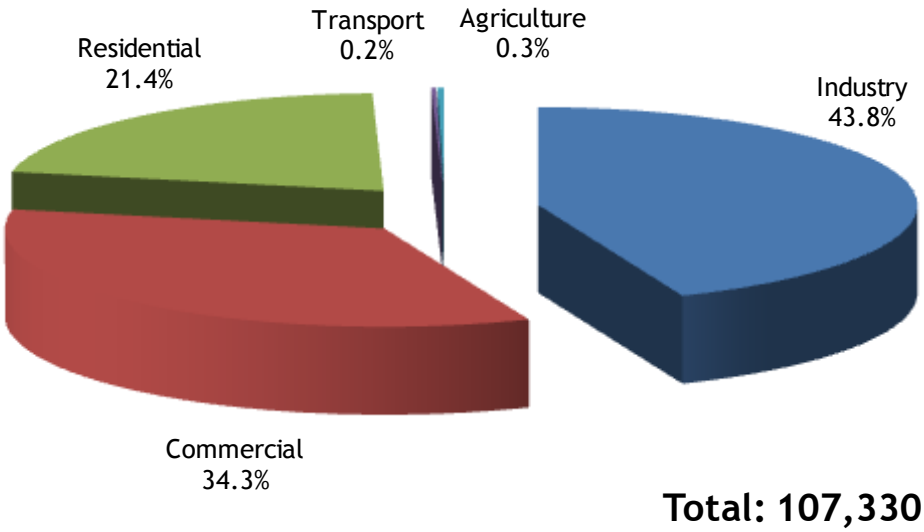
Source: National Energy Balance

Figure 8: Final Energy Consumption by Type of Fuels

The total final energy consumption by type of fuels show that petroleum products constituted about 55.1 percent of total energy demand, followed by electricity at 21.3 percent, natural gas at 19.6 percent and coal and coke at 4.0 percent. All fuels experienced demand growth in 2011, except for coal and coke and total petroleum products. Natural gas demand recorded the highest growth rate with 36.2 percent, followed by electricity at 2.7 percent growth. Coal and coke final demand decrease by 3.7 percent to 1,759 ktoe. Total demand for petroleum products also experienced a similar trend with a negative growth rate of 1.9 percent to register at 23,946 ktoe.

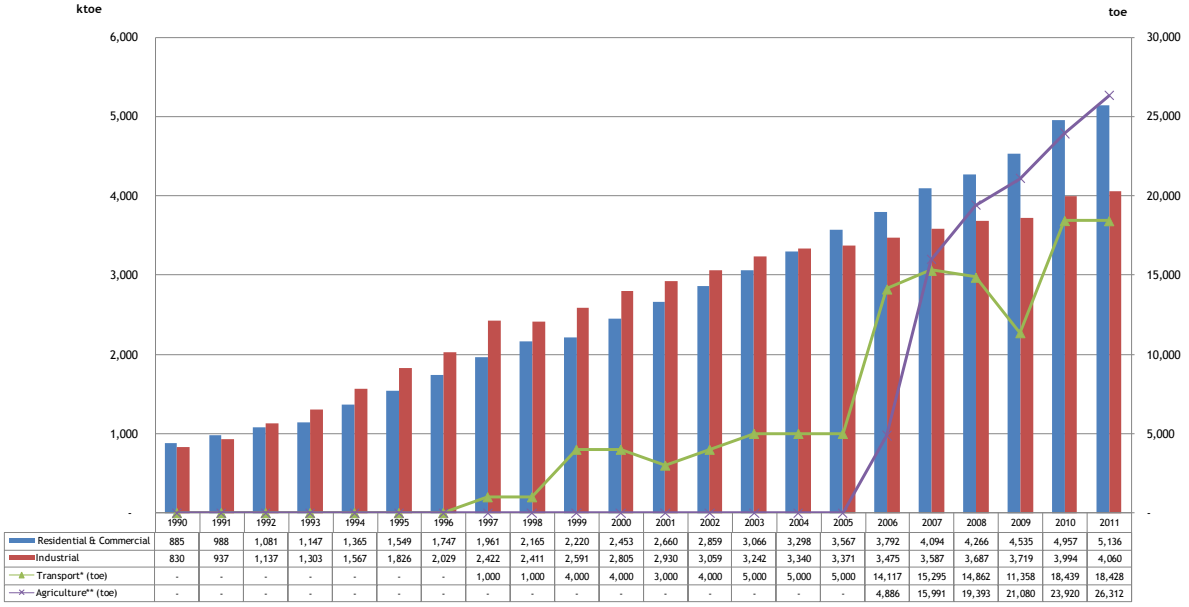
1.3.1 Total Electricity Consumption

The total electricity consumption in the country remained robust with a growth rate of 2.7 percent. The agriculture sector showed the highest growth with 9.6 percent, followed by commercial at 4.8 percent and the remaining residential and industrial sectors both grew at 1.7 percent. The industrial sector was the main consumer of electricity in Malaysia with its share of 43.9 percent of the total consumption in 2011. This was followed by the commercial sector at 34.3 percent, residential sector at 21.4 percent, agriculture sector at 0.3 percent and transport sector at 0.2 percent.



Source: National Energy Balance

Figure 9: Electricity Consumption by Sectors, 2011



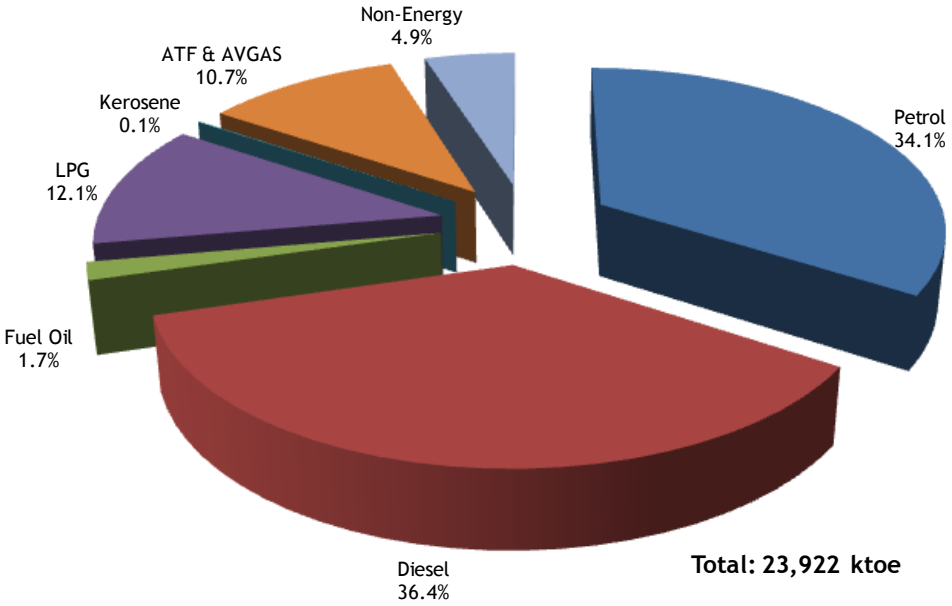
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Residential & Commercial	885	988	1,081	1,147	1,365	1,549	1,747	1,961	2,165	2,220	2,453	2,660	2,859	3,066	3,298	3,567	3,792	4,094	4,266	4,535	4,957	5,136
Industrial	830	937	1,137	1,303	1,567	1,826	2,029	2,422	2,411	2,591	2,805	2,930	3,059	3,242	3,340	3,371	3,475	3,587	3,687	3,719	3,994	4,060
Transport* (toe)	-	-	-	-	-	-	-	1,000	1,000	4,000	4,000	3,000	4,000	5,000	5,000	5,000	14,117	15,295	14,862	11,358	18,439	18,428
Agriculture** (toe)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4,886	15,991	19,393	21,080	23,920	26,312

Source: National Energy Balance

Figure 10: Electricity Consumption by Sectors, 2011

1.3.2 Final Consumption for Petroleum Products

In 2011, the total final energy demand for petroleum products declined by 2.0 percent with the major drop coming from the Petrol and Fuel Oil. Final demand for Petrol dropped by 14.7 percent whilst demand for Fuel Oil and LPG decreased by 13.4 percent and 1.0 percent respectively. In terms of share, diesel (36.4 percent) and petrol (34.1 percent) continued to be the largest contributors to the total demand for petroleum products. This was followed by LPG (12.1 percent), ATF and AVGAS (10.7 percent), non-energy (4.9 percent), fuel oil (1.7 percent), and kerosene (0.1 percent).



Source: National Energy Balance

Figure 11: Final Consumption for Petroleum Products, 2011

2. MALAYSIA ENERGY SECTOR: AUTHORITIES AND INSTITUTIONS

The players in the energy sector (i.e. electricity supply industry and gas supply industry at the reticulation stage) in Malaysia are as follows: -

i. The Government which acts as a policy maker;

ii. Energy Commission which acts as the regulator;

iii. Sustainable Energy Development Authority which acts as the implementing agency of the Feed-in Tariffs;

iv. Energy Supply and Service Companies;

v. Research and Development Institutions; and

vi. Consumers

2.1 MINISTRIES AND GOVERNMENT AGENCIES

Policy making for the energy sector resides with the following government institutions: -

INSTITUTIONS	AREAS OF JURISDICTION
Prime Minister's Department (Economic Planning Unit)	Petroleum (oil and gas) Privatization of the electricity supply industry i.e. IPPs
Ministry of Energy, Green Technology and Water	Electricity supply industry Energy efficiency Renewable energy
Ministry of Rural Development	Rural electricity supply

The economic and technical regulatory functions reside with the following government institutions: -

INSTITUTIONS	AREAS OF JURISDICTION
Energy Commission	Electricity in all states except Sarawak (technical including safety and economic)
Department of Occupational Health & Safety	Safety in gas sector (at reticulation stage).Safety in oil sector (upstream and downstream)
Prime Minister's Department (Economic Planning Unit)	Natural Gas prices
Ministry of Domestic Trade, Co-operatives And Consumerism	Price of petroleum products
State Governments	Exploitation of coal resources
Ministry of International Trade and Industry	Licensing on petroleum processing activities
Sustainable Energy Development Authority	Implementation of the feed-in tariff mechanism

2.1.1 Economic Planning Unit

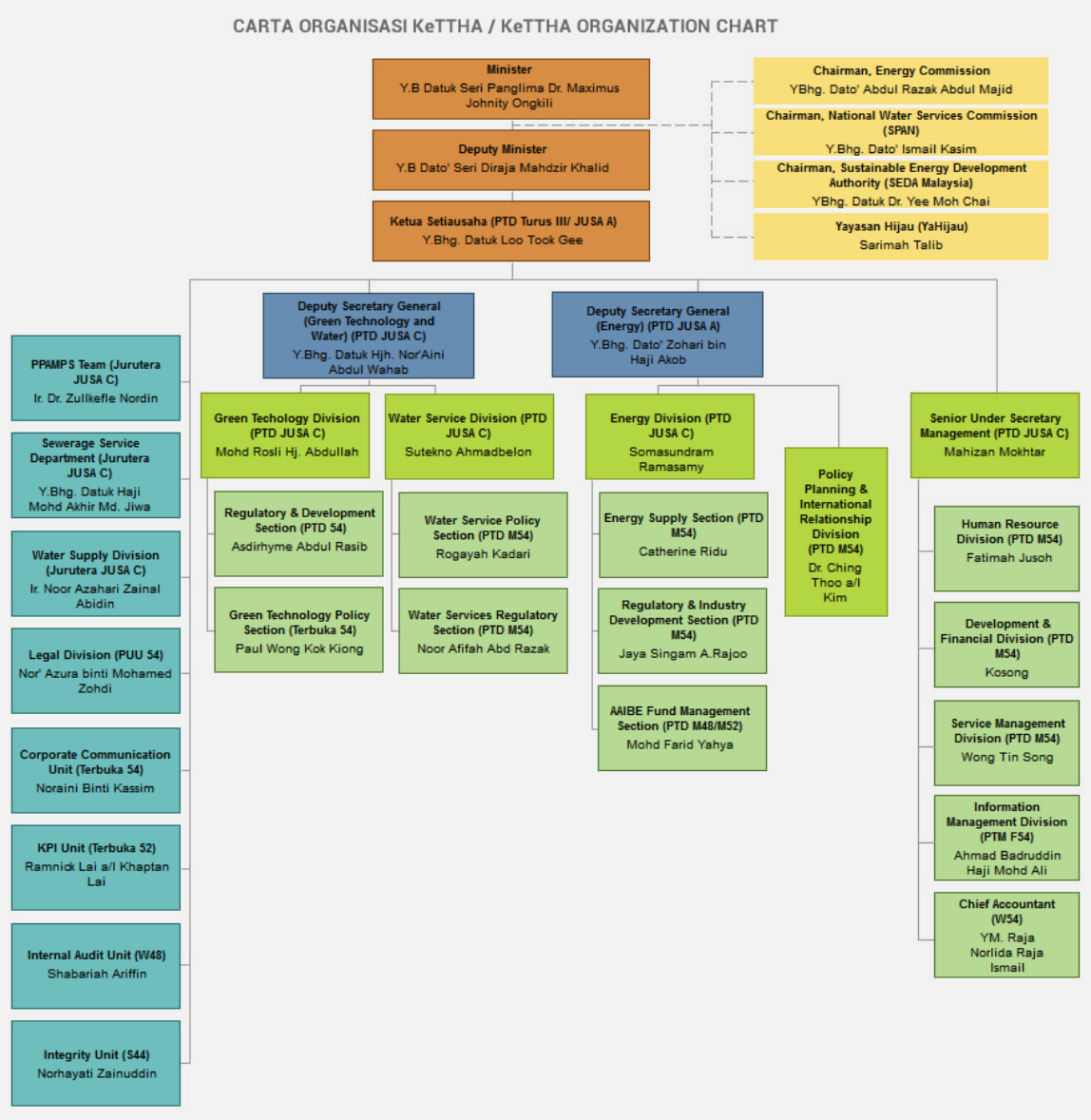
The Economic Planning Unit is the principal government agency responsible for the preparation of development plans for the nation. The EPU provides the overall macro-economic planning and general direction for Malaysian energy policies.

Under the EPU, the Energy Section key functions are to:

- Formulate policies and strategies for the sustainable development of the energy sector;
- Promote the development of oil and gas industries;
- Ensure adequate, secure, quality and cost-effective supply of energy;
- Promote the increase utilization of renewable energy and energy efficiency in the energy sector;
- Provide allocation for energy-related development programmes and evaluate their achievements;

2.1.2 Ministry of Energy, Green Technology and Water Malaysia (KeTTHA)

The Ministry of Energy, Green Technology and Water Malaysia (KeTTHA for its acronym in Malay Language) was established on 9 April 2009 to be the principal catalyst for the development of a dynamic and robust energy, green technology and water industry in the country.



Source: KeTTHA Website (Accessed 7 May 2014)

Figure 12: KeTTHA Organizational Chart

The following are the functions of the divisions presented in KeTTHA's organisation chart:

a) <u>The Energy Division</u>

The Energy Division looks at policy issues related with energy, especially issues on national electricity supply. Other sub-divisions were created under the Energy Sector to provide more comprehensive management of policy issues, and the sub-divisions are as follows:

1.1 Electricity Supply Division:

The functions of this division are to coordinate, manage and monitor matters related policy and planning of the country's electricity supply; undertake a review of the Electricity Supply Act; and reviewing and restructuring the tariff in Peninsular Malaysia, Sabah including Federal Territory Labuan.

The division is also involved in the preparation of the country's nuclear policy; the development of the electricity supply industry; the supply of gas and coal in the peninsula; the strengthening of the electricity supply system in Sabah; the planning of the electricity supply in Sabah; and propose Ministry stance relating to electricity supply.

1.2 Regulatory and Industry Development Division:

This division's function is to plan and implement policies, programmes, projects and activities for developing new renewable energy resources such as biomass, solar, wind, mini-hydro and others, in keeping with the national energy policy; promote energy efficiency and conservation in all economy activities; develop the budget for Renewable Energy and Energy Efficiency / Energy Conservation activities and development of alternative energy such as hydrogen fuel cell, biofuel, nuclear energy and so on.

Apart from that, this division is also responsible for coordinating the review of all legislation related Renewable Energy and Energy Efficiency while also performing all activities related to international cooperation Renewable Energy and Energy Efficiency including ASEAN, APEC, Bilateral and Multilateral International Organizations and the World Trade Organisation.

1.3 MESITA Fund Management Section/AAIBE:

This division manages the Akaun Amanah Industri Bekalan Elektrik (AAIBE) (Electricity Supply Industry Trust Deed) which was officially established on 1 January 1997. The types of programs funded by the AAIBE Trust Deed are as follows; rural electrification program; research and development (R&D) program for the electricity industry including R&D on the development of new and renewable sources of energy; training and educational program for human resource development in the electricity sector; energy efficiency program and; the promotion and development of the electricity supply industry.

b) Green Technology Division

The Green Technology Division was established to ensure sustainable development of the country while protecting the environment for future generations. This division is also responsible for reviewing and developing the National Green Technology policies and programs, to facilitate the growth of the Green Technology industry and enhance its contribution to the national economy; to increase national capability and capacity for innovation in Green Technology development and enhance Malaysia's competitiveness in Green Technology in the global arena and to enhance public education and awareness on Green Technology and encourage its widespread use.

The Green Technology Division is also responsible for supervising the activities of the Malaysia Green Technology Corporation (MGTC) that acts as KeTTHA's implementing arm for green technology development in Malaysia.

2.1.3 Energy Commission

Energy Commission of Malaysia is a statutory body responsible for regulating the energy sector particularly the electricity supply and piped gas supply industries in Peninsular Malaysia and Sabah. The Energy Commission ensures that the supply of electricity and piped gas to consumers is secure, reliable, safe and at reasonable prices. Energy Commission of Malaysia is a statutory body responsible for regulating the energy sector particularly the electricity supply and piped gas supply industries in Peninsular Malaysia and Sabah. The Energy Commission ensures that the supply of electricity and piped gas to consumers is secure, reliable, safe and at reasonable prices.

Energy Commission is committed in:

- Setting up a regulatory system that encourages the electricity and gas industry to be strong and consumers' interests are protected;
- Monitoring effectively electricity supply and gas reticulation in terms of its service quality, safety and reasonable price;
- Carrying out effective legal enforcement; and
- Providing efficient and friendly services within the stipulated time for licensing and issuance of certificate.

2.1.4 Sustainable Energy Development Authority Malaysia (SEDA Malaysia)

The Sustainable Energy Development Authority Malaysia (SEDA Malaysia) is a statutory body formed under the Sustainable Energy Development Authority Act 2011 [Act 726]. The key role of SEDA is to administer and manage the implementation of the feed-in tariff mechanism which is mandated under the Renewable Energy Act 2011 [Act 725].

2.1.5 Malaysia Green Technology Corporation (MGTC or GreenTech)

GreenTech is the focal point to drive and facilitate the implementation of the development and promotion of green technology in Malaysia. Their goal is to develop and establish a conducive environment, which will encourage nationwide acceptance of green technology as a new engine for economic growth.

As the focal point for green technology development in Malaysia, GreenTech provides, inter alia, services for consultancy, research and training to spearhead the realisation of the national green technology agenda through the creation of promotion, coordination and collaboration programmes. This includes:

- Conducting promotional activities such as the annual International GreenTech & Eco-Products Exhibition and Conference Malaysia (IGEM), Green Carnival, My Hijau Roadshows, Malaysia GreenTech Awards, Green Kids, publications and other activities to enhance public awareness on green technology;
- Serving as the appointed Secretariat of the working committee under the Green Technology and Climate Change Council and as the Secretariat for the Clean Development Mechanism (CDM) and are responsible for the evaluation of all CDM energy project application in the nation; administers the Green Technology Financing Scheme (GTFS) and evaluate projects for certification that will entitle applicants to financing incentives. Additionally, collaborate with SIRIM to administer the Green Labelling scheme and Green Tag to help consumers decide if the products they buy are environmentally friendly.
- Project manager to the Green Technology Roadmap, Electric Vehicle Infrastructure Roadmap, and Low Carbon Cities Framework.

2.2 ENERGY SUPPLY AND SERVICE COMPANIES

In Malaysia, the government-owned company Petronas holds exclusive ownership rights to all oil and gas exploration and production projects, and all foreign and private companies must operate through production sharing contracts (PSC).

In terms of electricity production, the industry is dominated by three integrated utilities: Tenaga Nasional Berhad (TNB) serving Peninsular Malaysia, Sabah Electricity Berhad (SESB) in Sabah state and Sarawak Energy Berhad (SEB) in Sarawak state. TNB is publicly listed while SESB and SEB are privately owned, with the government owning some shares in each utility. The three utilities are complemented by various independent power producers (IPPs), dedicated power producers and co-generators.

3. RENEWABLE ENERGY DEVELOPMENT IN MALAYSIA

3.1 GOALS, OBJECTIVES, TARGETS AND ROADMAPS

Malaysia has started to promote the use of renewables since the year 2000 through the introduction of the Five Fuel Policy where renewable energy sources such as biomass, biogas, mini-hydro and solar PV have been identified as alternative fuel sources for power generation. The principle adopted was to use market forces to deliver the intended outcomes towards electricity generation and the Small Renewable Energy Programme (SREP) was introduced by the Government in 2001 to support the policy.

However, through the mechanism the progress of RE development in the country has been quite minimal. These results provide valuable lessons in identifying the barriers from such an approach and the key lesson is that a 'business-as-usual' approach is not sustainable, appropriate or productive. Thus the Government of Malaysia introduced **National Renewable Energy Policy and Action Plan (NREPAP)** which was implemented starting from the 10th Malaysia Plan (2010). The REPAP provides long-term goals and a holistic approach with the main objective to spearhead the sustainable development of renewable energy. The NREPAP seeks to increase generation of RE power capacity in Malaysia to **2,080 MW** by 2020 and **4,000 MW** by 2030.

Table 3: Malaysian National RE target

Year	Cumulative RE Capacity	RE Power Mix (vs Peak Demand)	Cumulative CO_2 avoided
2015	985 MW	5.5%-6%	11.1 mt
2020	2,080 MW	11%	42.2 mt
2030	4,000 MW	17%	145.1 mt

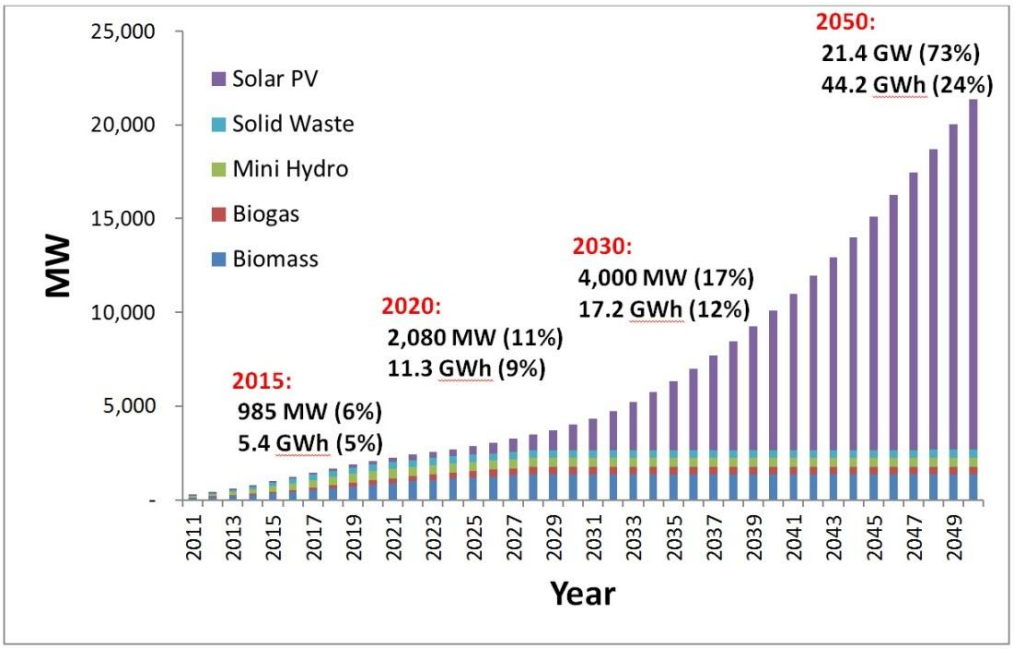


Figure 13: Malaysian National RE target

The NREPAP is a convergence of actions pushing the initiatives of the energy, industry, environment, green technology and information dissemination policies. The specific actions needed to provide the most effective results should take on either one of both of the following:

(i) Direct actions to create or establish the necessary institutional arrangements ; and

(ii) Supporting measures to encourage and nurture the growth and development of the RE businesses.

NREPAP has five (5) key objectives that embody elements of energy, industry and environmental policies:

(i) To increase RE contribution in the national power generation mix;

(ii) To facilitate the growth of the RE industry;

(iii) To ensure reasonable RE generation costs;

(iv) To conserve the environment for future generations; and

(v) To enhance awareness on the role and importance of RE

3.2 NATIONAL RENEWABLE ENERGY POLICY AND ACTION PLAN (NREPAP)

The NREPAP was introduced to enhance the utilisation of indigenous renewable energy resources to contribute towards national electricity supply security and sustainable socio-economic development. Under this policy, the implementation of the Feed-in Tariff (FiT) mechanism is implemented on 1st December 2011 via the enforcement of the RE Act 2011. The FiT aims to drive the development of RE in Malaysia systematically and rapidly. To achieve these policy objectives, five (5) strategic thrusts have been identified which would enable Malaysia to pursue RE development more aggressively as in Figure 14:

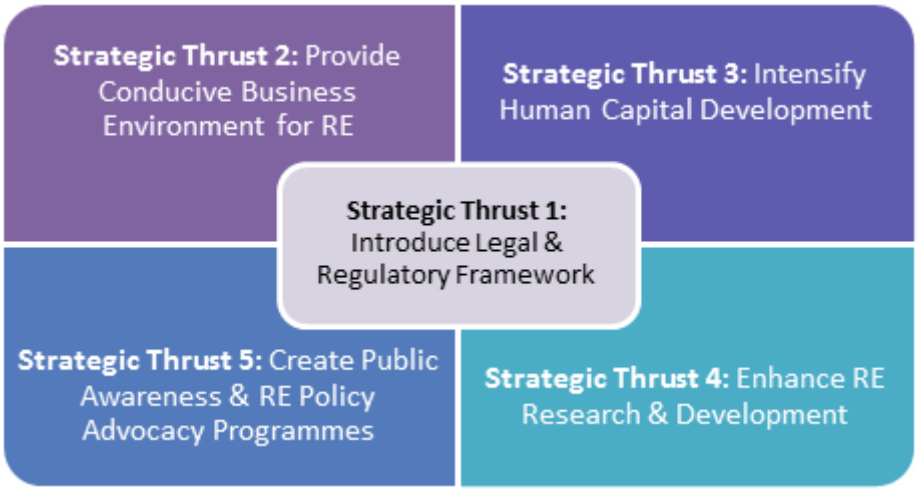


Figure 14: Strategic trust of the NREPAP

Strategic Thrusts of the NREPAP

Strategic Thrust 1: Introduce Appropriate Legal Framework

(i) The most important element to achieve RE development success in Malaysia is the establishment of a Renewable Energy Act. The RE Act 2011 have been approved in Parliament in April 2011 and was enforced on 1st December 2011.

(ii) The Act is critical to provide clarity and certainty, and is the fundamental thrust of the RE Policy. The RE Act 2011 established a regulatory framework to address the exiting market failures and provide clarity of the roles to be played by parties involved in RE such as the obligations of the utility and RE developers.

(iii) The most important element under the RE Act is the Feed-in Tariff (FiT) mechanism which allows electricity produced from RE resources to be sold to power utilities at a fixed premium price for a specific duration. It is one of the most effective mechanisms to promote RE and has been successfully implemented in countries such as Germany, Spain and Italy.

(iv) The Sustainable Energy Development Authority (SEDA) Act was enacted to establish an FIT implementing agency. It was approved by Parliament in April 2011 and enforced on 1st September 2011.

Strategic Thrust 2: Provide Conducive Business Environment for RE

(i) The FiT Mechanism key function is to ensure the viability of RE projects and guarantee return on investments to the RE players.

(ii) In terms of the manufacturing sector, Malaysia has been successful in attracting foreign direct investments in the Renewable Energy sector, solar PV in particular. Existing FDI policy that encourages the setting up of highly skilled related services sector in RE will be continued with a new model where the attraction to be invest would be the readily available facilities and infrastructure as well as the local value chain. More local SMEs to be involved in this sector.

(iii) Apart from that, innovative economic instruments must be introduced and implemented and include the following:

a) Creation of a long term low interest financing for RE projects

The banking sector must be educated on the viability of RE projects with FIT so that long term loans with reasonable interest rates can be made available to RE developers.

b) Continuation of Existing and the Introduction of new Fiscal Incentives for RE

Certain existing Fiscal incentives for RE which has been offered before the enforcement of the RE Act 2011 has in 2010 but the following incentives still continues until 2015:

i) Pioneer Status;

ii) Investment Tax Allowance;

iii) Import Duty for imported machinery, equipment, materials, spare parts and consumables; and

iv) Sales Tax Exemption for locally purchased machinery, equipment, materials, spare parts and consumables.

New fiscal incentives will be proposed to the Finance Ministry to further promote the use of renewable energy.

Strategic Thrust 3: Intensify Human Capital Development

(i) RE is a relatively new technology in Malaysia and is expanding rapidly especially with the introduction of the FiT Mechanism. Therefore, there is an urgency to intensify human capital development to support the emerging RE industries. Specific trainings for identified RE technologies need to be established to build up local capacities to serve the need of the industry. Currently SEDA Malaysia has established a number of trainings in collaboration with various institutes as follows:

a) SEDA Malaysia Grid-Connected Photovoltaic Systems Course for Wireman and Chargeman;

b) SEDA Malaysia Grid-Connected Photovoltaic (PV) Systems Design Course; and

c) Grid Connected Solar Photovoltaic (PV) Systems Installer and Maintenance Training Course.

Malaysia is currently offering these courses to ASEAN Member countries.

(ii) However, there is also a need for a short-term measure to fill the human capital void in Malaysia by encouraging knowledge workers to relocate to Malaysia.

(iii) Malaysia's Knowledge Economy Master Plan identifies the importance of human resource development as it can increase the overall productivity of the Malaysian economy. The institutional arrangement to implement this thrust effectively requires the intervention of the other ministries and other relevant government agencies to coordinate the actions in intensifying the human capital development to meet the requirement of the RE industry.

Strategic Thrust 4: Enhance RE Research and Development (R&D)

(i) R&D is one of the most important areas that have to be emphasized to reduce the cost of RE power generation. Local technologies must be developed to ensure efficient processes/techniques being used in utilizing indigenous renewable resources to produce electricity. It is important that R&D on RE to be done systematically to ensure it could be matched to local needs and commercialized for local market.

(ii) One of the areas is the reduction of costs for RE technology. Apart from that, enhancement of coordination and co-operation between Government and the private sector on RE efforts in technology and economic research and strong linkages between local and international research institutes in RE must be emphasised.

Strategic Thrust 5: Create Public and Stakeholder Awareness using RE Policy Advocacy Programmes

(i) Advocacy programmes are tailored with specific messages for specific audiences should be implemented. Strategic Thrust 5 involves the following:

a) establishment of an effective, continuous promotion and information dissemination mechanism to increase public awareness in RE and the Policy itself;

b) enhancement of relationship with media, NGOs and private entities to further promote RE;

c) implementation of demonstration programmes on RE applications and technologies;

d) identification and appointment of champions for RE within the ministry and outside; and

e) Execution of periodic monitoring and evaluation on RE achievements.

Potential Impact of NREPAP by Year 2020

The Government projects the implementation of the Renewable Energy Policy and Action Plan will bring positive impacts from environmental and economic perspective for Malaysia as follows:

(a) By 2020, an accumulated 42 million tonnes of CO_2 would have been avoided due to RE generated power;

(b) Minimum **RM19 billions of loan values** for RE projects, which will provide local banks with new sources of revenues (at 80% debt financing for RE projects); and

(c) More than 50,000 **jobs created** to construct, operate and maintain RE power plants (on the basis of 15-30 jobs per MW).

FiT Implementation Status in Malaysia

As at 30 September 2013, the FiT implementation status in Malaysia is as follows:

Table 4: FiT implementation statistic as of 30 September 2013

FIT APPLICATIONS	TOTAL	CAPACITY(MW)
Received	3,497	748.66
Approved (Details in Table 4.1)	2,589	520.48
Received FiTCD (Details in Table 4.2)	656	118.19
Waiting for FiTCD	1,871	352.84
Refused	709	218.62
Revoked	11	30.96
Withdrew	52	14.49
Verification	198	9.56

Table 4.1: Details of approved RE projects as of 30 September 2013

No.	RE Source /technology	No. Applications	Capacity (MW)	Percentage from total capacity (%)
1	Biogas	18	27	5.19%
2	Biomass	18	166	31.99%
3	Small hydro	18	119	22.87%
4	Solar PV	2,535	208	39.95%
	Individual	2,283	25	4.77%
	Non - Individual	252	183	35.17%
Total		**656**	**2,589**	**520**

Table 4.2: Details of projects achieving FiTCD as of 30 September 2013

No.	RE Source /technology	No. Applications	Capacity MW)
1	Biogas	5	8.53
2	Biomass	5	50.40
3	Small hydro	5	15.70
4	Solar PV Individual	592	8.98
5	Solar PV Non - Individual	49	34.58
Total		**656**	**118.19**

3.3 RENEWABLE ENERGY DEVELOPMENT PROGRAMS IN MALAYSIA

Malaysia is blessed with many indigenous Renewable Energy (RE) sources and the identified potential sources are as follows:

a) Palm oil biomass wastes; usually Empty Fruit Bunches (EFB) and Palm Kernel Shells (PKS) and palm oil mill effluents;

b) Mini-hydro;

c) Solar power;

d) Solid waste and landfill gas;

e) Wind energy* and geothermal*;

* *Note: The detail resources potentials are yet to be fully examined and verified.*

3.3.1 Biomass Wastes and Biogas Potential

Malaysia is the world's second largest producer of crude palm oil (CPO). The by products from the mills processing palm oil include solid wastes from the EFB, PKS, mesocarp fibres and palm oil mill effluent (POME).

A study by Pusat Tenaga Malaysia (PTM) / SIRIM estimated that in 2002, 362 palm oil mills in the country processed about 59.8 million tonnes of fresh fruit bunches (FFB) and produced 11.9 million tonnes of CPO. From this a total of 22.6 million tonnes of solid biomass (EFB, fibres and PKS) and 41.9 million tonnes of POME were generated from the palm oil industry. The palm oil industry has since grown at an average rate of 7.5% p.a. and in 2006; more than 15.8 million tonnes of CPO were produced. It can be concluded all figures relating to EFB, POME and energy potential from wastes

were all revised upwards by 33% from 2002 to 2006. By 2009, the numbers of palm oil mills in the country have grown to 417. **Table 5** identifies the number of palm oil factories in Malaysia which could produce a quantity of biomass necessary for a 10 MW class EFB power generation plant. There are 17 factories located in Sabah and Sarawak, whilst 12 are in Peninsular Malaysia.

Table 5: Palm Oil Factories Producing >300,000 ton p.a. of FFB

State		Factory FFB Process Amount	
		more than 300,000 ton/yr	more than 250,000 ton/yr
Peninsular Malaysia	Kedah	1	2
	Pulau Pinang	0	0
	Perak	4	11
	Selangor	1	2
	N.Sembilan	0	1
	Melaka	0	2
	Johor	6	17
	Terengganu	0	0
	Kelantan	0	0
	Pahang	0	2
	Total	**12**	**37**
East Malaysia	Sabah	15	30
	Sarawak	2	9
Total		29	76

Source: Market Survey, Biomass Power Generation Industry in Thailand, Indonesia and Malaysia, Sumitomo Corp, 2009 (translated from Japanese to Bahasa Malaysia).

Based on the size of palm oil plantations in Malaysia, their annual production of biomass material is a maximum of 26 million tonnes per year. Of the total annual biomass production: EFB is 12.5 million tonnes, fibre 9 million tonne and 5 million tonnes.

Regionally 60% of palm oil factories are from Peninsular Malaysia and 30% are from Sabah and Sarawak. The transport cost of biomass is estimated priced at USD 0.20/tonne/km; which needs to be considered when exploring the use of smaller plantations as fuel feeders, bearing in mind the location of the RE biomass plant.

The current utilisation of mesocarp fibres and palm kernel shells to generate steam and power for palm oil mills across the country because of their high quality as fuels and the ease in preparation, mean this source need to be excluded in the estimation of biomass potential. PKS have a higher economic value as they have a market price of RM120-140 per tonne for utilisation in the production of carbon black. This higher price (compared to RM20 for EFB) also discourages the use of palm kernel shells as an RE fuel source. Details of biomass potential in Malaysia are shown in **Table 6**;

Table 6: Total Amount of Biomass Released from Palm Factory

State		EFB	Fibre	Fibre (Palm Kernel Shell)	Total p.a. (tonne)
Peninsular Malaysia	Kedah	96,126	67,288	38,450	201,885
	Pulau Pinang	59,805	41,863	23,922	125,590
	Perak	1,494,341	1,046,038	597,736	3,138,115
	Selangor	688,414	481,890	275,366	1,445,115
	Negeri Sembilan	426,452	298,366	170,581	895,549
	Melaka	66,837	46,786	26,735	140,358
	Johor	2,687,200	1,881,040	1,074,880	5,643,119
	Terengganu	405,316	283,721	162,126	851,164
	Kelantan	199,209	139,446	79,684	418,339
	Pahang	2,252,946	1,576,433	900,819	4,729,298
	Sub-Total	**8,375,746**	**5,863,022**	**3,350,298**	**17,589,067**
East Malaysia	Sabah	3,477,723	2,434,406	1,391,089	7,303,217
	Sarawak	667,891	467,524	267,157	1,402,572
Total		**12,521,360**	**8,764,952**	**5,008,544**	**26,294,856**

A survey of 100 palm oil mills carried out by PTM in 2008 has shown on average, about 22% (by weight of palm oil fresh fruit bunches (FFB) in the milling process were left over as EFB. Most of the mesocarp fibres from the fruits are utilized (98%) for energy generation for self-consumption, topped up by palm kernel shells (38%) as fuels. These figures confirm the commercial value of palm kernel shells which are being sold for other purposes.

The RE potential lies in the use of EFB and POME. However the EFB have multiple purposes and are used by the palm oil plantation as follows: 62% for mulching, 6% composting, 11% burned in incineration, 5% sold commercially and 16% being dumped somewhere in the plantation. Incineration without energy extraction is only allowed by the Department of Environment (DOE) for older plants from the time they were approved and constructed, but not for newer plants.

Biomass and Biogas Power Estimate

Based on 2008 data's, 20 million tonnes of EFB were produced where the total initial potential for power generation is 1,065MW. Based on PTM's study, 20% of the EFB produced can be used for power generation amounting to 213 MW. For biogas, the potential is approximately 217 MW based on 58 million tonnes of POME (Source: Malaysian Palm Oil Board (MPOB), 2008). This estimate is based on an "as-is" basis.

However with a more conducive RE policy and action plan, improvements in existing combustion efficiency in palm oil mills (to extract more energy from the mesocarp fibres and shells as well as from the EFB) can be expected; the amount for mulching would be reduced to a more optimal level and open incineration would be abolished; the estimate could be revised.

In 2008, the MPOB unveiled "The Roadmap for Palm Oil Industry and Latest Advances in the Industry" which will have a direct impact on the use of palm oil EFB as a biomass fuel for RE sources. With the Roadmap MPOB seeks to increase industry productivity, empower technology, expand investment, modernize infrastructure and ensure sustainability and advance the industry towards

increased yield and oil extraction rate (OER), reduced wastes (reduced POME and zero discharge), increased conversion of wastes into non-energy products.

Taking into consideration these factors for purposes of target setting, a potential of 1,340 MW connected to grid from palm oil biomass by 2030 is therefore considered realistic and achievable. This is a very conservative estimate as it is expected the palm oil industry is forecasted to continue growing and increasing in output despite decreasing rate of new acreage being converted to palm oil plantations.

The reliance on EFB and other agriculture waste as fuel for biomass plants means that the size of the land used for palm oil plantations and agriculture is limited. The acreage of palm oil plantations is expected not to exceed 4,000 hectares. Therefore the inherent limitations of biomass mean that a reliable maximum capacity that can be made available is 1,340 MW by 2030.

Biomass and Biogas Power Installed Capacity

As of 30 September 2013, there are 166MW of biomass and 27MW biogas sources have been approved under the Feed-in Tariff (FiT) mechanism for the project until 2015. To date, 50.40MW of biomass and 8.53MW of biogas installations are already in operation.

Biomass and Biogas Strategies and Programs

The 1 Malaysian Biomass Alternative Strategies (1MBAS) initiatives aim to integrate all activities for all Malaysia biomass, to ensure smooth delivery through close collaboration with Ministries, Agencies, Academia and Industry. A cross-agency 1MBAS taskforce has been formed to be a one-stop point of contact for all biomass utilisation activities and to monitor and help execute initiatives and Entry Point Projects (EPPs) related to biomass utilisation. The 1MBAS taskforce will report to the relevant National Key Economic Areas (NKEA) steering committees.

The objectives of 1MBAS for palm oil biomass are;

i) To mobilize a further 20 million tonnes of biomass from exiting plantations;

ii) To increase RM30 billion to Malaysia's Gross National Income by 2020;

iii) To create 66,000 new jobs for Malaysians in the field of RE, Palletisation and Bio-chemicals. At least half of which 'high-value' job;

iv) 12% CO_2 abatement of emission in Malaysia; and

v) Malaysian corporate champions as regional and global leaders in biomass.

3.3.2 Mini-Hydro Potential

Although Malaysia has had the experience and expertise in mini-hydro systems since the 1970s, these have not been exploited for added advantage to the country. At the same time data on mini-hydro potential sites, their respective power potentials, etc. are not easily available because rivers are under the jurisdiction of the state authorities.

Table 7: Installed Capacity of Mini-Hydro Power Stations in Malaysia

State		Installed Capacity (MW)
Peninsular Malaysia	Kedah	1.556
	Perak	3.207
	Terengganu	1.936
	Kelantan	3.158
	Pahang	3.504
	Sub-Total	13.361
East Malaysia	Sabah	8.335
	Sarawak	7.297
Total		**28.993**

Source: National Energy Balance 2007

In general, the suitable mini-hydro projects would be those based on the run-off-the-river schemes of sizes of up to 10 MW to 30 MW in capacity. Exemption to the requirement that eligible mini-hydro projects should be run-off-river types should be given to dam-toe projects from water supply schemes.

A common barrier n mini-hydro development is their remote locations although the potential could be quite high. The feasible projects should be those within reasonable distance of around 10 km or less from the nearest points of interconnection. Therefore the scarcity of available data means there is a need to collect sufficient data to undertake an evaluation of the potential. Taking into account the paucity of data, and making an extremely conservative guesstimate of the potential, mini hydro target of 490MW is capable of being achieved by 2020.

Small Hydro Installed Capacity

As at 30 September 2013, there are 119MW of small hydro sources have been approved under the Feed-in Tariff (FiT) mechanism for the project until 2015. To date, a total capacity of 15.70MW are already in operation.

3.3.3 Solar Power Potential

Malaysia being a tropical country receives sunshine throughout the year. Coupled with a high irradiance level the whole country is well suited for PV generation. The investigations of PV applications demonstrated a modified tilt angle at 30º is not optimum for locations around the Equator. Near horizontal tilt is more favourable and installations will normally have about 5º to 15º tilt angle to be efficient and still allow the PV system to follow the roof slope. **Figure 15** shows the irradiance level in Malaysia.

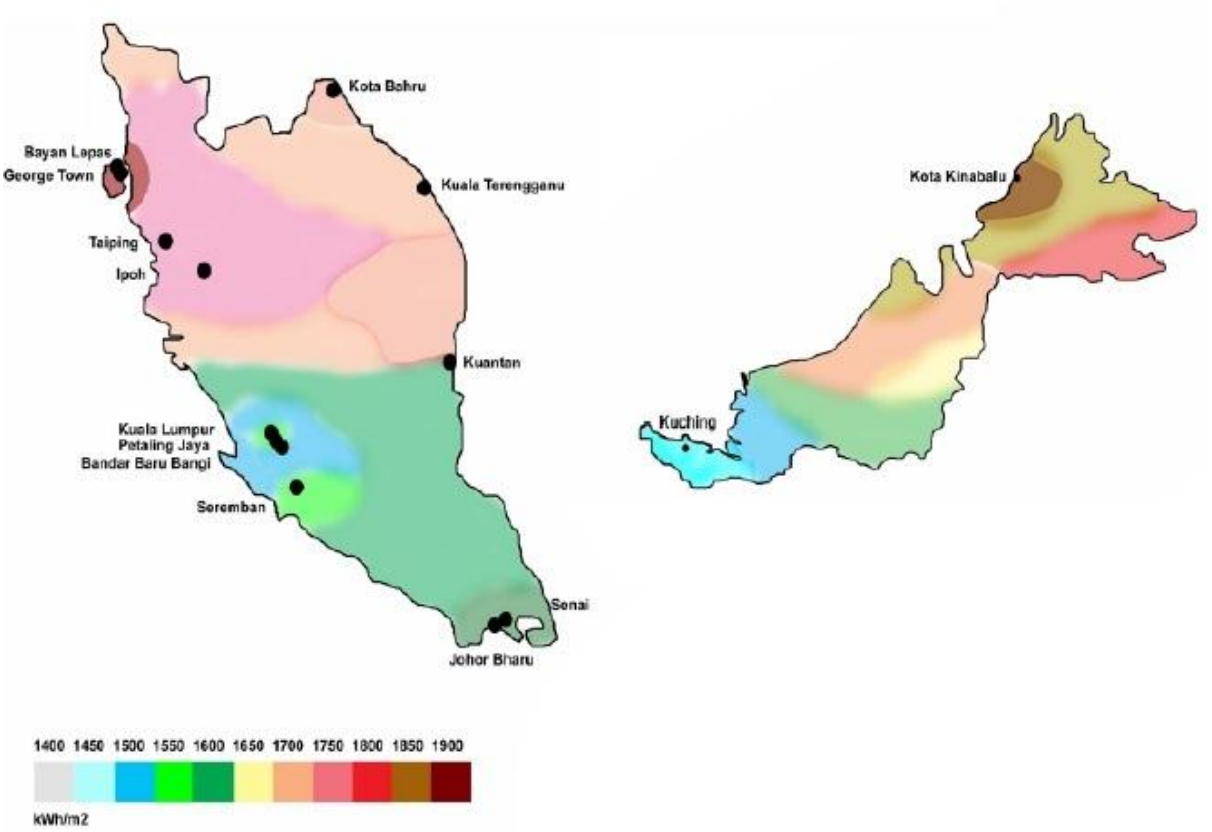


Figure 15: Solar Irradiance Levels in Malaysia

The details yearly average values of solar irradiance are set out in **Table 6.**

Table 8: Irradiance (Yearly Average Value) by Towns in Malaysia

Towns in Malaysia	kWh/m²
Kuching	1470
Bandar Baru Bangi	1487
Petaling Jaya	1571
Kuala Lumpur	1571
Seremban	1572
Kuantan	1601
Johor Bahru	1625
Senai	1629
Kota Bharu	1705
Kuala Terengganu	1714
Ipoh	1739
Taiping	1768
Kota Kinabalu	1900
Bayan Lepas	1809
George Town	1785

Looking at the yearly average values of solar irradiance in Malaysia it is foreseen we need to take advantage of this situation as many European countries with lower irradiance already have an aggressive solar PV promotional policy which includes Germany and Spain.

Solar Power Estimate

As a rule of thumb, a three storey energy efficient building in Malaysia installed with solar PV panels on its 1,000 m^2 roof may be able to generate all the electricity it needs. Taller urban buildings have higher density of occupancy but do not have a large volume per square meter of roof area, hence roof-top solar PV modules cannot provide all the energy needs for these types of buildings.

The real opportunity for solar PV lies in homes (residential areas), warehouses, and other low-rise commercial buildings. Factories, however, typically consume high levels of energy due to production machineries or similar equipment, and will never be expected to be energy self-sufficient through solar PV but can provide the large roof spaces for solar PV.

In estimating the solar power potential in Malaysia and the setting of targets, it is recognised the constraint is not so much on the availability of solar irradiation, but more on the availability of funding and the domestic and international production facilities to cope with demand. Currently the Malaysian solar PV module market is subjected to and focuses on the global market, and even current local production outputs are directed towards export to high growth demand in Europe, USA and Japan.

Therefore a reasonable target for grid-connected solar PV as building integrated (BIPV) application is 850 MW by 2030 (and more than 8,000 MW by 2050) could grow unlimitedly as it is not constrained by land availability.

This is arrived at by the following assumptions:

a) Using 2003 data and suitable building roof surfaces the estimated amount of energy PV can produce is approximately 6,500 MW (i.e. ~ 65 million m2 x 100 W/m);

b) The building roof surfaces are from 40% of total number of households (i.e. 2.5 million houses) and 5% of total commercial buildings (i.e. about 40,000 commercial buildings);

c) Solar BIPV energy opportunity ~ 7.8 TWh, about 21% of residential and commercial electricity demand in 2005 (1 kW = 1200 kWh/year)

Solar PV Installed Capacity

As at 30 September 2013, a total capacity of 25MW under individual and 183MW under non-individual of Solar PV installation have been approved . To date, a total capacity of 43.56MW of solar PV installation are already in operation.

3.3.4 Solid Wastes Potential

Traditionally in Malaysia the most economic option of solid waste disposal is through landfills or dumpsites. The state governments upon recognising ineffective solid waste management would result in catastrophic environmental problems such as water resource pollution from leachate including public

health reasons have adopted using sanitary landfills instead. However many municipalities are still using open dumpsites to manage their solid waste.

Current data from the Ministry of Housing and Local Government suggest the total waste collected and disposed per day in Malaysia is approximately 21,000 tonnes. From **Table 9** below it is seen that the states of Selangor, Johor and Sarawak produce the most amount of solid waste, while Perak, Pahang, Sabah and Sarawak have high numbers of dumping sites in the states.

Table 9: Total Waste Generation in Malaysia

State	Waste collected and dumped per day (MT/d)	Number of operating dumping sites	Number of closed dumping sites
Perlis	120	1	1
Kedah	1,504	12	3
Penang	1,800	1	2
Perak	1,864	21	9
Pahang	1,094	20	12
Selangor	3,240	7	11
Kuala Lumpur	1,950	1	7
Negeri Sembilan	1,162	8	10
Melaka	906	2	5
Johor	2,439	13	21
Kelantan	729	13	5
Terengganu	651	9	12
Sabah	1,174	20	1
Sarawak	2,001	51	12
Total per day	**20,633**	**179**	**111**

Solid Wastes Power Estimate

Based on the current data it is estimated from solid wastes (RDF, incineration, sanitary landfills): 378 MW can be installed by 2024. This is based on the assumption 30,000 tonnes/day of solid wastes produced as projected by Ministry of Urban Wellbeing, Housing and Local Government, followed by 3% annual growth post 2024 according to increase of the population.

Additionally there are already many solid waste dumping sites that have been closed as shown in **Table 9** previously. These sites have potential to generate electricity from landfill gases.

Currently, an integrated waste management plant owned by *Recycle Energy Sdn Bhd* is already operating in Semenyih, Selangor managing the solid waste of the Kajang municipality. This plant with a capacity of sorting and treating a maximum 1,000 tonnes per day also has a power generation plant. From the normal intake of 700 tonnes/day of wastes, the plant could sort the combustible waste and generate a gross power of 8.9 MW, of which 5.5 MW are available for export to the utility.

If all future waste-to-energy plants are based on this integrated concept involving recycling initiative, etc., the power potential for target setting would naturally be reduced as other waste products are either recycled or directed towards more value added products.

3.3.5 Other RE Technologies

I. Wind Energy

Malaysia does not have comprehensive data and information about the wind energy resources to ascertain the potential of wind resources available for the development of wind plants. The data available is incomplete and is being used for the purpose of research in universities or research institutions. Most of the data are obtained from the Meteorological Department in which the data were recorded at meteorology stations with an installed wind masts especially at the airport with an altitude of 10 meters. Moreover, the absence of central databases and comprehensive information about wind energy also complicate the process of identifying the potential of wind energy in Malaysia.

To obtain more accurate data and extensive, Sustainable Energy Development Authority Malaysia (SEDA Malaysia) and University Malaysia Terengganu (UMT) are currently developing the Comprehensive Study on Wind Map in Malaysia. A desktop study has been carried to produce a GIS map with a zoom-in feature through the simulation model using the available Meteorological data from Meteorological Department and Global model wind and terrain data. **Figure 16** shows the average wind velocity in Malaysia.

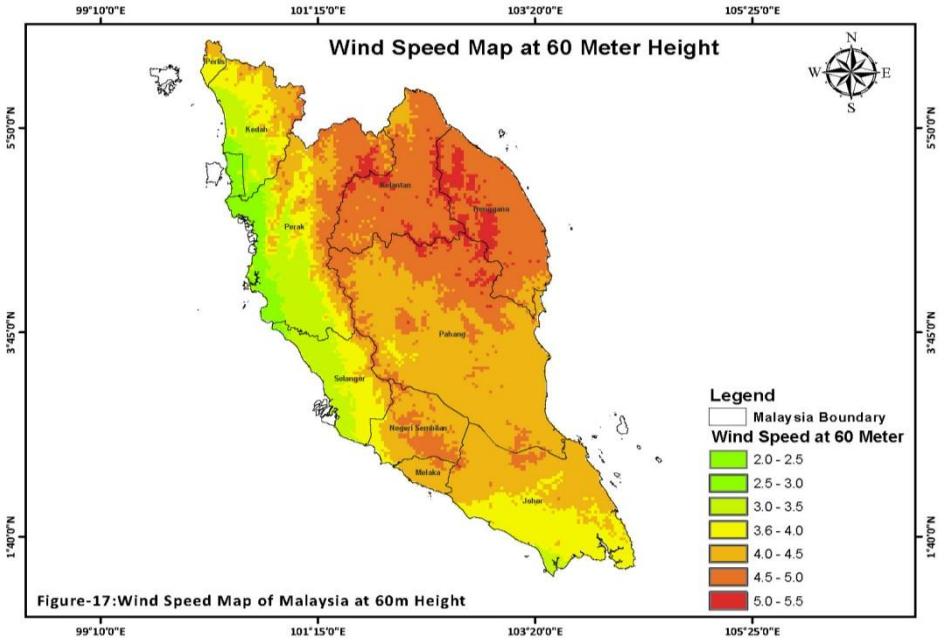


Figure 16 (a): Average wind velocity in Peninsular Malaysia – Peninsular Malaysia

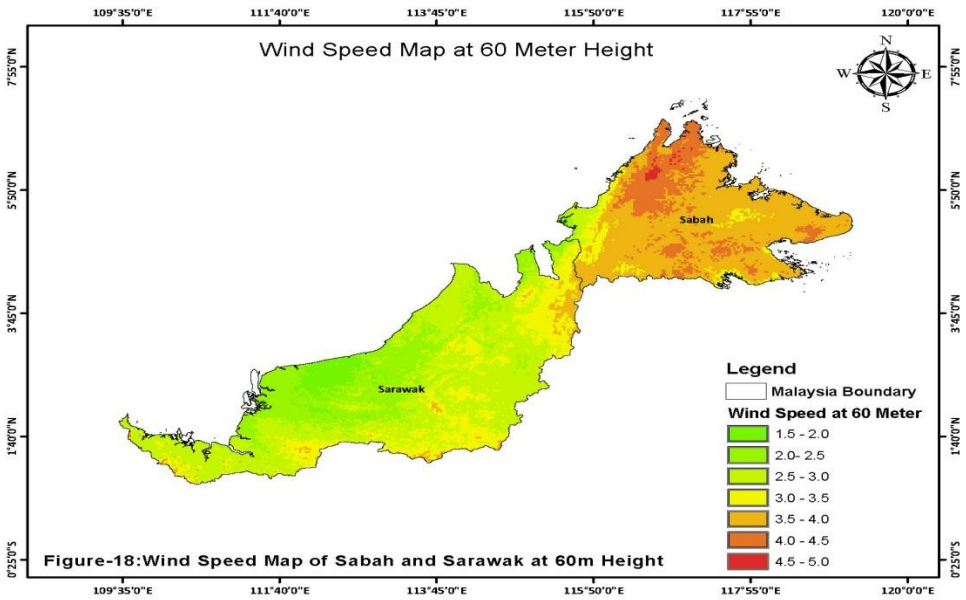


Figure 16 (b): Average wind velocity in Peninsular Malaysia – Sabah and Sarawak

Eleven (11) sites have been identified wind masts installations with average height of 60 to 70 meters. The sites are;

a) Kudat, Sabah;

b) Pulau Banggi, Sabah;

c) Kota Marudu, Sabah;

d) Kijal, Terengganu;

e) Kuala Terengganu, Terengganu;

f) Setiu, Terengganu;

g) Langkawi, Kedah;

h) Mersing, Johor;

i) Durian Tunggal, Melaka;

j) Bachok, Kelantan; and

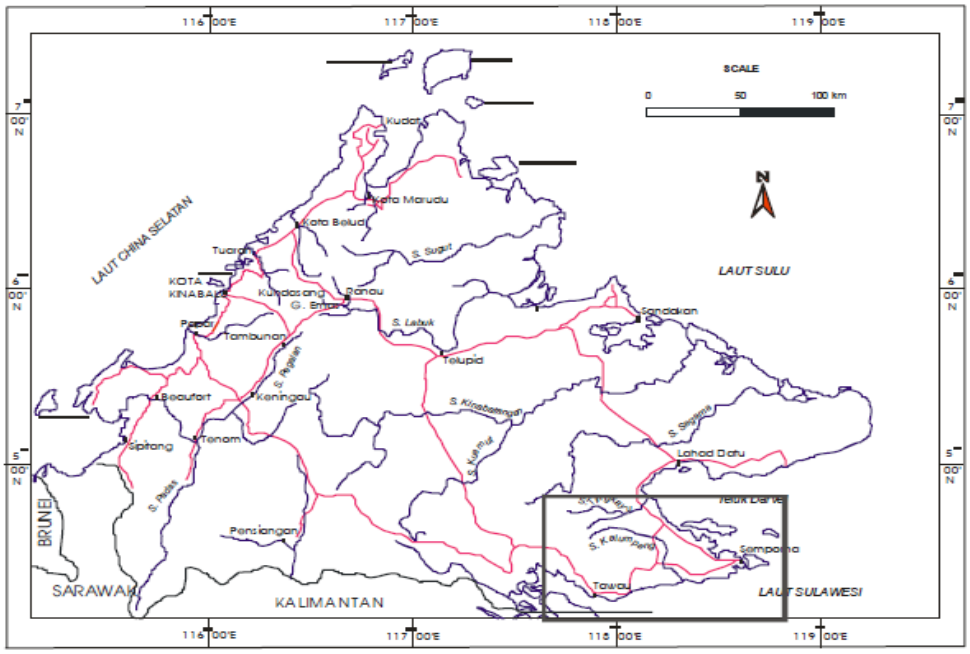
k) Chuping, Perlis.

The wind data to be collected are such as wind velocity and direction, ambient temperature and barometric pressure. The data will be collected starting January 2014 for 12 months period.

II: Geothermal Energy

Geothermal energy is the heat from the Earth. It's clean, sustainable and one of the renewable energy resources. The heat is stored in rock and the water within the earth and can be extracted by drilling wells at depths shallow enough to be feasible.

A Magnetotelluric (MT) survey has been conducted in Apas Kiri, Tawau, Sabah by the Mineral and Geoscience Department. The potential of the Tawau geothermal reserve is assessed to be about 67 MWe, which is very promising in the utilization for electrical power generation. The location of the site is shown in **Figure 5**.



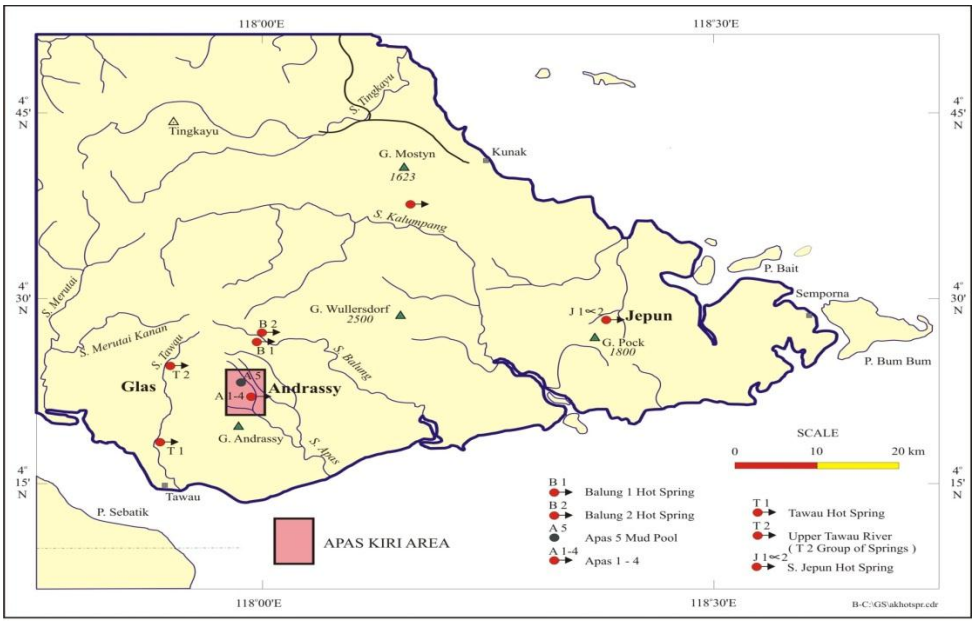


Figure 17: Location Map for Geothermal Site in Apas Kiri, Tawau, Sabah

3.4 RE INVESTMENT AND FINANCIAL MECHANISM

3.4.1 Fiscal Incentives

The promotion of renewable energy (RE) in Malaysia was previously based on the Small Renewable Energy Power (SREP) programme. However with the implementation of the feed-in tariff (FiT) via the RE Act 2011 the SREP programme ceased to be implemented. The existing SREP players are given the option of either remaining in the SREP programme or migrate into the FiT mechanism regime.

Projects developed under the FiT mechanism are still eligible for Pioneer Status (PS) or Investment Tax Allowance (ITA). These incentives have been provided from 2001 but have been enhanced over the years. The Government has expanded the scope of RE to include photovoltaic (PV) generated power and has extended the range of fiscal incentives (in the National Budgets for 2008 and 2009) to promote the adoption of grid-connected building integrated PV systems as well as other forms of RE and energy efficiency initiatives. The incentives offered can be divided into two main categories;

i) Incentives for End-Users

Incentives for End-Users mean that *Companies* generating energy from renewable sources have a choice of applying for the following incentives:

- Pioneer Status with income tax exemption 100% of statutory income for 10 years; OR
- Investment Tax Allowance (ITA) of 100% on qualifying capital expenditure incurred within a period of 5 years. This allowance can be set-off against 100% of statutory income for each year of assessment; AND
- Import duty and sales tax exemption on equipment used to generate energy from renewable sources not produced locally and sales tax exemption on equipment purchased from local manufacturers.

The term *'Companies'* refer to companies locally incorporated under the Companies Act 1965- Syarikat Berhad and Syarikat Sendirian Berhad. This type of application is also known as a 'project' application. Under the Budget 2011 announcement this incentive will be extended for applications received until **31 December 2015.**

ii) Incentives for Third Party Distributors

The Budget 2011 has extended incentives to grant exemptions of import duty and/or sales tax as appropriate, to Registered Third Party Distributors (TPDs) as well as manufacturers of the relevant products as follows:

- Import duty and sales tax exemption on solar photovoltaic system equipment for the usage by third parties be given to importers including photovoltaic service providers approved by the Energy Commission; and
- Sales tax exemption on the purchase of solar heating system equipment from local manufacturers.

However, the above incentive has expired on 31st December 2012.

3.4.2 Green Technology Financial Scheme (GTFS)

In the budget speech for 2010, Dato' Seri Najib Tun Abdul Razak, the Prime Minister of Malaysia announced the establishment of Green Technology Financing Scheme as an effort to improve the supply and utilization of Green Technology. The scheme could benefit companies who are producers and users of green technology.

As a sign of commitment, the Government will bear 2% of the total interest/profit rate. In addition, the Government will provide a guarantee of 60% on the financing amount via Credit Guarantee Corporation Malaysia Berhad (CGC), with the remaining 40% financing risk to be borne by participating financial institutions (PFIs). The Prime Minister also appointed GreenTech Malaysia as the conduit for the Green Technology Financing Scheme (GTFS) application. The scheme is expected to provide benefits to more than 140 companies of which the application has been open starting from 1st January 2010.

4. CLEAN DEVELOPMENT MECHANISM (CDM)

4.1 CDM AUTHORITIES/INSTITUTIONS

The institutions involved in implementing the Clean Development Mechanism in Malaysia (including Designated National Authority) are listed in the table below:

Table 10: Authorities for CDM in Malaysia

Designated National Authority (DNA) & National Committee on CDM	Ministry of Natural Resources and Environment
Technical Committee on CDM (Energy)	Deputy Secretary General (Energy), Ministry of Energy, Water and Communications - Chairman Malaysian Green Technology Corporation – Secretariat
Technical Committee on CDM (Forestry)	Ministry of Natural Resources and Environment – Chair Forest Research Institute Malaysia - Secretariat

4.2 APPROVAL PROCESSES FOR CDM PROJECTS

The project proponent will start by producing a brief description of the suggested CDM project. A standardised format for a Project Idea Note (PIN) in Malaysia can be used to approach potential buyers of Certified Emission Reductions (CERs) and can also form the basis for the initial or conditional national approval.

Project proponents are required to submit the Project Idea Note (PIN) as the preliminary screening document to the Designated National Authority (DNA), which is the Conservation and Environmental Management Division (CEMD) of Ministry of Natural Resources and Environment (NRE).

Based on the PIN, the DNA will determine whether the submitted project proposals meet the national CDM criteria. In addition, this would reduce the cost and the time to prepare the PDD if the PDD is submitted without the PIN and subsequently rejected by the DNA.

However, the project proponent can also directly submit the Project Design Document (PDD) together with Additional Information for PDD Submission Form to the DNA, and thus skip the phase of submitting a PIN. In case the project qualifies as a small scale project, the PDD template for small scale projects can be used.

Small-scale projects are defined as follows:

- Renewable energy project activities with a maximum output capacity equivalent of up to 15 MW-electric or 45 MW-thermal ;
- Energy efficiency improvement project activities which reduce energy consumption by up to the equivalent of 60 GWh per year;
- Other project activities that both reduce anthropogenic emissions by sources and directly emit less than 60 ktCO_2-equivalents per year.

For the latest PDD templates and the guidelines for completing the PDD, the project proponents are advised to check at following link http://cdm.unfccc.int/Reference/Documents.

For energy projects, the PIN or PDD will be forwarded to MGTC for technical evaluation of the project. CDM proposals from the forestry sector will be forwarded to Forest Research Institute Malaysia (FRIM).

4.3 CURRENT STATUS OF CDM PROJECTS

As of October 2013, there are 110 CDM energy projects registered with CDM EB, with estimated potential emission reduction amounting to 7,524,500 tCO_2eq /yr.

Out of 110 projects, 46 projects were issued the CERs, amounting to 7,360,448 tCO_2eq.

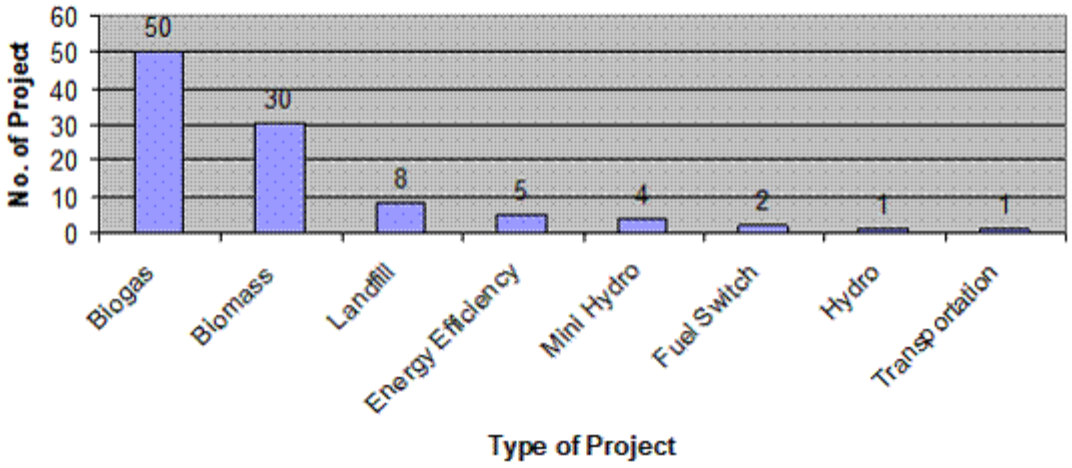


Figure 18: Number of CDM Projects by Project Type

APEC PEER REVIEW

ON LOW-CARBON POLICIES (PRLCE)

PART II: PEER REVIEW TEAM REPORT

This part of the report presents the PRLCE Review Team's conclusions and recommendation about low carbon energy policies and programs in Malaysia.

1. INSTITUTIONAL CONTEXT

1.1 ACHIEVEMENTS AND CHALLENGES

In Malaysia, the Economic Planning Unit (EPU) in the Prime Minister's Office is responsible for setting the overall direction for national energy policies. However, unlike other APEC ASEAN[1] economies, the implementation of energy policy in Malaysia is not centralized under the energy ministry. Instead, specific ministries and/or government agencies are then given the mandate for implementing different aspects of the energy policies.

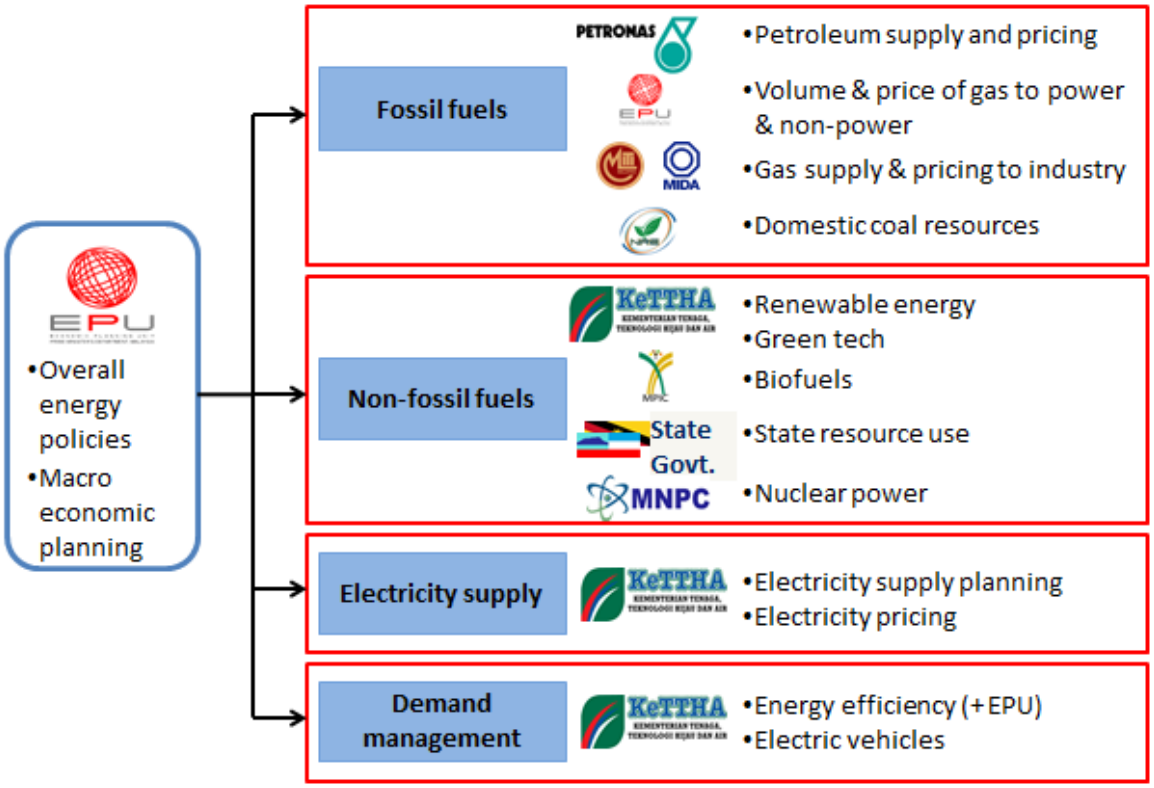


Figure 1-1: Jurisdiction of different ministries and agencies in the Malaysian energy sector[2]

For renewable energy (RE), the allocation of tasks is very specific. Some of these are related as below.

RE Power Generation

The Ministry of Energy, Green Technology and Water (KeTTHA) is responsible for overseeing RE policy implementation for the power generation sector via two statutory authorities; the Sustainable Energy Development Authority (SEDA) and the Energy Commission (EC).

[1] APEC ASEAN economies are economies that are members of both the APEC and ASEAN (Association of Southeast Asian Nations) organizations, namely: Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam.

[2] SEDA (2013), Overview of Malaysia National Renewable Energy Policies, Strategies and Regulatory Framework, presentation during the PRLCE Review Team Visit on 9 December 2013.

SEDA was established to administer and manage the Renewable Energy (RE) Fund and implement the feed-in tariff mechanism. This effectively limits the role of SEDA to grid-connected renewable electricity generation in Peninsular Malaysia and Sabah.

EC regulates the electricity supply and piped gas supply industries in Peninsular Malaysia and Sabah. As the electricity supply regulator, EC issues licenses for RE power generation installations (for both on-grid and off-grid connections) and is responsible for ensuring the safety, quality and reliability of the RE technologies being installed in Malaysia.

Both agencies play a role in promoting RE development in Malaysia, but when it comes to monitoring and regulations, there is a clear boundary as to the jurisdiction of each statutory agency[3]. Therefore, while the possible overlapping of promotional roles may be confusing for industry outsiders, in itself this may not pose serious problems as the administrative role is well-defined. In any case, SEDA and EC are under the purview of the ministry, KeTTHA, which can coordinate all activities to ensure smooth implementation.

The Ministry for Rural and Regional Development (KKLW) is mandated to coordinate the rural electrification program, which is part of government initiative to improve basic rural infrastructure. KKLW works closely with Malaysia's three utilities[4], KeTTHA and SEDA to meet its target of providing 24 hour electricity access for the rural communities in Malaysia.

RE biomass, biogas and biofuels

Malaysia has a thriving plantation and agricultural industry which is under the purview of the Ministry of Plantation Industries and Commodities (MPIC). One of its implementing agencies, the Malaysia Palm Oil Board (MPOB), takes the leading role in coordinating and developing the palm oil industry of Malaysia by conducting and promoting research related to planting, production, harvesting, extraction, processing, storage, transportation, use, consumption and marketing of oil palm and oil palm products. This includes biogas, biomass and biofuels.

Green technology and climate change

Given the cross-sectoral nature of climate change, the National Green Technology and Climate Change Council was formed to provide high-level coordination among ministries, agencies, private sector and all other stakeholders. The council is chaired by the Prime Minister and supported by a steering committee (chaired by the Ministry for Natural Resources and Environment (NRE)) and eight working committees. The Malaysia Green Technology Corporation (GreenTech) is the implementing arm for green technology and climate change initiatives in the energy sector.

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[3] SEDA is in charge of all FIT-eligible RE projects (grid-connected, up to 30 MW). EC is responsible for licensing all installations and regulating the development of large-scale (above 30 MW) RE projects (usually hydro).

[4] The three utilities are Tenaga Nasional Berhad (TNB), Sarawak Energy Sdn Bhd (SEB) and Sabah Electricity Sdn. Bhd. (SESB)

As mentioned above, unlike other APEC ASEAN economies, the jurisdiction of energy policy in Malaysia is not centralized to one energy ministry. This fact leads to a concern that there may be potential difficulties in prioritizing RE in national energy policies.

Another challenge that has been identified relates to energy governance at the state level. Malaysia is a federal economy and state governments wield a wide range of juridical power. This is especially true for the State of Sarawak, which has comparably more autonomous privileges as part of the agreement signed when joining the Federation of Malaya in 1963[5]. At the same time, each state has the right to administer the utilization of forests, land and water within their boundaries. This means that for RE project development, state authorities have jurisdiction for issuing land conversion approvals, water abstraction rights and permissions, planning permissions and access to reserve lands. Environmental impact assessments (EIA) are another requirement that must be completed and approval obtained from the relevant state authority before the project can be implemented. These assessments and procedures are highly essential to protect local natural resources and environment as well as the rights of the indigenous peoples, however, there has been some indication that these procedures tend to be lengthy and requirements can be changed arbitrarily as evaluation is by project-basis.

Somewhat related to this issue, RE stakeholders in Malaysia appears to be less well organized compared with other APEC ASEAN economies. With the exception of the solar photovoltaic (PV) industry, there seems to be no associations of stakeholders for other RE resources to represent their collective views and interests.

1.2 RECOMMENDATIONS

Recommendation 1: *It is desirable for all government entities to continue close cooperation in implementing renewable energy policies. However, a more streamlined structure would improve accountability and coordination as well as help mitigate problems with overlapping roles.*

The EPU provides general direction for energy policies, but implementation is delegated to different ministries and agencies. Therefore, each ministry takes the lead for different utilisation and works together with other stakeholders (which may include other ministries) towards achieving their goals successfully. In practice, this has led to several overlaps especially in the promotional role, and this can become an inefficient use of available resources.

Recommendation 2: *Encourage state authorities to streamline and standardize renewable energy approval processes and procedures across different departments.*

This would provide clear signal for investors of strong support from the state for RE project developments; as well as provide transparency and reduces the risk of project delays or cancellation. At

[5] For instance, the electricity industry in Sarawak is regulated by the Electrical Inspectorate Unit under the Sarawak Ministry of Public Utilities instead of EC.

the same time, stipulating and maintaining clear rules on development constraints[6] would ensure the protection of natural resources, the environment and local communities. Finally, is it also important to develop local expertise and workforce that can effectively assess, manage and regulate RE developments in their states.

Recommendation 3: *Create an official forum for regular dialogue sessions between RE stakeholders and the authorities.*

When required, SEDA organizes workshops and dialogues with stakeholders in order to solicit stakeholder feedback on changes to the system, especially when introducing new or making changes to the rules, regulations or mechanism. Continuous and transparent communications with stakeholders would provide valuable insight into which policy instruments would be suitable for the economy and enable policymakers to identify emerging or potential issues early on, thus improving policy design, acceptance and implementation. Therefore, providing a more formalized and regular dialogue platform would be a useful channel for both policymakers and stakeholders.

Recommendation 4: *Encourage RE stakeholders to establish associations that fosters RE development in the economy.*

With the rapid growth of RE industries, establishing stakeholder associations would provide a platform for similar stakeholders to discuss and exchange ideas, views and expertise on common issues; collaborate to serve common goals (for example, associations for RE manufacturers may collaborate on standardization or technical capacity building); and provide a united voice during discussions with policymakers.

[6] Some examples of development constraints that could be implemented includes: prohibiting RE projects within a certain range of residential areas, prohibiting RE projects within national parks that would endanger fragile flora and fauna, and prohibiting RE projects that would require the relocation of indigenous tribes or threatens their sources for food and water.

2. RENEWABLE ENERGY GOALS, TARGETS AND STRATEGIES

2.1 ACHIEVEMENTS AND CHALLENGES

Malaysia's first, distinct renewable energy (RE) policy was revealed in 2001. Incorporated into the Eighth Malaysia Plan[7], the Five-Fuel Policy defined renewable energy as the fifth fuel (alongside oil, gas, coal and hydro) and identified various tools to promote greater utilisation of RE (for example biomass, solar, mini-hydro and others). These tools include demonstration projects, commercialisation of research findings, and extension of financial and fiscal incentives. With this new Five-Fuel Policy, RE development in Malaysia started taking off. However, by 2009, RE penetration was still low[8] due to the following barriers[9]:

(1) Misuse of monopsony (single-buyer) power and information asymmetries;

(2) Economic, financial and technical constraints that impede market performance;

(3) Arbitrary price setting and RE cost-burden on the utility;

(4) Absence of proper RE regulatory framework that provides clear and standardised procedures;

(5) Poor governance detrimentally affecting stakeholders' participation and legitimacy of actions by implementing agencies;

(6) Insufficient institutional measures to meet informational and technological needs.

In order to address these market failures and system weaknesses; to provide long term sustainability; to stimulate a new growth industry; to recognise the importance of the environment as an economic growth contributor; to develop human capital resources particularly in the field of research and development (R&D) in RE technologies; and to improve the coherence of current policy, a comprehensive vision and objectives in the form of the National Renewable Energy Policy and Action Plan (NREPAP) was introduced and approved by the Malaysian Cabinet on 2 April, 2010.

It can be seen that the NREPAP has been schemed clearly, and it was incorporated into the Tenth Malaysia Plan[10]. According to NREPAP, the infrastructure for deploying RE has been built step-by-step to incubate RE laws, incentive measures and other instruments.

Moreover, the RE Policy and Action Plan is an initial effort towards the progress of the National Green Technology Policy to ensure the government's effort would bear fruit and the vision can become a reality. The National Green Technology Policy is built on four pillars including energy, environment, economy, and social.

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[7] Five-year Malaysia economic development plan, the Eighth Malaysia Plan covers the years 2001-2005. Available at http://www.epu.gov.my/en/eighth-malaysia-plan-2001-2005

[8] According to the *National Renewable Energy Policy and Action Plan (NREPAP 2009),* by December 2009 only 53 MW of RE power generation has been connected to the electricity grid. The NREPAP 2009 is available at http://seda.gov.my/?omaneg=000101000000010101010001000010000000000000000000000&s=31

[9] Summarised from Chapter 3 of the *National Renewable Energy Policy and Action Plan (NREPAP 2009).*

[10] The Tenth Malaysia Plan is available at http://www.epu.gov.my/en/tenth-malaysia-plan-10th-mp-.

Under the NREPAP, Malaysia's RE policy vision was stated as below:

"Enhancing the utilisation of indigenous renewable energy resources to contribute towards national electricity supply security and sustainable socio-economic development"

In addition, the objectives the policy and action plan were set out as below:

(1) to increase RE contribution in the national power generation mix;

(2) to facilitate the growth of the RE industry;

(3) to ensure reasonable RE generation costs;

(4) to conserve the environment for future generation; and

(5) to enhance awareness on the role and importance of RE.

In order to achieve the above objectives, a policy mission comprising five strategic thrusts (or action plans) have been identified, including:

(1) introducing appropriate regulatory framework;

(2) providing conducive environments for RE businesses;

(3) intensifying human capital development;

(4) enhancing RE research and development; and

(5) designing and implementing an RE advocacy programme.

This vision and objectives can be visualized as a house with a roof, pillars and underlying foundation as in Figure 2-1. Then Thrust 1 is the most important foundation, and Thrusts 2, 3, and 4 are the pillars with the support from Thrust 5.

Figure 2-1: Relationship between NREPAP goals and strategic thrusts

Currently, based on the National Energy Balance 2011[11], the grand total of installed capacity of RE by public and private licensees in 2011 was 335.97 MW (less than 2% RE in generation capacity mix) with 757,912 MWh of electricity generation. The RE resources in the public sector were mini-hydro, biomass (including land fill gas, palm oil mill effluent (POME), palm shell & empty fruit bunch (EFB), wood waste and palm oil waste) and solar. In the public sector, the total installed capacity was 131.3 MW with 336,879 MWh of electricity generation. The largest contribution was from EFB in Sabah, accounting for 165,425 MWh (49.11%). In the private sector, the total installed capacity was 204.67 MW with 421,033 MWh of electricity generation. The RE resources were agricultural waste, wood waste, wood / sawmill dust, industrial waste heat, EFB, palm oil waste and mini-hydro. It can be seen that biomass energy was the main RE power in the private sector, accounting for 78.11% of electricity generation. The largest contribution was from wood waste in Sabah region, accounting for 254,856 MWh (60.53%).

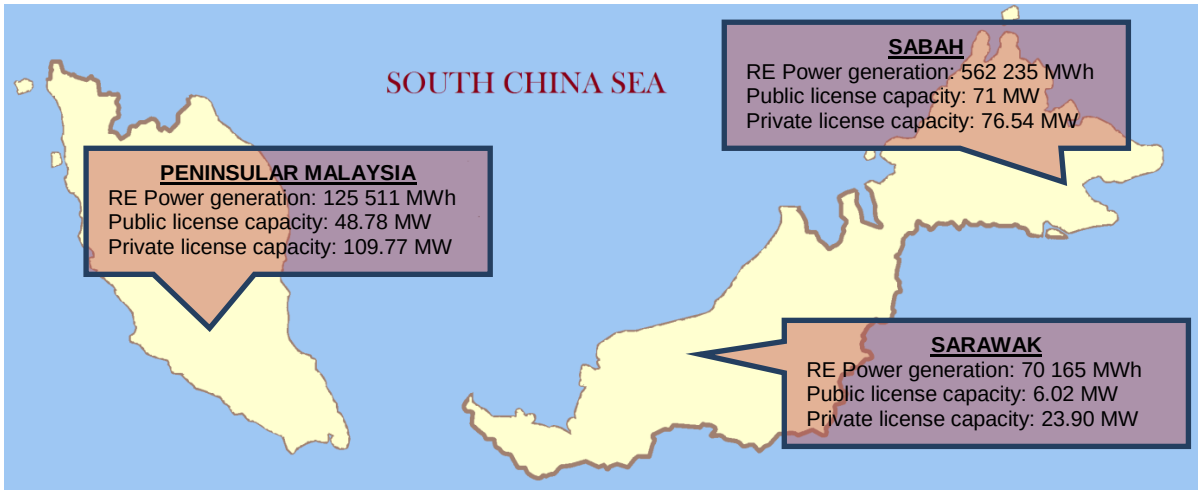

Figure 2-2: RE power generation and capacity by region in 2011[12]

No doubt that Malaysia is abundantly blessed with many indigenous RE resources. The RE resources identified are palm oil biomass wastes (usually EFB and palm kernel shells (PKS)) and POME, solid waste and land-fill gas, wastes and gases from agro-based and farming industries, mini-hydro, solar power, wind energy, and geothermal energy.

According to the detailed analysis and taking into consideration the technical limitations (particularly of the availability of fuel sources), and the need for sustainability, RE targets for Malaysia was set in the NREPAP in 2010, and named as the "SMART" target: specific, measurable, achievable, realistic and time-specific.

Under the NREPAP, the objective was to increase RE installed capacity and concurrently the RE electricity generation. The set goals are up to 975 MW (6% of total peak electricity demand) and 5.3 TWh/year (5% of total electricity) by 2015; 2,065 MW (11%), and 11.2 TWh/year (9%) by 2020; and

[11] Energy Commission (2013), Malaysia National Energy Balance 2011, http://meih.st.gov.my/documents/10620/6ee119f3-8bcf-4a7b-930e-ae375dbbc544

[12] Ibid

3,484 MW (14%), and 16.5 TWh/year (11%) by 2030. The targets are also projected up to 2050, when RE would constitute up to 11.5 GW or 36% of total peak electricity demand capacity and 29.3 TWh/year or 15% of total electricity generated.

For individual RE technical potential, the assessment showed that biomass (EFB, agro-based) can reach 1,340 MW by 2028; biogas (POME, agro-based, and farming) 410 MW by 2028; mini-hydro (< 30 MW) 490 MW by 2020; solid waste (Refuse derived fuel (RDF), incineration, and sanitary landfill) 378 MW by 2024 (at 30,000 tonne/day, by 3% annual growth post 2024); and unlimited grid-connected solar PV.

Nevertheless, these RE targets are limited to grid-connected RE in Peninsular Malaysia and Sabah.

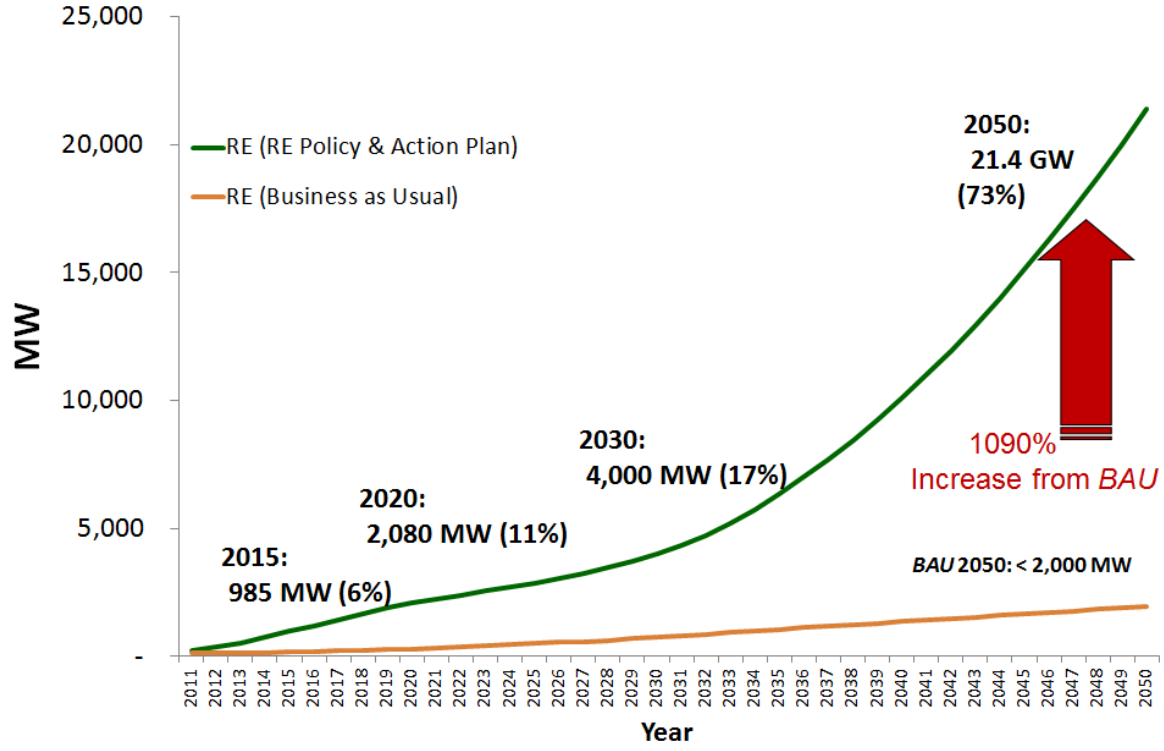

Figure 2-3: Malaysia National RE Targets[13]

Since the implementation of the NREPAP in 2010, Malaysia has lifted some of the previous barriers slowing RE penetration in the economy. From December 2011 to October 2013, 119.47 MW of renewable energy has commenced operations under the feed-in tariff mechanism, which is more than double the total RE capacity installation in the previous decade. This is a remarkable achievement.

[13] SEDA (2013), *Overview of Malaysia National Renewable Energy Policies, Strategies and Regulatory Framework*, presentation during the PRLCE Review Team Visit on 9 December 2013.

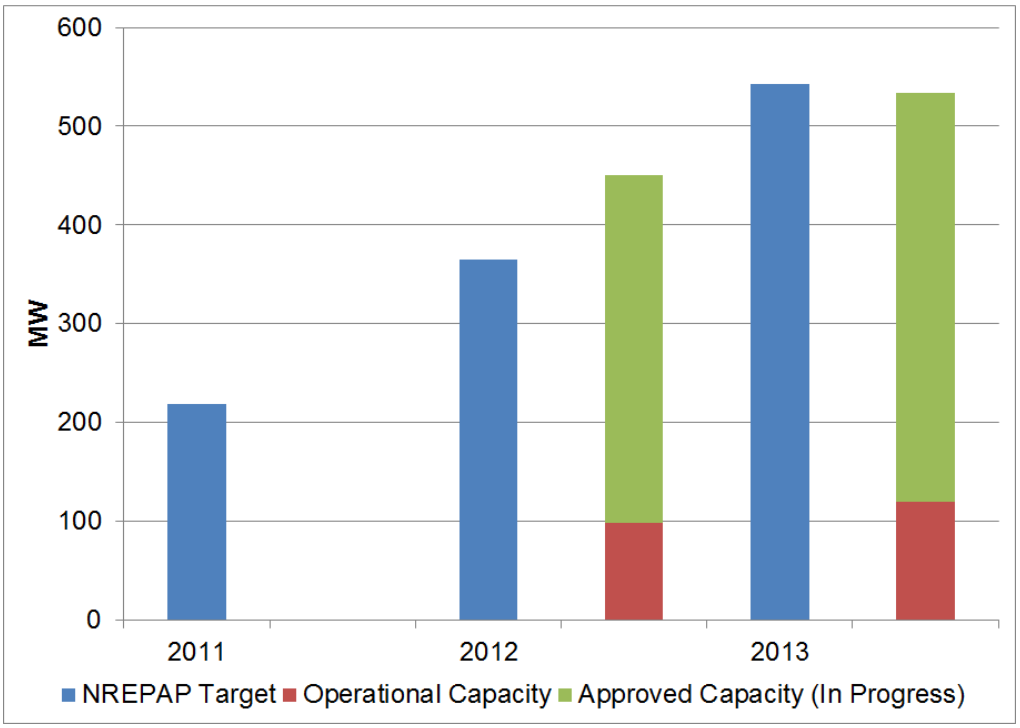

Figure 2-4: Comparing NREPAP targets and actual installed capacity (MW), 2011 – October 2013[14]

However, from Figure 2-4, it can be observed that while allocated capacity is in line with annual NREPAP targets, actual operational installed capacity falls far short from these same targets. This most likely can be largely attributed to "teething problems" that are inherent when introducing new regulations and mechanisms in an economy. Please see Chapter 7 for further discussion on this issue.

Moving forward, some key challenges have been identified. Some are underlying problems; others are just emerging given the rapid changes in global and domestic circumstances.

- Subsidized energy pricing has led to overconsumption and high dependence on fossil-fuels in the economy, especially in Peninsular Malaysia. This has caused primary energy reserves to rapidly deplete and the economy has begun to import energy to meet demand.
- Subsidies and the inability to pass-through tariffs have acted as a disincentive for investments in infrastructure or in new, alternative technologies.
- On demand-side, consumers are less motivated to apply smart energy savings initiatives like energy efficiency and renewable energy as the potential savings benefits are artificially perceived as lower due to energy subsidies.
- Availability, accessibility and affordability of certain RE technologies continue to be difficult to assess as these can be very site- and technology-specific.

[14] Data for installed capacities (operational and in progress) in 2011 and 2012 are taken from SEDA Annual Reports, data for 2013 is from SEDA presentation during the PRLCE Review Team Visit and is up to 31 October 2013 only.

2.2 RECOMMENDATIONS

Recommendation 5: *As the current National Renewable Energy Policy and Action Plan (NREPAP) was endorsed by the Malaysian Cabinet in 2010, it is highly recommended that Malaysia updates the NREPAP targets and action plans to adapt to the changes in global and local circumstances and to take into account the two renewable energy laws and funding available for RE development.*

While the NREPAP was officially endorsed by the Malaysian Cabinet in 2010, the document itself was actually completed two years earlier in November 2008 with initial endorsement by the Planning and Implementation Committee for Electricity Supply and Tariff (JPPPET). By the time of PRLCE Review Team Visit in December 2013, the document has already been over five years in circulation.

Within that five year period, there have been rapid changes in RE technology and RE prices, both domestic and abroad. There have been also been many lessons learned from the implementation of the Renewable Energy Act 2011 and the Sustainable Energy Development Authority (SEDA) Act 2011.

Therefore, it is reasonable for Malaysia to now take stock and update the targets, goals and strategies to reflect these new circumstances in order to maximize the benefits of RE utilisation in the economy.

Recommendation 6: *Consider expanding definition of national renewable energy targets to include sub-targets for Sarawak state and renewable energy applications in different sectors like power generation (off-grid and on-grid), heat generation (process and water heating), transportation and others.*

The current definition of the national renewable energy targets is limited to small-scale, on-grid, power generation from renewable energy resources in Peninsular Malaysia and Sabah.

Contribution from Sarawak is not included, even though the state is home to a big portion of Malaysia's RE resources. This is likely because energy governance in Sarawak is under the jurisdiction of state rather than federal authorities (See Chapter 1 for further discussion). Furthermore, electricity consumption in the state is very low compared to Peninsular Malaysia, so there is less urgency for RE development in the state.

Nevertheless, the state of Sarawak may consider submitting a voluntary RE target as part of its contribution to the national RE target and then formulate its own roadmap for RE development that may either follow the same path as Peninsular Malaysia (feed-in tariff mechanism) or a different path that may better suit the state's conditions. A clear target and roadmap would provide a market signal for investment opportunities in RE in Sarawak.

At the same time, expanding the definition to include other applications of RE in addition to power generation will broaden consumer and industry awareness and encourage investment and R&D into these areas. Currently, national RE targets in Malaysia are only disaggregated by year and by power generation sources (solar, small-hydro, biomass and biogas). Allocating sub-targets to different sectors and according to application (for instance biofuel for transportation, residential water heating, commercial water heating, industrial process heating and others) breaks-up ambitious targets into manageable goals that can be easily monitored to ensure the economy is on-track to reach its set targets.

It is also highly recommended that sub-targets are allocated to government-linked companies (GLCs) and multinational companies (MNCs) as part of their corporate social responsibility (CSR) activities. This was also one of the recommendations from the original NREPAP 2010 that can be easily revived as it allows the government of Malaysia to leverage on private sector participation to contribute to RE sector growth.

Recommendation 7: *In order to maximize the uptake of renewable energy technologies, consider integrating the deployment of smart networks (including advanced metering infrastructure (AMI) and smart grid) into the upcoming New National Energy Policy Study.*

As Malaysia's electricity mix begin to incorporate increasingly higher shares of RE, the power grid infrastructure will have to evolve accordingly in order to adequately support this transition. Smart grid technologies like AMI, distributed automation, distributed storage, smart inverters and renewable resource forecasting helps the power grid to cope better with the variable and distributed characteristic of renewable energy[15]. Tenaga Nasional Berhad (TNB), the utility operating the power grid in Peninsular Malaysia, has launched a TNB Smart Grid Initiative (2010-2015) that is already in its second phase as can be seen in Figure 2-5. The PRLCE Review Team applauds this initiative.

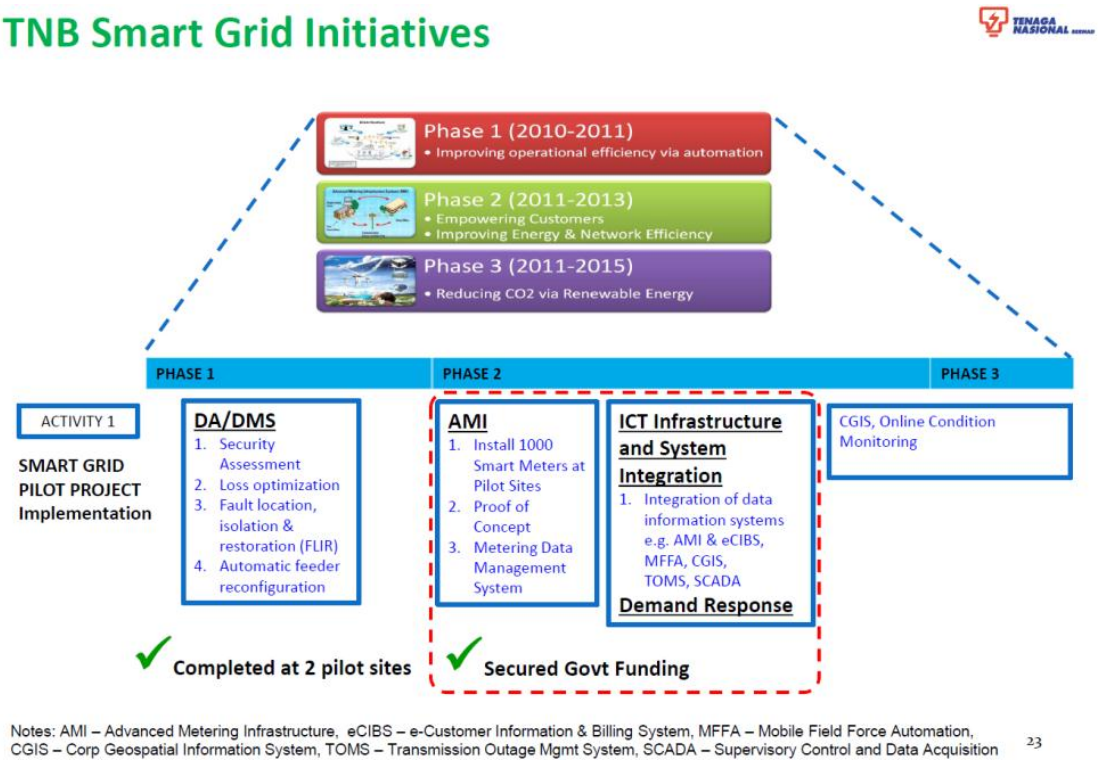

Figure 2-5: TNB Smart Grid Initiatives[16]

[15] To better understand how smart grids can be implemented to support high penetration of renewable power generation, see International Renewable Energy Agency (IRENA)'s *Smart Grids and Renewables: A Guide for Effective Deployment* report, available at http://www.irena.org/menu/index.aspx?mnu=Subcat&PriMenuID=36&CatID=141&SubcatID=362.

[16] TNB (2013), *Smart Grid Innovation in the Electricity Supply Value Chain*, presentation during the PRLCE Review Team Visit on 10 December 2013.

Figure 2-6 shows the framework for the New Energy Policy for Malaysia (2013-2050). Smart grids can be designed to benefit several categories in this framework; this includes power, energy efficiency and transport as well as energy security and emergency. Given the cross-sectoral nature of smart grid applications, it may be advisable for the Government of Malaysia to play a larger role in smart grid deployment as this will provide a stable and transparent environment that will encourage smart grid investment and facilitate cooperation for utilities and to gain support from stakeholders across all sectors (for instance electricity power producers (large and small) and power consumers from power sector, electric vehicle manufacturers and buyers from the transport/manufacturing sectors, appliance and equipment suppliers and others).

The first step towards highlighting the importance of smart grid in the government agenda is by incorporating these technologies and the TNB Smart Grid Initiatives Roadmap into the New Energy Policy for Malaysia (2013-2050).

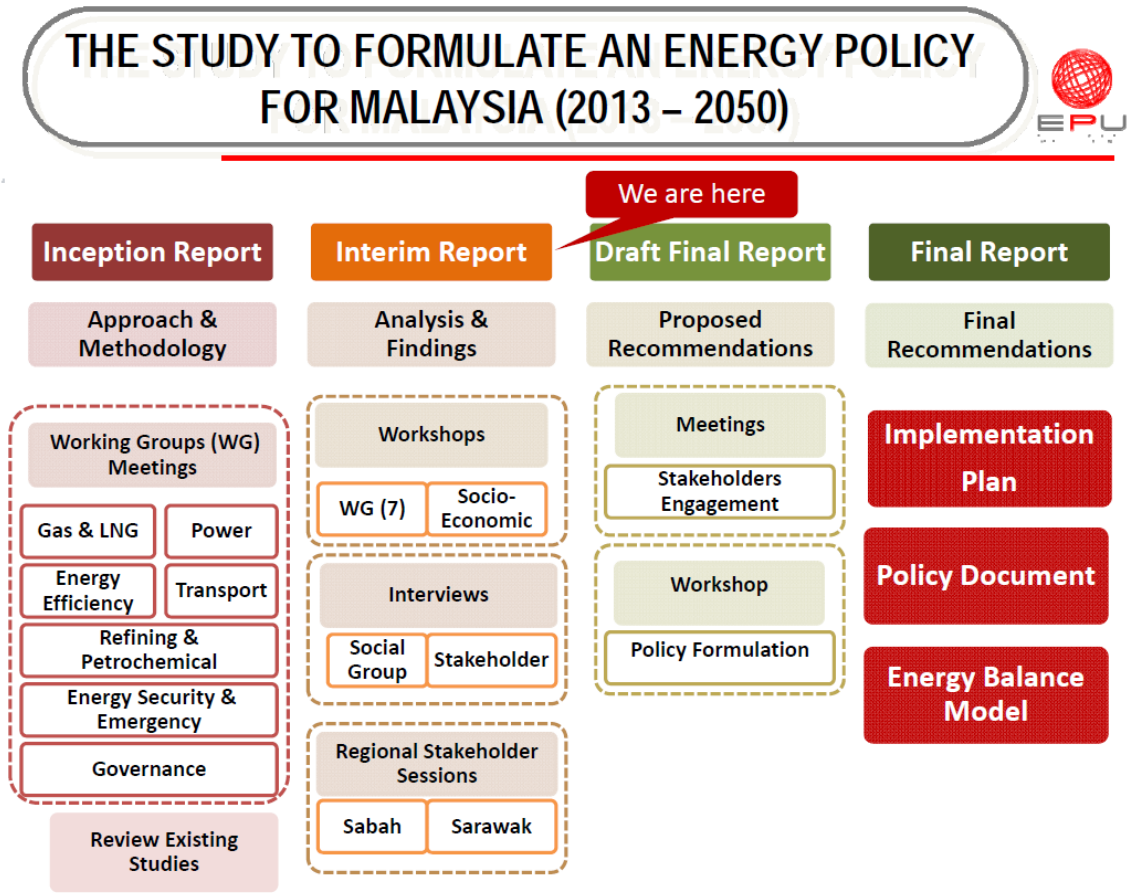

Figure 2-6: Study to formulate an energy policy for Malaysia (2013-2015)[17]

[17] Economic Planning Unit (2013), *Highlights of the New Energy Policy Study (2013-2050)*, presentation during the Fifth Malaysia National Energy Forum on 3 September 2013.

Recommendation 8: *Enhance international cooperation to help lift barriers (like market and technology barriers) for renewable energy applications.*

Malaysia is recommended to strengthen international cooperation with regional and international organizations; particularly economises and organizations like APEC that has extensive and successful renewable energy experience, expertise, advanced technologies, as well as strong funding. The scope of cooperation may include information exchange, technology transfer, human resources/capacity building and financing.

3. ENERGY REGULATION AND INFRASTRUCTURE

3.1. ACHIEVEMENTS AND CHALLENGES

National Renewable Energy Policy and Action Plan (NREPAP) was introduced in 2010 and provides long-term goals for renewable energy (RE) development for power generation in Malaysia. Yet, the role of RE in the overall national energy plan is not necessarily clear from the NREPAP. NREPAP is a policy document which is not based upon a law and therefore its goals and targets for RE development are not legally binding. Malaysia enacted the Renewable Energy Act 2011 and Sustainable Energy Development Authority (SEDA) Act 2011 to provide legal basis for RE strategies. However, these acts only stipulate the feed-in tariff (FIT) mechanism and it's implementing agency, SEDA, instead of presenting overall goals and targets for RE development.

The New National Energy Policy Study is now in progress, in which RE is expected to play a greater role in the total energy supply.

While the RE industry in Malaysia is fairly new, the economy has achieved a lot of progress within the short time-span since the establishment of the two renewable energy acts. Some issues still exist that can be easily rectified:

1. Limited local expertise in RE technologies
2. Slow approval process at state-level, especially for environmental assessments
3. Limited structure for monitoring the results of RE policy implementation

3.2 RECOMMENDATIONS

Recommendation 9: *It is worthwhile to consider the introduction of an RE development plan based upon a law in which goals and targets are legally binding in order to strongly promote RE development.*

Although administrative plans based upon laws might be unfamiliar to the legal tradition in Malaysia, APEC economies which have previously hosted PRLCE have introduced energy plans based upon their laws.

PRLCE Case Studies

Case Study 1: In the case of the Philippines, the Renewable Energy Act of 2008 and the Biofuels Act of 2006 both stipulate the goals of renewable energy development. These legislative goals are supported by the Philippine Energy Plan 2012-2030 (PEP 2012-2030); the National Renewable Energy Plans and Program (NREP) 2011-2030; the National Biofuels Program (NBP); the National Energy Efficiency and Conservation Program (NEECP); the 2012-2016 Missionary Electrification Development Plan (MEDP), the Clean Development Mechanism (CDM) and other sector specific plans.

Case Study 2: In the case of Indonesia, Law No. 30 Year 2007 regarding Energy was enacted. This Energy Law contains two main principles of the National Energy Policy, the energy diversification and conservation energy and mandates the formation of the National Energy Council (*Dewan Energi Nasional,* or DEN) which is in charge of drafting the National Energy Policy (*Kebijakan Energi Nasional*, or KEN) and endorses the National Energy Master Plan (*Rencana Umum Energi Nasional,* or RUEN).

These tight links of laws and plans can prioritize RE development in various regulations such as those for environmental protection.

Recommendation 10: *It is recommended that the authorities continue to develop human capital, improve information sharing and increase public awareness raising activities.*

Human capital development is essential in order to grow a strong workforce in Malaysia that is capable of successfully developing, implementing and maintaining RE projects.

Information sharing and public awareness will ensure strong public support for RE, that would translate to the successful and smooth implementation of RE policies.

Recommendation 11: *State-level approval processes for RE projects should be reviewed and where necessary, standardized or even streamlined.*

RE developer feedback and statistics from authorities indicate that there are many delays occurring during the project development stage that are related to state-level approvals. Reviewing these procedures to identify overlaps, inconsistencies or repetitions and other areas of weaknesses and then improving through standardization across different departments or streamlining the process would likely accelerate project completion time. It should be noted that streamlining does not mean compromising or relaxing regulations, particularly regulations on the environment.

This also applies for technical approvals for access to power grid system by the electricity utilities involved with the FIT mechanism.

Recommendation 12: *There should be a feedback mechanism to monitor the achievements of RE policy and other action plans in terms of actual performance of RE facilities installed and other indicators (jobs created, CO_2 savings and others).*

This will enable Malaysia to monitor the gap between target and achievements, and modify their policy actions accordingly.

It will be wise to rope-in local universities and research institutes to organize and analyse the information collected from RE installations and identify potential areas of improvement based on concrete data. These findings can be used to support investment decisions in the future as well as build local capacity for RE research and development.

4. SUSTAINABLE DEVELOPMENT

4.1. ACHIEVEMENTS AND CHALLENGES

Financial Incentives

Incentives for End Users

The Government of Malaysia has made a number of financial incentives available to companies that generate renewable energy (RE), including those using the feed-in tariff (FIT) mechanism. Tax exemptions and/or tax allowances are available to companies through Incentives for End-Users.

These incentives were previously available to projects under the now defunct Small Renewable Energy Power (SREP) Program and have been made available to projects that migrate to the FIT mechanism, ensuring continuity for businesses. Incentives for End-Users will be available to applicants until 31 December 2015.

Green Technology Financing Scheme

The Green Technology Financing Scheme (GTFS), which began on 1 January 2010, provides financial benefits to companies that supply and use green technology, with limits of RM 50 million and RM 10 million respectively (approximately USD 15 million and USD 3 million). Malaysia Green Technology Corporation (GreenTech Malaysia) administers the GTFS and evaluates projects for certification, entitling applicants to financing incentives.

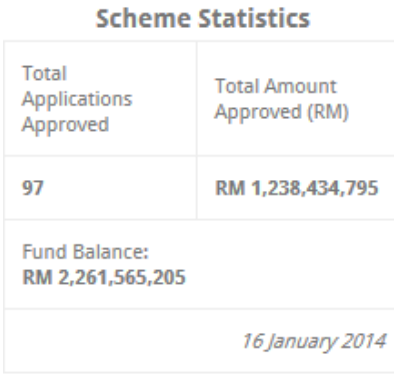

Figure 4-1: GTFS Statistics[18]

For applications prior to 11 October 2013 the government bears 2% of the total interest/profit rate charged by financial institutions[19] and guarantees 60% of the green loan via Credit Guarantee Corporation Malaysia. The remaining 40% financing risk is borne by the financial institution. From 11 October 2013, the Ministry of Finance announced that GTFS applicants can receive either a 30% green loan guarantee or 2% off the total interest/profit rate. The scheme has also been extended by two years

[18] Credit Guarantee Corporation, *Government Funded Schemes – Green Technology Financing Scheme,* http://www.cgc.com.my/government-funded-schemes/

[19] Participating financial institutions include all commercial and Islamic banks and Development Financial Institutions (DFIs), http://www.gtfs.my/page/gtfs-guideline

to 2015, while its budget has been extended by RM 2 billion to RM 3.5 billion in total (approximately from USD 0.6 billion to USD 1.05 billion).

A number of GTFS applications have been rejected by financial institutions due to loans being perceived as high risk, suggesting that the Malaysian financial institutions may be unfamiliar with financing green technology projects, while the applicants may be new businesses and do not meet the credit requirements. To improve the financing environment, the GreenTech Malaysia and the Sustainable Energy Development Authority (SEDA) Malaysia have been engaging with Malaysian financial institutions so that they become more familiar and comfortable about funding green businesses.

Decoupling the 30% loan guarantee from the 2% discount on interest/profit rate is likely to decrease the attractiveness of the scheme to companies, evidenced by the decline in applications since the changes were announced. It is also likely that financial institutions will now perceive GTFS projects as having an increased risk, especially where loans are not guaranteed by the Credit Guarantee Corporation Malaysia. This may result in a higher number of applications being rejected by financial institutions.

Financial Mechanisms under the United Nations Framework Convention for Climate Change (UNFCCC)

Clean Development Mechanism

The National Steering Committee on Climate Change has established a two-tiered structure for Clean Development Mechanism (CDM) implementation in Malaysia:

- The Ministry of Natural Resources and Environment (NRE) is the CDM Designated National Authority (DNA). The DNA is empowered to issue relevant endorsements, host country approvals and manage the local regulatory aspects of the CDM. The endorsement from the host country DNA is required in order to register a project with the United Nations Framework Convention for Climate Change (UNFCCC) CDM Executive Board.
- The National Committee on CDM (NCCDM) was set up in May 2002 and includes members of the government sector and non-governmental organizations (NGO)[20]. The NCCDM is responsible for reviewing and evaluating CDM project proposals as requested by the DNA and assists the DNA in other CDM policy issues for which they seek advice.

Supporting the NCCDM are three Technical Committees for Energy, Agriculture and Forestry, which carry out technical and financial evaluations of CDM project proposals. A Secretariat provides support to the respective Technical Committee in carrying out its duties. GreenTech Malaysia serves as the Secretariat for the Energy Technical Committee and is responsible for the evaluation of all CDM energy project applications in the economy.

[20] The full list of members for the National Committee on CDM (NCCDM) is available online at http://cdm.greentechmalaysia.my/cdm-malaysia/nccdm.aspx

In Malaysia, approximately 70% of the registered CDM projects are related to RE. Since 2002, the number of energy projects has grown; reaching peaks in 2008 and 2012 (see Figure 4-2). As a result Malaysia's greenhouse gas emissions have been reduced mainly through avoided methane emissions and replacement of fossil fuels. This is evidenced by a growing number of biomass and biogas projects.

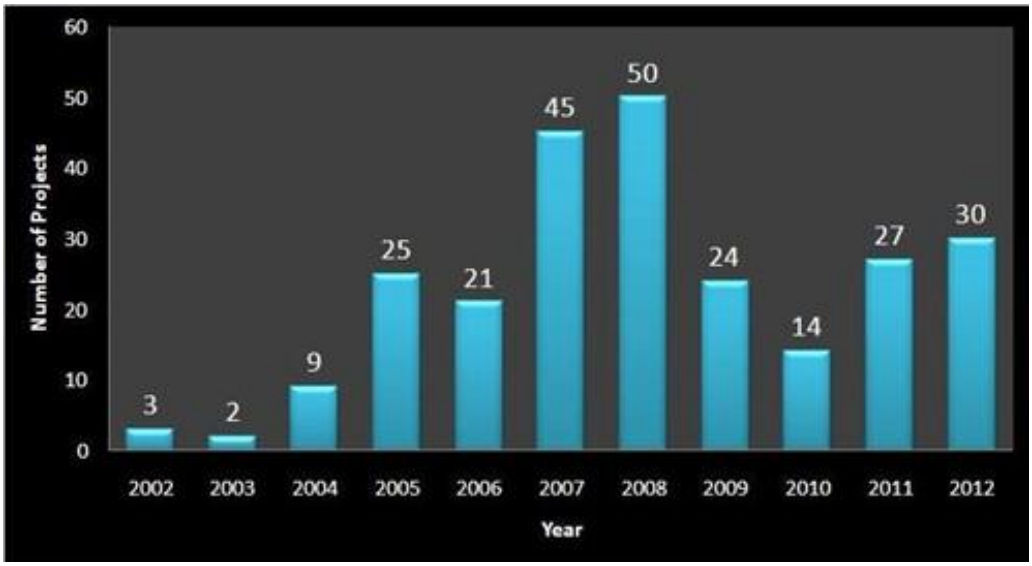

Figure 4-2: CDM Projects by years[21]

As of October 2013, there were 110 CDM energy projects registered with the CDM Executive Board. Out of the 110 projects, 46 projects have been issued with Certified Emission Reductions (CERs) resulting in a total reduction of 7,360,448 tonnes of CO_2-equivalent[22].

As Figure 4-3 demonstrates, most of the registered projects are related to bioenergy.

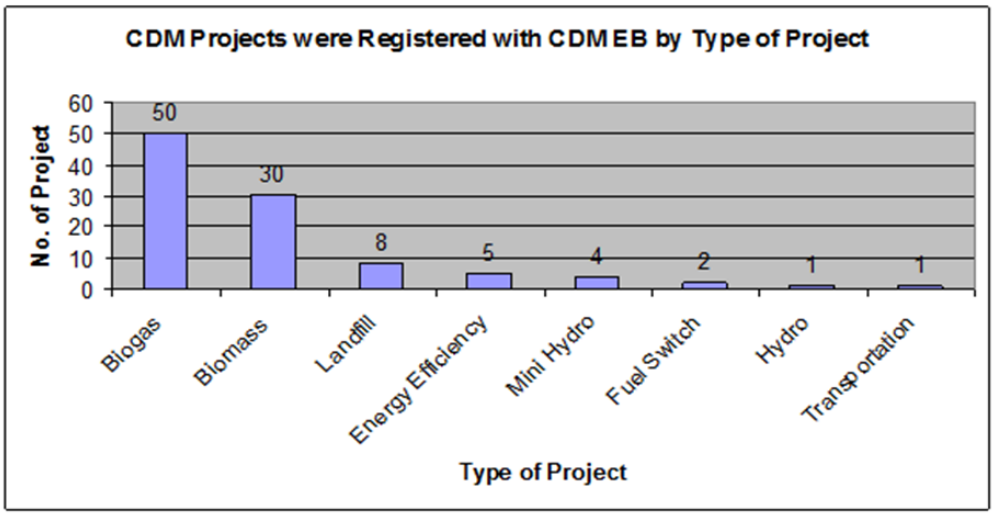

Figure 4-3: Registered CDM Energy Projects by Technology[23]

[21] GreenTech Malaysia, *CDM Statistic for Energy Project,* http://cdm.greentechmalaysia.my/cdm-malaysia/cdm-statistic.aspx

[22] Quoted from PRLCE Background Review Report prepared by GreenTech Malaysia and KeTTHA.

In addition to stimulating investment in renewable technologies, CDM projects generate CERs which have a monetary value. Host countries may or may not impose taxation on CER revenues depending on the stage of development of CDM in a given country. Mitigating or exempting CER revenues from taxation is a powerful means of promoting CDM projects and encouraging private sector investment; the challenge lies in isolating CDM revenues. Many countries, including China, Vietnam and Thailand have taxation provisions that are designed to encourage RE projects. In Malaysia, the first issuance of CERs is currently exempt from any tax. Additional tax incentives for CER revenues could further promote investment in CDM RE projects.

The biggest challenge for Malaysia is the current state of the global CDM market. The market price for CERs has dropped to an all-time low, resulting in no CDM applications for Malaysia in 2013 (Figure 4-2). The market is not expected to improve in the short to medium term, until a global agreement to reduce carbon emissions is reached (2015) and agreed (2020).

Nationally Appropriate Mitigation Actions

NAMAs are a policy instrument launched under the UNFCC process which provides a mechanism for finance, technology and capacity building transfer from developed to developing countries to support scaling-up of climate change mitigation efforts[24].

As of December 2013, Malaysia has not communicated any nationally appropriate mitigation actions (NAMAs) to the UNFCC[25], nor has it registered any NAMAs at the NAMA registry[26]. However, Malaysia's economy is involved in two major NAMAs initiatives:

1. The Mitigation Action Implementation Network (MAIN) initiative via the Center for Clean Air Policy (CCAP)
2. The Low Emission Capacity Building (LECB) Programme with the United Nations Development Programme (UNDP)[27]

The NAMA Facility[28] was set up by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety Environmental Ministry (BMUB) and the United Kingdom

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[23] Figure from GreenTech Malaysia (2013), *Clean Development Mechanism in Malaysia,* presentation during the PRLCE Review Team Visit on 9 December 2013.

[24] For a more detailed discussion on NAMAs, see http://www.ecofys.com/files/files/ecofys_policyupdate_issue4_may_2012.pdf.

To better understand the difference between NAMAs and CDM, see http://ccap.org/assets/NATIONALLY-APPROPRIATE-MITIGATION-ACTIONSNAMAs-AND-THE-CLEAN-DEVELOPMENT-MECHANISMCDM-AnOverview_CCAP-May-2011.pdf.

[25] The updated UNFCC Database of NAMA communications is available at http://unfccc.int/meetings/cop_15/copenhagen_accord/items/5265.php. The compilation of information on NAMA communications up to May 2013 is available at http://unfccc.int/resource/docs/2013/sbi/eng/inf12r02.pdf.

[26] NAMA Registry is available at http://www4.unfccc.int/sites/nama/SitePages/Home.aspx.

[27] Mitigation Momentum, *Annual Status Report on Nationally Appropriate Mitigation Actions (NAMAs) 2012,* http://www.mitigationmomentum.org/downloads/Annual_Status_Report_27-11-2012.pdf.

Department for Energy and Climate Change (DECC). Its aim is to facilitate the implementation of NAMAs by addressing the funding gap in international climate finance. The NAMA Facility gives priority to ambitious activities that have the potential to transform the respective sector and contribute to the goal of achieving a low-carbon development pathway.

After the successful completion of the first call for NAMA Support Projects, additional funds of EUR 50 million (approximately USD 68 million) have been made available for a second call to be held during 2014. Unless further funding is made available, the NAMA Facility will only provide participating economies with short term financial support for sustainable development projects.

Developing Renewable Energy Projects Sustainably

Malaysia has excellent solar and biomass potential which it is exploiting through the FIT mechanism. There is an opportunity for Malaysia to exploit its untapped renewable resources including wind, geothermal and tidal, and this greater diversity of RE technologies can be encouraged through the various financial mechanisms available. Preliminary studies[29] indicate that the west coast of Peninsular Malaysia and Sabah have good wind resources, while Apas Kiri in Sabah has promising geothermal potential. Malaysia's first geothermal power plant is currently being built at Apas Kiri and is expected to have an initial capacity of 36 megawatts[30]. Tidal energy is highly predictable and therefore has the potential of being a reliable RE resource.

Renewable projects could be granted benefits such as streamlined approvals procedures and more favourable tax treatment. These benefits could be specifically targeted towards renewable technologies that are less established in Malaysia such as wind, geothermal and tidal.

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[28] Further information on the NAMA Facility and the projects under this fund is available at http://www.nama-facility.org/news.html. Another supporting initiative, the NAMA Partnership, focuses on information and knowledge sharing to deliver know-how in support of NAMAs in developing countries, and its official website is at http://www.namapartnership.org/.

[29] From PRLCE Malaysia Background Review Report prepared by KeTTHA and SEDA.

[30] Further information on the progress of the first geothermal power plant in Malaysia is available at the Tawau Green Energy Sdn. Bhd. (project developer and owner) official website, see http://www.tgepower.com.

4.2 RECOMMENDATIONS

Recommendation 13: *Monitor and evaluate the progress of the Green Technology Financing Scheme (GTFS) in light of recent changes to the scheme.*

The Government of Malaysia will need to continue to work closely with financial institutions to ensure they are comfortable funding renewable technologies. GreenTech Malaysia should monitor the progress of GTFS loan applications, in particular those that opt for the 2% discount option and do not have a loan guarantee as these applicants may be perceived by banks as having a higher risk.

GreenTech Malaysia should also monitor the trend in applications following the changes to the scheme and seek to re-build confidence in companies by promoting the benefits of the scheme. This exercise will enable GreenTech Malaysia to verify the effectiveness of the changes and evaluate whether further incentives should be provided or if the market is already able to operate independent of government support.

Example:

Thailand initially introduced its Energy Efficiency Revolving Fund in 2003 that provided a zero credit-line to banks to familiarize the local financial institutions with funding energy efficiency projects. By 2011, local banks were considered competent and willing to finance energy efficiency projects, thus the Revolving Fund has been concluded. Based on the success in Thailand, Peru and Namibia have also adapted similar models to support their own RE and energy efficiency projects[31].

Recommendation 14: *Consider another extension to Incentives for End-Users, pending evaluation of the success of the current implementation.*

This incentive should be monitored and evaluated prior to 2015, to determine its success in contributing to the uptake of the FIT mechanism. Feedback from industry indicates that RE companies are benefiting from incentives available under Incentives for End-users including: Pioneer Status with income tax exemption, Investment Tax Allowance, and import duty and sales tax exemptions. If this incentive continues to play a significant role in influencing companies to develop projects under the FIT mechanism, another extension to 2020 should be considered.

Recommendation 15: *Expand the Incentives for End-users to include:*

- *Import duty and sales tax exemption for imported spare parts (currently only applies to large equipment such as gas engines).*
- *Sales tax exemption and investment tax allowance for individual (residential) projects that purchase from local manufacturers (currently only available to commercial projects).*

[31] Center for Clean Air Policy, *Thailand's Funds for Energy Efficiency and Renewable Energy Finance*, 29 March 2013, http://ccap.org/the-road-to-namas-blog-series-thailands-funds-for-energy-efficiency-and-renewable-energy-finance/.

In its current form, the Incentives for End-Users are limited to capital expenditure equipment[32] and as such; do not cover spare parts or other operational expenditure equipment, which are usually imported at high cost. This presents challenges for companies, preventing them from performing optimally in the long-run.

It was also brought to the PRLCE Review Team's attention that the Incentives for End-Users only covers companies and are not extended to individuals who generate electricity using RE, for example rooftop solar PV owners. Since a big share of the Malaysian FIT mechanism applicants fall under this category, the economy may consider expanding the incentives to include the individual generators as well.

Recommendation 16: *Investigate the possibility of fiscal incentives in the form of tax payments for local communities to encourage social acceptance and build support for local renewable energy projects.*

Renewable projects are generally located in rural areas, especially small hydro, biomass, biogas and wind. Ensuring financial benefits for the local population serves to increase the social acceptance of renewable technologies.

Example:

In Germany, the trade tax law was reformed so that local communities profit from wind farms as 70% of the trade tax revenues is directed to the local government. The other 30% of revenues are paid to the municipality where the management company has its headquarters. When community-owned wind farms are managed by a local company, 100% of the trade tax stays within that community.

The production of wind power not only provides the region with clean electricity, investments and jobs; local governmental budgets also benefit from a stable source of revenue. This has resulted in communities generally being in favour of accommodating RE projects in their region.

Denmark, Ireland and Spain apply similar local tax benefits to encourage local communities support[33]. The Malaysian Government would need to analyse its tax regime and local authority structure in order to determine whether a similar incentive is possible.

[32] The Incentives for End-Users is administered by the Malaysian Investment Development Authority (MIDA), and the official statement for the Incentives for End-Users is detailed at http://www.mida.gov.my/env3/index.php?page=environmental-management.

At the MIDA website, the Incentives for End-Users encompass two types of incentives, namely: (1) Incentives for Energy Generation Activities Using Renewable Energy Resources and (2) Incentives for Generation of Renewable Energy for Own Consumption.

[33] Centre for Sustainable Energy, *Community Benefits from Wind Power,* http://www.cse.org.uk/downloads/file/pub1051.pdf

Recommendation 17: *Malaysia should encourage the development of renewable technologies that are less established; including wind, geothermal[34] and tidal energy.*

Figure 4-3 above demonstrates that over 80% of registered CDM projects are biomass and biogas related, while the FIT mechanism only covers biomass, biogas, hydro and solar PV. Available support from other international organizations like the International Renewable Energy Agency (IRENA) could also be utilized to assess and develop the potential of other RE resources including wind[35], geothermal and tidal.

Recommendation 18: *Encourage renewable energy projects by giving these projects preferential treatment.*

Renewable projects should enjoy benefits such as streamlined approvals procedures and more favourable tax treatment. These benefits could also be specifically targeted towards renewable technologies such as wind, geothermal and tidal.

The success of this preferential treatment has been demonstrated under the CDM where mitigating or continuing to exempt[36] CER revenues from taxation has proven to be a powerful means of promoting CDM projects and encouraging private sector investment.

Recommendation 19: *It is recommended that the Government of Malaysia accelerate the design and implementation of its NAMAs through the Mitigation Action Implementation Network (MAIN) and Low Emission Capacity Building (LECB) program.*

ASEAN APEC economies like Indonesia and Thailand have already successfully received funding for their NAMAs project[37]. Malaysia may consider building its low emissions capacity by learning from these economies, in addition to focused engagement with MAIN and LECB.

Malaysia's NAMAs should be developed in line with existing policies, particularly the National Policy on Climate Change. In doing so the economy should recognise the strengths that already lie in the existing strategies and address the weaknesses and gaps that may have been identified since the introduction of the existing policy in 2009.

Recommendation 20: *The Government of Malaysia should consider establishing its own registry or database of domestic mitigation actions.*

Adding NAMAs to the UNFCC NAMAs Registry is a voluntary process, and the Government of Malaysia may opt to register suitable NAMAs in the future; in order to seek either international recognition or international support in the form of financing, technology-transfer or capacity building.

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[34] Geothermal was introduced as an eligible resource under the FIT mechanism in January 2014, after the PRLCE Review Team visit in December 2013.

[35] SEDA has initiated a wind-map study with Universiti Malaysia Terengganu (UMT) to assess wind potential in Malaysia. The study is expected to be completed by the end of 2014.

[36] Malaysia granted tax exemption to income received from the sale of CER from CDM projects approved by the NRE from 2009 to 2012. From the *2011 Budget Speech –Appendices*, http://www.treasury.gov.my/pdf/budget/appendices11.pdf

[37] Country specific information is available at the LECB website www.lowemissiondevelopment.org/countries/

Building its own database of existing or future mitigation actions would provide both a common platform for knowledge-sharing among Malaysian practitioners as well a method for consistently tracking the various mitigation actions implemented across all sectors and agencies. This would provide a good foundation towards preparing Malaysia's own NAMAs framework and identifying opportunities for improvement. Furthermore, adding a measuring, reporting and verification (MRV) component to the process would enable a transparent and consistent method of tracking the progress and effectiveness of each mitigation action in reaching the stated goals.

Allowing public access to the online database is also highly recommended as this encourages knowledge-sharing of best practices (especially among industry practitioners), attracts funding by building investor confidence in new technologies and emissions reduction methods, raises awareness of available expertise and technologies in Malaysia, and provides recognition to successful projects in the economy.

5. BIOMASS AND BIOGAS

5.1. ACHIEVEMENTS AND CHALLENGES

Malaysia possesses abundant biomass resources courtesy of its climatic condition and fertile land. Oil palm is currently the most important economic crop as it is one of the economy's top export commodities. In fact, while the agricultural sector usually accounts for 7% of Malaysia's gross domestic product (GDP), the palm oil sector alone contributes up to one third of the agricultural sector share[38].

In 2012, biomass production from palm oil industry was over 83 million dry tonnes per annum and it is expected to reach about 100 million dry tonnes by 2020. With such large volumes, the government has recognized its great potential for RE fuel in the transport and power sectors and formulated the National Biofuel Policy in 2005[39] and the National Renewable Energy Policy and Action Plan (NREPAP)[40] in 2010 based heavily on palm biomass. The palm oil industry also plays an integral part in the National Biomass Strategy 2020[41], published in 2013.

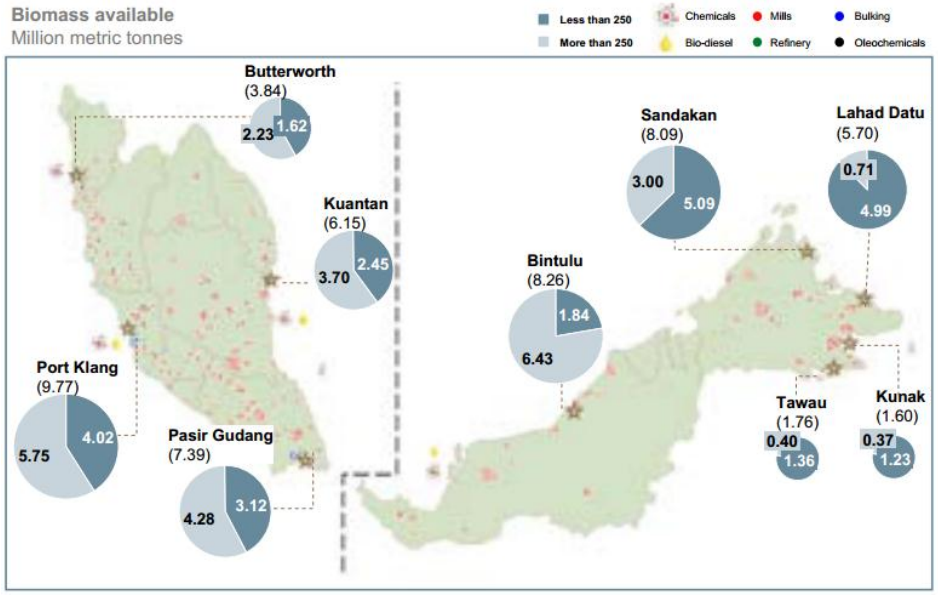

Figure 5-1: Biomass availability[42]

Biomass from the palm oil industry include empty fruit bunches (EFB), mesocarp fibres (MF) and palm kernel shells (PKS) as well as the oil palm fronds and trunks. All of these could be converted into

[38] Ministry of Finance (2013) *Economic Report 2013/2014,* pp. 76 and 96, http://www.treasury.gov.my/index.php?option=com_content&view=article&id=2588%3Alaporan-ekonomi-20122013&catid=73%3Asenarai-laporan-ekonomi&Itemid=174&lang=en

[39] Outline for the National Biofuel Policy is available at http://www.greentechmalaysia.my/Pages/pages.aspx?View=GreenBiofuel#second

[40] SEDA (2009), *National Renewable Energy Policy and Action Plan, a*vailable at http://www.seda.gov.my

[41] Agensi Inovasi Malaysia (AIM) (2013), *National Biomass Strategy 2020: New wealth creation for Malaysia's biomass industry, Version 2.0, 2013.* available at http://innovation.my/pdf/1mbas/Biomass%20Strategy2013.pdf

[42] ibid, Exhibit 4, pp.14.

energy, which is mostly done through combustion. The last but not least important by-product from the palm oil industry is the palm oil mill effluent (POME) derived from the oil extraction process. This extremely high organic content wastewater has a vast potential to produce biogas that can also be used as fuel. Under the NREPAP, Malaysia has set the target for 410 MW of biogas power generation capacity to be installed by 2030.

Figure 5-2: Biomass from palm oil industry[43]

The current practice in the industry is for the palm biomass and POME to be returned to the oil palm plantation for soil nutrient recycling; but there are efforts to increase their value by conversion to wood products, pellets, bioenergy, biofuels and bio-based chemicals.

The main obstacle for harnessing biomass in Malaysia has been the economic aspect of these products; especially in comparison to the cheap prices for energy and petro-based chemicals in Malaysia. Nevertheless, Malaysia continues with research and development (R&D) of high-value, bio-based chemicals from oil palm residues. While this is still in the developmental stage, the concept has been keenly addressed in Malaysian national policies and is on-track for expansion into commercial scale in the near future.

Existing players in the market, particularly from the palm oil mills industry, are motivated to expand into renewable energy (RE) power generation, especially with the attractive long-term buy back guaranteed through the feed-in tariff (FIT) mechanism and financial assistance through the Green Technology Fund Scheme (GTFS). To better promote this interest, the Malaysian Palm Oil Board (MPOB) works alongside the Sustainable Energy Development Authority (SEDA) through constructive dialogues to formulate viable solutions for RE power generation from palm oil mills.

Table 5-1: FIT rates for biomass and biogas, as of December 2013[44]

Technology / Source	FiT Duration	Range of FiT Rates (RM/kWh)	Annual Degression
Biomass (palm oil waste, agro based)	16	0.26 – 0.35	0.5%
Biomass (Solid waste)	16	0.36 – 0.42	1.8%
Biogas (palm oil waste, agro based, farming)	16	0.27 – 0.42	0.5%

[43] Figures from MPOB (2013), *Roles and Functions of Malaysian Palm Oil Board (MPOB) and Updates on Bioenergy Development in Malaysia*, presentation during the PRLCE Review Team Visit on 9 December 2013.

[44] SEDA (2013), *Roles and Functions of SEDA*, presentation during the PRLCE Review Team Visit on 10 December 2013.

One often-cited challenge for palm-oil mill power generation is related to grid interconnection. Palm oil mills in Malaysia tend to be in isolated locations, with long distances from the mill to the power grid connection points. Also, for now, the law assigns RE project owners with the responsibility to bear the costs involved in connecting their installations to the power grid, and long distances can make the project economically unfeasible for the developers. As a result, only a small percentage of biomass power generation is connected to the grid, over 500 MW is off-grid. Since the government is well-aware of this barrier, SEDA and the other stakeholders are working together towards mitigating this barrier in the future.

Table 5-2: RE Installations in Peninsular Malaysia and Sabah, as of December 2012[45]

Current RE Installations In Peninsular Malaysia and Sabah

Category	Mini-hydro	Biomass	POME & biogas	Landfill Biogas	Solar PV	Wind	Total
Grid-connected (MW)	45.8	67.4	3.3	3.2	28.1	-	147.8
Off-grid (MW)	-	515.7			8.1	0.2	523.9
Co-Gen (MW)		192.4					192.4
Total (MW)	**45.8**	**775.5**	**3.3**	**3.2**	**36.2**	**0.2**	**864.1**

RE Capacity as of December 2012:
Connected to power utility grid: 147.8MW

Several of the existing biogas and biomass installations were developed under the Clean Development Mechanism (CDM) which focuses on the reduction of greenhouse gases. These plants are now in the process of fine-tuning towards RE generation from the available resources within the industry.

There is a mandate under the Economic Transformation Programme (ETP) for 500 palm oil mills to develop biogas plants for electricity generation by 2020[46]. For now, out of the 437 mills in operation, only 61 have biogas plants with a further 13 under construction. MPOB collaborates with Tenaga Nasional Berhad (TNB) to identify potential biogas plant and facilitate biogas plant connection to the national grid as well. This includes mapping of biogas plant locations and facilitating pre-power supply studies that is a requirement for FIT approval.

[45] EC (2013), *Roles and Functions of the Energy Commission*, presentation during the PRLCE Review Team Visit on 9 December 2013.

[46] The Economic Transformation Plan (ETP) is available at http://etp.pemandu.gov.my/download_centre.aspx. See Chapter 9, EPP 5.

Table 5-3: Biogas plants status, as of November 2013[47]

Status of Biogas Projects
No of Mills : 437

Status	As of November 2013
Completed Biogas Plants	61
Under Construction	13
Under Planning	148

Biomass from palm residues are domestically utilized at full capacity in industrial boilers and some are exported to neighbouring countries. The expected increase in palm biomass production of 20 million dry tonnes by 2020 will be better utilized in sustainable ways and transformed into a value added products that contribute to the strength of the Malaysian economy.

5.2 RECOMMENDATIONS

Recommendation 21: *Identify mechanisms to incentivize isolated plants such as easing transmission costs for long-distance connections or exploring other sustainable applications for biogas like biofuel for on-site transport utilization.*

Biomass and biogas availability often exists in remote areas with low energy demands and high transmission costs. Measures to promote RE generation from biomass and biogas in the distant areas will have to be identified, evaluated and pursued. Examples include co-investment (and co-ownership) of grid expansion by the utility company and project developers, leasing of transmission lines by utility or RE project developer (in case of ownership/investment by the other party), permission of localized distribution license to residential or commercial areas.

Biogas can also be utilized as vehicle fuel, so palm oil mills may consider powering their vehicles and equipment (like trucks and forklifts) with biogas produced in-house rather than transporting fuel from outside the plantations. This would also be a suitable alternative application to power generation for sites that are too remote for grid connection. Please see Chapter 8 of this report for further discussion on this option.

[47] MPOB (2013), *Roles and Functions of Malaysian Palm Oil Board (MPOB) and Updates on Bioenergy Development in Malaysia*, presentation during the PRLCE Review Team Visit on 9 December 2013.

Example:

The Rodefeld Landfill Biogas Vehicle Fuel Project makes use of methane gas from local landfills to produce biogas to be used as a vehicle fuel on a small scale (20 standard cubic feet per minute or 100 gasoline gallons equivalent per day)[48].

Figure 5-3: BioCNG system

Recommendation 22: *Regulate environmental laws to enhance biomass/biogas production and incentivize plants to achieve excellent environmental performance.*

Environmental standards imposed on biomass/biogas RE generation can be designed to facilitate its growth without compromising public health. Some incentives may be set forth such as FIT bonus for plants with higher environmental standards to keep return on investment (ROI) to an acceptable level.

Recommendation 23: *Stimulate the co-firing of biogas/biomass in boilers of new and upgraded facilities.*

Promote co-firing of biogas-biomass boilers both in new and upgraded facilities through advanced R&D, demonstration plants, subsidies for off-takers and other incentive schemes such as FIT bonus based on the cost and difficulty of the fuel and technology.

Figure 5-4: Biogas burners installed at biomass boiler

[48] Further information on the project available at http://www.epa.gov/lmop/documents/pdfs/conf/15th/29Torresani_Final.pdf

Recommendation 24: *Promote local content to improve technological self-dependency.*

Establish a joint task force between MPOB, SEDA, MOSTI and other related organizations to develop local content such as suppliers or even manufacturers of biogas engine parts, biomass boilers[49] as well as service providers to operate and maintain the machinery and systems. This will enable bio-energy plants to significantly cut down on maintenance costs and downtime period. As neighbouring APEC ASEAN economies also have substantial biomass and biogas potential, the market for these products and services can be expanded beyond domestic boundaries.

Recommendation 25: *Provide research funding and incentivize commercial pioneering for second generation technologies.*

Utilization of the oil palm residues for second generation technologies often come with the higher risk since these technologies are still in developmental stage. Research funds to academic institutions shall be planned in order to successfully reach pilot scale or demonstration plant level and into the commercialization phase. At this early stage, it may be required to provide subsidization at higher ratios to pioneering investors, possibly from a special fund that is tied with the FIT RE fund.

Recommendation 26: *Distribute benefits of RE to the local community to ensure continued public support.*

Bioenergy production activities occur within the industrial sector, however the cost for bioenergy incentives is borne by taxpayers and electricity consumers (via the FIT RE Fund collection – see Chapter 7 of this report for further information). The environmental effects will likely impact the local communities the most, although environmental laws are in place to keep this to a minimum.

Therefore, to cultivate better understanding and acceptance for bioenergy, a portion of the RE promotion fund should be shared with local communities in other forms such as scholarships, community activities, community infrastructures (like community centres, rural health clinics, education centres, nurseries and sports centres), educational media, and others. Together with mass media, these efforts towards public inclusion would likely ensure continued public support for bio-based energy policies.

Recommendation 27: *Explore potentials of other forms of organics.*

Although a large part of the biomass available in Malaysia comprises of palm residues, other biomasses could become a significant source of secondary alternatives. These include rice husk, sugarcane bagasse, animal manures, forest residues, grass crops, and organic portion of municipal solid waste. Industrial wastewaters from agro-product processing plants also have vast potential since converting them to biogas could also improve environmental performance as well as contribute to energy savings in the plants. A systematic study to determine actual availability and feasibility study of these alternative resources is highly recommended, which should be followed by R&D and demonstration projects that can be quickly commercialized to maximize economic and environmental benefits.

[49] Effective 1st January 2014, SEDA has introduced higher bonus incentive (RM0.05/kWh) for locally manufactured/assembled gas engine technology for biogas and boiler/gasifier for biomass.

6. SMALL-SCALE HYDRO AND SOLAR

6.1. SMALL-SCALE HYDRO

6.1.1 Achievements and Challenges

Hydropower, large and small, remains by far the most important of the "renewables" for electrical power production worldwide.

Malaysia has plenty of renewable energy resources, especially hydropower and biomass. The potential of hydropower in Malaysia is over 20 GW, mostly located in East of Malaysia[50]. The conventional estimate for run-of-river scheme with minimum impounding has been identified as 490 MW[51].

In Malaysia, hydropower development is taken-up by different agencies; large-scale hydropower is generally developed by utilities or IPPs, hydropower for rural electrification (usually off-grid) is under the jurisdiction of the Ministry of Rural and Regional Development (KKLW), while small-scale hydropower (grid-connected and privately-owned) was covered under the SREP program which was later migrated to the feed-in tariff (FIT) mechanism. Small-scale hydropower is defined as hydropower schemes under 30 MW.

As of 31 December 2011, hydroelectric installed capacity in Malaysia is 3015 MW. The breakdown is for Peninsular Malaysia: 1952 MW, Sabah: 77 MW and Sarawak: 1001 MW[52].

The Tenth Malaysia Plan[53] has set a target for 985 MW of renewable power generation by 2015, with 290 MW to be from small-scale hydropower contribution. As of 30 September 2013, 22 small-scale hydro projects with a combined total capacity of 130.99 MW have been approved under the FIT mechanism. To date, a total capacity of 15.70 MW is already in operation[54].

At the same time, Malaysia has continued to develop large-scale hydroelectric projects. Two major projects are under construction in Peninsular Malaysia; the Hulu Terengganu Hydroelectric Project consisting of 2x125 MW Units in Puah Station and 2x7.5 MW Units in Tembat Station as well as the Ulu Jelai Hydroelectric Project consisting of 2x186 MW units. Both projects are expected to be commissioned over the 2015-2016 period[55]. Four new hydroelectric projects with a total capacity of 716 MW have also been proposed. The first unit, an addition to the Chenderoh hydroelectric scheme, is expected to begin operations by 2018. The other units will likely come online during the 2020-2024

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[50] See Chapter 6, EPP 12 of the Economic Transformation Plan (ETP), pp. 196, http://etp.pemandu.gov.my/download_centre.aspx

[51] From PRLCE Malaysia Background Review Report prepared by SEDA and KeTTHA.

[52] Malaysia National Energy Balance 2011, pp. 50.

[53] Five-year Malaysia economic development plan, the Tenth Malaysia Plan covers the years 2011-2015. Available at http://www.epu.gov.my/en/tenth-malaysia-plan-10th-mp-.

[54] SEDA (2013), *Renewable Energy Development & Feed-in Tariff (FiT) Implementation in Malaysia*, presentation during the PRLCE Review Team Visit on 10 December 2013.

[55] TNB (2013), *TNB Annual Report 2013*, pp 165-166, http://www.tnb.com.my/investors-media/annual-reports.html.

period[56]. In the state of Sarawak, the 944 MW Murum Hydroelectric Project is under construction and the state utility has identified a further nine sites that may later be developed into dams for hydroelectric projects[57].

There is much potential for hydropower development in Malaysia, and with the FIT mechanism in place, even small-scale projects are becoming more economically attractive as well. The challenge for Malaysia is to match this potential to locational demand. Hydro resources are usually located in remote locations with low demand for electricity locally. If the local demand is too small, then the installation should be connected to the power grid. However, the connection point to the power grid may be very far from the small-scale hydropower site, thus necessitating long transmission lines that will increase cost. Therefore, there is a need to correctly assess both the potential hydropower sites and local demand in order to ensure a good match between the two.

Figure 6-1: Perting Small-Hydro

The same matching of demand and supply should be taken into account when developing large-scale hydroelectric projects as these projects have a bigger impact on the local communities and the environment, potentially causing widespread deforestation and adversely affecting hydrological patterns, water quality and native flora and fauna. On the other hand, small-scale hydro projects, particularly community-owned hydro projects, can offer significant financial and environmental benefits[58].

[56] Energy Commission (2013), *Peninsular Malaysia Electricity Supply Industry Outlook 2013,* http://www.st.gov.my/index.php/component/k2/item/544-peninsular-malaysia-electricity-supply-industry-outlook-2013.html

[57] Sarawak Energy Berhad (2013), *About Hydropower,* http://www.sarawakenergy.com.my/index.php/hydroelectric-projects/about-hydropower

[58] B.K. Sovacool and S.V. Valentine, *Bending Bamboo: Restructuring Rural Electrification in Sarawak, Malaysia,* Energy for Sustainable Development, Volume 15, Issue 3, pp 201-346, September 2011.

6.2.1 Recommendations

Recommendation 28: *Re-evaluate the potential of hydro resources (especially in Sarawak) by conducting a comprehensive study on hydro potential, taking into account new technologies (like low-head and ultra-low-head technologies), accessibility and proximity to load demand centres. Based on the findings of this study, formulate a long-term plan for small-scale hydropower development.*

To best take advantage of its hydro potential, it is time for Malaysia to embark on a comprehensive study of hydro potential in Malaysia for large-scale and small-scale (which includes micro-, mini- and pico-hydro[59]) development. This study should take into account new technologies that were previously unavailable, like low-head and ultra-low-head technologies, changes in land-use, accessibility in terms of infrastructure as well as proximity to load demand centres. Hydro sites that can be identified as technically and economically advantageous should be prioritized in the economy's development plans.

Small-scale hydropower development requires approval from local authorities. If it can be established that rivers under their jurisdiction have good small-scale hydro potential with minimal environmental impacts, these authorities may become motivated to encourage hydropower development in that area, maybe through more streamlined approval processes, or allowing the developers to directly bid for these sites. Local authorities may even decide to generate more local consumption by promoting local businesses (for instance traditional cottage industries, recreational or tourist facilities) and thus capitalize on this clean electricity resource to improve local economy.

Recommendation 29: *Micro-grids powered by small-scale hydro should be investigated and incentivized to supply rural communities.*

One of the main targets under the Tenth Malaysia Plan is to achieve electricity coverage of 100% for Peninsular Malaysia and 99% for Sabah and Sarawak during the plan period (2011-2015)[60]. This is to be achieved by grid extension and the utilisation of mini-hydro and solar-hybrid. The PRLCE Review Team applauds this initiative and encourages Malaysia to further leverage on the experience the economy can gain from existing small-scale hydro projects, both domestic and in other APEC economies, to maximize the benefits from small-scale hydro in improving rural communities.

[59] Typical categorisation for small-scale hydro: Mini-hydro (100kW to 1MW), micro-hydro (5kW to 100kW) and pico-hydro (a few hundred watts up to 5 kW).

[60] Rural electricity coverage in 2010 for Peninsular Malaysia: 99.6%, Sabah: 80.8% and Sarawak: 72.6%. Tenth Malaysia Plan, pp. 407.

Example:

An excellent local example of community-based hydroelectric project is the Mudung Abun Micro-Hydro System funded under the GEF Small Grants Programme. The project took two years to complete, costs USD 50,000 with manpower and labour provided by the local villagers[61].

Figure 6-2: Various photo from the Mudung Abun micro-hydro project

The system now provides 20 kW of renewable energy a day to the community, powering about 22 homes, community verandas, a women cooperative sundry shop, food processing centre, blacksmithing and welding workshop[62]. The local community is no longer dependent on expensive, polluting fossil-fuels and are now more personally invested in protecting the forest, rivers and water-catchment areas as these are the source of clean water for their micro-hydro system.

This community-owned, operated and maintained micro-hydro system is a project that is easily replicable in other communities in East Malaysia.

[61] The GEF Small Grants Programme, *Integrated Community Based Micro Hydro System To Improve Sustainability Livelihood of Indigenous Kenyah Community in Mudung Abun, Belaga District, Sarawak*, https://sgp.undp.org/index.php?option=com_sgpprojects&view=projectdetail&id=13029&Itemid=205

[62] Seacology (2011), 'Our Projects – Mudung Abun, Borneo, Malaysia', website page, http://www.seacology.org/project/65-malaysia/

6.2 SOLAR ENERGY

6.2.1 Achievements and Challenges

Solar radiation intensity is the main factor affecting the performance of solar photovoltaic (PV) systems. Malaysia has good conditions for solar energy applications, the abundance of sunshine throughout the year and its annual average solar radiance of 1,400-1,900 kWh/m[63]. Solar energy resources are abundant in Malaysia. The low-latitude economy is particularly well-suited for harnessing power from solar photovoltaic (PV). Malaysia is in the equatorial region and the suitable tilt angle of solar PV installation for Malaysia is about 5° to 15°.

To support solar PV growth, the government has conducted and completed an assessment for solar power potential and produced solar radiance profile map for Malaysia[64]. The potential capacity for solar rooftop PV was approximated at 6,500 MW[65]. This is a relatively conservative data since the estimation uses data from 2003 and the assumptions for suitable building roof surfaces is constrained to 40% of total residential buildings and 5% of total commercial buildings at that time.

In July 2005, Malaysia initiated the Malaysia building integrated PV Project (MBIPV) with the long-term aim of developing a sustainable domestic BIPV market and reducing the long-term cost of BIPV in Malaysia. Under the MBIPV project, more than 80 demonstration projects were successfully completed. Furthermore, the project has catalysed the local PV market by addressing cost and technical barriers; developed capacity and increased awareness for solar PV in the economy; and improved the institutional and financial support mechanisms for BIPV projects. The lessons learned under the MBIPV project became the foundation block for developing the National Renewable Energy Policy and Action Plan (NREPAP) and the establishment of the feed-in tariff (FIT) mechanism.

Following the establishment of the FIT mechanism in December 2011, solar PV development in Malaysia has been even more rapid. The current FIT target for solar PV installed capacity is 65 MW by 2015 and 190 MW by 2020[66]. As of 31 October 2013, 755 projects (individual) and 52 projects (non-individual) of solar PV installation are in operation with total capacity of 44.83 MW[67].

The Solar PV Rooftop Programme launched in September 2012 [68] further encourages public participation particularly private home-owners (although the programme is also open for applications from shop-owners). Before the program launch, only 200 households have applied for and successfully received FIT approval. The Solar PV Rooftop programme was designed with the long-term target to

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[63] From PRLCE Malaysia Background Review Report prepared by SEDA and KeTTHA.

[64] From PRLCE Malaysia Background Review Report prepared by SEDA and KeTTHA.

[65] KeTTHA (2010), *National Renewable Energy Policy and Action Plan (NREPAP)*, pp.36, www.seda.gov.my

[66] TNB (2013), *Role of TNB in RE Deployment in Malaysia under the FIT Mechanism* ,pp19, presentation during the PRLCE Review Team Visit on 10 December 2013.

[67] SEDA (2013), *Overview of Malaysia National Renewable Energy Policies, Strategies and Regulatory Framework*, presentation during the PRLCE Review Team Visit on 9 December 2013.

[68] SEDA (2012), Notice on Availability of Quota for 2,000 Solar Home Rooftop Programme, http://seda.gov.my/?omaneg=000101000000010101010001000010000000000000000000000&s=2148

reach 100,000 households by 2020[69]. Out of the 8 MW of solar PV quota for individuals (2 MW Q4 2012 and 6 MW 2013; equivalent to around 2,000 households) released on 24 September, 2012, all had been taken up. This programme is strongly supported by financing packages from a couple of local banks, namely the 'Home Complete Plus – Solar Panel Financing' by Alliance Bank and the 'Smart Green Mortgage for Solar PV FIT Plan' by Bank Muamalat.

Figure 6-3: BIPV Rooftop installation with capacity 1.5 MW in Ipoh, Perak

Based on Malaysian National RE target, Malaysia solar capacity by 2050 will reach 18,700 MW, so in addition to solar rooftop PV; the government may also consider developing ground photovoltaic power plants.

Figure 6-4: 2.5 MW Ground Mounted Solar Farm in Bagan Datoh, Perak

[69] Green Prospects Asia (2012), 'Malaysia: 8 MW of solar PV FIT quota up for grabs from September 24th', 14 September, http://www.greenprospectsasia.com/content/malaysia-8-mw-solar-pv-fit-quota-grabs-september-24th

The agricultural sector is one of Malaysia's pillar industries, so an integration of agriculture and solar technologies is one of the possible important pathways for solar PV development in Malaysia.

Example:

In China, there have been many projects to integrate agriculture with new energy integrated applications, and solar PV greenhouses are one example of these integrated applications.

Figure 6-5: Solar PV greenhouses in China

Malaysia should develop other applications of solar energy like solar crop drying, water heating, air circulation and lighting in buildings or running compressors and pumps for fish farms. This would be a more efficient method of utilizing solar energy, maximizing land-use and improving sustainability.

The growing domestic market for solar PV systems, especially since the introduction of the FIT mechanism, has spurred the development of domestic manufacturing industries in the PV supply chain.

To date, Malaysian-owned and managed manufacturers include one cell manufacturer and three solar module manufacturers. The total supply capacities are up to 60 MW of cells and at least 100 MW of solar system annually. More than 30% of the projects implemented under FIT make use of domestically produced solar panels.

In addition to the local manufacturers, Malaysia is an attractive destination for international solar PV manufacturers and is now the base for several solar PV manufacturing plants producing polycrystalline silicone (Tokuyama), wafers (AUO Crystal, Panasonic), PV cells (AUO Sun Power, Q-Cells), thin film PV modules (First Solar), assembling of PV modules (Flextronics) and balance of system components (Huber+Suhner, ABB, Schneider Electric)[70].

[70] Full list of local and international manufacturers available in Malaysia Solar Industry Report 2012-2013, http://www.might.org.my/en/SiteAssets/FINALSolar4web.pdf

Figure 6-6: Local solar PV manufacturing industry[71]

6.2.2 Recommendations

Recommendation 30: *Investigate appropriate incentives to encourage more building-integrated PV (BIPV) installations for public and commercial buildings.*

Given the overwhelming success of the Solar PV Home Rooftop Programme for the residential sector, the next step would be to extend the success to public and commercial sectors. SEDA and KeTTHA are strongly advised to leverage on the experience of these existing projects to design initiatives to increase BIPV deployment in non-residential sectors.

Possible initiatives can come in the form of goal-setting (similar to the 8 MW capacity target for the Solar PV Rooftop Programme), fiscal incentives, building regulatory policies (mandatory for new buildings above a certain threshold of consumption or building size) and setting minimum standards for BIPV installations (waterproofing, BIPV compliance certification for compliant buildings).

[71] Malaysia Solar Resources (2013), *Private Sector Perspective of FIT Implementation - Local PV Manufacturers, presentation during the PRLCE Review Team Visit on 11 December 2013.*

a) Solar PV aesthetically integrated into building design at the Suria Petronas KLCC Shopping Centre

b) Solar PV as skylight atrium at the Malaysia Green Technology Corporation Office

Figure 6-7: Solar PV installations in commercial and public buildings in Malaysia

Recommendation 31: *State and local authorities may consider developing additional incentives to attract public participation in solar PV development.*

State or local government may consider providing additional support for the development of solar PV, in order to optimize local energy structure, and increase renewable energy applications. The support does not have to be fiscal but instead can be in the form of showcase projects in municipal buildings, awareness building programs especially in schools and local religious centres, one-stop information centres for renewable energy to ease information collection, or leasing rooftops to solar PV developers.

Example[72]:

The Malacca State Government has declared that Malacca will be a fully functional green state by 2020. The '400 Solar: Taman Rembia Perkasa' pilot project was initiated by the state government as part of its efforts to fulfil this commitment. This is a joint partnership project with Green Earth Design Solution Sdn. Bhd. (GEDS), Alor Gajah Municipal Council and Yayasan Melaka. This projects offers homeowners in Taman Rembia Perkasa the opportunity to lease their roofs to the project developer GEDS, for a duration of 11 years at the rate of RM 100 (USD 30) per month. GEDS will be responsible for purchasing, installing and maintaining the solar PV system on the leased rooftop, as well as providing insurance coverage for the house for the duration of the contract (11 years). At the end of the eleventh year, the PV system ownership will revert to the homeowners, along with the FIT payment for the rest of the FIT duration (10 years).

Figure 6-8: Demonstration site for Malacca's first community solar project

Recommendation 32: *Analyse instruments for promoting and incentivizing solar applications beyond solar rooftop PV to include solar thermal applications in commercial (solar water heating) and agricultural sectors (solar-assisted drying systems, solar-assisted dehumidification systems) as well solar PV applications integration with agricultural activities.*

Thermal utilization is an important aspect of solar energy, and its applications include solar water heating, solar-assisted drying systems, solar space heating and cooling, ventilation and solar refrigeration. Solar water heating is considered a mature technology and its associated costs are comparatively low, thus solar water heating has been widely used worldwide.

In Malaysia, year-round sunshine provides good climactic condition for solar thermal applications. However, due to high initial costs of solar water heaters, electric water heaters are more popular in the economy for meeting the residential heating requirements. Local research has shown that in the long-

[72] Summarized from GEDS Company Profile (http://www.geds.com.my/images/company-profile.pdf) and newspaper article from The Star (http://www.thestar.com.my/Lifestyle/Features/2012/10/16/Harnessing-rooftops-to-generate-solar-power/)

run solar water heaters have better economic and environmental benefits[73]. The Government of Malaysia should consider highlighting these benefits and providing other incentives to promote the use of solar water heaters for domestic and commercial applications.

Malaysian research centres have advanced several sophisticated solar drying systems for drying various agricultural and marine products as well as medicinal herbs. Compared to open-air sun-drying, these systems are more efficient and keep the products safe from contaminations[74]. Commercializing these systems locally and abroad would enable Malaysia to build its own niche market in the future.

Another possible application would be integration of solar energy with other agricultural activities, as has been done in several other APEC economies.

Figure 6-9: Solar dryer with chemical heat pump (for lemongrass)

[73] Baharuddin Ali, Kamaruzzaman Sopian, et al (2009), 'Economics of Domestic Solar Hot Water Heating Systems in Malaysia', *European Journal of Scientific Research*, Vol.26 No.1 (2009), pp.20-28, http://www.microsolarsystem.com/images/European%20Journal%20of%20Scientific%20Research.pdf

[74] Kamaruzzaman Sopian, Ahmad Fudholi, et al (2013), 'R&D of Advanced Solar Dryers in Malaysia: (2) Water Based Solar Collectors', Latest Trends in Renewable Energy and Environmental Informatics, pp 247-254, http://www.wseas.us/e-library/conferences/2013/Malaysia/RESEN/RESEN-39.pdf

Example:

1. The "solar-sharing" concept in Japan[75] enables farmers to install solar PV systems on existing crop-producing farmland, thus earning profit from both the farm products and electricity sold to the grid via the FIT mechanism. PV panels are installed on pipe structures 3 to 5 metres above ground, leaving enough sunlight to reach crops on the ground and space for manoeuvring agricultural machineries. Crops cultivated under this system include peanuts, yams, eggplants, cucumbers, tomatoes and cabbages.

Figure 6-10: Solar-sharing concept in Japan

2. The New York State Energy Research and Development Authority has published a guideline "Solar Energy Applications for Agriculture"[76] that provides a brief overview of solar energy technologies used in agriculture. In the publication, technologies are group under three categories as below:

    i. Space and water heating: Air ventilation for livestock and dairy operations, water heating for cleaning purposes, solar crop dying.

    ii. Greenhouse heating

    iii. Solar electric systems: Generates electricity for heating, lighting, water pumping systems (for remote livestock water supply, pond aeration, small irrigation systems)

    Agricultural practices in Malaysia will be quite different from the practices in the United States, however, several of these technologies are easily adaptable given the appropriate incentives.

[75] Renewable Energy World (2013), 'Japan Next-Generation Farmers Cultivate Crops and Solar Energy', web article, 10 October, http://www.renewableenergyworld.com/rea/news/article/2013/10/japan-next-generation-farmers-cultivate-agriculture-and-solar-energy

[76] Available at https://www.nyserda.ny.gov/Energy-Efficiency-and-Renewable-Programs/Renewables/-/media/Files/EERP/Renewables/Introductory-Guide-typical-farm-applications-variety-solar-technologies.ashx

Recommendation 33: *Improve local capacity and capability to build-up a sustainable and competitive solar PV industry value chain.*

Malaysia already has a fairly good solar industry value chain, as evidenced in the figure below produced by Malaysian Industry-Government Group for High Technology (MIGHT) and Malaysian Investment Development Authority (MIDA).

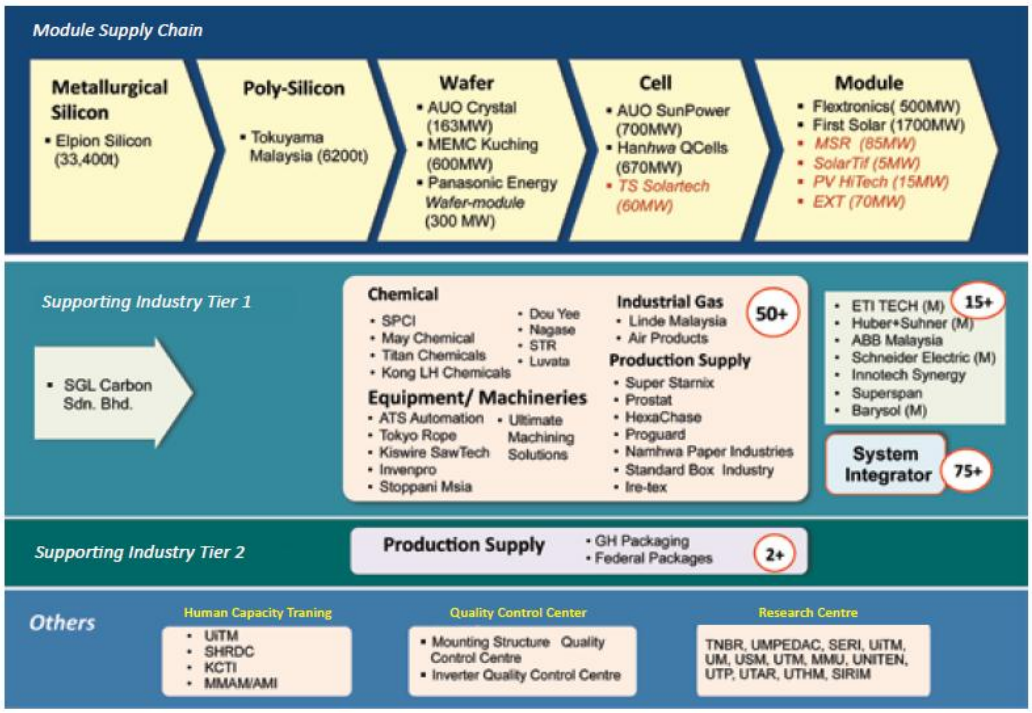

Figure 6-11: Malaysia solar PV industry value chain[77]

This can be further strengthened by developing and improving local talent that is capable of growing and sustaining all aspects of the value chain by:

i. Providing more professional, technical and vocational training for highly skilled (engineers) and skilled (technicians and operators) to fulfil positions in the many solar sectors namely materials supplier; manufacturing; system integrator sector; research and development; engineering, procurement and construction; operation and maintenance; and even policymakers and regulators. This training should be in addition to the existing courses conducted by SEDA for PV service providers, which includes courses on the design of PV systems and courses for charge-men, wiremen and installers.

ii. Accelerate engineer readiness with opportunities to train with technical domain experts and industry hosts prior to graduation.

iii. Establish collaborative research between international and local PV manufacturers, system integrators and local research institutes to ensure continuous improvement and innovation.

[77] Figure 4.1.1 from Malaysia Solar Industry Report 2012-2013, pp.37. Note that the list of industries and key players identified above are not exhaustive.

7. LOW-CARBON POWER SUPPLY

7.1. ELECTRIC POWER SYSTEMS

7.1.1 Achievements and Challenges

Malaysia has three geographically-separated electric power grids. The grid in Peninsular Malaysia is operated by Tenaga Nasional Berhad (TNB) while the other two grids on Borneo Island are operated by the Sabah Electricity Sendirian Berhad (SESB) in Sabah state and Sarawak Energy Berhad (SEB) in Sarawak state. There is some potential to interconnect TNB grid to the Sarawak grid via underwater cables to increase energy security and diversity, but it is unlikely that this will take place before 2022.

The TNB grid already has one interconnection with Singapore since 1986 (2x200 MW) and two interconnections with Thailand, the HVAC Bukit Ketri – Sadao since 1986 (85 MW) and the HVDC Gurun – Khlong Ngae since 2001 (300 MW). Two possible interconnections are being considered, a second 300 MW HVDC interconnection with Thailand and an interconnection to Sumatera in Indonesia.

Figure 7-1: Malaysia Power Grid Characteristics

As of December 2012, Peninsular Malaysia grid has already achieved 99% electrification ratio[78] while Sabah's electrification ratio is 91%[79]. The latest statistics available for Sarawak are from 2010 and in that year, the state has reached 66% electrification ratio with a target to reach 95% by 2013[80].

While the bulk of electricity demand comes from Peninsular Malaysia, most of the economy's indigenous resources are located in East Malaysia. As a result, Peninsular Malaysia power supply is generated largely by fossil-fuels; pipeline natural gas from domestic fields, coal imported from Indonesia

[78] Defined under the Malaysian context as 24-hour access to electricity.

[79] Tenaga Nasional Berhad (2013), *Annual Report 2013*, http://www.tnb.com.my/tnb/application/uploads/annualreports/2e51ab12c69b173820afd6fcf49d21f7.pdf

[80] Sarawak Energy Berhad, *Annual Report 2010,* http://www.sarawakenergy.com.my/AnnualReport/SEBAR10.pdf

and Australia, and starting from 2013, imported liquefied natural gas (LNG). The high dependence on fossil-fuels means that the power sector is the largest contributor to carbon emissions in Malaysia[81].

Malaysia has established the Five-Fuel Policy in 2001, defining renewable energy (RE) as the fifth-fuel in order to increase RE share in the energy mix over the long-term. Large-scale hydropower already plays a small but significant role in all three electricity networks. Malaysia plans to continue building-up large-scale hydropower capacity in Peninsular Malaysia[82] and Sarawak[83]. Small-scale renewable power generation from small hydro, biomass, solar and wind are also already in place in Malaysia, and to further accelerate penetration, the feed-in tariff (FIT) mechanism was introduced in Peninsular Malaysia in December 2011 and in Sabah three years later (January 2014). Further discussion on the FIT mechanism follows in Section 7.2 of this report.

Malaysia's targets for cumulative RE capacity in Peninsular Malaysia for the years 2015 and 2020 are 985 MW and 2080 MW respectively[84]. At the same time, the economy plans to add 1353 MW of thermal capacity by 2015 and another 8724 MW by 2020 in Peninsular Malaysia[85] [86]. Therefore, thermal generation will likely continue to play a major role in Malaysia's electricity capacity mix.

Under the National Renewable Energy Policy and Action Plan (NREAP 2011), one of the main barriers identified for RE development is the low electricity tariffs in the economy. Malaysia has been gradually rationalizing subsidies for electricity; the latest exercise sees an increase of 14.9% and 16.9% in average tariff for Peninsular Malaysia and Sabah. The PRLCE Review Team applauds this exercise as it is in line with the 2009 APEC Leaders Declaration to "rationalise and phase out over the medium term fossil-fuel subsidies that encourage wasteful consumption, while recognising the importance of providing those in need with essential energy services".

Another commendable progress in the economy is the implementation of the "TNB Smart Grid Initiative" by TNB in Peninsular Malaysia. The aim of the initiative is to gain experience for future widespread application, get stakeholder buy-in, and to use as platform for proof-of-concept of smart grid technologies.

The first phase, in which distribution automation was introduced at two sites (Bukit Bintang in Kuala Lumpur and Bayan Lepas in Penang), has been successfully completed. The initiative is now in its second phase, where smart grid technologies (namely advanced metering infrastructure (AMI),

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[81] Up to 32% of total CO_2 emissions in Malaysia in 2005. From TNB's presentation "Introduction to TNB Sustainability for the Future" to the PRLCE Review Team on 10 December 2013.

[82] Energy Commission (EC) (2013), *Peninsular Malaysia Electricity Supply Industry Outlook 2013*, pp 28, http://www.st.gov.my/index.php/component/k2/item/544-peninsular-malaysia-electricity-supply-industry-outlook-2013.html

[83] PEMANDU, Prime Minister's Department (2010), *Economic Transformation Program*, pp 197, http://etp.pemandu.gov.my/download_centre.aspx

[84] Sustainable Energy Development Authority (SEDA) (2013), *Overview of Malaysia National Renewable Energy Policies, Strategies and Regulatory Framework*, presentation during the PRLCE Review Team Visit on 9 December 2013.

[85] EC (2013), *Peninsular Malaysia Electricity Supply Industry Outlook 2013*, pp 28.

[86] Total retirement capacity projected over the 2012 to 2020 period is 4798 MW.

information and communications technology (ICT) infrastructure and system integration) will be implemented and a demand response trial study will take place. The next phase will see the integration of smart grid technologies with renewable energy in pilot projects at selected sites in the economy.

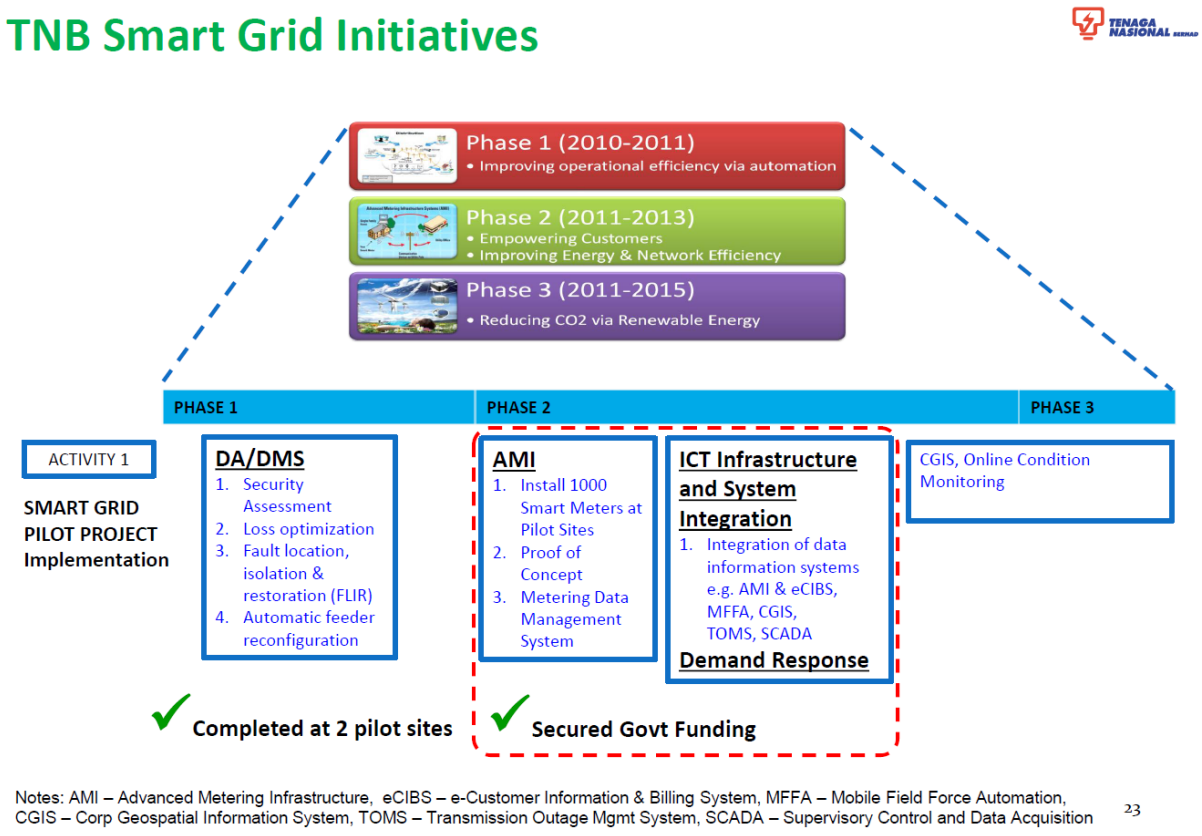

Figure 7-2: TNB Smart Grid Initiatives[87]

7.1.2 Recommendations

Recommendation 34: *Continue to explore and implement high-efficiency, low-emissions technologies for new and existing thermal generation capacities.*

To meet projected electricity demand and fill the capacity gap when existing power generation assets are retired, Malaysia has plans to add over 10 GW of thermal power capacities (using coal and gas as fuel) over the 2012-2020 period. Mitigating the negative impacts of rising fossil-fuel prices, depleting indigenous fossil-fuel resources and increasing emissions from fossil-fuel combustion are major challenges for this economy. One common mitigation measure is to improve overall thermal power generation efficiency. This can be achieved by improving operational efficiency, investing in the refurbishment or retrofitting of existing capacities to improve performance and if new generation capacities is still required, then invest in high-efficiency and low-carbon options. TNB is already adopting new technologies in its new and aging power plants to reduce emissions, and these efforts should be continued and intensified.

[87] TNB (2013), *Smart Grid Innovation in the Electricity Supply Value Chain*, presentation during the PRLCE Review Team Visit on 10 December 2013.

Table 7-1: Technologies adopted by TNB to improve efficiency and reduce emissions[88]

Technologies Adopted By TNB in reducing the CO_2 Emissions

NO.	TECHNOLOGY	POTENTIAL EFFICIENCY IMPROVEMENT (%)	STATUS (APPLIED/POTENTIAL)
1	Supercritical Boiler	42% Thermal Efficiency (HHV)	Janamanjung 4 PS @ 1000MW (COD Mid 2015)
2	Advanced Single Shaft CCGT	>60% Thermal Efficiency (LHV)	New Prai PS - 2 x 535MW (COD Jan 2016) Connaught Bridge PS - 1 x 350 MW (COD Aug 2015)
3	Compressor up-rating on Alstom GTs	Around 1.1% efficiency improvement additive/GT	Pasir Gudang PS GT 3A &3B uprated. Paka PS GT 4A &4B will be done in 2014.
4	Turbine Section Uprating of GE Frame 9E CCGT	Around 1.6% efficiency improvement	Gelugor PS GT 1 & 2 (2011 & 2013) Paka PS GT2A, 2B, 1A, 1B (2012, 2013)
5	Compressor water washing installed at all CCGTs	~ 0.5% efficiency sustainability	Standardised for all Combined Cycle Plants within TNB Fleet
6	High Efficiency Particulate Air-filters (HEPA) and Nano-fiber air-filters installed	Sustainability of high GT efficiency performance	Applied - Significant reduction in GT compressor fouling rate hence, sustaining GT efficiency.

Recommendation 35: *Accelerate and increase electricity efficiency and conservation measures in tandem with renewable energy solutions to decouple electricity consumption from economic growth and defer the need for building-up new thermal power capacity.*

Malaysia already implements various energy efficiency and conservation (EE&C) measures; namely energy efficiency demonstration and showcase projects, appliance labelling, awareness campaigns, as well as training and workshop programs. The economy is currently working towards consolidating all EE&C initiatives and strategies under an overall, long-term EE&C master plan. A strong EE&C framework that establishes fair and stable regulation with appropriate incentives will stimulate investment and ensure EEC implementation is successful and sustainable in the long-term.

Recommendation 36: *Continue to gradually rationalize electricity subsidies on schedule and consider transferring a portion of the savings benefit from the fossil-fuel subsidies rationalisation to promoting low-carbon technologies.*

[88] TNB (2013), *Low Carbon Technologies in the Power Sector – Generation Division*, presentation during the PRLCE Review Team Visit on 10 December 2013.

Three out of the four components that contribute towards the electricity tariff increase in January 2014 are related to fossil-fuels; the four components for Peninsular Malaysia are[89]:

i. The adjustment of domestic gas price

ii. The adjustment of imported LNG price

iii. The adjustment of base price for coal

iv. The review of Tenaga Nasional Berhad's (TNB) base tariff (non-fossil fuel related)

Subsidised electricity pricing in Malaysia has led to underinvestment in infrastructure improvement in the supply-side and overconsumption in the demand-side. Subsidies also artificially lowers electricity prices which would then lengthen the recoupment time for RE and EE&C investments, thereby dis-incentivizing investments in these projects. Therefore, Malaysia is advised to not only continue the phasing-out of wasteful electricity subsidies, but also to continue educating the public on the harmful impacts that wasteful energy subsidies can have on the environment and economic sustainability.

It is also important to note that at the same time of the tariff adjustment, the surcharge for RE billed to electricity consumers (except for domestic consumers who use not more than 300 kWh per month) was increased from 1% to 1.6%. This increase may negatively impact public perception of RE as it can be seen as a burden on the consumers whereas fossil-fuels are subsidised by the government. To gain public goodwill, the Government of Malaysia may consider making it obligatory for electricity generators using subsidised fuels to contribute to the RE Fund (or other funds to promote low-carbon technologies) or diversify its fuel source to include some share of RE (like the Renewable Portfolio Standards (RPS[90]) mechanism).

Recommendation 37: *Accelerate resource mapping for new renewable energy potentials (wind, geothermal, biomass, small-hydro) to diversify resources for renewable energy power generation.*

Mapping renewable energy resources is a crucial step in providing resource and policy certainty that developers need to scale-up investment in renewables[91]. Reliable resource maps provide information not only on the technical resource potential, but also other key enabling factors and constraints like the reach of the transmission and road networks, transmission flow patterns between different parts of the country, protected areas (including areas for landscape, environmental, military, or civil transport uses), and potential cumulative effects on endangered or sensitive species.

These maps would be useful to both RE project developers as well as the government, since this information can be used to strategically guide commercial development, establish pricing incentives, and take account of environmental and social constraints.

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[89] Announcement by Minister of Energy, Green Technology and Water on the Electricity Tariff Review in Peninsular Malaysia, Sabah and WP Labuan, 2 December 2013.

[90] Under the RPS mechanism, electricity producers are obliged to provide a certain percentage of energy from RE sources, otherwise a certain amount of penalty will be imposed. The target amount is set by regulatory authorities. One advantage of this scheme is the relatively low burden on the government and consumers.

[91] Quote from World Bank, http://www.worldbank.org/en/news/feature/2013/06/17/mapping-the-energy-revolution

Recommendation 38: *Accelerate the development and implementation of smart grid and low carbon cities to maximize renewable energy potential.*

Smart grid technologies and low carbon cities are cross-sectoral by nature and require coordination across various ministries, agencies, authorities (federal, state and local), consumers and stakeholders for successful implementation. The Government of Malaysia is highly encouraged to incorporate these two initiatives as components of the New National Energy Policy Study being conducted by the Economic Planning Unit (EPU) to give the initiatives higher priority in national plans.

The TNB Smart Grid Initiative is already underway, and Malaysia has several cities[92] that have goals to achieve low-carbon city status as well as a guideline on Low Carbon Cities Framework and Assessment System[93], published by KeTTHA in 2011. The next step would be to build capacity through demonstration projects, encouraging and facilitating technology transfer from successful smart grid and low carbon cities projects[94], developing effective funding mechanism and increasing awareness level at residents' level to create a low-carbon society that can take full advantage of the benefits offered by these two technologies.

[92] Examples of cities with low-carbon goals include Putrajaya, Cyberjaya and Iskandar Malaysia.

[93] Available at http://esci-ksp.org/wp/wp-content/uploads/2012/04/Low-Carbon-Cities-Framework-and-Assessment-System.pdf

[94] APEC has several initiatives for knowledge sharing on smart grid and low-carbon cities like the APEC Smart Communities Initiative, the Low Carbon Model Towns project, the APEC Smart Grid Initiative and others that Malaysia can participate in.

7.2. FEED-IN TARIFF SYSTEM

7.2.1 Achievements and Challenges

The Feed-in Tariff (FIT) mechanism was introduced in Malaysia in 2011 with the aim of achieving the national renewable energy (RE) target laid out in the National Renewable Energy Policy and Action Plan (NREPAP). The implementation of FIT is ensured by the Renewable Energy Act 2011 (Act 725) and the Sustainable Energy Development Authority Act 2011 (Act 726)[95].

The Malaysian FIT mechanism has unique features that are aligned with the RE policy aims of the economy. The more notable features include:

1) The creation of the Sustainable Energy Development Authority (SEDA) as the sole implementing body of the FIT mechanism

   SEDA is the statutory body that oversees the entire operation and management of the FIT mechanism. SEDA works closely with RE developers, the utility and local governments in order to obtain all stakeholders' point of view to identify possible areas of improvements in the process and adjusting the FIT implementation process where necessary.

2) The creation of the RE Fund to keep the cost and expense of the FIT mechanism transparent and under control

   The RE Fund was first created with government grant of RM 300 million (about USD 90 million) and thereafter supported by a 1% surcharge on electricity consumers. The FIT payment is made within the budgetary framework of the RE Fund, thus the Fund functions as the budget cap. This concept was introduced based on the observations of other FIT implementing economies where the FIT cost (surcharge) is adjusted ex-post according to what has been paid to the RE developers, which has caused unpredictable hike of the FIT cost.

   In Malaysia, the ratepayers whose electricity consumption is not more than 300 kWh per month are exempted from the surcharge. In addition to easing the burden of residential consumers, this approach (based on the "polluters pay" concept) also encourages large-scale electricity consumers to become more energy efficient in order to reduce their electricity bills.

3) Annual degression schedule for the the FIT rates

   In order to reflect the current local RE market, annual degression rates are set in advance to give the correct and timely signals to investors.

As a result of the two-year implementation of the FIT mechanism, by 31 October 2013, 533.8 MW of RE capacity has been installed and 119.47 MW already put into operation under the FIT mechanism. This is double the installed RE capacity of the previous decade, prior to the introduction of the FIT mechanism.

With the introduction of the FIT mechanism in Malaysia, other co-benefits were accomplished, including the creation of over 11 000 RE related-jobs, the development of new local RE industries and the reduction of over 1.5 million tonnes in CO_2 emissions.

[95] Both the RE Act 2011 and the SEDA Act 2011 are available online at the SEDA website, http://seda.gov.my/

On the other hand, the Malaysian FIT mechanism is facing several important challenges:

Challenge 1: Share of solar photovoltaic (PV) is high compared to other forms of RE

From Figure 7-1, it is obvious that the interest for FIT in Malaysia has been concentrated on solar photovoltaic (about 89% of total approved FIT applications as of 31 October 2013), while small hydro and biogas are less popular.

Approved Applications At 31 October 2013

Source	No of Applications	Installed Capacity (MW)	% Installed Capacity
Biogas	18	27.03	5.06%
Biomass	19	166.49	31.19%
Small Hydro	22	130.99	24.54%
Solar PV			
Individual	2,447	26.27	4.92%
Non individual	252	183.06	34.29%
Total	**2,758**	**533.84**	

Installations in Operation As At 31 October 2013

No.	Source	Applications	Installed Capacity (MW)
1	Biogas	5	8.53
2	Biomass	5	50.40
3	Small Hydro	5	15.70
	Solar PV		
4	Individual	755	10.15
5	Non individual	52	34.68
Total		**822**	**119.47**

Figure 7-3: Approved applications and operational capacity[96]

Compare the operational capacity in 2013 to the table below on operational capacity as of 2012. Only solar categories have shown large increase in capacity, whereas the other categories remain fairly constant.

Table 7-2: Total projects in operation (as of 31 December 2012) [97]

Exhibit 5: Total FiT Projects Operational (as at 31st December 2012)

RENEWABLE RESOURCE	NO. OF APPLICATIONS	% OF TOTAL APPLICATIONS	CAPACITY (MW)	% OF TOTAL CAPACITY
Biogas	5	3.2%	7.41	7.5%
Biomass	5	3.2%	50.40	51.2%
Small hydro	5	3.2%	15.70	15.9%
Solar PV (Individual)	111	71.6%	2.21	2.2%
Solar PV (Non-individual)	29	18.7%	22.81	23.2%
Total	**155.00**	**100%**	**98.52**	**100%**

It is also highly important to understand that compared to the other RE categories, solar PV is by far the most expensive, yet on MW basis, its capacity factor is the lowest (See Figures 7-3, 7-4 and 7-5). Therefore, it is a challenge for SEDA to balance between ensuring progressive uptake of solar PV and at the same time ensure that the cost is not burdensome on the general public as the FIT mechanism is funded by surcharges on electricity consumer.

[96] SEDA (2013), *Overview of Malaysia National Renewable Energy Policies, Strategies and Regulatory Framework*, presentation during the PRLCE Review Team Visit on 9 December 2013.

[97] SEDA (2013) SEDA Annual Report 2012, pp 69.

Table 7-3: Capital investment by renewable resource, in RM/kWh[98]

Resource	Biogas	Biomass	Small Hydro	Solar PV (Individual)	Solar PV (Non-Individual)
Annualized Capital Investment in RM/kWh	0.0497	0.0527	0.0669	0.4624	0.4459

* Note that Average Electricity Tariff in Peninsular Malaysia is RM 0.3853/KWh since 1 January 2014

Table 7-4: Annual power generation from operational FIT projects, in MWh[99]

Annual Power Generation (MWh) of Commissioned RE Installations

Year	Biogas	Biogas (Landfill / SeWage)	Biomass	Biomass (Solid Waste)	Small Hydro	Solar PV
2014	1702.76	1581.16	51505.25	2824.77	14174.82	11025.69
2013	9039.84	9477.59	209407.59	11144.25	73032.12	47639.70
2012	98.11	7465.40	101309.87	3234.52	25629.78	4714.01

Table 7-5: Operational capacity, generation and capacity factor by renewable resource in 2013[100]

Source	Operational Capacity (MW)	Electricity Generated (MWh)	Capacity Factor (%)
Biogas	11.74 (6.3%)	26080.94 (5.2%)	25.4%
Biomass	52.3 (28.2%)	325096.23 (64.7%)	71.0%
Small Hydro	11.7 (6.3%)	98661.9 (19.6%)	96.3%
Solar PV	109.51 (59.1%)	52353.71 (10.4%)	5.5%
TOTAL	185.25 MW	502192.78 MWh	

Challenge 2: Matching grid infrastructure to load demand in remote areas

Harnessing of local RE resources has been severely hampered by limited grid infrastructure, especially in remote areas where the RE resources are located very far from the grid connection point. Under the RE (Technical and Operational Requirements) Rules 2011 Section 11[101], RE project developers are responsible for their own cost in carrying out the design, construction, installation and testing of RE

[98] Calculated based on data provided in the SEDA Annual Report 2012, pp 69 where it is estimated that the capital investment required for 450.85 MW of RE is RM 4 billion (USD 1.2 billion)

[99] Data from SEDA website, http://www.seda.gov.my/. Accessed 30 April 2014.

[100] Capacity factor is measure of how often an electric generator runs for a specific period of time, in this case one year or 8760 hours. Data for this table is from the SEDA website, http://www.seda.gov.my/. Accessed 30 April 2014.

[101] SEDA (2011), *Renewable Energy (Technical and Operational Requirements) Rules 2011*, http://seda.gov.my/?omaneg=000101000000010101010001000010000000000000000000000&s=1207

installation and applicable interconnection facilities up to the connection point. Therefore, the cost of RE development significantly increases for RE projects in remote areas which require long-distance interconnection facilities.

Furthermore, the current grid infrastructure was originally designed under a more centralized electricity supply scheme by TNB. Under this design, remote areas traditionally have load levels that are too low to economically justify the build-up of new grid interconnection infrastructure. This mismatch between the availability of grid infrastructure and demand in local areas may be further exacerbated as favourable locations are quickly taken up by early movers.

Challenge 3: Support from local authorities and communities

Unlike small-scale solar PV, most RE resources are likely to have an impact (positive or otherwise) on the local environment and community. Therefore, RE developers are expected to comply with local authority requirements before applying for the Feed-in Approval (FIA) certificate[102].

Malaysia currently has 149 local authorities[103], each with its own by-laws that developers must meet. At the same time, the district offices for the utility and Department of Environment may have their own specific technical and environmental requirements for developing projects in their jurisdiction that are not required at the federal level. As a result, the process of obtaining local approval may become cumbersome and time-consuming; even with assistance from SEDA as liaison between the RE project developers and the local authorities.

Therefore, local authorities and communities can play an important role in encouraging local projects, especially by streamlining or standardizing approval procedures across different departments as well as taking a promotional role.

Challenge 4: Percentage of operational capacities is still low

The approved[104] capacity so far (533.84 MW as of 31 October 2013) is quite close to the NREPAP cumulative capacity target (543 MW by 2013[105]). However, only 22% of the approved RE capacity are in operation (See Figure 7-4).

[102] SEDA (2011), *How to Apply for FIA for Other RE Installations*, http://seda.gov.my/?omaneg=000101000000010101010001000010000000000000000000000&s=340

[103] There are 149 local authorities in Malaysia consisting of 12 City Halls/Councils, 39 Municipal Council and 98 District Council.

[104] These are projects for which quota has been allocated and approved, and includes plants that are in progress but not yet in operation in addition to operating plants.

[105] KeTTHA (2011), *Handbook on the Malaysian Feed-in Tariff for the Promotion of Renewable Energy*, pp20, http://efit.seda.gov.my/?omaneg=000101000000010101010001000010000000101000001000110&id=303

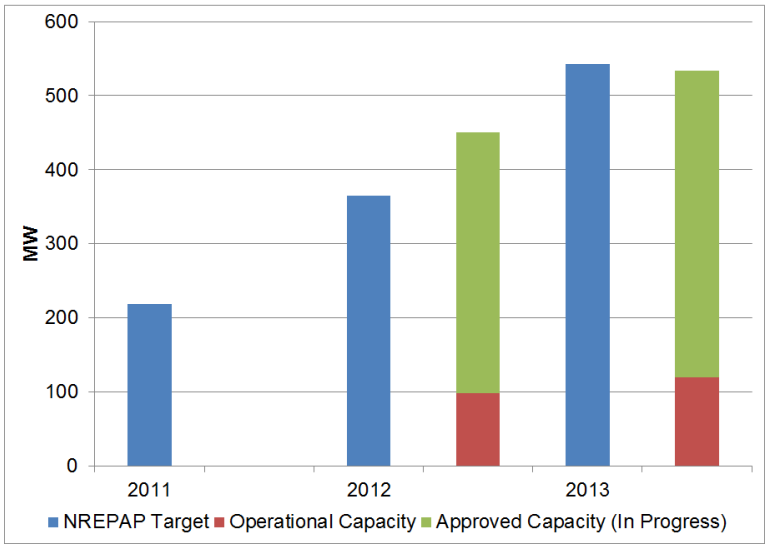

Figure 7-4: Comparing FIT capacity allocation to NREPAP target[106]

Currently, the FIT quota is released twice a year. Interested applicants are required to undergo the technical approval process (connection confirmation check and power systems study) which is undertaken by TNB before submitting their applications. Once the application deadline ends, SEDA undertakes to process the large number of applications received. The sheer amount of applications coming in at the same time creates a bottleneck at both stages of the FIT approval process. This may delay when the project developer receives the REPPA from TNB.

The next stage after receiving the FIT consent is to secure funding and if required, site approvals from other agencies (for example environmental impact assessment, land conversion approvals, water abstraction rights, planning permissions and others). The ease of completing these approval procedures will be a big factor towards whether the project can be commissioned on-time or otherwise.

Challenge 5: Securing continuous public support

Securing continuous public support for the FIT is an important challenge for the sustainable operation of the FIT. This issue is related to two different layers of public participation:

Firstly, increasing participation for the RE industry. To encourage competent new players, intensive capacity building is required to provide information regarding the opportunities that FIT may offer and boost technical as well as business skills in building and running RE generation facilities.

Secondly, electricity consumers shoulder the cost of the FIT mechanism as currently, the only source for the RE Fund is from the surcharge on consumers' electricity bills. In the first two years of FIT implementation, the surcharge was set at 1% of the total electricity bill but from January 2014, the surcharge will be increased to 1.6%. Keeping the cost of the FIT at planned level is an important challenge as well as keeping the FIT as cost-efficient as possible is a key success factor in the face of dynamic development of the RE market.

[106] Graph created based on data from the SEDA presentation to PRLCE Review Team and SEDA Annual Report 2012.

Currently, several RE projects and installations are showcased in government buildings and large commercial facilities. However, the degree of "visibility" seems limited and majority of the public are not aware of the actual benefits or cost that can arise from these types of projects. Increasing visibility of RE projects will likely foster public interest and thus build support for RE in the future.

Furthermore, as the cost of FIT is borne by electricity consumers, keeping consumers informed on the development of RE and its associated costs is a necessary part of running the FIT. However, up-to-date information such as how the budget of RE Fund is allocated and how much is being spent on different RE technologies are not necessarily easily available and accessible by the public. Periodic sharing of this type of information on how FIT is being utilized may be a service that SEDA would consider providing in the future.

7.2.2 Recommendations

Recommendation 39: *Local authorities should be encouraged to play a wider role in promoting RE development in their respective jurisdictions.*

Local resource potential and local requirements are best understood and regulated locally, so it would be highly advisable to leverage on local authorities expertise and encourage them to develop and package their own local RE promotion incentives. The role of local authorities may come in the form of RE awareness-raising at the local level, conducting detailed survey of potential local RE resources to pinpoint "hotspots" for development and/or streamlining local application procedures, to name a few.

For instance, mapping potential RE resources at the national or even state-level is a time-consuming and expensive process, but for a small district this can be done quickly and economically by local experts.

Another example how local authorities can easily promote RE in their jurisdiction is by streamlining all local administrative procedures for RE project development and accelerating the approval process; this can also be achieved by providing a one-stop information centre at the local level to address this issue. This information centre can also take the role of promoting RE to all segments of the local community to increase awareness on the benefits of RE.

Convincing local authorities to take ownership of RE promotion at their local jurisdiction will be much easier if incentives can be provided in such a way so that local governments and/or communities gain direct fiscal benefit from the utilization of local RE resources. Such an incentive could be in the form of fiscal arrangement so that a part of investment taxes may be directly payable to the local authorities (please refer to Chapter 4).

Recommendation 40: *Encourage wider public participation by providing easily accessible information on where electricity supply is needed, what renewable energy resources and technologies are available and what benefits can be achieved.*

Related to above, the authorities (either at the federal or local levels) may initiate targeted efforts in identifying weak nodes in the grid where more generation capacity is required. In such areas, the build-up of new RE projects may be further incentivized through financial arrangement (such as differentiated tariffs) and/or administrative treatment (such as fast-track approval), to encourage participation of the wider public.

At the same time, providing more visibility for RE facilities may help raise wider public awareness (and consequently public acceptance) of RE and its benefits. Showcase projects at locations with major foot traffic such as shopping malls, airports, recreational parks would be a good start as the wider public can easily see and understand the benefits of RE installations.

Example: Two examples of public showcasing of RE installation benefits are as below:

1. Real-time data on electricity generated by solar PV installations can be displayed on large-size monitors for public information. The three items usually shown are instantaneous power output by the solar PV system, the total energy produced and the total CO_2 reduction.

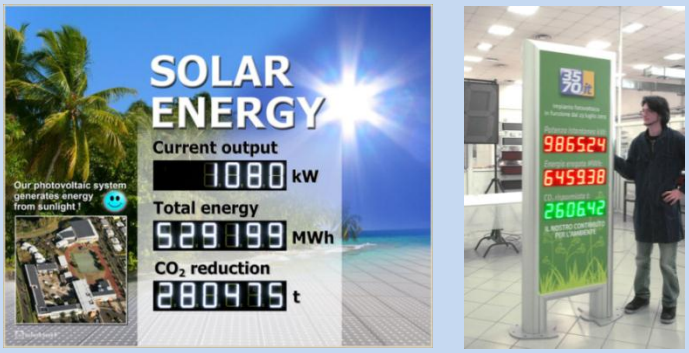

Figure 7-5: Large-sized displays at public areas[107]

2. Online monitoring of solar PV installation at the University of Texas parking garage includes even more detailed historical and real-time information on electricity generated from solar PV and benefits accrued from the installation in easily relatable terms like savings in CO_2, savings in gas and equivalent usage in light bulbs.

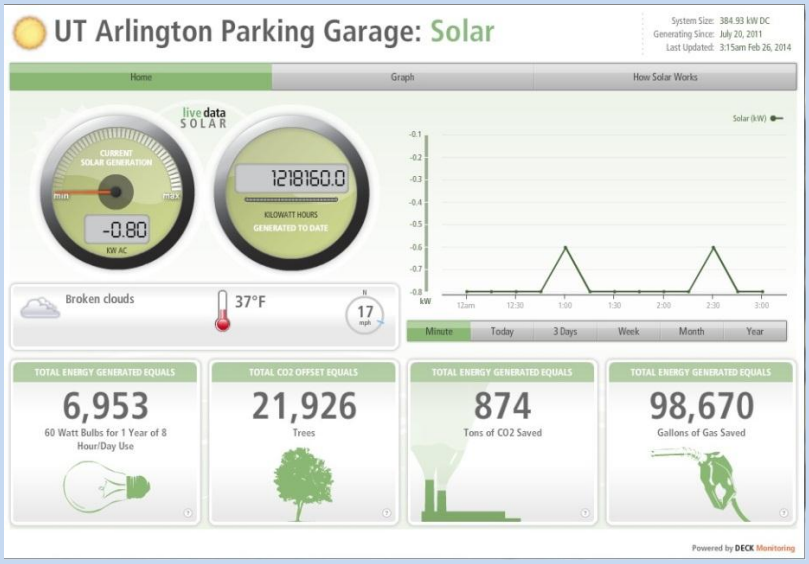

Figure 7-6: Solar PV monitoring at University of Texas[108]

[107] LED display pictured on the left is marketed by Siebert Group (http://www.siebert-group.com/en/product-xc460-xc470.php) and display totem on the right is marketed by Bios Elettronica S.r.l. (http://www.bioselettronica.it/prodotti/fotovoltaici/power-display_en.asp)

Under the current FIT mechanism, the solar PV allocation is either in the individual or commercial categories. The public sector may become an important player if properly targeted for RE deployment. The participation of rural communities, hospitals and schools, apartment building associations, and other may be also be promoted by the measures mentioned above[109].

Recommendation 41: *Coordination between renewable energy development and grid infrastructure perspectives should be secured at an early stage to accommodate future expansion of renewable energy.*

Higher policy coordination between all relevant authorities at an early stage is highly desirable to secure RE deployment that is in line with long-term perspective of electricity supply system and grid infrastructure arrangements.

In order to pre-empt local congestions of the network capacity that may develop in the future, the promotion of self-consumption or speeding-up the introduction of net-metering may need to be considered as soon as possible.

Example of Grid Expansion:

Large scale RE deployment usually requires the expansion and strengthening of grid infrastructure. In Germany, 51 grid expansion projects, many of which are AC grid expansions, have been identified necessary in the coming decades to accommodate the targeted increase in RE installations.

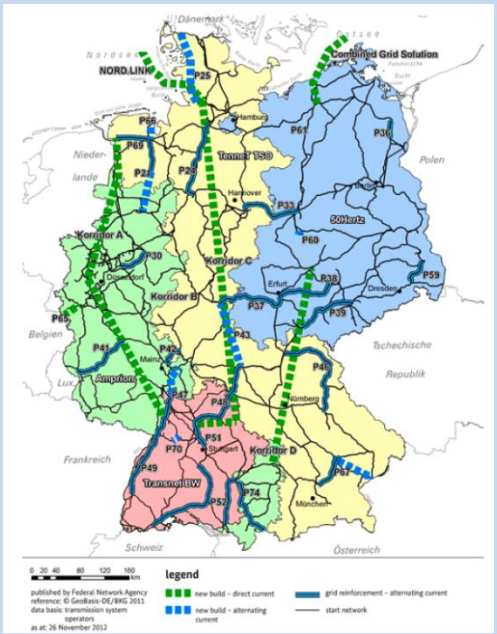

Figure 7-7: Planned grid expansion projects in Germany[110]

[108] Screenshot of http://live.deckmonitoring.com/?id=ut_arlington_parking_garage on 26 February 2014.

[109] Community category of solar PV is incorporated in the quota release for 1st July 2014 for public schools, religious places of worship and welfare homes.

[110] First Monitoring Report "Energy of the future", December 2012, BMU and BMWi

Example of Net-Metering Mechanism:

There are various models of self-consumption or net-metering mechanism of RE (mainly solar PV) generation. In the case of the UK, small-scale RE facilities (smaller than 5MW) receive generation tariff and export tariff under the FIT. The latter is paid on top of generation tariff when the owner of the facilities feed the excess power to the grid. The owner saves on their electricity bills by reducing the power they need to buy from the electricity supplier.

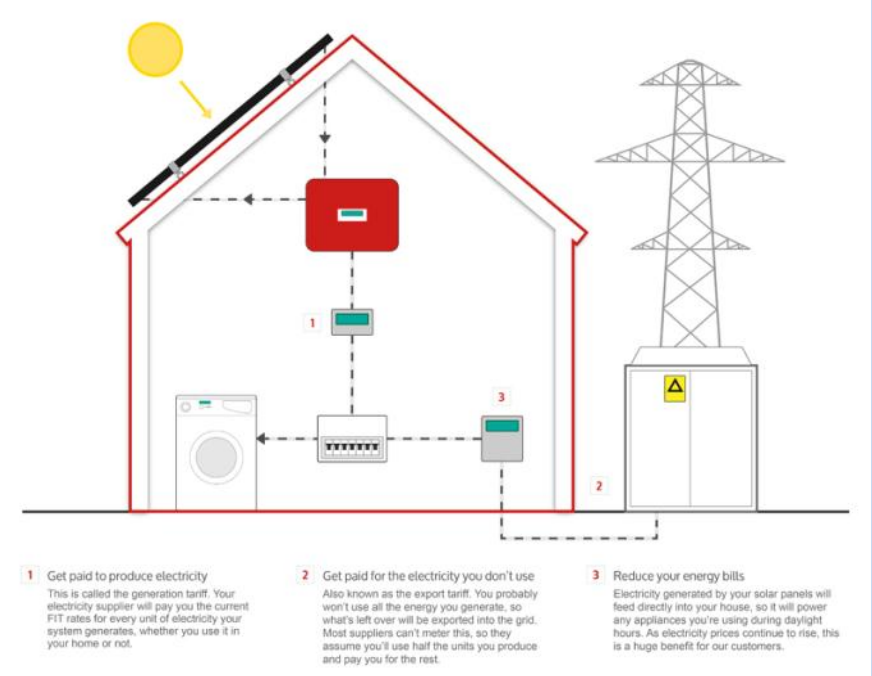

Figure 7-8: Net-metering mechanism[111]

Recommendation 42: *Consider applying degression on solar PV tariffs more frequently and based on a pre-determined mechanism or formula.*

Given that solar PV market has been growing at an unpredictable speed and scale, the cost implication has likely been broader than anticipated in many FIT implementing countries. The massive volumes of applications submitted for the solar PV category under the FIT mechanism in Malaysia is a good indicator of possible information gap between the FIT tariffs rates set and the market price.

In order to prevent over-generosity of the PV tariff which leads to onerous burden on ratepayers, increasing the frequency of degression (from once a year to either monthly or quarterly) may be worth considering.

Furthermore, in the interest of increasing transparency and improving procedural efficiency, it is also worthwhile to consider applying a pre-determined mechanism or formula for calculating the degression rate at each time.

[111] EvoEnergy Ltd, *Solar Panels Buyers Guides*, http://www.evoenergy.co.uk/solar-panels/

While this exercise may incur higher administrative cost when first implemented, it will likely become more cost effective in the longer term. The current arrangements means that each time SEDA plans to change the degression rate, stakeholder consultation sessions are conducted with RE stakeholders to ensure fundamental issues involving stakeholders are taken into account when finalizing the FIT prices, bonuses and degression rates. This process can become time-consuming. With a pre-determined mechanism or formula that has been agreed upon by all parties at the beginning of its implementation, this process can be eliminated, thus saving time and resources without compromising stakeholder relations.

Example: In Germany, solar PV capacity has expanded faster than planned under the German FIT mechanism. The German government made an amendment to the FIT mechanism which has enforced since April 2012. The amendment stipulates for automatic degression rate for solar PV tariffs depending on the amount of installed capacity in the previous three months. Now that solar PV tariffs are altered on a monthly basis in practice by this measure, the domestic market has become better regulated.

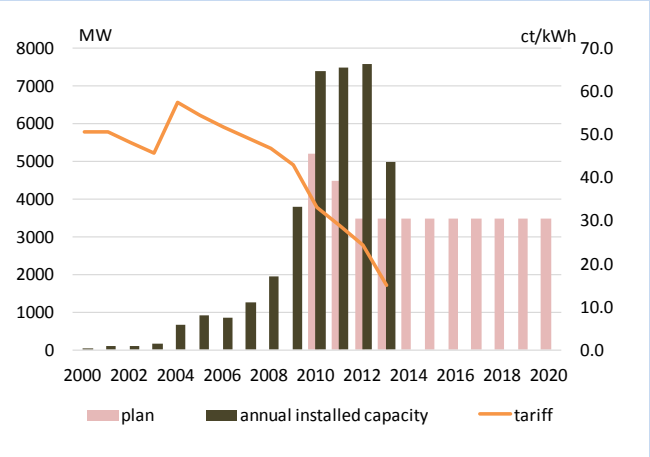

Figure 7-9: Annual installed capacity for German solar PV market, before and after the FIT degression rate amendment

Table 7-2: PV tariff degression mechanism in Germany[112]

Newly accredited capacity (MW)*	Monthly degression
7,500<	2.8%
6,500<	2.5%
5,500<	2.2%
4,500<	1.8%
3,500<	1.4%
2,500-3,500	1.0%
2,500>	0.8%
2,000>	0.5%
1,500>	0.0%
1,000>	-0.5%

* Total capacity accredited in 3 month period converted to annual

[112] Die wichtigsten Änderungen der EEG-Novelle zur Photovoltaik 2012, 28.06.2012

Recommendation 43: *Consider staggering the time and amount of quota released throughout the year as this would help ease the burden of administrative processing and provide accessibility for the developers.*

Staggering the time and amount of quota released throughout the year will help ease the pressure on manpower as well as decrease the bottleneck of FIT approval processing. The frequent applications of degression rates (discussed earlier) may also contribute in mitigating the bottleneck issue.

Similarly, considering that the large number of applications can be speculative, screening measures may be considered. Requiring that applicants of large projects pay a deposit[113] (refundable upon successful start of operation) may help shorten the long-list of applications to be processed.

Recommendation 44: *Continued efforts for capacity building in various stages of renewable energy from planning, construction, operation and decommissioning stages would benefit the increase and expansion of feasible renewable energy projects.*

Malaysia already conducts various RE-related training programs; ranging from RE systems design courses to RE systems installation and maintenance workshops with several educational institutes like Universiti Teknologi Mara (UiTM), University Kuala Lumpur British Malaysia Institute (UniKL BMI) and Selangor Human Resource Development Centre (SHRDC). These efforts are commendable, and it is highly recommended that capacity building initiatives should be continued and expanded to address the many technical processes involved in the FIT deployment. This is applicable not only for RE facility developers and operators but also for FIT relevant authorities to address FIT regulatory processes (such as TNB (district level); state and local authorities; financial institutions).

Some examples of RE technical and regulatory capacity that may require further enhancement includes capacity for off-grid and on-grid network design and safety checking for RE interconnections, wireman/chargeman for PV installations, development for RE technologies, operations and maintenance of RE facilities, compliance checking, safety checking and others.

Recommendation 45: *Promote the formation of energy service companies (ESCOs) focused on renewable energy.*

The RE market is growing very rapidly in Malaysia. Reliable and credible companies to carry out RE projects successfully are important to guarantee consumer confidence and successful project completion. Unlike traditional energy consultants of equipment suppliers, energy service companies or ESCOs, can also finance or arrange for the projects, and as their remuneration is directly tied up to savings achieved, ESCOs also have a stake in ensuring that projects perform satisfactorily over the long-term.

Malaysia already has a number of ESCOs focusing on energy-efficiency projects, so the model is not new in the economy. As RE projects are eligible for the FIT mechanism, RE projects has an economic advantage over energy efficiency projects which are hampered by energy subsidies that artificially lowers energy prices (thus lowering amount of savings that can be achieved).

[113] Under the new quota release for solar PV in May 2014, interested applicants are now required to provide a deposit of RM 100/kW that will be forfeited if application is withdrawn.

Some key strategies that the government can apply to better promote reliable RE-focused ESCOs include:

- Ensure there is a standard accreditation system for ESCO providers
- Provide an easily accessible list of registered and accredited ESCOs[114]
- Standardise performance measurement, reporting and verification (MRV) process
- Knowledge sharing of successful ESCO projects and innovative RE financing schemes

[114] SEDA has initiated a directory for RE service providers in January 2014.

8. LOW-CARBON TRANSPORT

8.1. ACHIEVEMENTS AND CHALLENGES

The transport sector has now overtaken the industry sector as the largest energy end-use sector in Malaysia, as shown in Figure 8-1[115], accounting for 39% of final energy demand. Growth in transport sector energy demand has been rapid, more than tripling over two decades, as illustrated in Figure 8-2. As nearly all transport demand is fuelled by petroleum products, CO_2 emissions from the transport sector have grown similarly. Petrol, diesel and aviation fuel jointly accounted for 98% of transport energy demand, as show in Figure 8-3.

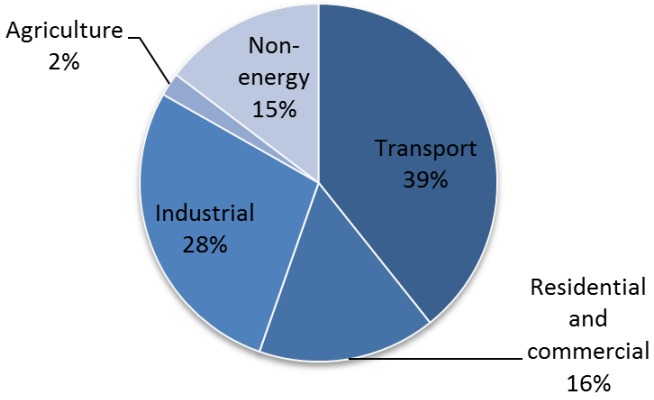

Figure 8-1: Final energy demand by sector in Malaysia, 2011

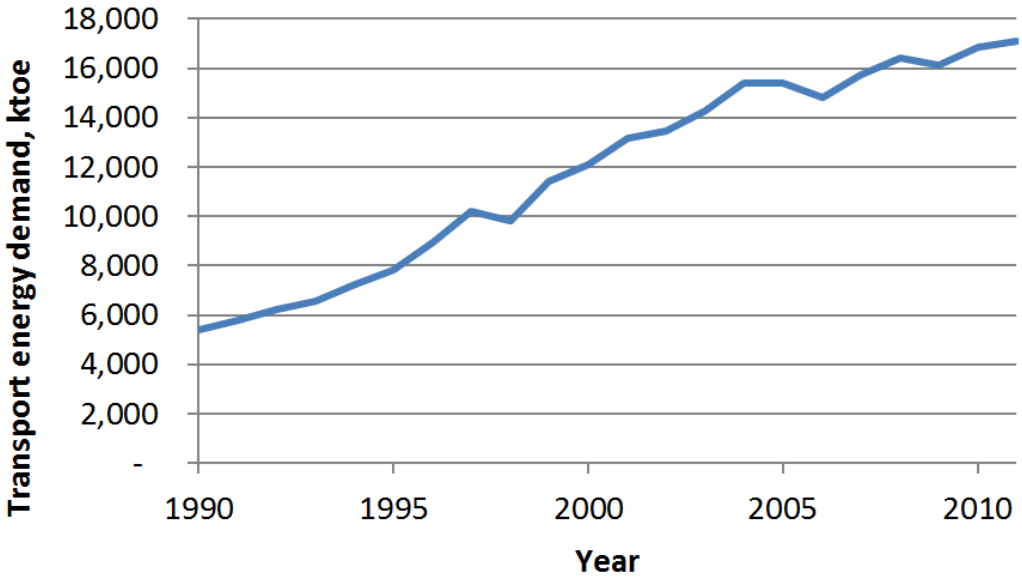

Figure 8-2: Growth in transport energy demand in Malaysia, 1990-2011[116]

[115] Data from Malaysia Energy Information Hub, http://www.meih.st.gov.my/web/meih/statistics

[116] ibid.

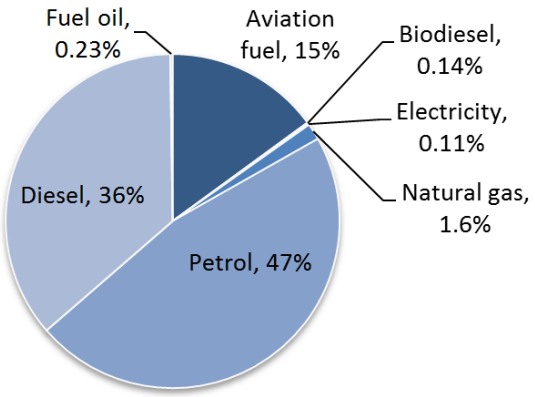

Figure 8-3: Transport energy demand by fuel type, 2011[117]

Biofuels

Malaysia is the world's second largest producer of palm oil. In 2011, Malaysia introduced a mandatory requirement for the blending of 5% biodiesel (B5) from palm oil in diesel fuel[118]. From November 2011 the mandate was in selected states in Peninsular Malaysia, covering around 50-60% of transport diesel fuel. Full implementation of the B5 mandate in Peninsular Malaysia is due by March 2014, with nationwide implementation by July 2014. The country is on track to achieve this roll out[119]. This is a significant accomplishment which should see biodiesel use rival natural gas as the third most commonly used land transport fuel.

Blending mandates are one of the best ways to facilitate biofuels into the market to overcome barriers, particularly in countries like Malaysia where petroleum product price subsidies create an additional barrier for renewable transport fuels.

The amount of reduction in net CO_2 emissions achieved by biofuels varies according to a wide range of factors including fossil-fuel use in agriculture and processing, transportation distances and land-use effects. Sustainability certification is one way to facilitate the production of biofuels which result in significant reductions in net CO_2 emissions. Around half of Malaysian palm oil production by plantation area is already certified sustainable[120].

The challenge for Malaysia is to ensure the net CO_2 reduction benefit of biodiesel blending is further increased by continuing to improve the environmental sustainability practices of palm oil production and processing.

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[117] Energy Commission (2013), *Malaysia National Energy Balance 2011*, http://meih.st.gov.my/documents/10620/6ee119f3-8bcf-4a7b-930e-ae375dbbc544

[118] Malaysian Biofuel Industry (Blending Percentage and Mandatory Use) Regulations 2011.

[119] Personal communication with Dr Harrison Lau Lik Nang, Malaysian Palm Oil Board, January 2014.

[120] Roundtable on Sustainable Palm Oil, Annual Communications of Progress Digest, November 2013, Page 19, retrieved from http://www.rspo.org/file/acop2013/RSPO%20ACOP%20Digest%202013.pdf

Electric Vehicles

Malaysia is looking at electric vehicles as a future technology that has the potential to provide reduced CO_2 emissions along with other benefits such as improved air quality.

Domestic car manufacturer Proton has been trialling prototype electric vehicles (EVs) with the government, and has said that it plans to market its EVs by the end of 2015[121]. The government also facilitated the uptake of new vehicle technologies, by providing an exemption to all import and excise duties on hybrid and electric cars from 1 January to 31 December 2013. Under the National Automotive Policy 2014 (NAP 2014), these exemptions were only extended for locally assembled models; for hybrids up to 31 December 2015 while for EVs up to 31 December 2017[122]. The same policy allocates a fund of RM 130 million (approximately USD 40 million) over the next seven years for developing infrastructure for energy efficiency vehicles, which includes public charging systems for EVs and plug-in hybrid vehicles (PHEV)[123].

The CO_2 reduction benefits of electric vehicles (both plug-in hybrids and battery electric vehicles) result from significantly increased efficiency compared with internal combustion engine vehicles; and from the substitution of petroleum products with electricity. Actual CO_2 benefits vary according to the generation profile of the power grid from which the vehicle is charged, or whether it is charged off-grid, for example using solar photovoltaic panels. CO_2 emissions per unit of electricity generation in Malaysia are forecast to decrease over the coming decades, providing further emissions reduction potential for EVs in the future.

Public Transport

Public transport is typically a more energy efficient way to move people in urban areas than private car use, as well as contributing to congestion relief and equitably facilitating access. Public transport use in Malaysia currently accounts for around 17% of passenger trips in urban areas[124].

Malaysia has recently created a new consolidated public transport agency, Land Public Transport Commission (SPAD), under the Prime Minister's department with a target to achieve 40% public transport modal share in urban areas by 2030. The creation of this new agency signals a priority focus on public transport which will be valuable in realising the lower carbon, congestion management and other benefits of public transport.

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[121] http://paultan.org/2013/12/26/proton-come-hybrid-car-end-2014-bring-ev-market-end-2015/

[122] The Star (2013), "NAP 2014 aims to turn Malaysia into EEV hub", 21 January, http://www.thestar.com.my/News/Nation/2014/01/21/NAP-2014-aims-to-turn-Msia-into-EEV-hub/

[123] Ministry of International Trade and Industry (MITI) (2014), *Dasar Automotif National (NAP) 2014 (National Automotive Policy 2014 in Bahasa Malaysia),* pp. 12, http://www.miti.gov.my/cms/documentstorage/com.tms.cms.document.Document_b2f4710b-c0a8156f-72974691-114fbdc5/Kenyataan%20Media%20Polisi%20NAP%202014.pdf

[124] Ministry of Transport (2013), *Roles and Functions of Ministry of Transport,* presentation during the PRLCE Review Team Visit on 9 December 2013.

Significant projects are already underway in Kuala Lumpur including construction of the Klang Valley Mass Rapid Transit rail system, light rail expansion, and plans are being developed for Bus Rapid Transit.

The challenge for Malaysia is improving the customer experience of public transport so that it attracts wider ridership by offering a convenient, reliable and affordable alternative to private car use which is currently subsidised by low fuel prices.

8.2 RECOMMENDATIONS

Recommendation 46: *Gradually rationalize petroleum products price subsidies.*

Malaysia has started to gradually rationalize petroleum products price subsidies. The relatively low price of transport fuels in Malaysia remains one of the significant challenges for improving transport energy efficiency. In December 2013, petrol (95 RON) was retailing RM 2.10 per litre and diesel at RM 2.00 per litre (approximately USD 0.60 per litre). The government provides subsidies of RM 0.63 per litre for 95 RON petrol and RM 0.80 per litre for diesel (approximately USD 0.19 and USD 0.24 respectively per litre). Budget 2014 allows for fuel subsidies of RM 24.8 million (approximately USD 7.5 million). The World Bank ranked Malaysia as 19th cheapest in the world for the pump price of petrol (in US$ equivalent) in 2012.[125]

Recommendation 47: *Continue implementing the B5 biodiesel blending mandate and investigating potential for B7 or B10.*

The B5 mandate appears to be being implemented successfully, and is on track to achieve nationwide implementation by July 2014. The potential for extending the mandate to a 7% (B7) or 10% (B10) blend of biodiesel in diesel is being investigated and should be considered. B7 is already accepted in Europe without the need for consumer information.

The ability to offer non-retail, higher biodiesel blends such as B20 voluntarily to fleets such as urban buses or truck fleets refuelling at specific locations, should also be investigated. B20 is sold to heavy vehicle fleets in Australia, New Zealand, the USA and Canada. The investigation should cover what fleets are capable of utilising B20 or higher blends, based on engine manufacturers' recommendations. This will allow further uptake of biodiesel without hitting a "blend wall".

Malaysia can also improve the net CO_2 emissions reduction gained from the substitution of diesel fuel with biodiesel by improving the sustainability of palm oil production and processing.

Recommendation 48: *Investigate other biofuel options including bioethanol and biogas for transportation.*

[125] World Bank (2013). Pump price for gasoline (US$ per liter), http://data.worldbank.org/indicator/EP.PMP.SGAS.CD/countries/1W?display=default. Accessed January 2014.

Biogas as a transport fuel

The utilisation of biogas from palm oil processing facilities by conversion to electricity often cannot be realised because of lack of electricity demand within an economic distance of the palm oil processing facility. However there are other ways that biogas can be used to offset fossil-fuel use and reduce net CO_2 emissions, including use as a transport fuel.

Malaysia already has a significant uptake of compressed natural gas (CNG) as a transport fuel, with just under 50,000 natural gas vehicles in use in 2011[126], and so already has technical expertise in this area. While most commonly substituting for petrol, CNG can also substitute fully or partially for diesel fuel in specially modified diesel vehicles. Biogas can be scrubbed, compressed and used in exactly the same way as CNG as a transport fuel. For example, it may be possible that vehicles associated with the palm oil production and processing facilities, such as delivery trucks and agricultural vehicles using diesel fuel, may be converted to bio-CNG use and refuel at the processing facility. Purpose designed farm vehicles which can use biogas are now also available in the international market.

Vehicles targeted for conversion typically operate in rural areas where the underlying price of diesel fuel would be higher than in urban areas due to additional transport costs for delivering the diesel fuel. The national benefit for the project may be higher than the financial benefit for the project developer, due to petrol and diesel fuel subsidies, and this distortion may justify government intervention in facilitating the uptake of biogas as a transport fuel.

Example: A developers' guide to biogas as a transport fuel, has been produced by the Biogas Association, Canada and is available at: http://biogasassociation.ca/bioExp/images/uploads/documents/membersOnly/DeveloperGuide-BiomethaneVehicleFuel.pdf

Bioethanol

Bioethanol is the most widely used transport biofuel in the world. It is used primarily as a substitute of petrol either in low level blends (for example E10: 10% ethanol in petrol) in existing petrol vehicles or in specially designed "flex fuel" vehicles either neat (E100: 100% ethanol) or as E85, an 85% blend of ethanol with petrol. Malaysia should investigate the opportunities for producing and encouraging the uptake of bioethanol as a transport fuel, and permitting its blending in petrol.

Recommendation 49: *Consider introducing vehicle fuel economy labelling which includes information on energy running costs.*

The Government of Malaysia recently set out the technical definition for energy efficient vehicles under the NAP 2014 as in Figure 8-4, with more specific kerb weight and fuel efficiency levels for different types of cars as in Table 8-1. Requirements for emission levels will come into effect once the government has made a decision on the introduction of Euro 4 fuels. Vehicles that qualify under these

[126] International Association of Natural Gas Vehicles(2012), 'Current Natural Gas Vehicle Statistics', website page, http://www.iangv.org/current-ngv-stats/

definitions will be eligible for certain incentives that have not yet been elaborated under the NAP 2014, but will likely be in the form of tax breaks.

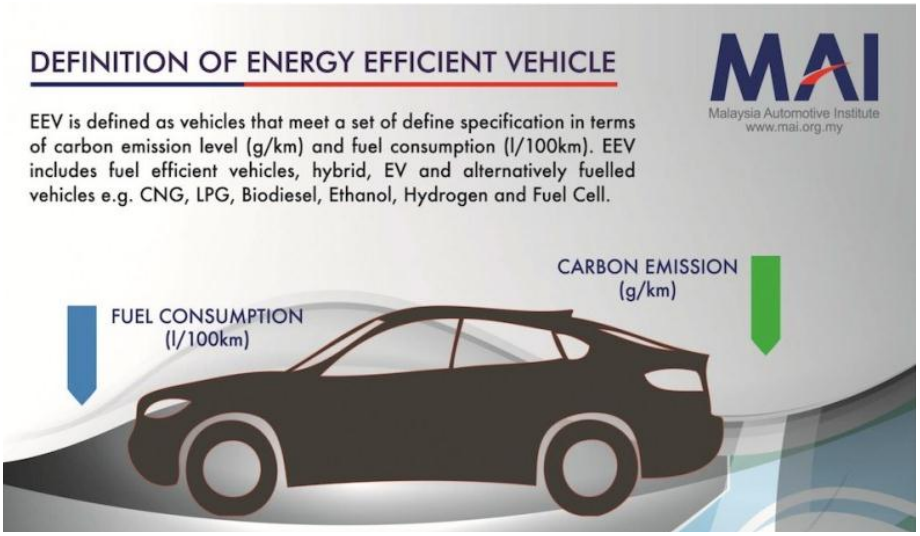

Figure 8-4: Definition of energy efficient vehicle under NAP 2014

Table 8-1: Energy efficient vehicle specification for cars

SEGMENT	DESCRIPTION	CURB WEIGHT (KG)	FUEL EFFICIENCY (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
J	Large 4x4	2,051 – 2,350	11.5
Others	Others	2,351 – 2,500	12.0

Even with these specified levels for fuel efficiency, there is still considerable variation between the fuel consumption of vehicles which otherwise appear similar and have similar engine size (cc rating). Providing vehicle buyers with fuel consumption information helps them determine which vehicles can meet their requirements on a total cost of ownership basis, rather than vehicle purchase price alone. The advantages of energy efficient technology advances, such as hybrid[127] vehicles, modern turbocharged diesel engines and engine stop-start systems, can also be more readily understood by vehicle buyers with fuel consumption labelling.

[127] Hybrid vehicles ('hybrids') use a combination of a petrol or diesel engine, a battery and an on-board electric motor to improve overall energy efficiency. The battery in a hybrid vehicle is charged by the engine and regenerative braking. This means that hybrids do not plug in to an electricity supply to recharge, their only source of energy is the fuel used by the engine.

Malaysia should require all new vehicles to display a label giving standardised fuel consumption information at the point of sale. The requirement should ideally cover vehicles offered for sale via the internet and promoted in other traditional and non-traditional media. Co-promotion of fuel economy information with safety ratings for vehicles will help ensure that fuel economy is not promoted at the expense of vehicle safety (safety is usually a core function of transport agencies).

Malaysia also promotes natural gas vehicles and electric vehicles and so consideration should be given to how consumers can readily compare energy consumption between vehicles with different fuel/energy and prime mover technologies.

As electric vehicles are a new technology, the public are generally not familiar with the energy costs required for recharging and how to compare these with conventional petrol or diesel vehicles. Information for the public is needed to help them evaluate the energy running costs for vehicle operation at the time of vehicle purchase. Annual or five year total running costs for a standardised annual travel distance may be one way to approach this, and also direct potential buyers into thinking about energy costs in terms of the length of time they will own and operate the vehicle.

Example:

Vehicle fuel economy labels are used for petrol and electric vehicles in New Zealand allow consumers to more easily understand the significant difference in energy costs between these two types of vehicles.

Examples of the labels are shown in Figure 8-5. The label for electric vehicles also provides important additional consumer information about the range the EV will travel on one charge.

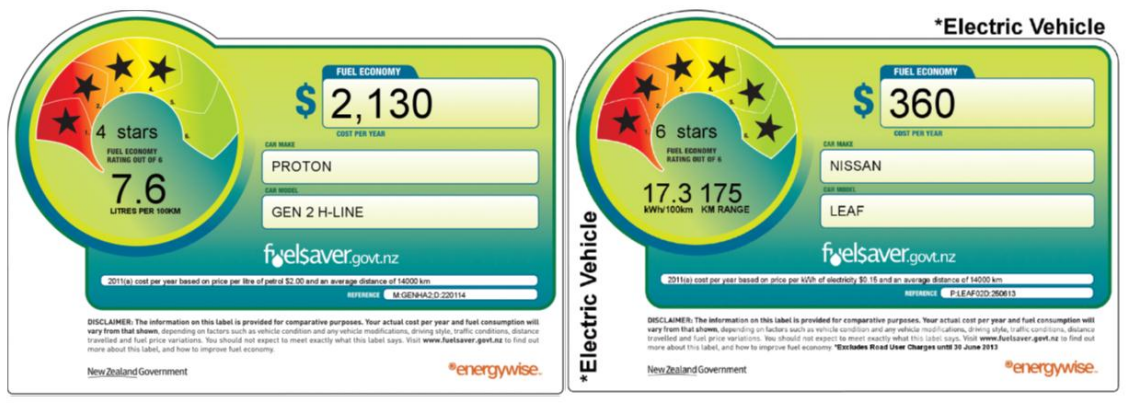

Figure 8-5: New Zealand fuel economy labels for a petrol vehicle and an electric vehicle which highlight the difference in annual energy costs to consumers

Monitoring consumer awareness of the label and the degree to which fuel consumption is a factor in vehicle purchase decisions will help evaluate the benefits of the labelling programme.

Malaysia provides financial incentives for the purchase of hybrid and electric vehicles. Electric vehicles offer significant CO_2 emissions potential, despite the relatively low proportion of renewable energy sources in the current generation mix, due to the very high efficiency of electric vehicles. The planned generation efficiency increases and renewable generation reported by TNB will see the CO_2 emissions factors (CO_2 per unit of generation) decrease over time. This means that the benefits of electric vehicles

will further increase over time in Malaysia. Table 8-2 gives the emissions factors for the generation mix today and estimated for 2035.

Table 8-2: Emissions factors for electricity generation in Malaysia, current and estimated for 2035[128]

	Average generation efficiency	CO_2 emissions factor, g/kWh
2011 generation mix, Peninsular Malaysia	38.3%	0.747[129]
2035 generation mix	53.5%	0.39

Malaysia provides financial incentives for the purchase of hybrid and electric vehicles. However, some very efficient, modern petrol or diesel vehicles can have similar high efficiency and consequently relatively low CO_2 emissions as some hybrid vehicles (not plug-in). The government should investigate the potential to modify financial incentives, or consider other policies, to encourage the purchase of more fuel efficient and lower carbon emission vehicles, not only new technologies. Ideally these should be based on "well-to-wheel" CO_2 emissions factors. This would allow diesel, petrol, hybrid, natural gas, electric vehicles and plug-in hybrids (plus other vehicle fuel/technologies) to be compared using a common metric, which is not yet defined under the NAP.

Interventions can be designed so that they have a neutral impact on government finances such as "fee-bates", where less efficient and high CO_2 emission vehicles have a financial penalty which funds incentives for more efficient, low CO_2 emission vehicles.

Care needs to be taken that any policies to encourage low CO_2 emission private vehicles do not have the unintended consequence of negatively impacting on the uptake of public transport.

Recommendation 50: *Projects for developing and improving public transport infrastructure should be implemented without delay.*

The new public transport agency, SPAD, is implementing a number of significant public transport infrastructure and service projects as follows[130]:

- Initiated the high speed rail link between KL and Singapore
- Initiated the Mass Rapit Transit (MRT) project which will be integrated with the Light Rail Transit (LRT), Komuter, Monorail and city bus networks
- Expanded high quality bus transport services through RapidKL, RapidPenang & RapidKuantan
- Provided access to soft loans for intercity, mini and school bus operators through the RM150 million Public Transport Fund at SME Bank
- Injected 478 new buses into RapidKL and introduced six Bus Expressway Transit routes to significantly reduce travel time on public buses

[128] Efficiency estimates and emissions factors for 2035 are based on APERC forecasts which takes into account planned new generation capacities from the Energy Commission.

[129] Malaysian Green Technology Corporation (2013), *Clean Development Mechanism in Malaysia,* presentation during the PRLCE Review Team Visit on 9 December 2013.

[130] Land Public Transport Commission (SPAD) (2013), *Roles and Functions of SPAD in Promoting Low-Carbon Transport*, presentation during the PRLCE Review Team Visit on 11 December 2013.

- Implementation of five Bus Expressway Transit services and the study on bus lanes and Bus Rapid Transit (BRT) networks
- Smart ticketing integration
- Improving bus networks
- Establishment of performance standards for operators.

The projects that are still to be finalised should be progressed without delay.

Urban buses are ideal niche markets for lower carbon alternatives to 100% diesel fuelling for the following reasons:

- buses are typically high mileage vehicles, meaning they may recoup investment in any additional capital for new technology vehicles and/or fuelling infrastructure relatively quickly;
- buses operate between fixed points and regular routes so they can have dedicated refuelling/charging facilities at depots and do not need a network of refuelling/charging stations;
- the weight of any additional equipment, such as cylinders or batteries, does not reduce payload as buses typically do not operate close to weight limits;
- buses typically operate in densely populated environments where many people have high exposure rates to diesel exhaust gases and so any local air quality benefits (health and urban amenity) from replacing diesel fuel with a lower emission alternative are maximized; and
- customer experience of bus use is enhanced, through improved air quality (reduced smell of diesel fumes and health benefits) and, for many alternative fuels/technologies, reduced noise and a smoother ride, making public transport more attractive and attracting increased ridership.

The first BRT line under construction, the BRT Sunway line, proposes to use electric buses[131], which is to be commended. The applicability and cost-effectiveness of lower carbon bus technologies/fuels for other bus routes should be investigated, along with ways to facilitate uptake by the bus owners. This should be part of the high quality buses initiative under the Bus Transformation Plan.

Example: Table 8-2 below gives a list of options for lower CO_2 transport fuels and technologies in urban buses which are in commercial service, along with examples of urban bus fleets using these technologies. The actual net CO_2 reductions achieved will depend on the net CO_2 for the fuel itself, along with the efficiency of the bus, which in turn depends on the bus technology and in-use factors including routes, loading, road conditions and driver behaviour.

[131] SJ Echo (2012), 'Electric Busses for Bus Rapid Transit Sunway line in 2015', article, 12 October, http://www.sjecho.com.my/ArticleDetails.aspx?ArticleID=997

Table 8-3: Lower carbon energy options for bus fleets, with fleet examples

Technology or fuel type	Public Transport Example	Notes and links	
Pure biodiesel (B100)	Graz, Austria: 130 B100 buses	B100 typically needs to be used in buses designed for this fuel. http://esteast.unep.ch/index.php?option=com_content&view=article&id=78&Itemid=14	
High biodiesel blends (B20-B99)	Deer Valley, USA: 140 school buses using B20	Many diesel buses can operate on 20% blends of biodiesel in diesel (B20 blends) without modification. http://www.epa.gov/region09/waste/biodiesel/arizona.html	
Biogas or landfill gas	Stockholm, Sweden: 120 biogas buses	Biogas and landfill gas can be scrubbed and compressed and used as CNG. Liquefaction of biogas to LNG is also possible. http://www.balticbiogasbus.eu/	
Ethanol E95	Stockholm, Sweden: 500+ ethanol buses	A blend of 95% ethanol with 5% ignition enhancer (E95) is used in specially designed compression ignition (diesel) engines. http://cenbio.iee.usp.br/download/projetos/frequently_blad_low.pdf	
Renewable synthetic diesel	Helsinki, Finland: 300 renewable diesel buses	Can fully substitute for diesel in all diesel engines without modification. Made either from hydrogenating vegetable oils or biomass-to-liquids processes. http://www.vtt.fi/inf/pdf/tiedotteet/2011/T2604.pdf	
Electric buses	Shenzhen, China: 1,300 battery electric buses	Re-charging occurs at depots. Buses have a range of around 250 km between charges. http://www.chinabuses.org/news/2012/0613/article_5484.html	

Technology or fuel type	Public Transport Example	Notes and links	
Hybrid electric buses	London, UK: 300+ diesel-electric hybrid buses	Hybrid technology improves fuel efficiency of buses – buses use only diesel (no external supply of electricity). http://www.tfl.gov.uk/corporate/projectsandschemes/2019.aspx	
Hydrogen fuel cell buses	Hamburg, Germany: 7 hydrogen fuel cell buses	Hydrogen is either produced on site via electrolysis or transported to the refuelling station from other sources of production. Buses have a range of around 250 km. http://gofuelcellbus.com/index.php/project/hamburg-fuelcell-hybrid	

Recommendation 51: *Continue efforts to attain targets for public transport infrastructure and ridership by improving the commuting experience, especially for the "first and last mile" journey.*

SPAD have a target to increase public transport modal share in urban areas to 40% by 2030 (from a current baseline of around 17%). While challenging, this should be achievable given around 70% of the urban population are currently within 400m of a public transport route. To achieve this target, public transport use should be more convenient, reliable and cost effective than private car use.

Increasing public transport modal share will involve looking at the whole experience of a public transport journey, including the "first and last mile" journey to and from public transport routes. Improving the customer experience includes all of the following:

- quality of the public buses and trains;
- quality of the supporting infrastructure such as sheltered bus stops, clean stations, availability of real time information on departures;
- level of service from the driver and other customer-facing staff such as ticket sellers;
- network integration and frequency of services;
- reliability of time of arrival at destination;
- total door-to-door journey time;

- quality of journey from home to the public transport route and from the public transport route to the destination;
- value for money;
- ease of payment, such as integrated, smart ticketing;
- behaviour of other passengers; and
- perceived and actual personal security.

Initiatives to address many of these factors have been commenced. Surveys of users and non-users of public transport should continue to be used and should inform the design of social marketing initiatives and other interventions to promote public transport use, and to monitor progress.

Recommendation 52: *Continue coordination with local authorities for integrating transport and land-use policies.*

Local authorities are responsible for urban planning, which has a significant influence on transport demand and modal share. This can range from the improved integration of land-use planning with transport for commercial developments and residential/mixed use area developments, to the detailed design of local environments, such as providing sheltered walking routes to and from public transport stops.

Parking demand management and priority for public transport can have a vital impact on public transport uptake. Proposed developments should be required to provide a transport impact analysis, including parking management plans, with any mitigations identified being a required part of the approvals for the development. New developments should ideally be sited around existing or planned public transport routes.

Designated bus lanes in the city, which are kept clear through strict enforcement and penalties, help public transport compete with private transport in terms of journey times and reliability of time of arrival at destination. Enforcement of parking rules, including informal parking, can also be significant contributors to increasing modal share of public transport.

APPENDIX A: PEER REVIEW TEAM MEMBERS

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APPENDIX B: ORGANISATIONS AND OFFICIALS CONSULTED

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