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Stimulating the Green Economy and Creating Sustainable Jobs for Malaysians



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Climate change is one of the most significant challenges facing contemporary human society, and Malaysia will not be spared of its consequences. Estimates indicate that without improvements to existing mitigation efforts, annual climate change-related damages across the country are projected to rise from RM11.9bil in 2020 to RM456.3bil in 2050, and up to between RM4.7 and RM6.7tril annually within the first decade of the twenty-second century¹. In order to limit these damages, action must be taken to both enhance and hasten the mitigation of emissions in Malaysia.

This paper proposes several steps for policymakers to take in order to stimulate the growth of Malaysia's domestic green economy. Such growth is intended to serve two purposes. First, investment in green infrastructure, which is defined here as the set of practices and technologies which enable the decoupling of economic growth and greenhouse gas emissions, can engender sustainable economic development and play a major role in the nation's climate change mitigation and adaptation efforts. Second, it presents an opportunity through which to create safe, sustainable, and long-term jobs for Malaysians.

A third reason for this emphasis on the green economy is borne purely of circumstance. The coronavirus-driven global recession presents a unique opportunity for countries to 'build back better' as governments increasingly adopt expansionary economic policy policies. This paper proposes that the Malaysian government devotes resources towards making the green economy central to its economic recovery efforts, allowing it to tackle climate change in the process. It calls for particular attention to be paid to four key areas where job creation and emissions reductions can be achieved simultaneously. These are agriculture and land use, electricity, transport, and waste.

The Green Economy, Sustainable Development, and Climate Change

The green economy, sustainable development, and climate change are intricately linked. In order to develop sustainably, economic growth must be decoupled from GHG emissions – which are the primary cause of climate change. Such decoupling can be achieved only through the widespread adoption of green practices and technologies across sectors and industries. The onus is, therefore, on policymakers to design and target policies that can successfully stimulate the growth of the green economy.

The green economy impacts climate change in two important ways. First, it assists in mitigating emissions by enabling transitions from high to low-carbon practices and technologies across industries. This is best exemplified by the increasing global shift from fossil fuels to renewable energy in power generation. Second, investment in the green economy enhances Malaysia's resilience to the consequences of climate change. Examples include investment in the research, development, and cultivation of crops able to survive a harsher and more unpredictable climate, or the building or preservation of physical infrastructure which can assist in coping with the consequences of rising sea levels and flooding.

Underlying the deployment of the necessary tools and technologies to achieve sustainable development are the set of policies used to accelerate growth within the green economy. This is where the government plays its most important role. The government should ensure that these policies have a twin focus: they must assist in the process of decoupling growth from emissions, and create the conditions for growth within the relevant industries. Targets must be enacted for a host of 'green' indicators, such as for renewable energy capacity, vehicle fleet electrification, public transport ridership, and agricultural efficiency and self-sufficiency.

¹ Rasiah et al (2015).

Incentives, subsidies, and other carrot-based measures such as tax allowances or exemptions must be provided to green sector players in order to reach these targets. Meanwhile, ambitious international climate commitments can act as a further spur for action within the domestic sphere, and in future climate conferences Malaysia should signal its intent to grow its domestic green industries, achieve significant reductions in its emissions, and invest heavily in its resilience to the effects of climate change. These actions can play an important role in setting emissions on a considerably lower future trajectory relative to what the status quo might bring about.

Failure to do so means climate change will itself set growth on a lower future trajectory; it is consequently important to identify areas where effective climate action can instead stimulate economic growth. Existing weaknesses must first be identified. This requires an understanding of the key sectoral sources of GHGs in Malaysia, and which sectors have the greatest potential for emissions reductions. At the same time, weight should also be placed on the potential for skilled job creation within these sectors, as shifts are made from carbon-intensive practices to those which are less so.

Table 1 displays the shares of various sectors to Malaysia's total annual emissions. This allows for identification of Malaysia's existing weaknesses, in terms of the sectors within which there is significant scope for emissions reductions.

Table 1: Selected Sources of Emissions in Malaysia, 2014

Activity	Emissions, tCO ₂ e	Share of National GHG Emissions
Electricity and Heat Production	99,297,710	31.26%
Transport	64,384,680	20.27%
Waste	28,173,280	8.87%
Manufacture of Solid Fuels and Other Energy Industries	25,534,550	8.04%
Fugitive Emissions from Oil and Natural Gas	24,923,300	7.85%
Manufacturing Industries and Construction	22,982,520	7.24%
Industrial Processes and Product Use	20,257,850	6.38%
Agriculture	14,167,910	4.46%
Petroleum Refining	8,653,900	2.72%
Total	308,375,700	97.09%
Source: MESTECC (2018) Note: This is not an exhaustive list of all sources of GHG emissions in Malaysia; as a result, the share of these emissions to the total does not equal 100%.		

The scope for effective climate action within each sector must be balanced against what existing practices or technologies make possible. These may not support emissions reductions across all sectors. The application of carbon capture-and-storage technologies, for instance, is less financially feasible – or indeed proven at scale – within cement production than it is for the oil-and-gas industry, whereas the potential for renewable energy to displace some fossil fuel use in the generation of electricity is well-established across the world.

Given the magnitude of emissions arising from electricity generation and transport, which together account for over half of Malaysia's total emissions, it is natural to direct considerable attention to these two sectors. The oil and gas industry, whose production processes account for a total of almost a fifth of national emissions², is another significant source of greenhouse gases, as is waste, which accounts for close to a tenth of the total. From the perspective of adaptation to climate change, on the other hand, it remains important for Malaysia to take steps to enhance its agricultural resiliency and long-run domestic food security, as well as protect its natural physical infrastructure through improved forest and wetland management.

A. Boosting Domestic Production and Deployment of Renewable Energy Technology

Across many countries, the replacement of fossil fuels with renewable energy (RE) within electricity generation is a crucial component of climate plans. This emphasis is due to the high share of emissions accruing to the sector³, as well as the availability of, and advancements within, RE technology. Given that RE has proven to be an effective avenue to curtailing emissions in many other countries, it is recommended that the boosting of Malaysia's production and deployment of RE technologies be at the forefront of its efforts to develop the domestic green economy.

Background

The growth of the contribution of renewable energy to electricity generation in Malaysia has been relatively lethargic, with solar, biomass, biogas, and small hydro accounting for under 3% of all electricity generated in 2015⁴. With three auctions held for utility-scale solar projects since 2016, however, the expectation is that a further 1.6GW of solar power will be added to the grid by 2022⁵. A fourth auction, with a quota of 1GW, was announced in June 2020, with these plants expected to be operational by end-2023⁶. This addition of a total of 2.5GW of utility-scale solar power generation capacity, accounting for just under 10% of Peninsular Malaysia's total electricity generation capacity of 26.6GW at the end of 2017, would bring the country closer to its target of generating 20% of its electricity from renewables by 2025. Further progress must still be made for these targets to be met.

Since the passage of the Renewable Energy Act (RE Act) and the creation of the Sustainable Energy Development Authority (SEDA) in 2011, numerous policies have been enacted with the goal of ramping up both the residential and commercial generation of electricity from RE sources. These include the feed-in tariff (or FiT, which commenced in 2012) and net energy metering (NEM, which commenced in 2016 and for which incentives were enhanced in 2018). While the latter policy mechanism has shown some promise, particularly since its revamp in 2018, it has yet to stimulate the swift and significant deployment of rooftop solar and other RE technologies. It is clear from experience that additional policies must be put in place to boost both the contribution of RE to electricity generation and the green energy sector more broadly.

Finally, Malaysia has over the past decade been amongst the top global producers of photovoltaic cells, ranking third in 2014 behind China and the European Union with a production capacity of 3.3GW⁷. This

² Emissions from oil and gas production processes include those arising from the 'Manufacture of Solid Fuels and Other Energy Industries', 'Fugitive Emissions from Oil and Natural Gas', and 'Petroleum Refining'.

³ Climate Watch (2018)

⁴ Joshi (2018a)

⁵ Suruhanjaya Tenaga (2020)

⁶ NST (2020)

⁷ Bradsher (2014)

indicates the presence of a skilled domestic workforce in PV production, but the major drawback is that almost all the companies producing these panels are foreign-owned⁸. Emphasis should therefore be placed on the creation of a greater number of 'national champions' within photovoltaic cell production. Given that much of existing production is exported, it is equally important to significantly increase the domestic deployment of these cells. Such moves will allow Malaysia to curtail emissions within the sector and create sustainable, long-term jobs in the green energy sector, as would a greater promotion of the use of another abundant source of RE in the country: biofuels.

Policy Recommendations

- I. Malaysia must fortify its position as one of the global leaders in the production of photovoltaic panels. With the solar industry already relatively established in Malaysia, it is proposed that steps are taken to create domestically-owned national champions within the industry, expand the production and generation capacity of solar across the country, and to position Malaysia as a global leader in cutting-edge photovoltaic design and production.
 - a. Incentivise more companies to produce, and existing producers to ramp up production of, solar panels, by maintaining or improving the generosity of the existing Green Investment Tax Allowance (GITA) and Green Investment Tax Exemption (GITE) mechanisms, as well as providing additional low-cost financing for capital investment. The key aims should be to increase Malaysia's production capacity of panels for both domestic and international consumption, while creating high-, medium-, and low-skilled jobs in the process.
 - b. Subsidise participant fees for photovoltaic systems training courses, such as for those conducted by the Malaysian Photovoltaic Industry Association (MPIA) and the Malaysian Photovoltaic Manufacturers Association (MPMA), and incentivise a greater number of certified training courses to be conducted by the MPIA, MPMA, or educational or vocational institutions. Greater production and deployment of solar panels will require a larger workforce; as a result, it is important to provide opportunities for the labour force to pick up and improve the skills required to produce, install, and maintain solar panel systems.
 - c. Offer financial and other incentives for subject-matter experts, engineers, and academics to research and develop cutting-edge photovoltaic panel technologies domestically. Examples include floating and thin-film photovoltaic systems and their potential for deployment in Malaysia. Such long-term, high-end investments can not only improve the efficiency of generating electricity from Malaysian-made photovoltaic panels, but help to put Malaysia at the forefront of the global solar industry.
2. Moving beyond solar, it is further proposed that steps be taken to promote the use of biofuels in electricity generation. These are attractive sources of renewable energy due to their abundance in Malaysia, as by-products of the agricultural (in particular from oil palm mills) and waste sectors. Yet both biogas and biomass presently contribute a minute share of the nation's electricity generation capacity. In order to stimulate growth in our use of biofuels, the following strategies are proposed:
 - a. Incentivise the development of grid-connected biomass- and biogas-based power plants. Given the abundance of the necessary feedstocks, raw material costs are low – indeed,

⁸ NST (2019)

the levelised costs of electricity generation from biomass are close to, if not lower than, grid displacement costs in some areas of the country. This would allow Malaysia to harness efficiently the use of its biofuel resources.

- b. Incentivise palm oil millers to invest in waste-to-energy projects. Improving grid connectivity to mills would allow millers to sell excess electricity to the national grid en masse, and low-cost financing or cost-sharing arrangements should be offered for these capital-intensive projects. Further options include the creation of mini-grids powered largely by biofuels, in areas where mills are clustered but remain distant from grid interconnection points. These steps would boost the contribution of biofuels to Malaysia's electricity mix, allow mills to meet their energy demands through RE sources, while earning returns on excess electricity generated.
 - c. Grants and incentives should be provided for research and development aimed at enhancing efficiency of biofuel plants and associated technologies, and exploring alternative applications of biomass and biogas. In particular, emphasis should be placed on biogas upgrading, the capture and use of landfill biogas, and furthering the use of biofuels in transport. Such investment should be made with the aim of placing Malaysia at the forefront of the global biofuel industry.
3. It is proposed that while incentivising the transition from fossil fuels to RE within electricity generation, investment is made in the research, development, and deployment of carbon capture-and-storage (CCS) technologies. This is to ensure that emissions arising from existing fossil fuel power plants are somewhat curtailed during these plants' remaining operational lifespan. CCS also has myriad industrial applications, including within oil and gas, for which investment in R&D can play an integral role improving economies of scale. The government can play a crucial role providing low-cost financing and participating in public-private partnerships to develop and deploy the requisite technologies to reduce the carbon intensity of processes across these sectors.
 4. Finally, it is proposed that studies be conducted on the feasibility of community microgrids in cities and rural areas, in addition to the emphasis on the development of microgrids amongst clustered oil palm and other agricultural plantations. Neighbourhood power-sharing microgrid trials should be set up, with households fitted with subsidised solar panels. Such trials can provide a proof-of-concept of microgrids using existing grid infrastructure, and set Malaysia towards the path of reducing its reliance on the large and polluting coal- and gas-fired power plants that supply the bulk of the country's electricity. Setting the framework for households and communities to engage in peer-to-peer energy trading and lending would allow, typically, solar power to be shared amongst neighbours. A future of neighbourhood-scale microgrids must be looked into, and funding must be provided for the research and development of large-scale batteries which can act as baseload support for such systems in the longer-run, as the country strives to reduce its reliance on fossil fuels in power generation.

B. Improving Long-Term Food Security and Land Use Management

The threats posed by climate change to agricultural resiliency and food security are well-documented. Changing weather patterns, the increased prevalence of flooding and pest outbreaks, and rising temperatures, amongst many other consequences of climate change, are all expected to play a role hampering agricultural yields and contributing to crop failure over the coming decades⁹. If steps are not

⁹ Cho (2018)

taken to hedge against and limit these risks, Malaysia's long-term food security and agricultural self-sufficiency will come under further question.

Background

The share of agricultural land in Malaysia used to grow food crops has fallen since 1960, from roughly 32% then to just 8% in 2019¹⁰. Malaysia's deficit in its balance of trade for food has consequently grown, particularly since the 1990s, and around a quarter of all food consumed in the country is now imported¹¹. Rice, for example, despite being a national staple has seen its self-sufficiency ratio drop from 92% in 1980 to 70% today. At the same time, paddy yields in Malaysia lag significantly behind those of other regional producers and are projected to diminish further as the effects of climate change continue to be felt over the coming decade¹². This is despite enormous annual government subsidies provided to rice farmers: in 2018, these amounted to RM2bn. Malaysia's fast-growing and increasingly wealthy population will only add to these burdens.

With more than 80% of agricultural land in the country dedicated to oil palm plantations, present and future land-use decisions are critical in determining Malaysia's long-term agricultural resilience and domestic food security. The government must play an active role ensuring that land-use is more diversified and that more land used to grow food. At the same time, it is imperative to put in place policies that promote efficiency within the sector, and which modernise Malaysian agriculture by incentivising the creation and growth of a domestic urban farming (or vertical farming) industry. Urban areas themselves can benefit from a more cultural shift, which prizes green spaces in cities more than it does luxury apartments, office spaces, and shopping malls.

Policy Recommendations

- I. A key element of many countries' climate resilience plans within agriculture involves making advancements within urban vertical farming. This is because of the lower demands of urban farming systems on energy, land, and resource use relative to conventional agricultural practices, as well as its ability to create some resilience within the sector to the consequences of climate change. It is proposed that the government incentivises farmers and/or entrepreneurs to enter this industry, and spur growth within the industry, by:
 - a. Providing financing and other financial incentives for farmers, entrepreneurs, communities, and/or non-profits seeking to start up urban farms. Additional assistance should also be provided by alleviating the bureaucratic processes involved in acquiring the necessary land or buildings, along with permits to grow and sell food. These steps simplify the processes involved in creating a number of urban farming sites across the country, as well as improve the financial viability of entrance into such a nascent industry.
 - b. Assisting in the procurement of necessary feedstocks for hydroponic, aeroponic, and aquaponics farming systems in order to minimise variable operational costs of urban farming systems. Another key area of government involvement includes subsidising participant fees for hydroponic, aeroponic, and aquaponics farming systems training courses, with the aim being to create a generation of skilled, modern-day farmers and upskilling existing farmers who seek to enhance their skillsets.

¹⁰ Sim (2019)

¹¹ Ahmad Nordin et al (2019)

¹² KRI (2019)

- c. Providing tax allowances or exemptions to urban farms in the first five years of operation, conditional on the meeting of specified production targets, particularly for produce of which current self-sufficiency ratios are low. Such a results-driven approach minimises state intervention while ensuring resources are being dedicated to enhancing domestic food security.
 - d. Financing further research and development within the context of urban farming. This would enable technological advancements within the industry, such as those which enhance crop yields and minimise resource use, as well as those which enable the use of artificial intelligence, robotics, automation in urban farms. Another key area of research involves broadening the scope of crops suitable for growth in urban farms – currently, these are largely limited to leafy vegetables.
- 2. At the same time, steps must be taken to enhance efficiency and yields at conventional farms. To achieve this, it is proposed that steps are taken to upskill farmers and create a new generation of skilled, modern farmers, as well as promote the adoption of modern and advanced farming systems and techniques. These goals can be achieved by:
 - a. Organising and subsidising fees for training programmes for existing and aspiring farmers. Courses and practical training should cover integrated and precision agriculture, the incorporation of technology into farming practices, and the utilisation of farm management technologies, amongst others. In upskilling existing farmers, training a new generation of skilled farmers, and encouraging the adoption of advanced farming techniques and technologies, agricultural efficiency can be enhanced across the country.
 - b. Extend further financial support and improve domestic and international market access for smallholders. This will enhance the affordability of cutting-edge agricultural technologies, including automated hardware, drones, robotics, and sensors, as well as high-quality feedstocks, including seeds and natural and organic fertilisers, as well as open up new market opportunities for smallholders.
 - c. Extend financial incentives and low-interest loans to larger agricultural-sector players. This, again, will enhance the affordability of cutting-edge agricultural technology and high-quality feedstocks.
 - d. Provide incentives for farmers to diversify crops and set targets for all crops based on self-sufficiency ratios (SSR). Products for which international demand is strong should have production incentivised, including durian and coconuts, with the aim of Malaysia attaining a significant share of the global market. At the same time, steps should be taken to export more produce of which Malaysia's SSR is high, a group which includes many fruits and vegetables. Targets should be set for annual increases in export capacity for these products. At the same time, it is important to increase the production of agricultural products for which Malaysia's SSR is low – including cabbage, chilli, mango, and many dairy products. These targets should assist in improving both the balance of trade, and self-sufficiency, for food.
- 3. Finally, it is proposed that significant changes are made with regard to land-use decisions more generally. Underlying these changes is the recommendation that a moratorium, without exception, be placed on deforestation, with efforts also made to enhance forest preservation and increase rates of reforestation. Malaysia should also commit to reducing the prevalence of mono-cropping, such as within palm oil plantations, in an attempt to increase crop diversity and efficiency. Within urban areas, greater emphasis must be placed upon the creation or maintenance of green

spaces such as parks. Finally, steps should be taken to enhance Malaysia's firefighting capabilities, particularly with regard to forest fires and wildfires.

- a. With climate change a key consideration, it is of importance that steps are taken to protect Malaysia's natural infrastructure. Malaysia contains some of the oldest, biodiverse, and important tropical rainforests in the world, yet estimates by the Global Forest Watch suggest that between 2000 and 2019, Malaysia lost close to 28% of tree cover¹³. Further, data from the Food and Agriculture Organization (FAO) finds that only 15% of Malaysia's forest cover is comprised of primary rainforests¹⁴, while in 2016 just 5.3% of tree cover was comprised of intact forest¹⁵. Budgetary allocations towards forestry should be increased, with the aim of creating jobs in forest preservation, restoration and management. A key aim of this approach should be to improve the condition of Malaysia's existing rainforests, alongside reforestation efforts. Rainforests, mangroves, and peatlands should also be gazetted and protected, with a nationwide moratorium on deforestation implemented for the foreseeable future.
- b. At the same time, the practice of mono-cropping – particularly within the oil palm industry – must be curtailed. At present, mono-cropping is common across Malaysia due to short-run profitability, but this produces negative long-run effects through land degradation, and pest and disease outbreaks, which in turn requires greater use of pesticides, causing further environmental harm. One way to mitigate the prevalence of mono-cropping would be to tie tax allowances to crop rotation and diversity.
- c. Within urban areas, a drastic rethink is required on land-use and/or zoning permits. Recent decades have seen Malaysia's cities transformed into 'concrete jungles', and even today the development of apartments and shopping malls takes precedence over that of parks or the maintenance of previously green spaces. Such practices must stop. Several options exist for policymakers, ranging from increasing the weightage of environmental costs in cost-benefit analyses of urban development projects, to imposing blanket moratoriums on new urban development within high-density areas. A glut in the supply of luxury residences, as well as office and commercial spaces in Kuala Lumpur, for instance, means there is little – if any – further need for such development. Building parks and maintaining greenery, in perhaps the form of mini-jungles, can on the other hand create jobs and add to the common good in a variety of ways.

C. Greening Mobility: Emphasising Efficiency, Electrification, and Exercise

The mitigation of emissions associated with the transport sector is an important policy issue for governments across the world. On a global level 14% of emissions arise from the sector¹⁶, although this figure varies across countries depending on rates of motorisation and public transport usage, amongst other variables. Many countries, then, have implemented a variety of policy measures aimed at curtailing these emissions. Such policies include expansions of mass transport networks and services, the promotion of research, development, and deployment of alternative energies for transport, and a host of regulatory measures such as the implementation of fuel economy standards. All these initiatives, and others still, have the potential to mitigate transport sector emissions.

¹³ Global Forest Watch (2020a)

¹⁴ FAO (2015)

¹⁵ Global Forest Watch (2020b)

¹⁶ IPCC (2014a)

Background

The transport sector is Malaysia's second-largest sectoral source of GHGs, accounting for over 20% of national emissions¹⁷. Much of this results from road transport, which alone is responsible for over 19% of national emissions. Part of the reason for this is Malaysia's high motorisation rate, of 439 vehicles per 1,000 inhabitants¹⁸, which is the highest in Southeast Asia and four times the continental average. There is therefore significant scope for emissions reductions within the sector. It is proposed that a variety of strategies are employed to achieve such reductions, including but not limited to greater penetration of electric vehicles (EVs) and the building of charging stations, the adoption of mandatory fuel economy standards for internal combustion engine vehicles (ICEVs), investments which improve both the efficiency and last-mile connectivity of public transport networks and services, and enhancements to the pedestrian- and bicycle-friendliness of Malaysia's cities.

Policy Recommendations

- I. A crucial component of a low-carbon transport future is the electrification of the vehicle fleet. Depending on the emissions intensity of electricity generation¹⁹, EVs have the potential to dramatically curtail emissions. This, of course, lends greater weight to the importance of decarbonising electricity generation in Malaysia (see Section A). Nonetheless, it is proposed that steps are taken to encourage the mass adoption of EVs, incentivise the domestic production of EVs and EV components, and build an extensive charging infrastructure for EVs across the country.
 - a. Remove excise taxes for imported EVs, and provide financial incentives for consumers to purchase EVs. This policy is predominantly aimed at lowering the costs associated with purchasing EVs. Excise taxes are in place to protect the market shares of local automakers, but in the absence of locally-produced EVs these disincentivise consumers from transitioning to 'cleaner' modes of transportation. The financial incentives provided for EV purchases, meanwhile, should be limited to non-luxury brands, targeting instead lower- and middle-tier car brands. In this way, ownership of electric vehicles need not be a luxury only the rich can afford, but enhance the potential of mass-market adoption of EVs.
 - b. Provide low-cost financing and other financial incentives for the domestic production of EVs, including buses, cars, and motorcycles, and EV components, particularly to Malaysian automakers. This policy has several objectives. The first of these is to create the conditions for low-cost, domestically-produced mass-market EVs that will speed up the process of vehicle fleet electrification. Second, this policy aims to create local jobs within an industry that is driving the present revolution in transport. Finally, such an emphasis would allow Malaysia to be a key global supplier of affordable EVs particularly to other developing markets.
 - c. Continued financing of the deployment of an extensive EV charging infrastructure across the country. Existing targets for the building of standalone charging stations should continue, but greater emphasis is needed on retrofitting existing buildings with dedicated parking areas for electric vehicles. New legislation should also be passed mandating a proportion of parking spaces in new building projects to be EV-friendly in order to prepare for the medium- to long-term mass-market transition to EVs. An ancillary benefit of this policy involves job creation in building charging stations, while further research and

¹⁷ MESTECC (2018)

¹⁸ International Organization of Motor Vehicle Manufacturers (2015)

¹⁹ Joshi (2018b)

development into more efficient modes of charging has the potential to create higher-skilled, research-based jobs.

2. As the transition to a highly-electrified vehicle fleet will take time, emphasis must in the meantime be placed on improving the energy efficiency of traditional ICEVs. Many countries, including China, Japan, and South Korea (as well as the European Union and the United States) utilise national fuel economy standards as a component of their policy toolkit²⁰, and such a policy has the potential to play a pivotal role mitigating emissions associated with private road transport in Malaysia.
 - a. Implement mandatory fuel economy standards in Malaysia. There is little reason for local standards to fall short of those in place in other countries: the Japanese automakers Honda, Nissan, and Toyota, who control over a third of the new vehicle market share in Malaysia, already meet stringent emissions standards in their domestic market, and the same holds true for Korean and German carmakers. The onus should therefore be placed on local manufacturers like Perodua and Proton to produce efficient ICEVs. In driving upwards the average fuel economy ratings of new ICEVs, these standards can lessen the carbon footprint of private road transport over time.
 - b. Incentivise, through tax allowances and exemptions, domestic automotive manufacturers to produce fuel-efficient vehicles and engage in research and development of next-generation, low-emission hybrid and ICE vehicles.
3. Possibly the most impactful of climate measures within the transport sector involves public, or mass, transportation. Buses and trains, for instance, are significantly less polluting per passenger-kilometre²¹ than all modes of private transport except bicycles. Recent years have seen tremendous investment in public transport infrastructure, particularly for trains, but further effort is necessary to improve the efficiency and ridership figures of these services. Steps must also be taken to improve last-mile connectivity, which presently is at best broken and highly inefficient, and at worst largely non-existent. Last-mile connectivity can also be aided by the creation of bus and bicycle lanes, as well as improvements to pedestrian infrastructure.
 - a. Bus frequencies should be increased, and networks revised and, in some cases, extended to cater better for the needs of presently underserved areas. It is proposed peak-hour bus lanes are created, in order to allow buses to bypass bottlenecks and in reducing consumers' travel times enhance the attractiveness of transit ridership.
 - b. By the same token, the government should continue indefinitely the provision of affordable, universal monthly (and/or annual) public transport passes which allow passengers seamless transitions between varying forms of transit. It is also proposed that congestion charges are implemented on drivers within high-traffic areas during peak hours and combined, these two cost-based measures can stimulate further growth in transit ridership.
 - c. It is proposed that investment be made in creating and/or improving infrastructure for pedestrians and cyclists. In addition to potentially creating social health benefits through exercise, extensive and safe pedestrian pathways and bicycle lanes can play an integral part tackling issues related to last-mile connectivity and congestion. Such action can also reignite economic activity within the construction industry.

²⁰ Yang (2018)

²¹ IPCC (2014b)

D. Modernising Waste Management Through Circularity

The global focus on waste management in the climate policy toolkit is not borne purely from the GHG emissions which arise from the sector, but its adverse effects on the environment²² – and public health²³ – more generally. Nonetheless, by employing modern waste management technologies and shifting away from the use of landfills, all three aforementioned concerns can be addressed to a degree. Further emphasis must also be placed on the “three Rs” (reduce, reuse, and recycle), and the concept of circularity. It is proposed that all these strategies are employed simultaneously so that Malaysia may address both the environmental and health concerns associated with poor and outdated waste management systems, as well as create modern, sustainable, and skilled jobs within the sector.

Background

The waste sector is a significant contributor to emissions in Malaysia, accounting for close to 9% of the total. Within the sector itself, the bulk of the emissions arise from two general sources: solid waste disposal sites (3.24% of total emissions) and the treatment and discharge of industrial wastewater (4.99%)²⁴. While there is scope to reduce these emissions, a more prominent concern with waste is the environmental degradation it causes if improperly managed. As a result, it is proposed that an overarching focus of any policies within the sector should be the promotion of waste reduction and increased recycling. Further steps should see a transition from the use of open dumpsites in favour of less environmentally-degrading and emissions-intensive waste disposal options, including sanitary landfills and incinerators, as well as an embrace of circularity – including an emphasis on significantly proliferating the generation of fuel from waste. Underlying all these policy measures should be the streamlining of bureaucracy and the federal-level imposition of state-level targets for key sustainability indicators within the waste sector. All waste management policies must also be better enforced, particularly within the commercial and industrial sectors, while efforts must be made to organise efficient and effective recycling programs.

Policy Recommendations

- I. An emphasis is proposed on circularity within the commercial, industrial, and residential sectors. This requires reductions in waste creation, establishing standardised public recycling systems, and an embrace of thermal and non-thermal waste-to-energy technologies, amongst other measures.
 - a. From a residential standpoint, recycling should be simplified. Households and apartment buildings should be provided with recycle bins for paper, plastic, and glass, and these should be collected on a biweekly basis. Potential new market entrants should be provided incentives to build sorting and recycling facilities, while existing facilities should be incentivised to expand their capacity and workforce in order for Malaysia to meet and exceed existing and future recycling rate targets. This can be achieved through the provision of low-cost financing and a streamlining of the bureaucratic processes involved in setting up such businesses. Household composting should also be encouraged, and subsidies should be provided for the purchase of the necessary equipment.
 - b. Thermal and non-thermal waste-to-energy (WtE) plants should continue to be commissioned, in tandem with the policies outlined in Section A to promote the use of biofuels in electricity generation. Funding should also be provided for the research and development of alternative WtE technologies, such as gasification plants and anaerobic digesters, in order to further reduce Malaysia's reliance on landfills. These technologies

²² El-Fadel et al (1997)

²³ WHO (2016)

²⁴ MESTECC (2018)

can assist in enhancing the circularity of Malaysia's economy while ensuring the creation of jobs.

- c. Another important goal should be to greatly increase Malaysia's recycling rate for metals, including for electrical and electronic equipment. The government should commission the creation of specialised facilities and extend low-cost financing for such initiatives. Financing will also be needed for further research and development, particularly to identify and deploy processes and technologies to maximise the recyclability of electronic waste. With e-waste a growing problem, Malaysia should strive to put itself in a position to be amongst the global leaders in dealing with this issue.
 - d. Measures should be introduced to support businesses and the creation of business which make products explicitly out of the waste stream. Low-cost financing and funding for research and development should be extended to such companies, and public-private partnerships inked in order to boost circularity.
2. It is recommended that effort is put into revamping waste disposal practices in Malaysia. To start, open dumpsites must be banned and shut down. The recent emphasis on the use of sanitary landfills should continue, albeit not as a permanent, long-term solution to the problem of waste disposal. Alternative solutions must be considered, in tandem with the aforementioned aim of generating less waste and improving the circularity of waste products.
- a. Landfill tipping fees should be increased²⁵ to the point where they are aligned to those in international markets. This can incentivise households and businesses to curtail waste, and disincentivise other countries from exporting waste to Malaysia. Landfill sites should be monitored routinely to ensure environmental and other safeguards are always in place.
 - b. A common concern over the use of incinerators in Malaysia relates to the comparatively higher moisture level of waste domestically compared to that found in developed countries, but potential for their use remains. Funding should be provided for research, development, and deployment of incinerator technologies that can address this, and other, concerns. Combined with the use of carbon capture technologies, this can mitigate emissions associated with the sector more broadly.

Concluding Thoughts

The strategies and policy recommendations in this paper were made with the goals of assisting Malaysia in decoupling its GHG emissions from economic growth, taking steps forward in adapting to climate change, and creating sustainable, long-term jobs within the green economy. While these are all important policy ambitions within the context of climate change and sustainable development, Malaysia's climate policies should not be limited to the targeted approaches highlighted here. At the heart of all climate action should be its optimal economic solution: carbon pricing. Creating a market for carbon corrects for the market failures that are causing climate change simply by placing a tangible value on the projected future economic damages of today's GHG emissions, regardless of their source. Indeed, carbon pricing can itself act as a further spur for the development of the domestic green economy since it raises the costs associated with the use of carbon-intensive resources and technologies, as well as provide the necessary financing for these endeavours.

Yet as Malaysia strives to build itself back better from the various economic and social shocks resulting from the coronavirus crisis, it is imperative that sustainable development is put at the centre of its recovery efforts. This cannot be achieved without action to stimulate the growth of its green industries. That such

²⁵ Mat Don & Muhaimin Samsudin (2013)

efforts will also culminate in the creation of jobs is an added, ancillary benefit – but an important one given the recent economic distress. With the benefits of action dramatically outweighing the costs of inaction, from both socioeconomic and environmental perspectives, it is important that the Malaysian government swiftly employs a comprehensive set of strategies to address both current and future threats to the nation's progress.

Appendix

Table A1: Selected Sources of Emissions in Malaysia by GHG, 2014

Activity	GHG	Emissions, tCO ₂ e	Share of Total GHG Emissions
Electricity and Heat Production	CO ₂	98,963,480	31.16%
	CH ₄	41,200	0.01%
	N ₂ O	293,030	0.09%
Transport	CO ₂	63,019,560	19.84%
	CH ₄	493,320	0.16%
	N ₂ O	871,800	0.27%
Petroleum Refining	CO ₂	8,624,040	2.72%
	CH ₄	8,820	0.00%
	N ₂ O	21,040	0.01%
Industrial Processes and Product Use	CO ₂	15,814,700	4.98%
	CH ₄	265,310	0.08%
	N ₂ O, Others	4,177,840	1.32%
Manufacture of Solid Fuels and Other Energy Industries	CO ₂	25,509,630	8.03%
	CH ₄	11,370	0.00%
	N ₂ O	13,550	0.00%
Fugitive Emissions from Oil and Natural Gas	CO ₂	1,728,930	0.54%
	CH ₄	23,194,370	7.30%
Agriculture	CO ₂	3,884,250	1.22%
	CH ₄	4,150,880	1.31%
	N ₂ O	6,132,780	1.93%
Manufacturing Industries and Construction	CO ₂	22,906,470	7.21%
	CH ₄	27,460	0.01%
	N ₂ O	48,590	0.02%
Solid Waste Disposal Sites	CH ₄	10,305,430	3.24%
Wastewater Treatment and Discharge	CH ₄	17,504,200	5.51%
	N ₂ O	363,650	0.11%
Total	Aggregate GHGs	308,375,700	97.09%
Source: MESTECC (2018)			

Table A2: Summary of Focus Areas, Strategic Thrusts, and Policy Recommendations

Focus Area	Strategic Thrusts	Policy Instruments
Renewable Energy	<p>Fortify Malaysia's position as a global leader in photovoltaic panel production.</p> <p>Create domestically-owned 'national champions' within the solar industry.</p> <p>Expand the domestic production and generation capacity of solar</p>	<ol style="list-style-type: none"> 1. Improve generosity of existing tax allowance and tax exemption mechanisms for 'green' investments, and provide further low-cost financing for capital and R&D investment. 2. Incentivise industry associations, and educational and/or vocational institutions to conduct a greater number of photovoltaic systems training courses, and subsidise training costs for participants. 3. Incentivise subject-matter experts, engineers, academics, and entrepreneurs to research and develop cutting-edge photovoltaic technology domestically.
	<p>Increase the use of biofuels in electricity generation, within microgrids and through the national grid.</p> <p>Promote 'circularity' within the palm oil industry.</p>	<ol style="list-style-type: none"> 1. Finance improvements in grid connectivity to underserved areas, such as near palm oil millers and/or waste sites. 2. Incentivise the development of grid-connected biomass and biogas power plants, and other waste-to-energy (WTE) projects. Targets should include energy, palm oil, and waste industry players. 3. Provide grants and incentives for R&D aimed at enhancing technological efficiency of biofuel plants and exploring alternative applications of biofuels, such as biogas upgrading, capture and use of landfill biogas, and furthering the use of biofuels in transport.
	<p>Study and trial the potential of a 'microgrid future'.</p>	<ol style="list-style-type: none"> 1. Finance the setting up of community microgrid projects, reliant on solar energy and battery storage, and trialled across urban and rural areas. Households and commercial properties must be fitted with subsidised solar panels, with the aim being that such trials provide proof-of-concept of a clean microgrid future. 2. Finance studies into the costs and benefits of the widespread adoption of community microgrids, as well as R&D into the development and deployment of large-scale energy storage options for a microgrid future.
Fossil Fuels	<p>Invest in deployment of carbon capture-and-storage technologies.</p>	<ol style="list-style-type: none"> 1. Finance R&D and deployment of CCS technologies to mitigate emissions from existing fossil fuel and industrial operations.
Agriculture	<p>Advance Malaysia's urban and vertical farming industry.</p>	<ol style="list-style-type: none"> 1. Provide financing and other incentives for farmers, entrepreneurs, communities and/or nonprofits to build and operate vertical farms. 2. Streamline bureaucratic process involved in acquiring land/buildings and permits to grow and sell produce. 3. Assist in procurement of necessary feedstocks for hydroponic, aquaponic, and aeroponic farming systems. 4. Provide tax allowances or exemptions to urban farms during the first five years of operation, conditional on the meeting of specified production targets. 5. Finance further R&D within urban farming, emphasising efficiency enhancements, the adoption of technology such as AI, robotics, and automation, and broadening the scope of produce suitable for vertical farming systems.

	<p>Enhance efficiency and yields at conventional farms by promoting the adoption of advanced farming systems and techniques and the greater use of technology.</p> <p>Upskill farmers and create a new generation of skilled, modern farmers.</p>	<ol style="list-style-type: none"> 1. Organise and subsidise fees for training programmes for existing and aspiring farmers, covering advanced farming systems, techniques, and technologies. 2. Extend further financial support and improve domestic and international market access for smallholders, to improve affordability of cutting-edge technology and high-quality feedstocks. 3. Extend financial incentives, tied to production, and low-interest loans to larger agricultural-sector players, to improve affordability of cutting-edge technology and high-quality feedstocks. 4. Provide incentives for farmers to diversify crop production and set explicit targets for self-sufficiency, particularly for crops facing high domestic and international demand.
Land Use	<p>Place a moratorium on deforestation.</p> <p>Invest heavily in forest preservation and management, as well as reforestation.</p> <p>Commit to a reduction in mono-cropping.</p> <p>Creation and preservation of urban green spaces.</p>	<ol style="list-style-type: none"> 1. Increase budgetary allocations towards the forestry sector, targeting job creation in forest preservation, restoration, and management, with the aim of improving the condition of Malaysia's rainforests. 2. Rainforests, mangroves, and peatlands should be gazetted and protected, and a nationwide ban on deforestation enforced. 3. Increase the weightage of environmental costs in cost-benefit analysis of urban development projects, potentially through the application of a carbon price to such analyses. Further, impose a blanket moratorium on new urban developments within high-density areas, particularly where demand for housing or commercial buildings are low.
Transport	<p>Promote the electrification of Malaysia's vehicle fleet and invest in building an extensive charging infrastructure across the country.</p> <p>Reduce the emissions intensity of Malaysia's petrol-powered vehicle fleet.</p> <p>Improve last-mile connectivity and incentivise the use of public transportation.</p>	<ol style="list-style-type: none"> 1. Remove excise duties for imported EVs and provide financial incentives for consumers to purchase EVs. 2. Provide low-cost financing and other financial incentives for the domestic production of EVs and EV components, particularly to Malaysian automakers. 3. Finance the building of an extensive EV charging infrastructure, including standalone units, as well as within existing and new commercial and residential developments. 4. Implement mandatory fuel economy standards. Offer tax allowances and exemptions to domestic automakers tied to the production of fuel-efficient vehicles. 5. Upgrade Malaysia's bus-related infrastructure, with frequencies increased and networks revised, to cater better to underserved and high-demand areas. Bus lanes should also be designated, particularly in congested areas. 6. Invest in improving the bicycle and pedestrian infrastructure, as an additional avenue towards solving the last-mile connectivity issues faced by urban Malaysia.

<p>Waste Management</p>	<p>Emphasise circularity within commercial, industrial, and residential sectors.</p> <p>Reduce Malaysia's reliance on open dumpsites and non-sanitary landfills, instead embracing modern waste management technologies such as sanitary landfills, WTE plants, and incinerators.</p>	<ol style="list-style-type: none"> 1. Incentivise improvements in Malaysia's recycling capacity in order to meet future recycling targets. 2. Continue the commissioning of thermal and non-thermal WTE plants. 3. Provide funding for the R&D into alternative WTE technologies, including gasification plants and anaerobic digesters. 4. Commission the creation of specialised metal and electronic recycling facilities, while providing funding for R&D to identify and deploy processes and technologies which maximise the recyclability of electrical and electronic waste. 5. Provide funding for R&D into incinerator technologies as a WTE option given the Malaysian climate. 6. Provide low-cost financing and other financial incentives to operators of WTE plants to utilise CCS technologies in order to limit emissions.
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