AUSSENWIRTSCHAFT AUSTRIA

AUSSEN WIRTSCHAFT BRANCHENREPORT MALAYSIA

ERNEUERBARE ENERGIEN

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TRENDS UND CHANCEN FÜR ÖSTERREICHISCHE FIRMEN
VERANSTALTUNGEN UND MESSEN
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1. INTRODUCTION TO MALAYSIA: SOCIETY, ECONOMY, POLITICS

A federal constitutional monarchy, Malaysia consists of 13 states and 3 federal territories. Its landmass is separated into Peninsular (where the country's capitals Kuala Lumpur and Putrajaya can be found) and East Malaysia on Borneo by the South China Sea.

The population of Malaysia is estimated at 32.6 million in 2019, an increase of 200,000 compared to 2018. The total population consists of 29.4 million (90.2%) Malaysian citizens and 3.2 million (9.8%) non-citizens. The Malaysian population is made up of a wide variety of ethnic groups. 23% of the Malaysian population is under the age of 15 and 70% are between the ages of 15 and 64, making the average population relatively young. Due to the multicultural demographic, the majority of the residents grow up multilingual and speak at least two languages fluently. In large cities this generally includes English, which is the language of business throughout the country.

Malaysia ranked 55th out of 157 countries according to the World Bank's Human Capital Index. In order to realize the full potential of its population, it will greatly need to make further progress in education, health and nutrition, as well as in the outcomes of social protection. Improving the quality of school education, rethinking nutritional interventions and providing adequate social protection are therefore among the main priority areas.

Malaysia is one of the leading nations in the Southeast Asian economic area: the gross domestic product (GDP) per capita was estimated at USD 10,270 in 2020, only behind Singapore and Brunei, and has almost doubled since 2005. Today Malaysia can be seen as a stable emerging country with a diversified economy. In addition to a traditionally strong agricultural sector, the production and service sectors also make a large contribution to the economy today. Meanwhile, the country has become a leading exporter of electrical appliances, electronic parts, and components.

According to the World Bank, Malaysia is one of the most investment-friendly economies in the world (ranking 12th for Ease of Doing Business in 2020). This has been a major contributor to job creation and income growth. After the global financial crisis in 2019, the Malaysian economy recorded average growth rates of around 6%. However, this growth slowly flattened out over the years and was 4.3% in 2019. According to Bank Negara (Malaysia's central bank), this was the lowest economic growth since the great financial crisis and was mainly due to lower production of palm oil, crude oil and natural gas, as well as a decline in exports amid the trade war between the US and China. Due to the unstable political situation and the effects of the Covid-19 virus, the economy shrunk by 5.6% in 2020.

In 2021, Malaysia was under a state of emergency between January to August, and a resurgence in cases prompted the government to declare a nationwide lockdown on June 1st to curb the spread of the coronavirus. The tightening of containment measures will push the country back into recession for the first half of this year. However, a modest recovery by end-year can be foreseen, due to the country's strong vaccination rollout as of July, and the government's National Recovery Plan. As of October 11th, almost all states are fully reopened, and Malaysians are allowed both inter-state and international travel, provided they have been fully vaccinated. As of November 1st, over 95% of the adult population, and over 75% of the general population have been fully vaccinated.

The current economic indicators per the Economist Intelligence Unit (EIU) forecasts (as of November 2021) are as follows:

Key indicators

	2021[a]	2022[b]	2023[b]	2024[b]	2025[b]	2026[b]
Real GDP growth (%)	3.8	4.0	4.6	4.4	4.7	4.6
Consumer price inflation (av; %)	2.4	2.5	2.2	2.0	2.1	2.2
Government balance (% of GDP)	-6.0	-5.4	-4.3	-3.9	-3.8	-3.6
Current-account balance (% of GDP)	2.7	3.5	3.7	3.6	3.1	3.2
Short-term interest rate (av; %)	1.9	2.2	2.7	3.2	3.6	3.6
Unemployment rate (%)	4.6	4.4	4.1	4.0	3.6	3.4
Exchange rate M$:US$ (av)	4.15	4.21	4.15	4.07	4.01	4.00

[a] EIU estimates. [b] EIU forecasts.

A detailed statistical analysis can be found in the Country profile Malaysia.

In the medium term, it is expected that Malaysia will successfully transition from an "upper middle-income economy" to a "high income economy" by 2024. According to the World Bank, Malaysia's economy will depend heavily on government measures to strengthen the private sector in the short term. Currently, the external environment makes export-oriented growth difficult, while local or investment-based expansion remains limited as the country recovers from the pandemic.

In the long run, economic growth will depend on increasing productivity levels. Although the productivity level in Malaysia has risen sharply over the past 25 years, it was still below that of several regional countries by comparison. Ongoing reform efforts are crucial.

At the political level, Malaysia is also far from stable. In 2018 the ruling coalition Barisan Nasional, which had been the dominant party, was defeated by the opposition for the first time since Malaysia's independence. This gave the country a strong, if temporary, upturn in sentiment. However, the resignation of the Prime Minister two years later, in February 2020, and that of his successor in August 2021, showed that the country still appears to be at a political impasse even after a change of government. You can find more about the current political situation in our Economic report Malaysia, as well as our Malaysia country report.

2. STATUS QUO

Malaysia's Economic Relations with Austria

The importance of Malaysia for Austrian foreign trade is often underestimated and lesser known compared to other countries in the ASEAN community. In reality, however, the situation is very different, as the following graphic illustrates.

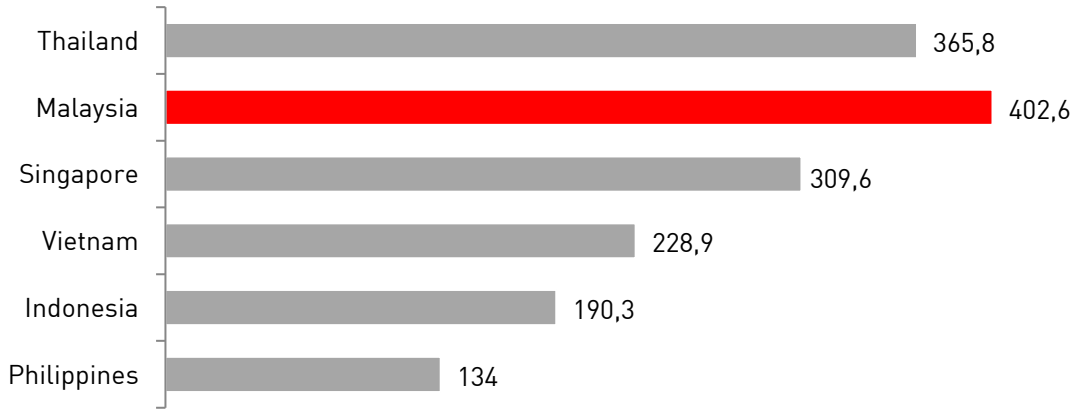


Illustration 1: Foreign trade - Austria's exports to the most important ASEAN countries in million euros (source: Statistics Austria, 2021)

With 402.7 million euros in Austrian exports, Malaysia ranks first among the ASEAN buyer countries in 2020. Thailand is in second place with EUR 365.8 million, followed by Singapore and Vietnam. Due to the effects of Covid19, all of the countries saw a steep drop from 2019, but the recovery in 2021 is particularly promising for Malaysia, with 245.5 million euros in the first half of 2021, a 19.9% growth from the same period in 2020. Singapore also shows a strong recovery, but it is important to note that some of the goods exports reported for Singapore also have their final destination in Malaysia.

In 2020, exports of manufactured goods were valued at RM847.66 billion, with E&E products holding the biggest share of Malaysia's total exports in 2020 at 39.4% or RM386.11 billion, an increase of 3.5% from 2019.

Other manufactured products that recorded significant growth in exports for 2020 were:

- Rubber products, ↑68.9% to RM43.64 billion;
- Other manufactures (SSD), ↑24.2% to RM38.78 billion;
- Optical and scientific equipment, ↑4.1% to RM41.55 billion;
- Iron and steel products, ↑7.2% to RM23.55 billion; and
- Wood products; ↑1.9% to RM16.08 billion.

In tandem with rising global demand for personal protective equipment (PPE) due to COVID-19 crisis, Malaysia's exports of rubber products notably rubber gloves recorded strong growth in 2020, doubling to RM35.26 billion from the previous year.

Malaysia's wealth of fossil resources has attracted a large number of foreign investors to the country over the past few decades. The well-developed infrastructure and low energy prices have made Malaysia an international industrial mecca. Many of the world's largest companies have settled here and set up their corporate headquarters. This period was marked by rapid economic, prosperity and population growth. However, this boom also had its downsides, as the development of water supply, sewage and waste management systems was not on par with the growth of the population, leading to ongoing issues up to today. In addition, the industry was not geared towards the sustainable use of resources, greatly increasing the pollution and waste per capita.

In 1990, CO2 emissions in Malaysia were 3.1 tonnes per capita; due to continuous annual growth rates, consumption of 8.1 tonnes was measured in 2014 - this corresponds to an increase in CO2 emissions per capita since 1990 by more than 200%, but has since dropped to 7.6 in 2018, a sign of the efforts to reduce emissions. The following graphic is used for an international comparison of CO2 emissions. By 2030, CO2 emissions in Malaysia are to be reduced by 45% of the 2005 level.

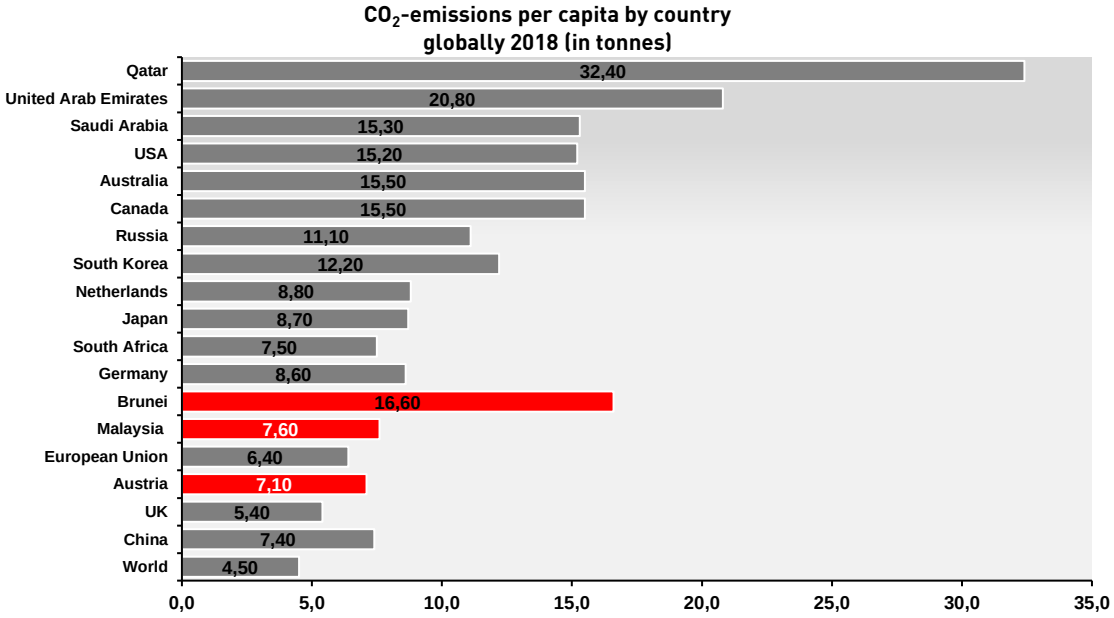


Illustration 2: CO2 emissions per capita, Source: World Bank (2018 as the last available year)

Malaysia's National Energy Policy (1979) set out to ensure the more cost-effective use of resources and more efficient use of energy. Until the late 1990s, the Malaysian government officially followed a "Four Fuel Policy", originally announced in 1981 with the aim of reducing dependence on oil as a source of electricity generation by introducing more coal and gas as energy sources. As a result, natural gas became Malaysia's main energy supplier, followed by oil and coal and hydropower. The Five Fuel Diversification Policy, which came into effect in 2001, added renewable energy to the mix.

Malaysia is rich in conventional energy resources such as oil, gas, and coal, but has recently intensified their focus on renewable energy such as hydropower, biomass, and solar. While some coal and gas power plants remain planned or under construction, the government and electricity producers have made concerted efforts to develop more energy-efficient technology improvements for power generation equipment.

The demand for electricity has increased considerably in recent years and will continue to increase in the future, in tandem with economic growth. Between 2012 and 2016, the average annual growth rate in electricity consumption was around 6%. The per capita energy consumption in Malaysia (5.1 MWh in 2019), while not alarming compared to other countries (the world average in 2019 was 3.3 MWh, with Austria at 8.3 MWh), is notable in its rapid increase in consumption, which is directly comparable to the country's economic growth (2.9 MWh in 2005).

While conventional energy sources will doubtlessly remain an important part of the country's energy mix, the share of renewable energies is to be expanded significantly with the introduction of new policies and targets: the goals have also increased from an initial 20% by 2025 to 31% RE contribution in the same period. Companies have also started to take renewable energy seriously as a profitable industry. Projects in this field are now supported by the government through many different initiatives and grants in order to pave the way into an age of environmentally conscious behaviour. This creates some exciting opportunities for Austrian companies on the Malaysian market.

VIEW IN THE FUTURE

Forecasts by the International Energy Agency (IEA) predict a continuously increasing energy demand in Southeast Asia. By 2030, demand is expected to have increased by 30%. The ASEAN member states have therefore agreed to a multilateral energy cooperation (the ASEAN Plan of Action for Energy Cooperation, APAEC), as well as committed to increase their share of renewable energies with an accelerated transition. The aspirational targets are a 23% share of RE in the region's energy mix, and 35% in installed capacity by 2025. To achieve these targets, the countries are both enhancing their respective national policy options and targets, as well as their strategies to accelerate their RE development.

For Malaysia, this includes the deployment of large-scale renewable energy systems, increasing infrastructure investment, and promoting smart grids, as well as improving the available technology and digitalisation. In particular, advanced RE technologies that are being explored are waste-to-energy, green hydrogen, energy storage, and solar thermal.

Although Malaysia has the shortest history of promoting renewable energy in Southeast Asia, it nevertheless has the fastest development in the region, and has surpassed its initial targets set for 2025, leading to a renewed higher target (from 20% to 31%). The current approaches and efforts suggest that there is great interest in achieving the set goals and that the country will take significant steps forward in terms of development. That is why Malaysia is certainly one of the most interesting ASEAN markets at the moment.

Furthermore, Malaysia offers the highest production density in this sector in Southeast Asia. With an expected increase in electricity demand, a corresponding infrastructure is required. According to Tenaga Nasional Berhad (TNB), the country's national energy provider, they foresee an increase in demand from 18 GW to 30 GW over the next 15 years.

Despite their swift advances in the sector, Malaysia still has a lot of catching up to do in some areas, particularly to guarantee stability and security of their energy supply. This presents manifold opportunities for Austrian companies in the sector who might have technological advancements suitable for the market.

The 11th Malaysia Plan (2016-2020) & 12th Malaysia Plan (2021-2025)

In its five-year plans, the Malaysian government regularly sets the strategic goals and formulates fundamental commitments to the economic policy pursued. Since the 8th Malaysia Plan (2000-2005), renewable energies and general issues of sustainability have played a role in Malaysian economic planning.

Despite initially modest goals from the 8th -10th plans, many of them were not realised due to cost issues. For the 11th Malaysia Plan of 2016-2020, the target was set at a fairly ambitious 2080MW, which they did manage to achieve and surpass, with the final actual installed capacity of 2774MW (excluding large hydro).

Further goals of the 11MP in the area of sustainability and environmental protection are:

- The reduction of greenhouse gas emissions up to 40% compared to the values from 2005
- Achieving a minimum quota of 20% for green investments in public tenders
- Achieving a national recycling rate of 22%

Meanwhile, the 12th Malaysia Plan has recently been announced in October 2021, wherein the topics of renewable energy, energy efficiency, as well as mitigation of climate change continue to be an integral part of the plans.

The new goals include a pledge for Malaysia to become a carbon neutral country by 2050 "at the earliest", alongside other measures to accelerate green growth.

CARBON NEUTRALITY: Although Malaysia only contributes 0.7% of global greenhouse gas emissions (GHG), the government would continue to fulfil its commitment to reduce its GHG emission intensity of GDP by 45% (based on 2005 levels) by 2030. While neighbouring countries plan for carbon neutrality between 2060 and 2070, Malaysia's carbon neutrality pledge is easily the most ambitious in Southeast Asia.

NO NEW COAL POWER PLANTS: The government pledged that it would no longer build new coal-fired power plants. Cleaner electricity generation will be implemented through the operation of several gas power plants in Peninsular Malaysia to replace coal-fired power plants. This would also be supported by energy efficiency and conservation laws to regulate consumption by high-intensity consumers in the industrial and commercial sectors.

NATIONAL ENERGY POLICY: A comprehensive National Energy Policy will soon be introduced to provide a long-term strategic direction. This includes the target for Renewable Energy generation from solar, biomass and biogas to increase to 31% of the total installed capacity in the country by 2025, as well as an expected total of 120 cities to achieve sustainable city status in the same timeframe.

CARBON PRICING: Economic instruments such as carbon pricing and carbon tax would be implemented. A Domestic Emissions Trading Scheme (DETS) is also being developed by the Environment and Water Ministry, in cooperation with the Finance Ministry, Bursa Malaysia and other stakeholders. The implementation of DETS in planned in phases, with a single business platform that could be leveraged by state government authorities and the private sector to execute carbon credit transactions at the domestic level. A tax may also be levied on GHG emissions in order to reduce the combustion of fossil fuels.

ELECTRIC VEHICLE TECHNOLOGY: The Malaysian government is also prioritising the development of energy-efficient vehicles (EEV) production to support environmentally friendly mobility initiatives. Alongside the cancellation of all related taxes for purchases of EVs, including import fees (usually the bulk of the cost of imported vehicles), the government is also expected to encourage investments in the production of EVs or their components and infrastructure support, including EV charging stations.

3. CONVENTIONAL ENERGY SOURCES

There are more than 3,500 local and international companies operating in the oil and gas industry in Malaysia. The Ministry of International Trade and Industry (MITI) in Malaysia is responsible for issuing licenses for the processing and refining of petroleum products. The Ministry of Domestic Trade, Cooperative and Consumerism (MDTCC) was also commissioned to license marketing and sales. Together, these two institutions regulate all of Malaysia's downstream activities.

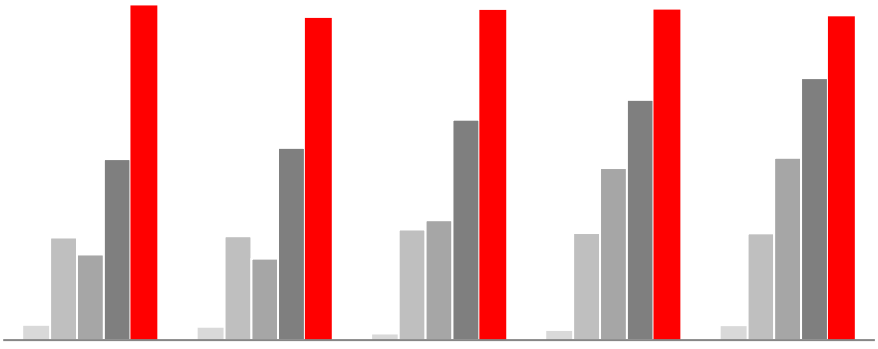
With the Petroleum Development Act (1974), the government gave all of Malaysia's petroleum resources to the state-owned Petroliam Nasional Berhad (PETRONAS). As the trustee of all Malaysian oil and gas resources, Petronas has grown to become one of the largest oil and gas companies in the world since it was founded in the 1970s. Petronas businesses cover large areas of the oil and gas value chain: exploration, development, production, transport and logistics, marketing and distribution of crude oil, natural gas and natural gas products in Malaysia and overseas, as well as liquefaction, transport and sales of liquid natural gas (LNG).

Since oil production reached its all-time high of 294 million barrels per year in 2004, production in Malaysia has been falling continuously. Malaysia's total proven oil reserves were 4.55 billion barrels in 2018. Malaysia's exports of petroleum-based products amounted to RM 142.8 billion (EUR 30 billion) in 2019 and thus accounted for around 15% of total exports. More than half of Malaysia's petroleum-based product exports go to Singapore (16%), China (14%) Japan (13%) and Australia (8%).

Malaysia has one of the best-developed natural gas pipeline networks in the ASEAN community, and its natural gas supply for the electricity supply industry is domestically sourced from Petronas with prices slightly discounted to international market prices. It is one of the most important net exporters of natural gas worldwide. However, coal is entirely imported from markets like Indonesia and Australia, used to fire power plants due to its cheaper cost compared to oil.

While Malaysia has large coal deposits on Borneo (Sarawak & Sabah), these have only been used to a limited extent because they are of low quality and are also difficult to access. However, mining has increased rapidly in recent years, with coal production to be increased further as a more cost-effective basis for electricity generation in Malaysia's industry, especially the iron and steel sector.

In 2018, 64,658 ktoe (kilotons of oil equivalent) of energy were consumed in Malaysia. Not surprisingly, the transportation and industrial sectors are among the top spots in the rankings.



	2014	2015	2016	2017	2018
agriculture	1045	895	415	674	1021
residential and commercial	7458	7559	8049	7796	7774
non-energy use	6217	5928	8729	12517	13262
industry	13162	13989	16019	17463	19046
transport	24327	23435	24004	24039	23555

Illustration 3: Energy consumption by sector 2014 - 2018 in ktoe (Suruhanjaya Tenaga, 2020)

With fossil fuels dwindling, the Malaysian government is feeling the urgency to find alternative energy sources, especially considering that oil reserves will run out in Malaysia in the next 20 years and gas in the next 30 years.

In 2021, according to a statement made by the Prime Minister's Department (Economy), Malaysia's energy mix is led by natural gas (41%), crude oil (25.8%), coal (22.3%) and hydro (6.2%), with renewable energy making up the balance (4.7%). This shows a large jump in RE contributions since the IEA's statistics of 2019, where natural gas contributed 42.9%, crude oil 29.2%, coal 24.4%, and hydro 2.5%, meaning RE only made up 1% of the energy mix.

While there is still a long way to go to achieve the 31% RE capacity by 2025, the sharp growth (over +180% annually) is promising and shows the commitment made by the government to achieve its ambitious goals. In order to promote the expansion of renewable energies, the Ministry of Science, Technology and Innovation (MOSTI), the Green Technology and Energy division of the Ministry for Energy, Green Technology and Water (formerly KeTTHA) and the divisions relating to climate change and the environment of the Ministry of Natural Resources and Environment (formerly NRE) have been merged. This created the Ministry of Energy, Science, Technology, Environment and Climate Change (MESTECC) in 2018. After another change of government, it was renamed the Ministry of Science Technology & Innovation (MOSTI).

Companies are also increasingly exploring renewable energy or energy efficiency, even ones traditionally in the O&G space. A prime example is Petronas, who is building up another pillar in the RE market, acquiring companies in the solar energy sector. In 2019, Petronas launched its first solar roof solution in Malaysia, (M + by PETRONAS). It is intended to represent a flexible and inexpensive solar solution that is designed for both commercial and industrial use.

Petronas is also collaborating with one of Malaysia's leading research universities, Universiti Kebangsaan Malaysia, to create sustainable energy solutions, and has so far invented an electrolyser design that enables better hydrogen yield with lower power consumption.

Tenaga Nasional Berhad (TNB), the only power company on the Malaysian Peninsula and the largest publicly traded energy company in Southeast Asia, founded its subsidiary TNB Renewables Sdn Bhd (TRe) in 2015 as part of a transformation program intended to help make the company one of the 10 largest electricity suppliers in the world. TRe covers several segments to expand the RE area in the local market, including Large Scale Solar (LSS), biomass and biogas projects, and emerging technologies such as battery energy storage systems (BESSs) and microgrids and virtual power plants (VPPs).

Another example of transitions towards improved energy efficiency is the recent Pulau Indah Power Plant (PIPP) project, a 1,200MW plant in Pulau Indah, Selangor, Malaysia, featuring a natural gas powered Combined Cycle Gas Turbine (CCGT) with an efficiency of more than 60%, much higher than its coal or oil equivalent.

4. RENEWABLE ENERGY

The IEA definition of renewable energy includes the following sources: "electricity and heat derived from solar, wind, ocean, hydropower, biomass, geothermal resources, and biofuels and hydrogen derived from renewable resources". For Malaysia, according to its Sustainable Energy Development Authority (SEDA), the relevant sources are:

- Biomass
- Biogas
- Hydropower*
- Solar photovoltaic

*Note: While large hydropower certainly plays a significant role in the nation's energy generation, it did not figure into the government's definition of Renewable Energy until 2021. This inclusion is also a factor in propelling the sharp growth of Malaysia's RE contribution to its targets.

A key goal of the government in Malaysia is to grow into a green economy in which green technologies make significant contributions to the nation's GDP. The establishment of green cities and increased subsidies for technology in the spaces of Renewable Energy and Energy Efficiency, make Malaysia even more interesting as a business location, and is predicted to bring in high levels of foreign direct investment.

SOLAR POWER

Geographically, Malaysia is ideal for solar power generation due to its proximity to the equator ensuring stable temperatures, a high average solar radiation, and over 2,200 hours of sunshine a year (over 6 hours/day, for an average PVOUT of 3.4 to 4.2 kWh/kWp).

Aside from the production of solar energy itself, this is also promising for the production and sale of the necessary equipment. Prices for solar panels have also continuously decreased over the past two decades, which makes solar energy increasingly attractive. Together with government incentives such as the Feed-in Tariff (FiT) and the Net Energy Metering (NEM) programs, and growing conscience of ESG goals, interest in solar energy has spiked in recent years: PV solar systems accounted for 63% of the total installed capacity of the commissioned renewable energy systems (RE) in the 2012 – 2018 period, while 2014 – 2019 saw solar as a RE source growing by 432% in installed capacity.

Solar Manufacturing

Malaysia is the third largest solar cell and module manufacturer in the world, after China and Taiwan, exporting mostly to the US, Singapore, and Hong Kong. Malaysia is also the largest supplier of solar cells and modules to the US. Chinese manufacturers, in face of trade disputes and tariff hikes, found a workaround by shifting production to other countries like Malaysia, which has further strengthened its position in the industry.

Malaysia has a complete solar energy industry value chain, from materials and PV modules manufacturing, to system integration. 7 of the 11 largest solar PV companies have operations in Malaysia, including First Solar, Longi, SunPower, Hanwha Q Cells, Jinko, and JA Solar. However, it must be noted that a large amount of the manufactured items are for export and not necessarily domestic usage, as solar energy remains in its infancy in Malaysia, representing less than 2% of total energy mix.

Photovoltaic

Photovoltaics is a technology that converts short-wave radiation energy into electrical energy, based on a physical process called the photovoltaic effect. This technology is extremely resource-saving, as it neither affects the air nor does it require an exhaustible resource. In order to optimize the use of the individual cells, they are often linked to one another in the form of modules. These modules are currently used in rural areas and in the form of isolated solutions, but this requires funding from the state.

In Malaysia, power generation from solar energy is monopolized by photovoltaic solar, due to a lack of knowledge regarding solar thermal technology. Most of the government initiatives and incentives related to solar energy are dedicated to PV technology, for example, the FiT scheme is limited for only four sources of renewable energy namely solar PV, Biomass, Mini Hydro and Biogas.

However, the issues with PV is that the installation of solar systems requires specialist knowledge and professional maintenance for long-term use. Compared to production, there is little expertise in this area in Malaysia and solar systems are often not maintained after installation, which slows down amortization. Therefore, even despite costs for solar PV dropping markedly, there is still hesitancy especially in the residential segment, where the initial overheads are too high a risk for the average customer.

The commercial sector is more accepting of PV and RE in general, due to corporate ESG goals and government incentives. There are also multiple agencies dedicated to assisting businesses to implement RE with financial assistance or shared savings plans.

There are several major solar energy projects. Among the government-led projects are a 50 MW solar park in the state of Selangor in 2018 and a 30 MW solar park in the state of Kedah in 2020, both of which are performing ahead of schedule; while in the private sector, 2 out of 4 Scatec Solar power plants are in operation.

Building Integrated PV (BIPV) is also increasingly important in Malaysia. The market for this is growing rapidly as the products are becoming more and more flexible and creative in terms of color and function, which means that solar cells can have a positive influence on the design of buildings and become a symbol of energy-efficient construction, design and modernity. BIPV is estimated to have a total potential of 11 GWp and could cover 20% of the energy demand through optimal use of the available surfaces.

Feed-in tariff

Solar photovoltaics (21-year contract):

Base FiT rate with installed capacity	2018 (RM / kWh)	2019 (RM / kWh)	2020 (RM / kWH)	2021 (RM / kWH)
up to and including 4 kW	0.6682	0.6014	0.5413	0.5413
Between 4 and 24 kW	0.6519	0.5867	0.5280	0.5280
Between 24 and 72 kW	0.4435	0.3770	0.3205	0.3205
Between 72 kW and 1 MW	0.4285	0.3642	0.3096	0.3096
Bonus payments	0.05-0.1256	0.05-0.1130	0.05-0.1017	0.05-0.1017

Illustration 4: FiT Rates, Source: SEDA

*any updates to new rates in the future will be published on SEDA's site.

Solar Thermal

Meanwhile, in Malaysia solar thermal is used almost exclusively for domestic water heating and while there is potential in this, it still remains under-explored. The government is now trying to intensify this, with passive systems in particular used in households, which are not only cheaper, but also easier to install and are well suited due to the climatic conditions. These systems are mainly used in residential areas in which there has not yet been a connection to the power grid and electrical water heaters cannot be used.

Hospitals are becoming a key interest for this sector as well, as they require warm water all day long, which means there is a potential saving of around 30%. There is also potential in tourism, for example in spas or hotels or in the food industry. Here, too, the government tries to set a good example, unfortunately all too often with prestige projects. The Awana Kijal Golf & Beach Resort in Terengganu is one of the hotels that now use solar energy to heat their hot water. Although this system only takes over 35% of the hot water supply, the investment has already been completely amortized within six years.

Solar thermal heating technology has a great potential in industrial application. Unfortunately, the enabling policy framework and support programs in Malaysia for RE have focused on solar PV for grid electricity power generation over thermal applications, despite the fact that large portion of the energy in the industrial sector is expended for heating requirement. Apart from domestic solar water heaters, the government does not yet have policies, incentives or standards that specifically target larger-scale solar thermal system applications in commercial buildings or in industrial applications.

Malaysia's National Energy Statistics Handbook 2020 reported that total final energy demand in 2018 was 64,658 kilotonne of oil equivalent (ktoe). From this demand, 29.5% was used by industry. Of this amount, the heating requirement accounts for a large portion i.e. approximately two-thirds of the total energy use. Therefore, solar energy has a big potential, especially given the fact that 30% of the total industrial process heat demand requires temperature below 100°C, which can be met by commercially available solar thermal collectors.

There is also potential for the application of solar thermal technology in cooling – while heating is important to the industrial sector, in the residential segment, it remains limited to water heating. Due to Malaysia's tropical climate, a bigger concern is cooling – in urban areas most houses (approx. 68%) have at least one air-conditioning (AC) unit, where it contributes between 26-50% of total energy consumption (depending on number and type of units). Meanwhile almost all commercial and office buildings have central AC, with a 42-57% share of total energy consumption. However, solar thermal's potential for cooling has not been explored, notably to either lack of access to the right technology, or high costs incurred.

Due to the space it requires, solar thermal energy competes with the palm oil industry, one of Malaysia's biggest industries. Another problem is the time factor: warm water is required in the morning and in the evening, but the highest amounts are produced at noon. This makes the installation of storage facilities necessary, further raising costs, as well as increasing the space requirements.

BIOENERGY

Importance of Palm Oil to Bioenergy

Bioenergy in Malaysia largely originates from the oil palm industry, with large contributions from biofuel and biomass. The reason for this is obvious, with over 4.2 million hectares of oil palm plantations, and Malaysia being the world's 2nd largest producer of palm oil (25.8% of world production), which leads to a large amount of raw materials for the production of biomass, which can be harvested all year round due to the climatic conditions.

Only about 5% of Malaysia's palm oil production goes directly into food processing. The remaining oil goes to industry and is processed there. The further processing is divided into three large areas, with the olein refinery having the largest share. The production of oil palm Empty Fruit Bunches (EFB) and Palm Oil Mill Effluent (POME) account for the highest proportion of waste. POME is then used to produce biogas, while EFBs are usually used to generate energy from biomass.

China is the largest export market for palm oil from Malaysia. China's imports are almost twice as high as those of the second-ranked importer, the EU. Approximately 12% of Malaysia's palm oil exports go to the EU, which in turn makes up 28% of total EU palm oil imports. Over the past few years, the consumption of palm oil in food in the EU has steadily decreased. However, its use as a biofuel has increased at the same time. In 2019, the EU imported more than 7 million tonnes, with around 65% used for energy.

However, also in 2019, the European Commission decided that palm oil cultivation leads to excessive deforestation and should not count towards renewable energy targets. As a result, biodiesel based on palm oil is no longer viewed as renewable and its use as a transport fuel will in fact end from 2024. This has created a strong point of contention between the EU and Malaysia as well as Indonesia, the world's largest supplier, and the two ASEAN countries are trying to discuss the issue with the EU in order to protect the income of their domestic palm oil industry.

As part of the efforts to assure sustainability of the industry, many initiatives have been undertaken by the public as well as private sector, in particular:

- Under the Malaysian Palm Oil Board (MPOB) licensing requirements effective Jan 1, 2014, new mills are required to trap/avoid methane gas emissions from palm oil mill effluent (POME). By 2019, 125 palm mills out of 452 had biogas plants, with 30 connected to the national electricity grid as green electricity.

- The possible revival of the production of bio oil using biomass-to-liquid technology as per Entry Point Project 7 (EPP 7) of the Palm Oil National Key Economic Area that was shelved in 2018.

- Much work is also going on to reduce palm oil loss at the mill. The industry uses the term "oil extraction rate" (OER) and in Malaysia, this is between 19% and 21%. Based on the global production of palm oil in 2018, about three million tonnes of additional palm oil can be produced globally with a 1% increase in OER. Conversely, in both instances, less land will be required.

- Oil palm biomass to increase in demand as the second-generation biofuel, not only be for palm kernel shells (PKS) and palm mesocarp fibres (PMF) but also the less-easy-to-use empty fruit bunch (EFB). The palm mill would be a self-sufficient production unit in terms of energy when it uses its own biomass and biogas, and such a mill could be considered to have net-zero carbon emissions.

- The industry has availed itself of digitalisation across all sectors. Currently, it is widely used for production management, improving efficiency, reducing cost and increasing productivity. A 3% to 4% increase in OER as a result has been claimed.

Biomass

Biomass is in a solid aggregate state and comprises non-fossil and biodegradable material, including products, by-products and residues from agricultural, industrial or municipal waste. Biomass is the main source of renewable energy in the country.

Palm waste and residues can be converted perfectly into biomass energy, which makes the palm oil industry the most important potential supplier to the biomass sector by far: about 88% of the existing biomass comes from this industry. For every hectare of a palm oil plantation, between 50 and 70 tonnes of biomass material can be generated annually.

Biomass conversion technology converts renewable biomass fuels into heat or electricity. The most widely used method currently is direct combustion, where biomass fuel is burned in a boiler to generate high-pressure steam. This is fed into a steam turbine, connected to a generator to produce energy.

Under palm biomass, the empty fruit bundles, fibres, casings or stems each have a different intensity for generating energy:

Component	**Amount available (Million tonnes)**	**Calorific value (kJ / kg)**	**Energy potential (Mtoe)**
Empty Fruit Bundles (EFB)	17.0	18,838	7.65
Fibers	9.6	19,068	4.37
Sheaths	5.92	21,108	2.84
Shells / stems	21.1	-	-
Cores	2.11	18,900	0.95
total	55.73		15.81

Source: Ahmad et al.

To a significantly lesser extent, other materials like bagasse and waste from sugar cane, rice hulls and waste wood are also used for the production of biomass. Of the biomass produced annually, 80 million tonnes of dry weight are fibrous palm oil biomass, 6.2 million tonnes of sawdust and other waste come from the wood processing industry, while household waste contributes 2.6 million tonnes of organic waste, and the residues from rice and sugar cane cultivation are around 1.2 million tonnes.

By 2030, biomass in Malaysia is expected to increase by 67.5% to 1,340 MW of installed capacity.

Feed-in tariff
Biomass (16 year contract):

Base FiT rate with installed capacity	2019 (RM per kWh)	2020 (RM per kWh)	2021 (RM per kWh)
up to and including 10 MW	0.3085	0.3085	0.3085
Between 10 and 20 MW	0.2886	0.2886	0.2886
Between 20 and 30 MW	0.2687	0.2687	0.2687
Bonus payments	0.01-0.05	0.01-0.05	0.01-0.05

Source: Sustainable Energy Development Authority Malaysia (SEDA)
*any updates to new rates in the future will be published on SEDA's site.

Biodiesel/Biofuel
The gradual depletion of fossil resources has led to renewable energy development, to cater to the demands in the future. Biofuel is alternative fuel conventionally made out of food crops such as palm, rapeseed, soybean and sunflower oils. Malaysia, being the world's second-largest producer of palm oil, has abundant raw materials for biofuel production.

Alternatives to palm oil, sourced from used cooking oil (UCO), palm fatty acid distillate (PFAD), palm oil methyl ester (POME) and algae later led to the production of second-generation biofuels, also known as advanced biofuels. Non-food crops, including lignocellulosic feedstocks, industrial waste and residue streams, also produce these biofuels.

In Malaysia, biofuels are largely used in the automotive and energy industries, but can also be used in various types of machinery without any modification to compression ignition engines designed to operate on diesel fuel. Biofuels are also becoming more and more interesting for aircrafts. There are now airlines whose tanks are filled with recycled cooking oil. This also creates interesting opportunities for the palm oil industry. Together with Airbus, AirAsia (Asia's largest low-cost carrier) announced in 2019 that it will invest more in research and development for biofuels for aviation and will soon be introducing biofuel for scheduled flights.

This move would likely lower the company's fuel costs and reduce carbon emissions. However, there is still a lot of work to be done in research and development in aviation biofuels, including extensive studies of how the alternative fuel burns compared to traditional kerosene. The airline's initiative to develop its biofuels for aviation is made possible by technical support from aircraft manufacturer Airbus. In order to provide more funding for joint research programs, Airbus plans to increase participation in the Aerospace Malaysia Innovation Center (AMIC).

The Government of Malaysia released its National Biofuel Policy in 2006, that encourages the use of biofuels, spelling out a comprehensive framework with concrete initiatives in line with the objectives of the United Nations Framework Convention on Climate Change (UNFCCC). The Policy envisions that biofuel will be one of the five energy sources for Malaysia, enhancing the nation's prosperity and well-being, and prioritises the use of environmentally friendly, sustainable and viable sources of energy.

Its key objectives are:

- supplementing the depleting supply of fossil fuels with renewable resources;
- mobilising local resources for biofuels;
- exploiting local technology to generate energy for the transportation and industrial sectors;
- paving the way for exports of biofuels; and
- benefiting from the spin-off effect of more stable prices for palm oil.

In 2007, the Malaysian Parliament passed the Biofuel Industry Act, which included provisions from the National Biofuel Policy, to implement a biodiesel blend mandate. The Malaysian Palm Oil Board (MPOB), under the Ministry of Plantation Industries and Commodities (MPIC), is entrusted to implement the mandate nationwide.

Many challenges remain for biofuel: one of the main challenges in implementing biofuels is the users' perception of the quality of biofuels produced locally, with concerns on the use of local biofuel production technology in meeting the stringent international biodiesel specifications. This has led to the rollout of awareness programmes in collaboration with relevant agencies to increase acceptance of local biofuels, and proving that Malaysia produces one of the high-quality palm oil in the world.

Another major issue in the Malaysian biofuel industry is its slow implementation of policies. The rollout of the initial B5 (5% biofuel blend), and the subsequent plans (B7, B10, B20) have all suffered from long delays. Full national implementation of the B5, originally targeted for 2008, was not achieved until 2014, while the B10 programme for the transportation sector and the B7 programme for the industrial sector were only implemented in 2019.

The B20 programme for the transportation sector was launched on Feb 20, 2020, with implementation done in phases, starting in Langkawi and Labuan on Jan 1 and Jan 15, 2020, respectively and later in Sarawak on Sept 1, 2020. However, with the impact of Covid19 on the country, the programme's subsequent introduction in Sabah and Peninsular Malaysia have been postponed to 2022 in order to prioritise the nation's economic recovery.

The ever-changing specifications are also a hurdle in the biofuel industry. Europe is one the largest producer and consumer of biodiesels in the global market along with the USA and Brazil. Despite its growing trend in major end-user industries including automotive, power generation, marine and machinery, palm oil production suffers from stringent limitations on import to the USA and EU.

Malaysia's exports of palm-based biodiesel are likely to fall this year (2021) to their lowest since 2017 due to European Union restrictions and the COVID-19 pandemic, according to the Malaysian Biodiesel Association (MBA), which expects Malaysia's biodiesel exports to fall to 350,000 tonnes in 2021, from 378,582 tonnes in 2020.

MBA estimates the EU's total consumption of palm biofuel in 2019 was 6.2 million tonnes, but actual exports in 2021 will start at much lower levels because EU member states pushing for a no palm-biofuel agenda can set a lower limit. Malaysian biodiesel exports are unlikely to best the performance seen in 2019 due to the European Union's Delegated RED II Act, which has capped palm oil-derived biofuel use as part of renewable energy targets, set at 2019 levels.

Biogas

Biogas is defined as a resource in a gaseous state that is created by anaerobic digestion or fermentation of non-fossil and biodegradable organic material. This includes manure, sewage sludge, by-products and residues from agricultural, industrial or municipal waste. Biogas mainly consists of methane, but has significant amounts of CO2 and smaller amounts of hydrogen and nitrogen. Methane, hydrogen and carbon monoxide can be burned, which allows it to be used, for example, as fuel for gas engines.

It is estimated that the palm oil industry generates 80 million tons of solid waste and 60 million tons of liquid waste every year. The potential to recycle this waste to generate energy, especially in the form of biogas, has for the most part not yet been fully exploited. The industry is still in its infancy, but projects are in the works:

in August 2019, a contract was signed between TDM Bhd (subsidiary of the Terengganu state government), and Concord Biotech Sdn Bhd. The project is to include two biogas plants on palm oil plantations with a projected value of RM38 million.

In September 2019 it was announced that Cenergi SEA Sdn Bhd, a wholly owned subsidiary of Khazanah Nasional Bhd (Malaysia's sovereign wealth fund), had secured 9 biogas projects with a total project value of RM100 million. The loans are provided by the 50:50 joint venture between MIDF Amanah Investment Bank Bhd and China Construction Bank Bhd. The plants should each generate between 1MW - 2MW of electricity. Contracts for 16-21 years have been concluded for feeding into the Malaysian power grid.

Finally, as of 2021, biogas from some water treatment plants (WTPs) are now used to generate electricity and reduce operational costs. According to IWK (Indah Water Konsortium, the nation's largest water operator), there are currently six plants with facilities to reuse methane, with the potential of generating up to 10, 000m3 per day and produce 20MWh per day.

Feed-in tariff
Biogas (16 year contract):

Base FiT rate with installed capacity	**2019 (RM / kWh)**	**2020 (RM / kWh)**	**2021 (RM / kWh)**
up to and including 4 MW	0.3184	0.3184	0.3184
Between 4 and 10 MW	0.2985	0.2985	0.2985
Between 10 and 30 MW	0.2786	0.2786	0.2786
Bonus payments	0.0199-0.05	0.0199-0.05	0.0199-0.05

Source: Sustainable Energy Development Authority Malaysia (SEDA)
*any updates to new rates in the future will be published on SEDA's site.

WASTE TO ENERGY

In general, little focus has been placed on the recycling of waste from palm oil mills, as the FiT for biogas and biomass is not as attractive compared to PV and offers little incentive to generate renewable energies. However, it should be noted that around 8% of the biomass produced in Malaysia comes from household waste. This makes this area the second most important supplier of biomass after the palm oil industry.

Malaysia's municipal solid waste (MSW) is estimated at 38,294 tonnes per day (2020). This amount is projected to have a 3-5% increase in annual generation, and consists of 50% organic fraction (45% food + 5% garden waste), which makes it a potential landfill gas (LFG) source.

Aside from incinerators, Malaysia currently has two waste-to-energy (WTE) plants. The first was the Kajang Waste-to-Energy Plant commissioned in 2009, where MSW is converted into fuel for use in an integrated steam power plant. It generates 9 MW of electricity from 700 tonnes of MSW per day.

In 2019, the second WTE plant begun operations in Port Dickson, Negeri Sembilan, which takes in 600 tonnes of segregated and processed MSW to produce between 20-25 MW daily.

The Ministry of Housing and Local Government aims to have 6 more plants built nationwide by 2025, and the first one has begun transformation from landfill to WTE plant – Sungai Udang in Melaka, which is expected to receive 1000 tonnes of MSW to produce 25 MW of energy.

HYDROPOWER

Malaysia has relatively abundant hydropower resources, albeit unevenly distributed among the different states, with heavier concentrations in Sabah and Sarawak (of the total estimated hydropower potential, two thirds are located in Sarawak). So far, Malaysia has used this in the form of large and small power plants, with 12 large projects and 58 small hydropower plants in existence, and very little micro-hydropower being explored.

The first major hydropower dam, the Chenderoh Dam (27MW), was constructed in 1930. In the decades that followed, systematic development of the country's natural resources has contributed over 27,300GWh of energy annually from an overall installed capacity of 6240MW. This represents about 17% of total generation capacity (34,200MW) in the country.

The development of major hydropower projects in Malaysia is generally undertaken by the utility companies such as Tenaga Nasional Berhad (TNB) in Peninsular Malaysia, Sarawak Energy Berhad (SEB) in Sarawak and by the Sabah Electricity Sdn Bhd (SESB) in Sabah. Attempts by private players to participate in the development of major hydropower in Malaysia has met with very little success to date, and instead they play a more important role in the development of smaller hydropower projects (below 30MW) which incentivized by the Feed-in Tariff (FiT) mechanism managed by the Government.

Tenaga Nasional Bhd's (TNB) subsidiary, TNB Power Generation Sdn Bhd (TNB Genco) will develop a RM5 billion 300MW hydroelectric power plant at Mukim Ulu Nenggiri, Jajahan Gua Musang, in Kelantan. The construction is estimated to take five years, with the expected scheduled commercial operation date in June 2027. This project, which also involves collaboration with Austrian company Andritz Hydro, would reinforce the security of energy supply in Peninsular Malaysia, particularly to the eastern region.

A general future problem of hydropower generated from rivers is the expected water scarcity and drying out of the rivers in 10 to 15 years, as well as their heavy pollution. Thus, Malaysia's water management is under pressure.

Despite the importance of hydroelectric power in Malaysia, due to some of the associated environmental impacts of large hydropower dams, it is important to note that the government did not consider large hydro as part of the RE contribution basket until this year (2021).

Sarawak Corridor Renewable Energy (SCORE)

The Sarawak Corridor Renewable Energy (SCORE) is the most important growth engine for the rural areas of Sarawak. It was one of the five economic development corridors initiated under the Ninth Malaysia Plan to address development imbalances across the country.

SCORE spans an area of more than 100,000km², about 80% of Sarawak, which extends from the central region to the northern region of Sarawak. SCORE leverages on abundant clean renewable energy (hydro-electric power) and natural resources to drive energy-intensive industries and attract other investments into the area, with an investment volume of RM 334 billion forecast, of which RM 267 billion (80%) is expected from the private sector and the remaining RM 67 billion from the public sector.

As of end 2019, SCORE has 26 approved projects worth RM40.5 billion. If the SCORE development plan is fully implemented by 2030, it is also expected to have created 1.6 million new job opportunities. A list of open tenders under SCORE can be found on their website.

Both the federal and state governments provide a range of tax and incentives for investors within the SCORE region. The Federal tax and incentives include pioneer status tax exemptions, investment tax allowance and more. The Sarawak Government provides additional incentives such as competitive land prices, electricity tariffs and water rates, to motivate investors to get involved in energy-intensive industrial projects and in energy generation in general in Sarawak.

At the moment, three hydropower plants in Sarawak are connected to the electricity grid and several more are in various stages of development (planned projects between 2017-2026):

Bakun:	2,400 MW	Trusan 2:	240 MW
Murum:	944 MW	Baram 3:	300 MW
Belaga:	160 MW	Baleh:	1.285 MW
Limbang 2:	130 MW	Pelagus:	465 MW

HYDROGEN

Malaysia began exploring the use of hydrogen as an alternative fuel source for the energy sector as far back as the 1990s. Despite the introduction of dedicated road maps or blueprints, implementation was slow and and most of the targets were not achieved. One of the major challenges was developing a large-scale supporting infrastructure for hydrogen.

But as hydrogen is increasingly being considered globally as a potential fuel of the future to decarbonise the energy sector, Malaysia has restarted their explorations into hydrogen energy, notably in the state of Sarawak.

In Malaysia, Sarawak Energy Bhd (SEB) launched Southeast Asia's first integrated hydrogen production plant and refuelling station in 2019, in collaboration with Linde EOX Sdn Bhd, a subsidiary of the Linde Malaysia / Linde Group. The refuelling station was initially intended for Sarawak's three buses that use hydrogen fuel cells, donated by the Chinese car manufacturer Foshan Feichi Automobile Manufacturing. The buses began servicing routes in 2020 on a 14 km route through the capital Kuching, free of charge. Spurred on by the success of the pilot project, the government in Sarawak announced at the beginning of 2020 that it would build six more hydrogen filling stations. The filling stations are to be built in Kuching, Sri Aman, Sibu, Bintulu and Miri.

That same year, another state-owned agency, Sarawak Economic Development Corp's (SEDC) subsidiary, SEDC Energy Sdn Bhd, inked a tripartite MoU with Japan's Sumitomo Corp and ENEOS to build a hydrogen plant in Bintulu. The plant project, with a capacity of 1,000 tonnes per annum, is expected to be ready by 2023.

Also in 2020, SEB teamed up with Petronas to explore the production and supply chain for green hydrogen. This comes on the back of Petronas's experience in producing blue hydrogen, which is extracted from by-products at their facilities. The plant, which uses water to produce carbon-free hydrogen, covers the possibility of utilising Sarawak's renewable hydro power in the electrolysis process to produce green hydrogen and in doing this, generate renewable energy certificates.

Although production cost of hydrogen is currently high, over time and with efficient production technology, production cost would come down, leading hydrogen to become a competitive fuel source with other available fuels for the world.

Fuel cells for energy storage are also becoming increasingly important. The stored energy can then be released to support strong demands at peak periods or when other RE generators are offline. SEDC is conducting feasibility studies on the manufacture/assembly of hydrogen fuel cell components to expand the hydrogen economy in Sarawak, where the service stations could be fully converted to electric charging and hydrogen refilling in the future when the usage of battery and fuel cell electric vehicles has increased.

All these hydrogen initiatives by different players in Malaysia will be streamlined into a roadmap so that the industries and the government will have a clearer direction of what to do to develop a hydrogen-based economy. This roadmap will cover a 20-year horizon to 2040, to be updated every two years to keep up with changes in technology.

OTHER SOURCES

Wind energy

Wind energy can be generated more cheaply than solar energy, but in contrast is subject to fluctuations. Wind energy has next to no place in West Malaysia, as there is neither enough wind on land nor on the water. Meanwhile in East Malaysia, there exist a few projects for the generation of wind energy, mostly offshore.

Malaysia, which is located in a low-wind location, would face difficulties to use wind for profitable energy production. The factors for successful wind energy include wind speed and its annual distribution, air density, and land costs. Since Malaysia's mean annual wind speed is no more than 2 m/s, and most commercially available wind turbines require a minimum switch-on speed of 4 m/s to generate electrical energy, it has been mostly unsuccessful in this area.

To date, there are no wind energy projects that have been executed for electricity generation in Malaysia, but wind turbines have been installed for educational and research purposes only, as the Government is still assessing whether to determine wind energy potential as one of the nation's RE sources. The list of wind turbines installed in Malaysia are as follows:

- 150 kW wind turbine at Pulau Terumbu Layang-Layang, Sabah
- 100 kW of wind turbines hybridized with 100 kW solar PV and 100 kW diesel at Perhentian Island, Terengganu
- 3 - 25 kW of wind turbines at Kudat (Sabah), Kuching (Sarawak), Kuala Perlis (Perlis) and Terengganu
- 3 kW wind turbine in Setiu, Terengganu

Despite the shortcomings in the research projects' results, the Government is still continuing its effort to study the potential of wind energy in Malaysia. Plans have been made to set up a research centre for RE in Kudat, Sabah which would be supported by local universities and ASEAN energy institutes.

Ocean energy

When it comes to generating energy from the tides, Malaysia faces a similar situation to wind energy, with even more negative initial results, as the tide force is too low to allow commercial use. So far, potential has only been found in Labuan. However, it is currently not possible to estimate how feasible it is.

Meanwhile, the use of thermal ocean energy (obtained from the different temperatures of the cold seabed and the warm surface) has only recently been considered as a possibility, and research is still in its infancy. The Universiti Teknologi Malaysia (UTM) has set up a research centre - the Ocean Thermal Energy Centre (OTEC), one of only 4 in the world - as it is expected that this area has great potential.

Geothermal energy

As far as geothermal energy is concerned, research is still being done into what possibilities exist in this area if at all, as Malaysia is safely located out of the Pacific Ring of Fire. The only potential is generally believed to be in Sabah as a study in Apas Kiri, near Tawau, found an underground hot water field with a potential of 67 MW. However, the total production volume requires a borehole to a depth of approx. 2.5 km. Another possible potential hotspot also exists in the state of Perak, but is still under research.

A few small mud volcanoes are also active in the same area of Tawau, indicating the presence of additional geothermal energy. Plans for the first geothermal power plant in Malaysia (a 21-year subsidy contract negotiated between the operator Tawau Green Energy and the SESB, which includes feeding 30 MW into Sabah's power grid) was put on hold in 2018, and no further progress in this sector has been made. Nevertheless, the government remains optimistic and geothermal is still counted as one of the RE sources under the FiT scheme by SEDA.

5. MARKET ENTRY

ACTORS AND INSTITUTIONS

The main players in the energy sector in Malaysia include the government and the Energy Commission (EC) as well as SEDA and MOSTI, which regulate the market in the form of guidelines and laws. EC is a statutory body responsible for regulating the energy sector in Peninsular Malaysia and Sabah with powers to regulate the energy supply activities in Malaysia, while SEDA is a statutory body established pursuant to the SEDA Act. SEDA's functions include promoting and implementing national policy objectives for renewable energy and promoting, facilitating and developing sustainable energy.

The Malaysian Green Technology and Climate Change Centre (MGTC) and the Malaysian Investment Development Authority (MIDA), which take care of financial matters and attract investors, also promote the development of green energy. MGTC in particular has been given the mandate to drive the country in the scope of Green Growth, Climate Change Mitigation and Green Lifestyle.

MGTC implements initiatives and programs that detail the long-term impact of the Nationally Determined Contribution (NDC) to reduce the intensity of greenhouse gas emissions by 45% based on GDP by 2030 (compared to 2005), increase green technology's contribution to the GDP to RM100 Billion, and generate 230,000 green jobs. This is done through a series of financing schemes, training and product/service certification programmes, as well as other roadmaps and platforms.

The country's power supply is dominated by three large state-owned companies: Tenaga Nasional Berhad (TNB), which takes care of the supply of West Malaysia and thus takes over the majority of the country's electricity supply (almost 90%), and Sabah Electricity Sdn. Bhd. (SESB) and Sarawak Energy Berhad, which supply to East Malaysia. TNB has undergone substantial restructuring over the past few years, including their recent explorations in the RE field.

Petroliam Nasional Berhad (PETRONAS), as the country's oil and gas supplier, also has its role in energy generation, and has also entered into the RE sector.

In addition to the three large electricity suppliers, there are several independent, smaller energy producers. These Independent Power Producers (IPPs) generate and sell electricity to the three major utility companies, and are heavily subsidized by the state, with secured prices for fixed purchase of the electricity they produce. The introduction of IPPs was due to repeated supply problems by TNB, leading to a decision to reduce this dependency and deregulate the industry.

LEGISLATIONS & POLICIES

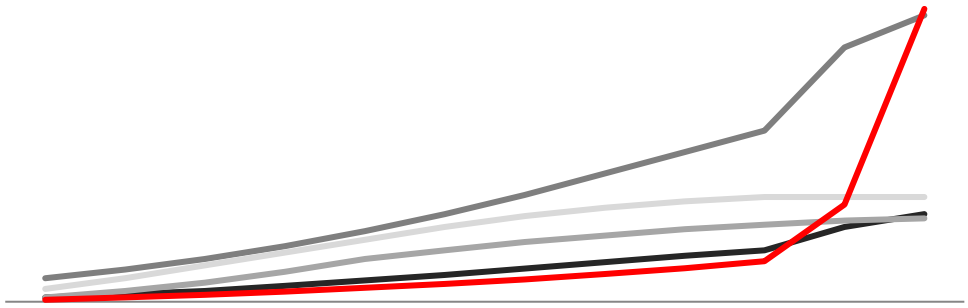
The Renewable Energy Act 2011 (REA) is the main legislation which provides the legal framework for RE in Malaysia, particularly for the establishment and implementation of a special tariff system (FiT) to catalyse the generation of RE. In addition to the REA, there are subsidiary rules, regulations and guidelines administered by SEDA pursuant to the REA such as the Renewable Energy (Feed-in Approval and Feed-in Tariff Rate) Rules 2011 and the FiT Guidelines which generally support the RE legal framework through the implementation of the FiT.

Other relevant acts include the Electricity Supply Act 1990 which regulates, amongst others, the electricity supply industry; the Energy Commission Act 2001 which provides for the establishment of the Energy Commission of Malaysia; and the Sustainable Energy Development Authority Act 2011 (SEDA Act) which provides for the establishment of the Sustainable Energy Development Authority Malaysia and to provide for its functions and powers and for related matters.

There is also the National Renewable Energy Policy (National RE Policy 2009) – approved by the Cabinet in 2010 with the objectives of increasing the renewable energy contribution in the generation mix (20% by 2025), facilitating growth of the renewable energy industry, ensuring reasonable renewable energy generation costs, conserving the environment for future generation and enhancing awareness on the role and importance of renewable energy.

Malaysia Energy Supply Industry 2.0 (MESI 2.0) – In September 2019, the Cabinet approved MESI 2.0, a 10-year masterplan to transform and liberalise the energy sector. MESI 2.0 sets out to increase industry efficiency in the industry, to future-proof key processes, regulations and structure in the industry, and to empower consumers by democratising and decentralising the electricity supply industry. MESI 2.0 is currently under review after the change in government in 2020.

With the implementation of the REA in 2011 also came the introduction of feed-in tariffs (FiT), intended to accelerate the growth of the RE sector. In 2018, the government aimed to achieve a RE share of 20% in the energy mix by 2025, and this goal has since been updated as of June 2021 to 31% RE capacity by 2025. The development of the policy shows the commitment of the government to improving RE in the local energy mix. This was also supported by the introduction of Incentive Based Regulation (IBR) in 2014 as part of the modernisation of the electricity supply industry, and aims to reduce fuel subsidies in a structured way.
In 2018, renewable energies made up approximately 6% of the total energy mix in Malaysia. In order to attain the 40% share the country aims for by 2030, the growth rates in the RE sector required would be over 15%. The following graphic illustrates the development of the individual energy sources in the state power grid.



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2025	2030
biogas	20	35	50	75	100	125	155	185	215	240	350	410
biomass	110	150	200	260	330	410	500	600	700	800	1190	1340
waste	20	50	90	140	200	240	280	310	340	360	380	390
small hydro	60	110	170	230	290	350	400	440	470	490	490	490
solar PV	9	20	33	48	65	84	105	129	157	190	455	1370

Illustration 5: Development of energy sources. Source: Sustainable Energy Development Authority (SEDA)

Future government plans to develop the RE sector include, most notably, the Green Technology Master Plan 2017-2030 and the Renewable Energy Transitions Roadmap (RETR) 2035, as well as dedicated segments in the 12th Malaysia Plan (12MP) 2021-2025. Meanwhile, Malaysia continues to enhance its Net Energy Metering (NEM) and Feed-In Tariff (FiT) schemes in support of RE.

Green Technology Master Plan (GTMP) 2017-2030
The master plan for green technology encompasses the six categories of:

- energy
- production
- transportation
- construction
- waste management
- water

and describes the strategic plans for developing green technologies to create a low-carbon and resource-efficient economy in Malaysia.

The master plan is intended to set out the country's advancement in green technologies and lays the foundation for cultivating mindsets and behavioural changes to instil a greener lifestyle amongst the community. The GTMP also plays an integral part in supporting the Transformasi Nasional 2050 (TN50) plan, an initiative that aims to put Malaysia in the top tier of countries in the world for economic development, citizen well-being, and innovation by 2050.

The GTMP outlines the targets of respective key focus areas of green technology applications and aims to provide a clearer picture on the Government's commitment to creating a conducive ecosystem for green technology development, shifting from technology adoption to technology production. The document also details within the key focus areas the achievements, targets, and existing initiatives which the Government and/or private sector are undertaking, or will commit to.

The six key sectors are Energy, Manufacturing, Transportation, Building, Waste and Water, and the goals established in each sector will be progressively fine-tuned in each 5-year National Development Plan. Each sector has its own unique challenges but there are also common cross-cutting challenges from which strategic areas of intervention have been identified.

A summary of the key points describing the embedding of green technology in the Energy sector is as follows:

- ensuring the long-term sustainability of the energy sector through resource diversification, continuous investment in new infrastructure and state-of-the-art technology deployment
- governance in the future energy economy especially harnessing renewable energies and energy storage technologies
- addressing efficiency in electricity generation and consumption: funding to buffer the transition to a more market-based approach in energy generation, and funding for R&D&C
- leveraging on disruptive technologies such as scale-up of distributed generation, micro-grids, independent energy storage, the internet of things, and electric vehicles

The targets for the Energy sector are summarised below:

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

Table A: Targets in Energy Sector

*Information taken from the GTMP.

Renewable Energy Transition Roadmap (RETR) 2035

Finally, the Renewable Energy Transition Roadmap (RETR) 2035 is a strategic roadmap developed by SEDA along with industry stakeholders which outlines, amongst others, the strategies and action plans to support and achieve the key renewable energy policies and targets in Malaysia.

In order to further strengthen and drive the growth of sustainable energies, SEDA carried out a study on the decarbonisation of the electricity sector. The resulting RETR 2035 is intended to support the government in expanding the share of renewable energies in the energy mix to 31% by 2025 (large hydropower plants with> 10 MW are not included).

Even if the exact details are not yet available as of today (Nov 2021), individual measures have already come into force. For example, peer-to-peer energy trading, which enables prosumers (producer-consumers) to sell their surplus electricity to consumers via net energy metering (NEM). As the roadmap forms part of Malaysia's 12th Malaysian Plan (2021-2025), the full details are expected to be released in conjunction with the 12MP after its tabling in Parliament., but as of November 2021 still has not been released.

Malaysia is also aiming to enable consumers to purchase 100% renewable energy from the electricity supplier and to mobilize the market for a mandatory renewable energy certificate (REC) instead of the voluntary REC market.

INITIATIVES

Feed-in Tariffs (FiT)

One important progress towards reducing dependency on fossil fuels was the establishment of the Feed-in Tariff (FiT). In Malaysia, FiT is a special tariff system which obliges distribution licensees (DL) such as power utility companies to buy from the producers of RE, known as Feed-in Approval Holders, the electricity produced from the RE sources (solar, biomass, biogas, and small hydropower) for a price set by SEDA.

In December 2011, the state began accepting applications for the new FiT system, which includes remuneration for feeding renewable energies into the state power grid. The concept is relatively simple with low administrative costs and has already been implemented in several other countries. To protect the poorer population, minimum levels have been set for energy consumption; if these are not met then there is no electricity price increase to those consumers. (For those who are affected, the money generated from the price increase goes to the Renewable Energy Fund, which collects payment from those who actually produce a lot of pollutants or consume more energy.)

By guaranteeing access to the grid and setting a favourable price per unit of RE, the FiT ensures that RE becomes a viable and sound long-term investment for individuals, companies and industries alike. FiT encourages the adoption of RE in households by enabling house owners to sell excess electricity generated for and from their homes.

The payout is divided into two parts. First, a minimum tariff is paid for the grid feed-in, and then for the amount delivered. The advantage compared to a flat rate is that it increases the installation of high quality equipment and ensures correct maintenance. However, the payout also depends on the time of market entry: a later start date leads to lower subsidies. This is due to the annual degression rates associated with the FiTs which aims to create a price balance between conventional, non-renewable and renewable energy sources, but also depends on how far the respective technology has developed and how high its potential for savings is.

Since their introduction, the FiTs have been particularly well received in the field of solar PV, while applications for the other three possible energy sources biomass, biogas and small hydropower seem to be less attractive despite significantly lower degression rates. The reason for this is a combination of factors

including lower tariffs, higher entry costs, less experience or knowledge, and a lack of price mechanisms and funding.

In the 4th quarter of 2018, SEDA introduced an e-bidding system for RE (biogas). The system was expanded in 2019 to include applications for small hydropower plants and then Biomass in 2021. The aim of e-bidding is to make it easier to set prices for renewables obtained from resources and to promote healthy competition. The average effective rate for the first round of e-bidding for biogas in the 4th quarter of 2018 was RM0.4055 / kWh. In the second round in July 2019 it was RM0.4058 / kWh. This price is far lower than the regular rate of RM0.4669 / kWh that was offered before e-bidding was introduced, and corresponds to total savings of RM 683 million for the EE fund during the 21-year term of the electricity purchase agreement

In December 2019, SEDA also announced the results of the first e-bidding system in the small hydropower category with an initial quota allocation of 160 MW. Due to the price efficiency of some of the submitted technologies with high funding levels, 176.69 MW were ultimately awarded to small hydropower plants as part of the e-bidding process.

At the moment only West Malaysia is participating in the FiT program. Sabah and Sarawak (East Malaysia) are not yet included. This is despite the fact that producers of wind energy, hydropower, and geothermal energy, which are important in East Malaysia, would benefit significantly from the FiT program. RE producers can earn more money per kWh with the FiT program compared to conventional feed-in.

Sabah fears, however, that the introduction of a Renewable Energy Fund would put too much strain on the industry and that it would migrate to cheaper countries as a result. Without the integration of Sabah into the FiT system, the government's goals will be difficult to achieve, as Sabah owns 1.4 million hectares of oil palm fields, the first and only geothermal power plant and the highest average solar radiation in the country. Meanwhile, Sarawak has developed its own incentives in the RE sector, notably in large hydropower, as outlined in the Sarawak Corridor Renewable Energy (SCORE) programme.

Net Energy Metering (NEM)

As a complement to the FiT, the Malaysian government introduced the Net Energy Metering Scheme (NEM) in November 2016 with quota allocation of 500 MW up to year 2020 to encourage Malaysia's RE uptake. The concept of NEM is that the energy produced from the solar PV installation will be consumed first, and any excess will be exported to TNB (Tenaga Nasional Berhad, a state-owned and sole electricity utility company in Peninsular Malaysia) at prevailing displaced cost. These measures were meant to accelerate the growth of the solar industry by increasing market capacity and helping to turn local players into regional solution providers.

After a successful rollout of the first NEM with all the quota taken up ahead of schedule, the government subsequently announced the introduction of a new NEM system and a Supply Agreement for Renewable Energy (SARE). The more comprehensive SARE program included a new solar leasing concept, enabling consumers to purchase and install solar modules on a leasing basis. This allowed consumers to benefit from solar savings while reducing the cost of installing PV panels.

NEM 2.0 was introduced on 1st January 2019, and the true net energy metering concept was adopted, where it allows excess solar PV generated energy to be exported back to the grid on a one-on-one offset basis. The 500MW quota under the NEM 2.0 was fully subscribed by 31st December 2020.

Due to this overwhelming response from the PV industry and in an effort to boost the usage of Solar energy, the new Net Energy Metering 3.0 programme (NEM 3.0) was announced that same month to provide more opportunities to electricity consumers to install solar PV systems on the roofs of their premises to save on their electricity bill. The NEM 3.0 will be in effect from 2021 to 2023 and the total quota allocation is up to 500 MW, divided into three new initiatives/categories:

Initiative/Categories	Quota Allocation (MW)	Quota Period
NEM Rakyat Programme	100MW	01/02/2021 – 31/12/ 2023
NEM GoMEn Programme (Government Ministries and Entities)	100MW	01/02/2021 – 31/12/ 2023
NOVA Programme (Net Offset Virtual Aggregation)	300MW	01/04/2021 – 31/12/ 2023

As of July 2021, the quota for NOVA (for businesses and commercial purposes) is almost fully taken up, with 90% approved, and the remaining quota pending approval. However, take up among citizens and government remains low, with only 12% and 15% of quota used respectively.

There is still great potential for rooftop solar panels in Malaysia. On the Malaysian peninsula alone, there are said to be at least 4.12 million buildings with an estimated technical potential of 37,429 MW. SEDA has therefore set itself the goal of continuing and intensifying efforts to increase public participation in the NEM programme.

Peer-to-Peer Solar Energy Trading (P2P)

Introduced by SEDA in 2019, the P2P energy trading programme provides a platform for producers of solar PV power ("prosumers") to sell excess power generated by them to other consumers through a retailer/grid operator, at a competitive rate. The requirements to be a prosumer is to be a NEM holder registered with SEDA Malaysia and hold a generation license for system capacity of more than 72kW with the Energy Commission.

The participating consumers under this programme would have the option of purchasing solar electricity either from the P2P or from the retailer. Under this programme, the grid operator is compensated with grid fee while the retailer operating the energy trading platform is compensated with retailer's fee.

The P2P programme operates based on energy arbitrage opportunities and SEDA has recommended for a maximum ten percent (10%) margin. Based on the current TNB tariff, this provides a win-win situation for both the prosumer and consumer; as the prosumer will earn a 10% profit from selling their energy and the consumer will experience an 11% savings on their costs by purchasing energy from a prosumer instead of TNB.

Large Scale Solar (LSS)

One of the major drawbacks often cited for solar power generation is the lack of consistency and reliability. It is expected that the large-scale generation of solar energy can increase and regulate the security of the electricity supply.

In an effort to reduce the Levelized Cost of Energy (LCOE) for the development of large scale solar PV (LSSPV) plants, the LSS, a competitive bidding programme, was introduced in 2016. The LSS programme is implemented by the EC who would invite bidders to submit their bids to build, own and operate LSSPV plants. The shortlisted bidders will subsequently enter into PPAs with TNB or Sabah Electricity Sdn Bhd (SESB).

With a successful pilot launch, the second round of the tendering process was carried out in 2017 with an increased total capacity of 557 MW for both Peninsular Malaysia and Sabah / Labuan.

After the success of the first two rounds, the government announced an open call for tenders for projects valued at an estimated RM 2 billion in February 2019. In 2019, LSS Round 3 had 112 bidders of which EC awarded 491MW in capacity to 5 bidders which included foreign solar developers from Germany and France

in consortium with local companies. With the implementation of LSS3, it is expected that every 1MW solar power plant will generate 1,490MWh / year. This is enough to supply around 160 households with electricity and reduce carbon emissions by 1,034 tons / year.

Meanwhile, LSS Round 4, launched end May 2020, saw a shortlist of 30 bidders with about 823 MW of total bids in two categories -- one for plants with capacities of 10 MW-30 MW and another targeting bigger projects of up to 50 MW. All projects are located in Peninsular Malaysia and are expected to reach commercial operation in 2022-2023.

MAEESTA

The Malaysian Energy Efficiency and Solar Thermal Application (MAEESTA) project is a national initiative launched on August 20, 2015. The executing partners are the Malaysian Government (Ministry of Energy, Green Technology & Water and Ministry of Science, Technology & Innovation), United Nations Industrial Development Organization (UNIDO), Global Environment Facility (GEF), Federation of Malaysian Manufacturers (FMM) and SIRIM Berhad.

The project aims to reduce GHG emissions by promoting and demonstrating sector-specific energy efficiency (EE) improvements and solar thermal technology utilization in the industry, focused on improving thermal EE at manufacturing and processing plants to integrate solar thermal systems in targeted sub-sectors (including but not limited to): Rubber gloves; Textiles; Food & Beverage; Surface treatment; and Agro-based industries like Palm oil and Poultry. It also aims to develop knowledge and new approaches to process optimization, particularly in heating and cooling.

Among its benefits, the project offers: consultation and training on thermal EE at user and expert levels; free audits and recommendations; and funding and financial assistance from UNIDO.

6. SUBSIDIES & FISCAL INCENTIVES IN GREEN TECHNOLOGY/RENEWABLE ENERGY

To strengthen the development of renewable energy in the nation, the Government of Malaysia will continue to provide incentives for green technology involving assets, services and systems. To encourage the development of green technology, the government offers various incentives in the form of tax breaks for the purchase of green technologies, or income tax exemptions for the use of green technology services and systems.

The incentives cover a broader scope of green technology activities in the areas of energy, transportation, building, waste management, and supporting services. Any company which undertakes a green technology project or services activity is entitled to apply to Malaysia Investment Development Authority (MIDA) for the incentives. In order to further promote investments in the field of renewable energies, the Green Investment Tax Allowance (GITA) and the Green Income Tax Exemption (GITE) have been extended until 2023.

Green Investment Tax Allowance (GITA) for Assets or Projects
Applicable to companies that acquire qualifying green technology assets listed under the MyHIJAU Directory, or carry out qualifying green technology projects (covering renewable energy, energy efficiency, green buildings, green data centres and integrated waste management activities).

The GITA incentive provides investment tax allowance for 100% of qualifying capital expenditure incurred on green technology assets/projects from the year of assessment 2013 until the year of assessment 2023 and such allowance can be offset against 70% of statutory income in the year of assessment. Unutilised allowances can be carried forward until fully absorbed. However, projects which have been approved with FiT for solar by SEDA are not eligible for the GITA for Projects.

Green Income Tax Exemption (GITE) for Services and Solar Leasing
Areas include renewable energy, energy efficiency, green buildings, green data centers, green communities, certification / review bodies and electric vehicles (EV). Services include system design and feasibility study, advisory and consultancy, testing and commissioning of renewable energy. For Solar Leasing, a new incentive launched in January 2020, the ITE is applicable for up to 10 years.

Qualifying companies must provide services verified by GreenTech Malaysia and listed under MyHIJAU. Applicants for services are eligible for income tax exemption of 70% of statutory income from the year of assessment until 2023. (Note: Prior to January 2020, the ITE was 100%.)

Activities that are qualified according to SEDA:

1. Renewable energy
Commercial and industrial companies that produce energy in the form of electricity, steam, heat and water using renewable energy sources such as:
   - Solar energy (including NEM)
   - Biomass
   - Biogas
   - Mini hydro
   - Geothermal energy

(Projects that have been approved by the SEDA with feed-in tariff (FiT) for solar systems are not eligible for the investment tax allowance.)

2. Energy efficiency
Companies that invest in energy-efficient or energy-saving machines or technologies.

Note: For both GITA and GITE, the dates to be considered are when the applications are received and approved by MIDA. The full conditions, latest updated procedures, guidelines and forms can be obtained from the MGTC website.

Green Technology Financing Schemes – GTFS 2.0/3.0
In addition to the abovementioned tax incentives, the Ministry of Finance had agreed to introduce the Green Technology Financing Scheme 2.0 (GTFS 2.0) for the period of 2019-2020, an enhanced version of the first GTFS in 2010 to encourage the supply and usage of green technologies.

The GTFS programmes offers financial aid to producers of green technology, users of green technology and Energy Services Companies (ESCOs). GTFS 2.0 had a total financing/funding approval amount of RM2.0 billion and offered rebates of 2% per annum on interest and/or profit rate for the first seven years for each financing with sixty percent (60%) government guarantee on green technology cost.

GTFS 3.0 has been announced in Budget 2021, with an allocation of another RM2.0 billion. As part of the Government's agenda to support Sustainable and Responsible Investment (SRI) as well as drive green and sustainable standards in Malaysia, the scheme now includes supporting the issuance of SRI Sukuk and green bonds and is open for application until 31 December 2022.

Funding - Waste Eco Parks (WEPs)
The Waste Eco Park (WEP) aims to promote waste recycling, recovery and treatment by industry and offers a sustainable solution to problems in the field of waste management. This encourages investments in facilities and infrastructure with a view to holistic waste management activities. In order to promote the activities, there are incentives for WEP developers, WEP managers and WEP operators.

The guides and procedure for funding for WEPs can be found on the MIDA website.

7. TRENDS AND OPPORTUNITIES FOR AUSTRIAN COMPANIES

COVID-19 Impact & Post-Pandemic Recovery

COVID-19 has forced Malaysia into several lockdowns, known as Movement Control Orders (MCO) since March 2020. Due to the prolonged nature of these lockdowns, the Malaysian economy was heavily impacted. In order to cushion the effects as much as possible, a total of 3 stimulus packages with a total value of RM260 billion have been announced. This included tariff reductions in electricity for domestic users and moratoriums on payments, that cost the government RM2.75 billion. The overall strain on the nation's coffers also means the prioritisation of healthcare and social welfare in the latest budget.

The pandemic also had its effects on the Energy and Electricity sector: while most of the population had increased energy use at home during lockdown, the shutdown of the commercial and industrial sectors led to a drop of between 25-50% electricity use, which in turn meant a large loss for energy providers – TNB for example saw a loss of USD 110 million compared to their 2019 profit earnings.

However, the first signs for a further expansion of renewable energies have already been set. At the end of May 2020, the Ministry of Energy and Natural Resources announced the fourth round of a large-scale solar program (LSS4). Tendering contracts with a total value of 1 GW are to be offered in order to further advance the RE sector. The ministry has also expressly linked the tender with efforts to reactivate the economy after COVID-19. It is estimated that the 1GW tender is expected to generate RM4 billion (USD 927 million) in investment and create 12,000 new jobs.

There have also been strong indicators of accelerated RE growth, as displayed by the early achievement of 2025 RE targets, leading to these targets being reviewed upward. From the initial target of 20% by 2025, the government set a new target of 31% for that year, having already achieved 24% in 2021.

The focus placed upon green technology in the recently released 12th Malaysia Plan also indicates promising developments in the sector, as new energy efficient technologies are sought out and cities aim to achieve low-carbon goals.

Trends

Below are some trends and new developments in the field of renewable energies in Malaysia.

Battery Energy Storage System (BESS)
Battery Energy Storage Systems (BESSs) are an interesting area that could contribute to the development of RE in Malaysia. As the volume of renewable energies increases, the use of a BESS will be urgently needed and even unavoidable, to support the energy supply infrastructure.

BESSs are able to take on several important functions at the same time. These include, for example, frequency control, voltage support, spin reserve and black start for network operators. For electricity suppliers, a BESS is able to reduce transmission bottlenecks and serve as an alternative to transmission and distribution shifts. A BESS can also be used for reserve power, reducing peak demand, energy arbitrage and increased PV solar self-consumption.

The current biggest challenge when using a BESS for electricity suppliers is the high cost. However, with an estimated 5% decrease in costs per year, or improved technologies, it ought to find wider application in the near future.

Biomass
The Malaysian biomass sector has gained significant momentum in recent years and already has considerable potential. Malaysia produces approximately 168 million tons of biomass and has achieved a significant use of RE technologies via the FiT mechanism compared to other technologies, making up around 17% of total use.

The demand for wood pellets from Far Eastern markets such as Japan, South Korea and China give Malaysia a lucrative export business, but the aim is to create a processing industry that can manufacture high-quality products itself and offer them on the world market. In this context, foreign know-how is essential.

Technically sophisticated composting solutions can also represent an additional source of income for producers of large quantities of biomass. European companies still have an excellent reputation in Malaysia and Austrian expertise and technology are highly valued.

Energy Efficiency
There is a multitude of opportunities in this sector, especially as Malaysia seeks to dramatically reducing its carbon footprint. In the electrical energy chain, this starts from energy generation, moving into its transmission, storage and finally consumption.

Firstly, there is the importance of securing existing resources, both conventional and renewable, by improving the energy output with the same input. This could be achieved by improving current processes and the associated efficiency gains. For conventional sources, global refinery and petrochemical benchmarks demonstrate that significant process improvements can be expected in this area, and typically contribute to efficiency gains of 0.5% per year.

With a growing and increasingly energy-demanding society (an expected increase in consumption of 3% annually), there is also an urgent need for energy-efficient products and services, or the technology to allow existing products to improve their efficiency and reduce the strain on energy demand. There is a particularly strong demand in the commercial, transport, and industry sectors, which are the highest consumers of energy. This encompasses all at once the technology for energy-efficient appliances, buildings, and storage.

Finally, there is also a need to minimise the emission of carbon or other polluting outputs from the use of such technologies. Ultimately, the goal is to develop clean electric power and reduce energy waste.

Hydrogen Energy
Globally, hydrogen is increasingly being considered as a clean energy source, as it addresses several issues that exist in other forms of green energy technologies, such as battery, solar and wind technologies. For Malaysia, the state of Sarawak has made several strong steps to advance in this sector.

Aside from Southeast Asia's first integrated hydrogen production plant and refuelling station in 2019, Sarawak also has buses using hydrogen fuel cells, and is looking to build six more hydrogen filling stations. Other hydrogen plants, especially for green hydrogen, have been announced.

The Malaysian government plans to introduce a Hydrogen Economy and Technology Roadmap, which will chart the development of the industry over a 20-year span to 2040, updated every two years to keep up with changes in technology.

Though the high production cost of hydrogen is expected to eventually come down, leading hydrogen to become a competitive fuel source, its applications still remain very limited. In the automotive sector, there are only a handful of models that run on hydrogen, such as the Toyota Mirai, Honda Clarity and Hyundai Nexo.

In its early stages of moving towards a hydrogen-based economy, Malaysia might consider exporting the hydrogen to immediate foreign markets who have already developed a hydrogen economy based on a user model, until local demand catches up.

Solar
Malaysia's solar energy industry is on the rise thanks to increased government support, increased investor confidence and cost reductions. As the largest employer in the field of photovoltaics among ASEAN countries, the Malaysian solar sector is well equipped for further growth.

Apart from the high irradiation levels, Malaysia also has an established solar manufacturing sector. While most of the produced systems are exported, the expanding domestic production for RE components will help ensure a reliable and cost-effective supply chain for project developers.

Other potential opportunities lie in East Malaysia, where despite steadily increasing economic growth, a third of the population in still live without a connection to the power grid. Currently, there are solar powered generators used to support small villages but these are not connected to the grid and would have capacity and generation restrictions. Therefore, there would be a need for other solutions to increase electricity supply and connectivity.

More proof of the sector's potential can be seen with the Large-scale solar (LSS) initiative. First introduced in 2016, the Large Scale Solar (LSS) initiative has become an important part of the government's initiative to increase the share of solar energy in the overall energy mix. After the success of the first two rounds, the government announced an open call for tenders for projects valued at an estimated RM 2 billion in February 2019.

In 2019, LSS Round 3 had 112 bidders of which EC awarded 491MW in capacity to 5 bidders which included foreign solar developers from Germany and France in consortium with local companies. Meanwhile, LSS Round 4, launched end May 2020, saw a shortlist of 30 bidders with about 823 MW of total bids in two categories -- one for plants with capacities of 10 MW-30 MW and another targeting bigger projects of up to 50 MW. All projects are located in Peninsular Malaysia and are expected to reach commercial operation in 2022-2023.

The success of the programme so far prove the strong potential of the sector, as well as the commitment by the government to invest in solar power. The openness to foreign bidders is also a notable point for Austrian companies that seek to expand their expertise into Malaysia.

Waste to Energy
Malaysia's high generation of municipal solid waste (MSW) - an estimated 38,294 tonnes per day (2020) – is a major point of concern for the government, especially as the country faces the impending maximum capacity limit for its landfills (expected within the next 10 years).

As 50% of the MSW consists of organic fraction, it has the potential to be a landfill gas (LFG) source. The incineration of waste for electricity generation is also developing, with two waste-to-energy (WTE) plants currently, and another 6 more plants planned nationwide by 2025. The sustainable treatment or recovery of household waste has great growth potential, as the government is still working on their plans for waste processing. Austrian companies in this field would have strong opportunities to present their expertise.

In addition, other technologies in this space are also sought out, as the nation seeks to swiftly reduce or reuse the waste being sent to landfills. The government has also begun explorations into the possibility of using waste to generate hydrogen energy.

Conclusion
While the Malaysian government certainly has ambitious plans and the will to achieve them, there has been a history of problems during execution, sometimes due to mismanagement or bureaucratic changes, but for the most part, because of costs or lack of access to the right technologies. It would be in this space that Austrian companies could enter the market to offer both their solutions but also expertise and experience.

8. EVENTS AND TRADE FAIRS IN THE SECTOR

International Greentech & Eco Products Exhibition & Conference Malaysia (IGEM)
Online | 01 July - 31 December 2021
Note: IGEM is South East Asia's largest trade event for green technologies and eco solutions, and is held annually. The 2021 edition is held online over 6 months, with the 2022 edition expected in October 2022. IGEM is a platform for solution providers and green energy businesses to tap into the fast expanding ASEAN market by showcasing the latest innovations to policy makers, government organisations, investors and the mass market.

International Conference on Smart Grid and Clean Energy Technologies (ICSGCE)
Kuching, Sarawak | 15-17 October 2021
Note: Due to the ongoing pandemic, this event is expected to be a hybrid version that brings together participants from around the world to exchange and discuss ideas, designs, technologies, problems, and experiences in smart grid and clean energy areas. ICSGCE has been an active platform which provides participants to establish business or research relationships and to find the partners for future collaboration. ICSGCE 2021 is financially co-sponsored by universities from Malaysia as well as China, Switzerland, UAE and Germany; and will invite and deliver keynote speeches on smart grid and new energy evolution.

ASEAN Solar Expo
Online | 1-31 November 2021 (Part of the annual ASEAN SUPER 8 Fair)
Note: Southeast Asia's Premier Solar Energy Expo event showcasing the complete range of renewable technologies. ASEAN Solar brings together the largest group of green technology and renewable energy developers and supply chain partners in Southeast Asia and proves to be the leading business platform in the region for reaching the green and renewable market place and the industry hub for exploring new opportunities, forging deals and participating in unrivaled networking.

ASEAN TENAGA Energy
Online | 1-31 November 2021 (Part of the annual ASEAN SUPER 8 Fair)
Note: Successfully held for two decades, ASEAN TENAGA Energy is Southeast Asia's Premier exhibition and dedicated to the power, electrical and utilities industry. Having been well-received by the industry over the years, the expo will feature leading suppliers, sub-suppliers and service providers, across the entire power generation value chain. ASEAN TENAGA Energy provides an avenue for participants to share their knowledge and expertise in the ever-evolving power and electrical industry.

8th International Conference On Renewable Energy Technologies (ICRET 2022)
Kuala Lumpur | 07-09 January 2022
Note: Due to the ongoing pandemic, the 2022 edition is tentatively hybrid but may shift to fully virtual. ICRET focuses on timely and emerging topics of interest to the renewable energy technologies and is devoted to technical innovations in renewable energy. The conference will bring together leading researchers, engineers and scientists in the domain of interest from around the world.

International Energy Week
Kuching, Sarawak | 22-24 November 2022
Note: Sarawak is a major hub for the energy and petroleum industry in Malaysia and the region, with huge oil and gas reserves coupled with an abundance of hydropower and the Government's Sarawak Corridor of Renewable Energy (SCORE) initiative looks set to propel Sarawak into a developed economy. There are immense business and investment opportunities to be tapped, and 2022 will be the Expo's fifth edition. Hosted by the Ministry of Utilities Sarawak, the Industry Show also encompasses related events such as Electro Power Asia 2022, Petroleum Asia 2022, Asia Infrastructure 2022 and the IEW 2022 Conference and Technology Symposium. An integrated event that is sure to generate numerous opportunities, IEW 2022 will also highlight the development of the SCORE, the Pan Borneo Highway project and more.

ASIA 2022 - Water Resources and Renewable Energy Development in Asia
Kuala Lumpur | 15-17 March 2022
Note: An event focusing on dams and hydropower, welcoming the global water and energy community. There will be conferences on hydroelectric power, as well as study tours to some of the large cascade developments in Peninsular Malaysia. A major element of the ASIA 2022 event will be the Technical Exhibition, the main hub for business networking between delegates and industry representatives who will be exhibiting their supplies and services. Exhibitors typically comprise consultants, contractors, manufacturers, developers and professional associations.

ASEAN Solar Expo
Kuala Lumpur | 8-11 November 2022 (Part of the annual ASEAN SUPER 8 Fair)
Note: Southeast Asia's Premier Solar Energy Expo event showcasing the complete range of renewable technologies. ASEAN Solar brings together the largest group of green technology and renewable energy developers and supply chain partners in Southeast Asia and proves to be the leading business platform in the region for reaching the green and renewable market place and the industry hub for exploring new opportunities, forging deals and participating in unrivaled networking.

ASEAN TENAGA Energy
Kuala Lumpur | 8-11 November 2022 (Part of the annual ASEAN SUPER 8 Fair)
Note: Successfully held for two decades, ASEAN TENAGA Energy is Southeast Asia's Premier exhibition and dedicated to the power, electrical and utilities industry. Having been well-received by the industry over the years, the expo will feature leading suppliers, sub-suppliers and service providers, across the entire power generation value chain. ASEAN TENAGA Energy provides an avenue for participants to share their knowledge and expertise in the ever-evolving power and electrical industry.

Events of Außenwirtschaftscenter Kuala Lumpur

Please visit **https://wko.at/aussenwirtschaft/my -> Veranstaltungen** for more details on the events below.

Austrian Technology Day South East Asia: Water, Waste, Traffic Management
Thailand, Malaysia, Philippines, Vietnam, Indonesia and Singapore
Online | 18- 20 January 2022

A conference-like programme (virtual) with panel discussion followed by B2B / B2G between Austrian and local companies and stakeholders.

Austria Showcase: Green Technology
Kuala Lumpur, **Malaysia** & Jakarta, **Indonesia | 7-10 June 2022**

A conference-like programme (physical presence) with presentations by Austrian experts and companies followed by B2B matchmaking.

Group Exhibition and Austria Showcase: Sustainable Building
(in conjunction with **ASEAN SUPER 8**)
Kuala Lumpur, **Malaysia | 8-11 November 2022**

A conference-like programme (physical presence) with presentations by Austrian experts and companies followed by B2B matchmaking, and physical exhibition at the ASEAN Super 8 expo.

9. CONTACTS – MINISTRIES, AGENCIES & ASSOCIATIONS

Malaysia Energy Information Hub (MEIH)
The Malaysia Energy Information Hub (MEIH) serves to establish a comprehensive national energy database to support the dissemination and distribution of energy statistics in Malaysia to local and international stakeholders and the public. MEIH is a portal undertaken and managed by the Energy Commission (EC) of Malaysia.

Malaysian Green Technology and Climate Change Centre (MGTC)
The Malaysian Green Technology and Climate Change Centre (MGTC) is an agency of the Ministry of Environment and Water (KASA) mandated to drive the country in the scope of Green Growth, Climate Change Mitigation and Green Lifestyle. MGTC implements initiatives and programs that provide specific details in achieving the long -term reduction of greenhouse gas emissions by 45% based on Gross Domestic Product (GDP) by 2030 (from 2005), increasing the rate of contribution to GDP from green technology and the generation of 230,000 green jobs.

Malaysian Investment Development Authority (MIDA)
MIDA is the government's principal agency to oversee and drive investment into the manufacturing and services sectors in Malaysia; and to advise MITI on industry matters including the formulation of related policies. MIDA assists companies which intend to invest in the manufacturing and services sectors, as well as facilitates the implementation of their projects. The services provided by MIDA include providing information on the opportunities for investments, as well as facilitating companies which are looking for joint venture partners. They also evaluate the following applications for projects in the manufacturing sector and selected services sub-sectors: Manufacturing licenses, Tax incentives, Expatriate posts, and Duty exemptions.

Ministry of International Trade and Industry (MITI)
The Ministry of International Trade and Industry (MITI) is responsible for international trade, industry, investment, productivity, small and medium enterprise, development finance institution, halal industry, automotive, steel, and strategic trade. Their goals are to promote and strategise Malaysia's global competitiveness in international trade by producing high value added goods and services, and to spur the development of industrial activities. MITI plans, legislates and implements international trade and industrial policies that will ensure Malaysia's rapid development, encourages foreign and domestic investment, and promotes Malaysia's exports by enhancing national productivity and competitiveness in the manufacturing and services sector.

Ministry of Science Technology & Innovation (MOSTI)
MOSTI's goal is to transform Malaysia into a high-tech nation through Science, Technology, Innovation and Economy (STIE), and to use STIE to address national issues and challenges for sustainable development. They aim to develop local technology and innovation by strengthening policy and regulation, and provide effective and efficient STIE enablers and services through agile governance.

Suruhanjaya Tenaga / Energy Commission (ST / EC) – The EC is established under the Energy Commission Act 2001 as the regulatory agency for electricity supply and piped gas supply industries in Peninsular Malaysia and Sabah. Among EC's other roles and functions is promoting economy in the generation, transmission, distribution, supply and use of electricity.

Sustainable Energy Development Authority (SEDA)
The Sustainable Energy Development Authority (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]. SEDA also promotes the deployment of sustainable energy measures as part of the solutions towards achieving energy security and autonomy.

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