Ministry of Foreign Affairs

Circular Economy Opportunities in Malaysia

Commissioned by the Netherlands Enterprise Agency

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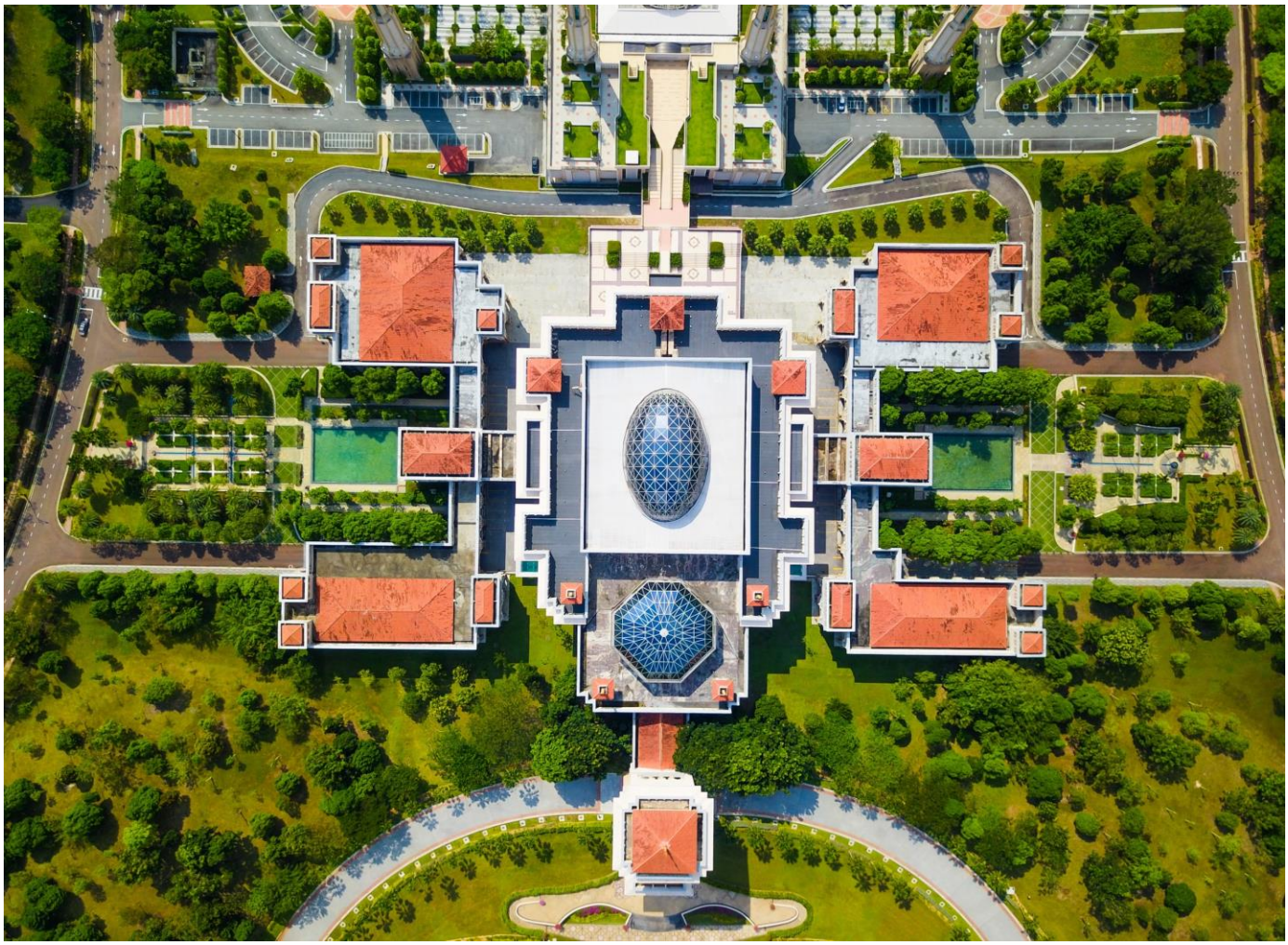
Circular Economy Opportunities in Malaysia

Dutch Solutions to Malaysian Challenges

Report – A Part of Booster Programs in Southeast Asia Region | December 17, 2021



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Dutch Solution to Malaysian Challenges

Executed by
Holland Circular Hotspot

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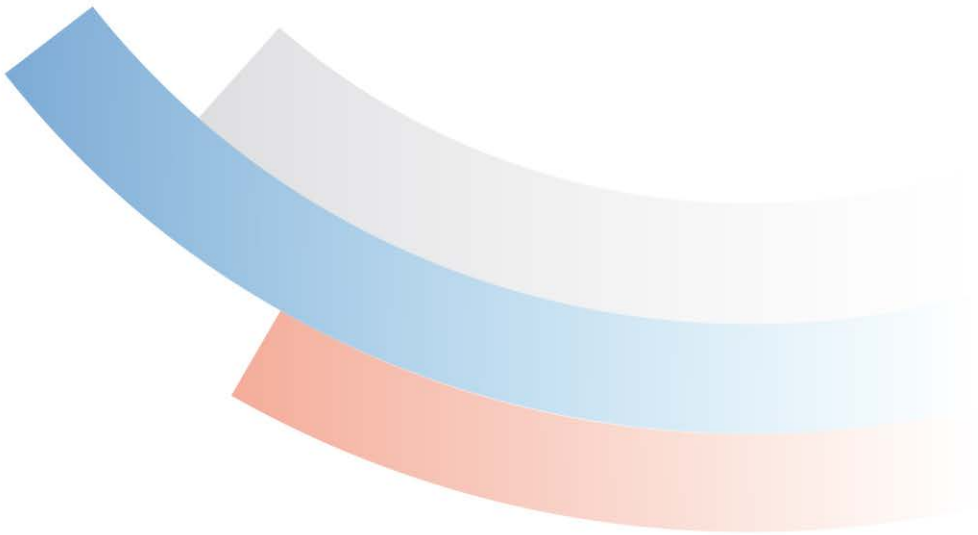
Embassy of the Kingdom of the Netherlands in Malaysia



Country Information

Key Indicators	
Size	Malaysia is 8 times larger than the size of The Netherlands
Total Landmass	329.847 square kilometres (Peninsular Malaysia and East Malaysia (Sabah and Sarawak)
Population (2020)	32,79 million people (ranking 44)
Nominal GDP (2020)	€ 342.442 billion (ranking 36)
GDP per capita (2020)	€ 9.201
Import from the NL (2020)	€ 884,6 million
Economic growth (2021 prediction)	3-4%
Ease of doing business rank (2020)	24
Global Corruption index (2021)	65/198
Unemployment rate (2020)	4,55%
Currency	Malaysian Ringgit
Time difference NL	6/7 hours

Malaysia is a country with a federal constitutional monarchy, which has 13 states and 3 federal territories. Both are separated by South China Sea. Malaysia still has a King as the head of the country, while the executive power is held by Prime Minister of the cabinet. The agriculture sector led the Malaysian economy until the 1970s, which continued as a multi-sector economy in the 1980s. It has now shifted into manufacturing and service sectors as the national leading industries.

Manufacturing is now Malaysia's core sector with several primary industries, such as electrical & electronics (E&E), petroleum products and petrochemicals, semiconductors and machinery, and equipment[1]. In the service sector, Malaysia is leading on wholesale, retail trade, and ICT (Information, Communication, and Technology), while other sectors supporting the country's economy are oil palm and livestock (agriculture). For foreign investors, Malaysia offers important opportunities to develop infrastructures, digitalization, and technological improvement in high potential sectors such as aeronautics (maintenance, repair, and overhaul), biotechnology, Electrical & Electronic, green energy, medical devices, and pharmaceutical equipment[2].

Malaysia has set ambitious goals towards the sustainability and circular transition. The country targets to achieve a 40% recycling rate in 2025 and reducing greenhouse gas emissions by 45% in 2030[3].

New development pathway has been set up by the government under the Twelfth Malaysia Plan 2021-2025 which is aligned with 2030 Agenda to eradicate hardcore poverty, building a peaceful and inclusive society, and creating sustainable environment with sustainable economic growth. Transitioning towards a circular economy has become one of the key topics as it will ensure the country to protect the environment and natural resources, measure efficiency, also promote shared prosperity[4].

[1] Ministry of Finance Malaysia. (2021). Report on Malaysia Economic Outlook.
[2] Malaysian Investment Development Authority. (2020). Report on Opportunities in Manufacturing.
[3] Department of Statistics Malaysia. (2020). Compendium of Environment Statistics.
[4] Economic Planning Unit, Malaysia Primer Minister's Department. (2021). Twelfth Malaysia Plan 2021-2025, A Prosperous, Inclusive, Sustainable Malaysia.

Chapter 1

Circular Economy Analysis

1.1 Circular Economy Initiatives, Challenges, and Opportunities

With fast-developing cities and over 32 million population, Malaysia faces challenges on managing waste. On top of that, more clinical waste is predicted to be generated in 2020-2021 due to the COVID-19 pandemic. Malaysia has set up their initiative on waste management regulation, but the government is now focused on reducing poverty by supporting SMEs and creating a greater number of jobs post COVID-19 pandemic. Several financial support mechanisms have been put in place to boost the market. There might be a post COVID-19 circular innovation momentum that can be linked to the strong global demand for E&E products and rubber gloves from Malaysia.

There has been a preliminary discussion to set up a blueprint on circular cities in Malaysia, together with the International Urban Cooperation European Union – Asia to draft a framework of sustainable smart city initiatives with a project duration until 2024. Their focus is to enable circular solutions using digital technology, with Amsterdam serving as a best practice. The blueprint also mentions the efforts on achieving water security and reducing food waste. However, there is no new action yet from the (new) government on this matter.

On the other side, the Dutch construction company, Arcadis, has started the initiative apply circular building practices in Malaysia. Applying circular strategies whereby, for example, building new layers on existing buildings is one of the solutions. Maintaining and extending lifetime using smart maintenance, repair, upgrades, and renovation, as well as identifying the materials being used in the construction can be considered as circular business models in the construction sector, specifically buildings.

Other practices involve the use of bio-based or biodegradable materials or repurposed or non-toxic high-grade recycled materials to substitute conventional raw materials and ensuring long-term confidence with new methods and materials.

There are several challenges which need to be addressed for the transition towards circularity. Business can play a major role in scaling-up circular economy. They need trust to invest. Even though there are various national policies and roadmaps on sustainability, the enforcement and implementation on the ground is low. The shifting of political power also affects the investment climate as more investors look for stable government networks. In addition, Malaysian government needs to improve their transparency for the public.

However, there is a Malaysian government agency called Malaysian Investment Development Authority which is always ready to help entrepreneurs set up their business in the country. It is relatively easy to start a business. Investors who want to put their money in circular programs are mostly supported. The awareness level within the private sectors on circular economy keeps increasing. The willingness to transition to circularity also comes from the younger generations in Malaysia. They start to establish local initiatives on recycling packaging materials, cleaning the rivers, collecting solid waste, and organizing events and discussions on circular economy.

Based on the existing circular economy initiatives, its challenges and opportunities, we have identified 4 sectors for economic growth and circular transition in the country: **Manufacturing, Packaging Materials, Biomass,** and **Waste Management**.

1.2 Manufacturing

The manufacturing sector is the most resource-consuming sector of the economy. Consequently, manufacturing activities utilize a considerable amount of energy and natural resources. The International Energy Agency declared that 36% of CO_2 emissions worldwide are derived from manufacturing industries.

Based on an OECD report on manufacturing industries, in 2019-2020, the top 4 industries in Malaysia, which generate RM 4 billion (around € 829 million) annually, are: **vehicle components, printer cartridges, electrical & electronics, and aerospace**.

Meanwhile, during COVID-19 pandemic, Department of Statistics Malaysia reported that the manufacturing sector remains a key sector for economic growth in the country, contributing 79,3% of the FDI (Foreign Direct Investment) inflow in second-quarter 2021. It is expected that manufacturing sector will be the largest recipient of FDI inflow until the end of 2021. **Electrical and electronics, rubber gloves,** and **medical devices** industries are predicted to keep boosting Malaysia's economy as the demands for these products are growing as a result of the pandemic.

Seeing the manufacturing sector maintains its stability as an economic booster, Malaysian government supports (with evaluation) 835 projects with proposed investment of RM 76,7 billion (€ 16 billion) in the manufacturing and service sectors in the half of 2021. These investments will generate 32.000 job opportunities and help Malaysia to lower their high unemployment rate during COVID-19 pandemic. Despite of the big support from the government, manufacturing industries will have to establish their sustainable and circular business plans in the nearer future as Malaysian government already drew their policies on the Twelfth Malaysia plan.

Federation of Malaysian Manufacturers (FMM) reported that there will be strong demand on semiconductor industries in 2022. The Dutch company, NXP Semiconductors NV, a major chip supplier to the automotive industry, for example, rose their revenue 43% from a year earlier to RM 10,99 billion (€ 2,2 billion). Furthermore, the promising business opportunity comes from automotive industry as their export income of automotive parts and components increased to RM 11,3 billion (€ 2,3 billion), from RM 4,7 billion (€ 981 million) during 2014-2020

However, the positive business climate for semiconductor and automotive companies should be followed by more initiatives aimed at transitioning towards a circular economy. Supporting the sector, Malaysia's government introduced the high value added and complex product development programme to improve capacities and competencies of its industry players. As a result, new industry enablers related to standards, testing, laboratories, and systems have been developed in 2020.

Another national policy geared towards Malaysia's industry 4.0 was launched in 2018. It was set up as a catalyst focussed on changing the human capital, industry processes, and on technology in manufacturing. Increasing circularity and creating more sustainable economic growth in the future was also one of the objectives[5]. In addition, there is a new market opportunity from the automotive sector, especially on electric vehicles (EVs) as Malaysian government announced as a part of their 2022 National Budget that they will eliminate all taxes on EVs in Malaysia, including import and excise duties, as well as road tax. Malaysia's National Power Agency has also signed agreement with private players to supply charging station along highways in the country. This policy is seen as one of the strategies to reduce carbon emission, as well as develop more circular business in the country.

On top of that, the level of awareness among the private sector is rising. More industries are now looking for experts to advice their companies to be more circular. The pressure from big multinational companies on their partners also helps increase consciousness levels towards the transition. Among the Federation of Malaysian Manufacturers, there has been also a discussion to increase resources and information efficiency to contribute towards the circular economy transition. Digitalisation is being seen as the game changer to be the most crucial elements for circular manufacturing businesses[6].

Improving information flows through digital networks will help the industries to track their sustainability efforts accurately and consistently across the value chain. In their latest publication for Business in Action July-September 2021, FMM also mentioned that application of machine-learning and data analytics in manufacturing sector will help the businesses recognize patterns and trends which may be missed, like the supply and demands for underutilised assets and products. Furthermore, digital matching platform will also help the industries to identify high-value reusability options for waste products and materials.

In the ICT field, based on the data of the Department of Environment (DOE), the e-waste recycling rate in Malaysia is not more than 25%, which means hundreds of thousands of tonnes of e-waste are disposed of in landfills every year. Also, large, licensed recyclers prefer to collect big volumes of e-waste from large corporates and factories as collecting small quantities from millions of consumers is not profitable.

In Malaysia, there is no legal framework that makes it mandatory for consumers to send electrical and electronic items to licensed e-waste recovery

[5] Malaysian Investment Development Authority, Report on Opportunities in Manufacturing, 2020.

[6] Federation of Malaysian Manufacturers, Business in Action, 2021.

facilities. Existing licensed e-waste recovery facilities mostly manage only e-waste from industries, according to the Department of Environment (DoE). However, there are already companies that collect e-waste from local markets, such as iCYCLE, ERTH, and Meriahtek. The most pressing need is to ensure that all the electrical and electronic items do not end up in landfills or at illegal recycling operations. Products or components that can still be used should be reused or refurbished, while the rest is recycled.

An EPR system had been proposed, which will cover six categories of items: TVs, washing machines, fridges, air conditioners, mobile phones, and laptops. At the same time, tightening the regulations for domestic e-waste as well as strengthening enforcement are needed. The EPR initiative from the public sector was unsuccessful due to the lack of enforcement.

1.3 Plastics

In 2019, WWF Malaysia reported that the country, compared to China, Indonesia, Philippines, Thailand, and Vietnam, was the biggest consumer of used plastics per year, with 16,78 kg per person[7]. It means there were 1,41 million tonnes per year plastic resins (PET, HDPE, LDPE, and PP) consumed in the country. However, only 24% of it was recycled. The loss of material value in plastics shows mismanagement of plastic waste and creates economic consequences as the country would potentially lose up to € 887 million per year[8] in the plastics recycling market.

The Malaysian government has set up a Malaysia Roadmap Towards Zero Single-Use Plastics for 2018-2030, and developed a regulation on plastic production, consumption, recycling, and waste management. However, missing efforts on EPR scheme implementation and lacking enforcement from the government have made local plastic recyclers to import plastics waste instead of processing the local waste. In addition, insufficient waste segregation at source, low waste collection rates, and lack of design for recycling standards hinder recyclers to meet the growing market demand for recycled plastics products.

On a side note, there is still limited awareness of the general local industries in Malaysia on why and how to transition towards a circular economy. As SMEs play a major role in Malaysia's economy, targeted and practical education, knowledge sharing and capacity building will be needed, from circular design to production to usage and plastic waste management. A circular hub or platform could have a role in sharing best practices from local industries in a variety of market segments. There is a place for experts or consultants to redefine value-chains in a circular manner.

The transition to a circular economy in the plastics sector has been driven by and initiated by FMCG multinationals in Malaysia for the past three years. Determined by consumer concern and global HQ commitments aimed at zero waste factories, recyclable, or biobased packaging, the multinationals started initiatives to collect and recycle their plastic waste.

Unilever is one of the Dutch companies which has shown strong commitment to embrace a circular economy strategy. Unilever aims to cut half of their usage of fossil fuel-based plastics and increase the recycled plastic material content in their packaging to 25% in 2025. They will, together with local communities, also develop projects to process more plastics waste instead of only collecting and landfilling them.

Another company embarking on circular economy initiatives is Dutch Lady Milk Malaysia (DLMI, part of Friesland Campina). DLMI is a company that offers an extensive range of milk based dairy products, from formulated milk powder, yoghurt drinks to fresh milk and UHT. Their activities are related to farming, production, nutrition, responsible consumption, and post consumption aspects (like waste management).

Friesland Campina has set objectives through a.o. the New Plastics Global Commitment, led by the Ellen MacArthur Foundation. Next to working on sustainable and efficient farming, nutrition, water & energy management in their operations, they are also working on design aspect of their packaging (like eliminated plastic straws or developing plant-based packaging in collaboration with other players like SIG and Tetra Pak Malaysia),

DLMI chose to partner with MAREA. MAREA (Malaysian Recycling Alliances) was established in early 2021. This collaboration was developed as part of voluntary-industry driven initiative to implement EPR to tackle packaging waste issues. Some multinational companies which are actively engaged in the project are: Nestle Malaysia, Unilever, Coca Cola Malaysia, Dutch Lady Milk Malaysia, and Mondelez International. The companies believed that collaborating their actions in an association like MAREA will create more cost

[7] WWF Malaysia, Study on EPR Scheme Assessment for Packaging Waste in Malaysia, 2020: https://www.wwf.org.my/media_and_information/publications/

[8] The World Bank, Market Study for Malaysia Plastics Circularity Opportunities and Barriers, 2021: https://www.worldbank.org/en/country/malaysia/publication/

efficient and scalable waste collection in the country.

However, due to relatively limited existing waste management infrastructure in combination with lack of enforcement and awareness, the companies manage, often with the help of the informal sector, to collect the lowest hanging fruit (the high value plastic waste like PET bottles) only. Most plastics, especially packaging, end up in nature, in landfills or get burned.

As in most fast-developing countries the waste collection in Malaysia is mostly driven by the informal sector. The recycling infrastructure however has been planned formally by the Malaysian government. Waste managers collaborate with local government in often (pro)long(ed) contracts that can last 20-30 years. Most projects are developed in urban areas where impact of waste and the need for sanitisation is highest (Kuala Lumpur, Petaling Jaya, Penang), and not through the entire country. As in most countries, more synergy can be obtained by better collaboration between waste managers and municipalities (also among themselves) for both commercial and industrial waste and municipal solid waste.

In order to manage plastic waste well, the government should improve the data collection. There is a need to measure volumes of waste flows, recycling and recovery data and recycling capacity inventory. The data challenge goes beyond waste managers and (local) government, it extends to producers. There is no specific information on the material content of plastics packaging and other plastic products. As an example, most of the plastics waste collected from MSW (municipality solid waste) is PET (Polyethylene Terephthalate). In Malaysia, PET products can be found in food and beverages packaging, medical, and cosmetics. Most of the PET products that are recycled are PET bottles from beverages. Non bottle PET plastics are mostly ending up in landfills. The information on the total number of PET waste products is missing. Developing technologies for repurposing and recycling other PET waste products could be a new business opportunity in Malaysia.

Lastly, in the future, to be more circular in plastics, Malaysia should not limit its efforts only to recycling, but also redesigning packaging/products, introducing new business models like refillable & reusable packaging or products as a service. There are many best practices from Dutch entrepreneurs to inspire their Malaysian counterparts.

1.4 Biomass

As a nation which is widely known for leading in agriculture, Malaysia produces more than 103 million tons of biomass, including agricultural waste, forest residues, and municipal waste. More than 90% of the biomass is derived from palm oil mill residues. Malaysia is the second largest palm oil producer in the world, with a total plantation area of 5,6 million hectares. Organic residues of the palm oil industry are partly converted into biogas in digesters. In 2017, this resulted in renewable energy representing 3,5% of the whole nation electricity, mixed with solar and small hydro power in the country.

In 2018, Malaysia had 485 palm mills spreading across the country, processing at least 98 million tonnes of fresh fruit bunched (FFB). Government estimated the installed capacity potential from biomass generated at the mills: empty fruit bunces (EFB), palm mesocarp fibres (PMF), and palm kernel shell (PKS) is between 2.400 and 7.460 MW, and biogas from palm oil mill effluent (POME) is between 410 and 483 MW[9]

Local companies, mostly based in Sabah and Sarawak, where palm oil plantations are located, have become the main sources in generating biomass energy in Malaysia. As data on the number of residues that are being reused is missing, there might still be a lot of untapped potential. Further digitalisation of palm oil sector (or biomass industry at large), also identifying residues available and residues utilised can be one of the newer opportunities.

However, having its own local actors to develop renewable energy does not hinder Malaysia from facing some challenges. New technologies, new expertise, and financial assistance to start projects are still hard to get, considering limited (stimulating) renewable energy policies in the country.

As an answer, from 2016 to 2020, Malaysia started collaborating with other Southeast Asia countries (Indonesia, Thailand, Singapore, Vietnam, and Philippines) through ASEAN Plan of Action on Energy Cooperation (APAEC). The objective was to increase the contribution of renewable energy up to 25% of ASEAN energy mixture and 30% of electricity generation mix by 2020. The effort continues through the Power Integration Project

[9] Ozturk M et al, Biomass and Bioenergy: an overview of the development potential in Turkey and Malaysia. Renew Sustain Energy Rev 79, March 2017: 1285-1302

which will be expected to generate electricity trade agreement among ASEAN members.

For Malaysia, this means that they need to sustain their electricity generation mix and pursue new methods to generate from domestic sources, like biomass, and improve sustainable production for smallholders in palm oil plantation. This offers also new collaboration opportunities for research institutes and universities in agriculture sector.

The Netherlands has a track record in thinking cross-silo. Combining the expertise fields of biomass, water-, waste- and energy management offers new opportunities for example in the palm oil industry.

From the environmental perspective, most of the emissions from industrial wastewater management come from palm oil mill effluent (POME). Improving the bioenergy conversion and implementing the right waste treatment with efficient equipment and technology will result in generating more energy (for in-house energy consumption or injection in electricity grid) and minimise POME.

1.5 Waste Management

The Malaysian government started to regulate waste management since 1976 under the responsibility of local authorities. In 2011 this changed into the federal regulation because the lack of financial assistance in local authorities had negative consequences on waste collection and treatment. New rules under Solid Waste and Public Cleansing Management Act (Act 672) were developed to regulate standardisation of public cleansing management services and categorize 8 solid wastes in Malaysia[10].

Department of Statistics Malaysia stated that the country generated about 38.000 metric tonnes of waste daily in 2019. Food waste was on the top position with 44,5% of the total Municipality Solid Waste, continued with plastics 13,2%, and diapers 12,1%. The figure below shows the waste composition for solid waste in 2019.

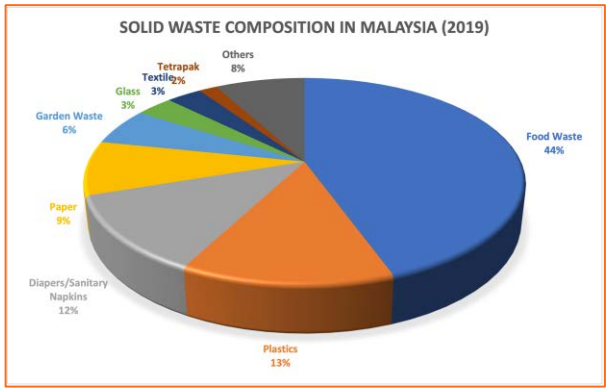


Figure 1: Solid Waste Composition in Malaysia (2019)

The high percentage of food waste generated in Malaysia should have compelled the government to find the right food waste treatment solution. However, they faced challenges as most of the waste collected from households and commercial buildings was sent directly to landfills. Most of the landfills in Malaysia are open site with over 80% of collected MSW ending there. This causes pollution and scarcity of land to accommodate the rising quantities of waste each year.

Addressing this problem, the government set big ambitions to raise the recycling rate, as the table below shows, but it can still be considered low.

Municipal Solid Waste recycling %	Target 2020: 22%
Actual 2018 (Department of Statistic Malaysia)	24%
Actual 2019 (Department of Statistic Malaysia)	28%

Figure 2: Municipality Solid Waste Recycling (%)

In addition, the Malaysian Department of Statistics reported that the country generated 4 million tonnes of scheduled waste[11], with health care service industry (clinical waste) increased 7,5% from previous year[12], while power plants, metal refineries, chemical industry, and E&E with the total contribution of 2,3 million tonnes (or 57%) from the total number.

The National Solid Management Policy has been developed in 2016. It marked also the first step on EPR regulation on waste collection and treatment in waste management sector in Malaysia. However, it has not been fully implemented. Waste

[10] There are: household waste, industrial solid waste, commercial solid waste, construction solid waste, institutional solid waste, imported solid waste, solid waste from public cleansing activities, and solid waste which may be prescribed from time to time (Solid Waste and Public Cleansing Management Act 672)

[11] Department of Environment defined scheduled waste as any wastes that possess hazardous characteristics and have the potential to adversely affect to the public health and environment. There are 77 types of scheduled wastes listed under First Schedule of Environmental Quality (Scheduled Wastes) Regulations 2005 and the management of wastes shall be in accordance with the provisions of the above Regulations.

[12] The number of clinical wastes in 2019 was 33800 tonnes, as compared to 31400 tonnes in the previous year.

management is mostly an artificial market. It costs more money than what would be earned back from the recovered resources. By modernising waste management and embracing circularity the government can significantly lower the costs, but a net cost will remain. The (full) cost of waste management must be carried by society through a set of regulations and economical steering instruments (EPR, waste tax, landfill tax etc.).

Making regulations is the domain of the government and can take time. The market will develop with the regulatory developments. The Netherlands has been working 150 years on bringing waste management where it is today (~ 2 % landfilling). In short, there are still many challenges that make the reality on the ground far from perfect. Waste is like water, and it flows to the lowest point. If there is no regulation (like EPR) or enforcement, waste will continue to end up in the lowest cost solution.

Another challenge is bypass and shortcut (corruption) in the field, which makes it hard to enforce the regulation. There are fines for illegal waste disposal in Malaysia, but in practice, no single industry has been punished. The data shows that only 6% of hazardous waste goes to integrated waste centres, while the rest of them find a shortcut and end up in dumpsites.

Some flows have momentum, like plastics and packaging. Other initiatives in the field of packaging have been formed through the collaboration of multinational companies in Malaysia with local partners. Unilever, Friesland Campina, Coca-Cola, for example, established the Malaysian Recycling Alliance as an effort to recycle and redesign packaging materials from FMCG (Fast-Moving Consumer Goods) companies in Malaysia. However, there is a lack of transparency around their projects and interests.

In addition, lack of information on the waste flows, waste segregation, and waste recycling also become challenges since the stakeholders do not know how effective their current methods on waste management system and how they can improve the waste treatment in Malaysia. While the civil society organisations and academics have limited data on volume waste generation and waste treatment, government must support the needs by improving the digitisation on this sector.

Chapter 2

Governance on Circular Economy in Malaysia

A transition towards a circular economy requires actions from all stakeholders:

- Government should set the ambition (urgency), set boundary conditions (regulation, enforcement) and allow for experimentation.
- Knowledge institutes develop new insights, enable valorisation of their knowledge, and create awareness.
- Entrepreneurs, both small and large, show guts, take risks, accelerate and are the main actors of a scale-up.
- Involvement of inhabitants and the leaders (and consumers) of tomorrow is crucial.

Developing circular economy initiatives depends on the government leadership, the industry involvement, and the network governance acceptance.

Malaysian government has established roadmaps and national policies to cut their carbon emission and reduce waste. They are however predominantly active in the field of waste management (last step in a circular strategy) with still import regulation like EPR to be put in place.

Our assessment of Malaysia's starting point:

- Government circular economy leadership: limited
- Involvement industry: medium/high
- Network governance: medium

Avenues for developing circular economy in different contexts

Starting point	Prospects for developing CE
Government CE leadership: **strong** Involvement industry: **high** Network governance: **medium/high**	**Conditions for starting and accelerating are favorable,** but several obstacles should be removed.
Government CE leadership: **limited** Involvement industry: **medium/high** Network governance: **medium/high**	**Starting is relatively easy.** Pro-active companies can start CE, but acceleration requires mobilization of additional drivers and actors.
Government CE leadership: **strong** Involvement industry: **low** Network governance: **low**	**Starting CE is relatively easy.** Government can implement policies and tackle additional challenges but acceleration requires actors' support.
Government CE leadership: **limited** Involvement industry: **low** Network governance: **low**	**Starting CE is complicated**; kick-off possible via first movers in industry (and others), but mobilization of additional drivers and actors is crucial.

Figure 3: Avenues for developing circular economy

Following the guideline set up by Professor Jacqueline Cramer, it means that developing circular economy initiatives can be relatively easy to start when pro-active companies take initiative, but acceleration requires mobilization of additional drivers and actors, such as local businesses, new industry players, NGOs, academics, consultants, and local communities.

Today, the main drivers to develop circular economy initiatives are carried by private companies especially FMCG companies through MAREA (Malaysian Recycling Alliance) and project collaboration within the states.

In addition, private sector association like MPMA (Malaysia Plastics Manufacturing Association) and FMM (Federation of Malaysian Manufacturers) also annually publish their reports and updates on circular economy initiatives of their members.

There are local champions from academics, circular economy experts, local companies that have been actively engaged with government to develop circular economy programs and initiatives in the country. NGOs, like WWF Malaysia, also play a major part on assisting government, for example, on co-drafting EPR regulation in waste management.

In the meantime, in October 2021, the Malaysian government launched the 12th Malaysia Plan (12MP) which focuses on three main themes: resetting the economy, strengthening security, wellbeing, and inclusivity, and advancing sustainability. The government will allocate RM 530 billion (€ 111 billion) for the existing and new development projects. This can be a fresh start for the government to push the circular economy transition into priority and develop circular economy strategies on high impact industries, such as manufacturing, tourism, agri-food & and biomass and strengthening existing regulation for waste and plastics.

As the government seems aware of their own still limited leadership on circular economy topics and realises the need to involve others, it is expected that the Malaysian government will start to engage with stakeholders and stimulate them to be more active in circular economy. The initiative is expected to be supported by public and private investments.

Chapter 3

Malaysian Dutch Cooperation and Business Opportunities

Feeding the world while reducing environmental impact and not increasing land-use is an important global challenge, which can be addressed through circular economy. As the second largest agricultural exporter globally, the Netherlands provides solutions for Malaysia's food production, such as horticulture and more productive seeds. Through new forms of bio-pesticides, Dutch innovations help to reduce both costs and environmental impact, while improving the yield for Malaysian farmers.

Newer opportunities pop up in the field of plastics. To combat plastics pollution, the Dutch Ocean Cleanup launched its first Malaysian "Interceptor" in 2019, a boat specifically designed to collect plastics and other waste from the Klang river in Selangor. The Ocean Cleanup is currently investigating to make Malaysia a production hub for its "Interceptors", with the aim to cut production cost and reach out to more Southeast Asian countries. Also packaging designers and recycling technology providers might find the time right to explore opportunities in Malaysia.

The Netherlands is not one of the larger manufacturing countries but is probably among the most circular manufacturing countries. These circular competences could bring the already strong Malaysian manufacturing sector to a more resilient and profitable level. Dutch companies have invested in manufacturing plants In Malaysia, especially in semiconductor businesses.

Dutch-based FMCG companies such as Heineken, Dutch Lady Milk Malaysia (Friesland Campina), and Unilever are also actively starting to implement circular economy programs in Malaysia. Dutch Lady Milk Malaysia, for example, is now building a new "green ready" factory (with the assistance from Royal-DHV Haskoning). Water management. Energy efficiency and green energy certification are key focus areas. At the same time the plant has a Zero Waste to landfill target (now only 5%). Next to that, there is a strong focus on design and waste management aspects (driven by both anticipated Malaysian regulation and corporate global commitments).

In addition, there are other Dutch companies, like Hyva and Paques that have been in Malaysia for a longer time and expand their businesses in Southeast Asia region on waste collection and waste management. They serve different kind of clients from different sectors, starting from manufacturing industries to assisting biomass industries to overcome the wastewater management issues.

On the longer term, as regulation develops, we expect more business opportunities for Dutch companies to develop, for example, in regulated markets like the waste management sector.

As the world recovers from COVID-19, recovery funding will become available, which adds on to funding related to climate adaptation and mitigation, expected to materialise faster than before. Where climate measures and circular economy business models strengthen each other, we expect other opportunities to materialise for circular economy in Malaysia.

Please find below the most important opportunities identified, as manufacturing and plastics become the high sectors which can be prioritized.

3.1 Manufacturing

Department of Statistics Malaysia reported, Malaysia's manufacturing sales in October 2021 achieved at RM 140,7 billion (€ 29,3 billion). It increased 15,3%, as compared to the same month, last year. The rise in sales value was driven by seven industries with electrical&electronics (16,9%), vehicle components (7,5%), and chemical,rubber,&plastics (27%) becoming the major sectors which contributed to the sales value. In accordance with circularity, Malaysia Investment Performance Report on 2019 stated that by using remanufacturing as one of the strategies to do circular economy transition, these top 3 industries (together with printer cartridge manufacturing industries) can generate **3 times the current value to Malaysia's economy.** On top of that, based on World Economic Forum, optimizing the products and materials from manufacturing sector in Malaysia will reduce an estimated 26 billion metric tons of net CO2 emissions until 2025, from just three industries: electricity (15,8 billion metric tons), logistics (9,9 billion metric tons), and automotive (540 million metric tons).

Therefore, in this important Malaysian sector, several opportunities can be explored. They can be related to building up technical skills, providing technology in digitisation, and setting up the return and remanufacturing supply-chain for industries.

In circular manufacturing, the 10 R-hierarchy of circularity can be applied. It is divided in three groups: Circular Design (R0-R2), Lifetime Extension (R3-R7), and Recycling (R8-R9)[13].

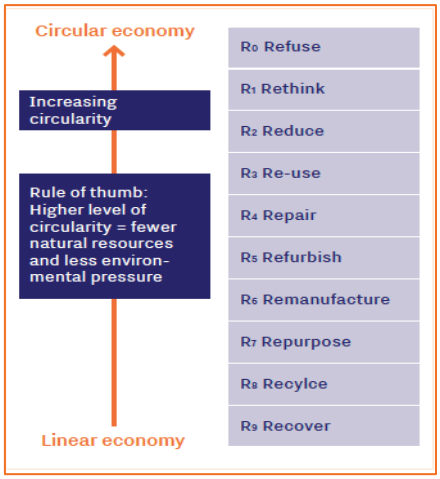


Figure 4: 10-R hierarchy of circularity

Adopting a **smart industry**[14] strategy and enhancing digitisation can make use of data matching platforms as a response to the need of the Federation of Malaysian Manufacturers (FMM). There is an urge from manufacturing industries to find a method to identify their own products performance and the reuse value potential. These actions need to be done to support recycling rate target set by the Malaysian government. There are several Dutch companies which have been providing the digital platform and application, also smart solution to assist manufacturing industries in The Netherlands. Using ICT sensors and application to know the availability and condition of each asset are one of the services they provide. These circular manufacturing companies are willing to set new market in Southeast Asia region, as well as provide technical skills for the local companies.

Furthermore, combining **servitisation (offering products as a service rather than one-off sale) and smart technologies** will help the industries create more value from the existing products as well as promoting resource efficiency. Vehicle components, ICT, medical devices, and aerospace industries can complement their data collection to identify their product performance and technical data performance during their lifetime. It can result in a recommendation for customers to buy less new machines and upgrade existing ones instead. A lot of Dutch companies have done extensive efforts on this matter; thus, they can assist Malaysia's industries in terms of knowledge transfer, skill training, and technicalities on using smart technology.

Establishing **refurbishment and remanufacturing** for Malaysia's top industries (electrical & electronics, vehicle components, printer cartridge, medical devices, and aerospace) can also be the key strategies and are expected to generate more value yet using more resource-efficient manufacturing products. There have been initiatives of local remanufacturing industries for vehicle components, printer cartridges, and ICT (especially on laptop and mobile phone industries). However, there have been issues with the quality standard of remanufactured products. Not more than 30% customers are happy with remanufactured products because of bad product performances. This challenge can be seen as new opportunity for Dutch companies which have been actively applying capital equipment strategy to identify most added value high-tech equipment in manufacturing industry and maintain its quality after being refurbished and remanufactured.

Another business opportunity for Dutch entrepreneurs to be explored is **batteries for e-mobility**. Huge support from Malaysian government on electric vehicle (EV) industries will also bring huge demands for sustainable batteries. Based on Malaysia's National Green Tech Policy, it is mentioned that the country has at least provided 100,000 Passenger EVs, 2000 bus EVs, and 100,000 Electric motorcycle or scooter. Assuming that passenger EV drives 52 km per day on average, the car will need 10,4 KWh (Kilowatts per hour) of electricity each day. The energy needed for EV is 10 times higher than running a refrigerator for a full day or keep an air conditioner switched on for 7 hours. There have been initiatives from Dutch entrepreneurs to supports business-to-business customers with circular design, repair, and recycling of Li-ion batteries used in EV. They manage to remanufacture 70-80% of the used batteries by using original components and other measures to comply with the global quality standards. These companies also reached out to battery manufacturers to influence the battery design so they can be easily repaired and recycled. Engaging these companies for Malaysia's automotive sector is

[13] Holland Circular Hotspot, Manufacturing: The Future is Circular, 2021, https://hollandcircularhotspot.nl/publications/

[14] Smart industry defines as a circular economy strategy to enhance resource efficiency by using sensor technology, digitization, artificial intelligence, and photonics. It will help the manufacturing industries achieve energy transition, avoid resource scarcity, and create new business opportunities. (Holland Circular Hotspot, Manufacturing Brochure 2021)

important to open a new market in Malaysia's EVs industries.

There is also the district cooling energy system as another sector which can be looked at as a part of Malaysian government commitment to reduce greenhouse gas emission by 45% in 2030. With a fast-growing population which two-third of the total population in Malaysia live in the cities, it is predicted that around 30% of energy use in the region is related to cooling, for household and business purposes. Unlike conventional air-conditioning system, district cooling energy systems consists of a network of underground pipes that pump cold water to multiple buildings in a district, neighbourhood, and city. These systems can use larger sources of cooling which cannot be connected to a single building. There has been a multinational French energy company, Engie, that has been collaborating with local partners since 2012 to set up a system in various Malaysian districts. Most of the energy used in their installation is solar energy. Currently, The Malaysian government is actively seeking for other companies that can provide the energy from other renewable energy sources, like biomass and hydro energy, or waste to energy projects linked to cooling installations. This opportunity can be explored further within Dutch entrepreneurs and local representatives to set up alternative solution to the current installation projects.

Lastly, based on Maslow's Diagram that identifies stakeholders by their interests and their powers, there are number of key players that can be considered important in the process of expanding business opportunities in this sector:

Associations (aim at the frontrunning companies within these associations)

- FMM (Federation of Malaysian Manufacturers)
- MAA (Malaysian Automotive Association)

Private sector actors

- Besi, Tonasco, NXP, EU car manufactures, Unilever
- Importers & distributors from automotive industries

Public actors

- Ministry of Finance
- Ministry of Environment and Water
- Malaysian Investment Development Authority (MIDA)

3.2 Plastics

As everywhere in the world, there is momentum in plastics and there are opportunities to grasp. The Ministry of Environment and Water Malaysia reported that if the country can recycle 1,4 million tonnes of PET, PP, LDPE/LLDE, and HDPE which are now still disposed in landfills the country it will create a potential value equal to € 2,7 billion. Currently only 19% of the total value per year is unlocked[15].

Governmental actions, like the implementation and enforcement of regulation (like EPR) can create a significant market. It will probably take some time before the market is professional but that might not scare away entrepreneurial first movers. Helping the Malaysian government with G2G support will create the boundary conditions for future business activities.

Till that time there will be voluntary initiatives driven by the private sector, mainly FMCG companies with global commitments that must walk the talk also in Malaysia. Helping these often-influential companies to organise their value-chains, getting actors on board, providing technology and redesigning packaging might be a relatively safe bet.

Malaysia has room to further scale and professionalise the closing of plastic value chains. This goes from design to production, usage to collection, sorting, recycling, and applying recyclate in new products. For Dutch entrepreneurs, a role in collection is less logical, as here, informal collection is still the standard.

There is room for Dutch product (packaging) designers and certainly in mechanical recycling and on the long term in chemical recycling. As products are not designed for recycling yet, the best performing countries in the world with EPR in place can roughly recycle 50% of all plastics. Chemical recycling is new and most of the time still more costly and more energy intensive than mechanical recycling. There are several technologies: solvolyse, depolymerisation, pyrolisis and gasification.

Together, they fill the gap between mechanical recycling and incineration and offer to create a loop towards virgin quality recyclate (removing substances of concern like fire retardants, stabilisers etc). Pre-sorting, sorting out of process disturbing flows (like for example PVC or PET), is needed for chemical recycling. Both technologies can/should exist next to each other.

Developing technologies for repurposing and recycling of non-bottle-PET waste products could be a new business opportunity in Malaysia. Providing

[15] Minister of Environment and Water. (2021). Malaysia Plastics Sustainability Roadmap 2021-2030: Market Potential.

digital technology to identify the type of plastics in MSW is expected to be a winning technology.

For consultants, there is market responding to the need to set up a sound waste management system. That involves not only G2G support, capacity building, but also help in measuring volumes of waste flows, gather recycling and recovery data and mapping the recycling capacity inventory.

Malaysia already has the infrastructure and capacity to move further on circular plastics initiatives, however, the existing actors are not acting in synchrony. The public mentality is estimated by almost all the respondents to be rather positive towards more circular and sustainable actions.

Next to having more collaborative action, more enforcement and actions against corruption, developing education program and training on waste segregation and recycle is another opportunity which Dutch consultants and experts can be explored.

As transparency is more and more a requirement, the lack of actors with capabilities related to auditing, measuring, and governing sustainability within the companies can be opportunities for Dutch entrepreneurs and consultant which have established international standardisation and certification on sustainable initiatives.

There is a mixed of actors in Malaysia's plastics value chain which the new entrepreneurs can put attention to as the figure below.

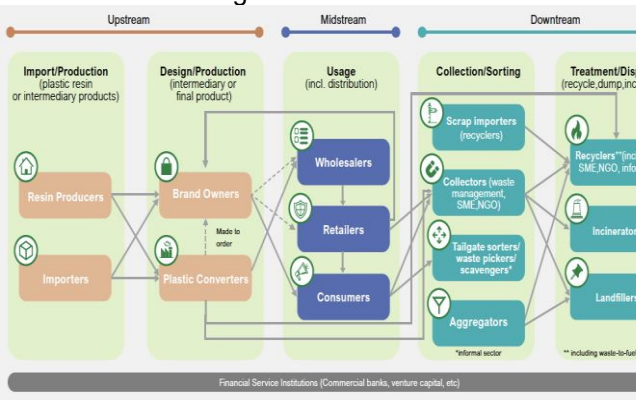


Figure 5: Malaysia's plastics value chain

In addition, there are key actors across the value chain that need to be considered in the plastics sector:

Public actors

- Ministry of Environment and Water
- Ministry of Housing and Local Government
- Federal Departments/ Central Agencies (i.e., Department of Government)
- State/ local Authorities
- Solid Waste Municipality Corp (SWCORP)

Private companies

- Unilever, Dutch Lady (Friesland Campina), Heineken, Nestle, Coca Cola
- Frontrunning retailers, packaging manufacturers, e-commerce

Association (aim at the frontrunning companies within these associations)

- MAREA, MPMA, MPRA[16]

NGO's and Institutions

- WWF Malaysia, World Bank, ADB (Asian Development Bank)
- Yayasan Buddha Tzu Chi

3.3 Biomass

The Malaysian government ambition, within the ASEAN region, aimed at developing higher amounts of renewable energy, especially from Malaysia's palm oil residues, is a driver for further market development. Dutch technology will however have to compete with the local technology suppliers.

If water, waste and energy challenges can be combined in one integral solution, Dutch suppliers might have the better hand. Sabah and Sarawak are target areas, as that is where most palm oil plantations are located. As data on the amounts of residues being reused is missing, there might still be a lot of untapped potential.

Further digitalisation of palm oil sector (or biomass industry at large), identifying residues available and residues utilised can be one of the newer opportunities. There is also another potential market from biogas trapping and methane capturing activities from POME (palm oil mill effluent) treatment. Engaging Dutch entrepreneurs and experts on this field will create business opportunities for renewable biomass energy projects and services.

In addition, there are key stakeholders which can be considered to engage for a new business opportunity in biomass:

Public actors

- Ministry of Environment and Water

[16] MAREA: Malaysian Recycling Alliance), MPMA (Malaysian Plastics Manufacture Association), MPRA (Malaysia Plastics Recycler Association)

- Malaysia Investment Development Authority (MIDA)

Private companies

- MYBiomass Sdn. Bhd[17]

Association (aim at the frontrunning companies within these associations)

- Malaysia Biomass Industries Confederation (MBIC)

NGO's and institutions

- World Bank

3.4 Waste Management

Waste management sector has been the focus on circular economy initiatives in Malaysia for the past five years. However, lack of speed and political will on, for example, EPR implementation is challenging for the development of business opportunities in the short term. Dutch businesses can provide technology and equipment supply for waste sorting and waste segregation.

Providing digital technology to identify the type of plastics in MSW is expected to be a winning technology. Transforming waste into energy is one of the recovery strategies that can elevate the waste management program in Malaysia. Recycling is the preferred action but not all waste can be recycled. Considering the ~80% landfilling today, energy from waste, whether small scale in the shape of digestion, or large scale in the shape of waste incineration has a place in the overall waste management strategy in addition to recycling initiatives for many years to come. If there is no separation at the source, MSW will contain a lot of organics (47%). This lowers the caloric value of the waste and makes it less attractive to generate energy.

The potential in organic and food waste valorisation from MSW is still underutilized. Composting and digestion are entry level technologies. However, there must be a market for the compost or a decent incentivisation for renewable energy. The federal government has started the initiative to draft policies, yet they still need more experts and companies to come to Malaysia and strengthen these efforts.

There are also opportunities in Selangor state to rehabilitate the ecosystem all along Klang river through Selangor Maritime Gateway Project. Assistance is needed to recycle, repurpose, and reuse river waste, develop circular building strategies, and knowledge transfer on river waste management and biodiversity preservation to promote the beauty of Klang river and its opportunities on supporting circular economy initiatives for the country.

Key stakeholders to engage with to establish new business in this sector are:

Public Sector

- Ministry of Environment and Water
- Ministry of Housing and Local Government
- Department of Environment
- Malaysia Investment Development Authority
- National Solid Waste Management Department
- Solid Waste and Public Cleansing Management Corporation (SWCorp)

Association (aim at the frontrunning companies within these associations)

- Waste Management Association Malaysia (WMAM)
- Malaysia Plastic Recycle Association (MPRA)

NGO's and institutions

- World Bank
- WFF Malaysia

Concluding Remarks

Previous Dutch circular efforts in Malaysia have focused on waste management and biomass valorization. From where Malaysia is standing today significant developments can be expected in these sectors. However, those markets are predominantly artificial and will develop over time in parallel to the implementation and enforcement of regulation and an incentivization system.

Helping the Malaysian government with G2G support will create the boundary conditions for future business activities.

While describing these markets more detail in this report we have also focused on sectors that will be driven by business, independent from government that might create opportunities for Dutch entrepreneurs in a shorter time span.

[17] MYBiomass Sdn. Bhd. Is a joint-venture company together with Felda Global Ventures Holdings Berhad and Sime Darby berhad to pioneer high value green chemicals biorefinery through coordinated aggregation. Efforts undertaken by MyBiomass have inderlined its new 360 degress public private business model by bringing together the upstream players, technology providers, and offtakers for a viable business venture. (MIGHT, Malaysia Biomass Industry Action Plan, 2020)

The global momentum for plastics will also manifest itself in Malaysia and FMCG companies, among others, Dutch multinationals, can be good partners to team up with. This goes from design to production, usage to collection, sorting, recycling, and applying recyclate in new product.

Malaysia has a strong manufacturing base, and the Netherlands is a niche leader in circular manufacturing. There are opportunities in the top 4 Malaysian manufacturing industry sub-sectors (electrical & electronics, printer cartridge, vehicle components, and aerospace). In addition, sales market in rubber gloves and medical devices industries during COVID-19 pandemic can be seen as new business opportunities in circularity. Collaboration can include guidance for product design, knowledge transfer on how to transform customer perception, procurement models to grow the market for new circular business models, application of smart technologies, digitisation, consultancy services, and creating a return and remanufacturing supply-chain in manufacturing. Malaysian government's ambition to reduce greenhouse emission by 45% in 2030 also opens new market opportunities for developing sustainable batteries for electric vehicles (EVs) in the country.

The Ocean Cleanup ambition to make Malaysia the manufacturing hub for its "Interceptors" is a nice testcase.

Circular economy is a system change and requires involvement from a multitude of stakeholders. Developing circular economy initiatives can be relatively easy to start when pro-active companies take initiative, but acceleration requires mobilisation of additional drivers and actors, such as government, local businesses, new industry players, NGOs, academics, consultants, and local communities.

Today the main drivers to develop circular economy initiatives are carried by private companies especially FMCG companies through MAREA (Malaysian Recycling Alliance) and project collaboration within the states. In addition, private sector association like MPMA (Malaysia Plastics Manufacturing Association) and FMM (Federation of Malaysian Manufacturers) also annually publish their reports and updates on circular economy initiatives of their members.

Stimulating the creation of a circular economy hub where frontrunners meet and act like transaction brokers and catalyst might be a way forward. Circular Economy Hubs are Networks of Networks, multi-level, multi-sector, multi-actor. The Netherlands can support in setting-up such platform and act as a trusted partner.

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Upcoming Events

NO	EVENT	TIME
1	Circular Waste Management series (workshop and matchmaking) in EU	January 27 – February 17, 2022
2	Week van de Circulaire Economie 2022 (in The Netherlands)	February 7-12, 2022
3	International Conference on Climate Change in Kuala Lumpur	February 17-18, 2022
4	Waste Management Sustainable Forum in Kuala Lumpur	February 22-23, 2022
5	2022 Circular Economy Stakeholder Conference (in EU countries)	March 01-02, 2022
6	International Conference on Sustainable Water Management in Petaling Jaya	March 02-03, 2022
7	The 3rd World Conference on Waste Management 2022 (A Virtual Conference)	March 10-11, 2022
8	Water Resources and Renewable Energy Development in Asia (conference in Kuala Lumpur)	March 14-16, 2023
9	International Conference on Urban Economy and Sustainable Development in Kuala Lumpur, Malaysia	December 06-07, 2022

Annex

List Waste Management, Plastics, Manufacturing, Biomass, Construction, and Water Companies NL-ASEAN-

WASTE MANAGEMENT				
		Exportable Waste Management/ Plastics/ Biomass/ Manufacturing/ Construction/ Water Expertise available in the NL	Dutch companies with ASEAN-5 interest	NL companies present in Malaysia
Collection		HYVA VDL Translift GeesinkNorba Van Schijndel Royal Dutch Bammens Kliko Procomat Granuband The Ocean CleanUp Trilo	Hyva Procomot GeesinkNorba Granuband The Ocean CleanUp	HYVA The Ocean CleanUp
Sorting & Recycling:	General	Bakker Magnetics Boa Recycling Equipment Banzo Europe Recycling Equipment Goudsmit Machinefabriek Emmen Nihot N.M. Heilig Colubris Cleantech Sweep Smart Harvest Waste Paperfoam (sustainable packaging)	Bluedec Despray Sweep Smart Colubris Cleantech Harvest Waste Paperfoam (sustainable packaging)	Paperfoam (sustainable packaging)

	Organics (composting and biogas)	Waste Treatment Technologies (WTT) Renewi-Orgaworld Maris Attero-VAR Hofstetter Nijhuis Water Technology Oosterhof-Holman BBE Biogas, Biogas Plus Colsen Frames Renewable Energy Solutions Adverio DMT Multriwell Van der Wiel Wastetransformers GreenGas All Optimal Christiaens Group Gicom Composting Systems, Vandenbroek International Van Kaathoven Group Dorset Green Machines Nutrient Platform Royal Cosun Paques Protix Royal Dutch Kusters	Waste Treatment Technologies (WTT) Sweep Smart DMT Orgaworld Asia Paques Waste transformers Hofstetter Christiaens Group Royal Dutch Kusters Frames Renewable Energy Royal Cosun	Paques (Biogas from Pulp and waste treatment technologies using anaerob bacteria) Frames Renewable Energy DMT
	Plastics	UPP! Umincorp Morssinkhof Plastics Van Werven ProLogics (SUEZ) Filigrade Serious Business Heilig B.V. Legacy Plastics collection from rivers: Interceptor (Ocean Cleanup) The Great Bubble Barrier Packaging: Oerlemans Packaging Hordijk Ozarka Bioplastics Avantium Chemical Recycling Ioniqa CuRe Obbotec	Value Chain catalysts (Dutch Multinationals): Unilever Heineken Friesland Campina (Dutch Lady Milk Malaysia) Van der Lande Bess trade (Polymer recycling)	Value Chain catalysts (Dutch Multinationals in Malaysia): Unilever Heineken Friesland Campina
EfW		Harvest Waste MOVI Charcoal Bottom-ash valorisation Blue Phoenix Boskalis Environmental NRC Non-Ferro Recovery Company	Harvest Waste Powerspex Blue Phoenix	
Landfilling		Afvalzorg Trisoplast/Multriwell	Afvalzorg Trisoplast/Multriwell	

Consultants		TNO Royal DHV-Haskoning ARCADIS Witteveen & Bos Rebel WUR Enviu Searious Business PACE Creation MVO Nederland Rebel Group DeltaRes Open Universiteit (knowledge) Experts: Metasus BreAd BV FBBasic Collaboration: HCH	TNO Royal DHV-Haskoning ARCADIS Witteveen & Bos WUR Enviu Searious Business PACE Creation MVO Nederland Circo Rebel Group DeltaRes Open Universiteit (knowledge) Experts: Metasus BreAd BV- FBBasic Collaboration: HCH	ARCADIS WUR Royal DHV-Haskoning (currently involved in the construction of Dutch Lady Milk new factory) Collaboration: HCH
MANUFACTURING				
	ICT	Reconnext ((known as Teleplan Technology Services)) Selection of companies from Circular Manufacturing Brochure: SNEW Closing The Loop E-Waste Race Fairphone HCH (collaboration)	Reconnext (known as Teleplan Technology Services) HCH (collaboration)	Reconnext (known as Teleplan Technology Services) HCH (collaboration)
	Capital Equipment	Signify Manufacturing Brochure: Philips Alec Revamo SEW-Eurodrive Lely Circo Aebi Schmidt	Circo Philips HCH (collaboration)	Signify HCH (collaboration) Philips
	Consumer Goods	NOWOS (batteries for EV) Flocus TM (kapok fiber) - TEXTILE Van de Sant (sustainable furniture) Arapaha (made out of advanced biobased materials)	NOWOS (batteries for EV) Flocus TM (kapok fiber) - TEXTILE Van de Sant (sustainable furniture) Arapaha (made out of advanced biobased materials)	
PLASTICS				
	Plastics	Circo (Design classes) UPP! Umincorp Morssinkhof Plastics Van Werven ProLogics (SUEZ) Filigrade Searious Business Heilig B.V.	Circo (Design Classes) Value Chain catalysts (Dutch Multinationals) Unilever Heineken Friesland Campina (Dutch Lady Milk) Van der Lande	Value Chain catalysts (Dutch Multinationals in Malaysia) Unilever Heineken Friesland Campina (Dutch Lady Milk) HCH (collaboration)

		Bess trade (Polymer recycling) Van Werven Searious Business Cure Technology Legacy Plastics collection from rivers: Interceptor (Ocean CleanUp) The Great Bubble Barrier Clear Rivers Packaging: Oerlemans Packaging Hordijk Ozarka Bioplastics Avantium Chemical Recycling: Ioniqa CuRe Obbotec HCH (collaboration) CONSUMER GOOD: GreenTom (greenest stroller) Join the Pipe (filtered tap water in reusable bottle) Arapaha (made out of advanced biobased materials) Recycle Sint	Bess trade (Polymer recycling) Van Werven Searious Business Cure Technology HCH (collaboration) Legacy Plastics collection from rivers Interceptor (Ocean Clean-Up) The Great Bubble Barrier Clear Rivers CONSUMER GOOD: GreenTom (greenest stroller) Join the Pipe (filtered tap water in reusable bottle) Arapaha (made out of advanced biobased materials) Recycle Sint	Legacy Plastics collection from rivers: Interceptor (Ocean Clean-Up)
BIOMASS				
PPP		Port of Rotterdam Groningen Seaport	Port of Rotterdam Groningen Seaport	Port of Rotterdam
Knowledge		Biorizon	Biorizon	
Experts/Consultants		Kees Kwant (RVO)	Kees Kwant (RVO)	Kees Kwant (RVO)
CONSTRUCTIONS/ INFRASTRUCTURE				
Private		ARCADIS Easy Housing Concepts BV Modulo Werflink CooLoo (circular coating) Royal DHV-Haskoning **HCH Infrastructure Brochure:** AGMI Traffic & Lighting	ARCADIS Easy Housing Concepts BV Modulo Werflink CooLoo (Circular Coating) Royal DHV-Haskoning	ARCADIS Royal DHV-Haskoning

		Water Board Drents Overijsselse Delta (WDODelta) Copper8 Cambio Sustainability Consolis Spanbeton NTP Cirkelstad EcoShape BAM Lumael Kaumera Smart Crusher Chaplin MX3D Meerdink Bruggen Arc2		
PPP		Groningen Seaport **HCH Infrastructure Brochure:** RWS UVW	Groningen Seaport	
WATER				
PPP		Groningen Seaport	Groningen Seaport	
Private		Paques (waste water treatment) Bluecon (waste water treatment solution) Oisann Engineering BV Join the Pipe (filtered tap water in a reusable bottle) Ammon Foundation/Ammon Innovation	Paques (waste water treatment) Bluecon (waste water treatment solution) Oisann Engineering BV Join the Pipe (filtered tap water in a reusable bottle) Ammon Foundation/Ammon Innovation	Paques (waste water treatment) Ammon Foundation/Ammon Innovation

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