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Building a Sustainable Industrial Base: Malaysia's Green Transition

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Building a Sustainable Industrial Base: Malaysia's Green Transition

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EXECUTIVE SUMMARY

Green issues and industrialisation have been intertwined in Malaysia since the colonial era, when the British exploited the region for tin and rubber, introducing scientific forestry for resource management. Post-independence, Malaysia implemented environmental regulations in the 1970s and advocated for a balanced approach between environmental and development objectives in the 1990s. Over the past three decades, Malaysia's policies have increasingly aligned with international standards like ESG and net-zero emissions driven by its reliance on foreign direct investment (FDI) and participation in global value chains (GVCs), highlighting the strong influence of investment priorities on environmental policies.

Since Malaysia's independence in 1957, the country has experienced several industrialisation phases. Malaysia's industrialisation began with import substitution in the 1950s, followed by export-oriented industrialisation in the late 1960s. A second round of import substitution focused on heavy industries from 1981 to 1985, followed by another export-oriented phase in the mid-1980s.

Key green industrialisation and economy policies began in 2009. Key policies introduced included the National Green Technology Policy, National Renewable Energy Policy and National Climate Change Policy. Subsequent initiatives such as the Renewable Energy Act (2011), Net Energy Metering (2016) and the establishment of Green Technology Corporation supported green technology. Fiscal incentives like the Green Investment Tax Allowance (GITA) were also introduced. In 2023, the government launched the National Energy Transition Roadmap (NETR) and the New Industrial Master Plan (NIMP).

Key sectors driving Malaysia's green industrialisation include Electrical and Electronics (E&E), solar photovoltaics and resource-based industries. Industrial policies have supported their growth making them significant contributors to Malaysia's net exports. However, these industries face various challenges and implications.

Emissions-centric green industry policies could leave Malaysia's industries vulnerable to climate change. If not properly balanced with local environmental conditions, such policies may divert resources from climate adaptation efforts that require context-based solutions. Southeast Asia is one of the most climate-vulnerable regions yet Malaysia's historical contribution to global emissions is less than 0.4%.

Malaysia's industrialisation has marginalised the Orang Asli, who face poverty, poor education and displacement from their lands due to large-scale agriculture. Government plans like cash crop schemes lack consultation and fail to align with their needs. To prevent further exclusion, development must involve the Orang Asli, respect their rights and provide targeted education and job opportunities, particularly in green industries.

Malaysia has experienced premature deindustrialisation for the past two decades, threatening the development of green industries. Deindustrialisation is concerning as manufacturing drives innovation, technological progress and high-skill job creation. Without a

strong industrial base, Malaysia risks losing these advantages, making it harder to develop green technologies.

Trade agreements and fiscal limitations constrain industrial policies. Malaysia's industrial policy space is constrained by WTO rules and free trade agreements that limit tools like tariffs and export incentives and impose stricter intellectual property and investment regulations. Additionally, Malaysia faces fiscal limitations due to the government's focus on reducing deficits and new laws that cap fiscal deficits and government debt. These factors reduce the government's ability to use industrial policies or fiscal expansion to support domestic industries.

Malaysia's high-tech industries face talent shortages and coordination problems. Malaysia faces a shortage of high-skilled talent to support the growth of high-tech industries. However, many STEM graduates are underemployed due to limited demand for skilled workers and declining R&D investment. The core issue is a coordination problem: even with more graduates, industries may not shift to higher value-added functions without substantial government support.

Malaysia's R&D efforts have been hindered by underutilisation of investments and weak collaboration between research institutions and industry. Unlike successful catch-up countries, institutions focus more on commercialising R&D outputs than addressing industrial technology needs. Initiatives like MIMOS have had limited success and the E&E sector remains in low-value-added segments. The lack of innovation-driven firms and strong corporate R&D policies has prevented industrial upgrading.

Political and structural challenges hinder the development of competitive local firms. The lack of domestic firms investing in technology development keeps many companies in low-value segments of global value chains. While business groups could drive innovation and market entry, political dynamics and early market liberalisation have weakened innovation and delayed industrial upgrading.

We conclude with the following policy recommendations:

1. **Strengthening Industrial and Technological Foundations** - Malaysia should combat deindustrialisation through targeted industrial policies, fostering competitive and innovative firms and promoting technological upgrades. Expanding state-owned enterprises and encouraging private-sector innovation can absorb skilled labour and drive knowledge-intensive growth. R&D efforts must align with industry needs and be supported by global technology transfers.
2. **Addressing Fiscal Constraints and Building Resilience** - Fiscal space can be expanded through tax reforms and carefully managed monetary financing, mitigating inflation and currency risks. Strong political coalitions and strategic governance are essential to support industrial policy, drive innovation, and create competitive national champions. Climate adaptation must also feature prominently in green industrial strategies.
3. **Promoting Social Equity and Inclusivity** - Policies should address the socioeconomic challenges of vulnerable and disadvantaged groups, such as the Orang Asli, by improving access to education, healthcare, and economic opportunities while ensuring respect for their rights. Inclusive development is crucial for equitable participation in green industrialisation initiatives.

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1. BACKGROUND

Green issues and industrialisation have been intertwined since the colonial period in Malaya. Under British colonial rule (1824-1957) Malaya was exploited as a mining and plantation colony focused on tin and rubber, and scientific forestry was introduced, along with the gazettement of forest lands. Scientific forestry did not equate to conservation as we now understand it; rather, it was for the 'rational' exploitation of timber and forest resources, as evidenced by the still extant category of 'production' forest. Much primary forest was felled to make way for rubber plantations.

In post-colonial Malaysia, environmental laws have been in place since 1974 to regulate emissions and require project proponents to conduct environmental impact assessments by qualified agents. This regulatory framework followed efforts to attract foreign manufacturing capital into free trade zones (FTZs) such as the offer of 'Pioneer Status' tax relief to foreign companies exporting their production.

Malaysia's industrial growth in the 1970s brought environmental concerns, leading to the rise of groups such as the Consumers Association of Penang (established 1969) and Sahabat Alam Malaysia (Friends of the Earth Malaysia) in 1977 who were among the organisations challenging pollution from FTZs in Penang. Radioactive pollutants from rare earth mineral processing have also given rise to tensions with investments like Asia Rare Earth in 1982 and Lynas more recently since 2012.

Global, rather than national or local, environmental issues gained international attention in the 1990s, leading to numerous United Nations treaties tackling sustainability, climate change, biodiversity, deforestation and desertification, and the ozone hole. Climate change has become the most prominent amongst its siblings. In a case of the global trumping the local, 'green' or 'environmental' issues in the present seemingly default to climate change, which cannot stand in for all environmental issues and sustainable development. This distinction appears to be lost in the mainstreaming of 'environmental, social and governance' (ESG) investing standards from developed countries since the orientation tends to be supply chain compliance for multinational corporations (MNCs).

Applying universal standards of climate action based on the particular situation of developed countries is an instance of the fallacy of composition, akin to that which has plagued international trade policy; that which is true of a part is held to be true for the whole. This is problematic because climate action is supposed to be highly differentiated based on each country's relative responsibility for climate change.

The climate treaties are based on a principle of 'common but differentiated responsibilities and respective capabilities' in order to arrive at just burden sharing among the state parties. Countries such as the United States, responsible for over 25% of historical carbon dioxide emissions, have a correspondingly greater responsibility to curb their emissions than Malaysia, responsible for

only 0.37% of historical CO2 emissions[1]. The great differentials in wealth and technology between the US and Malaysia also mean that the US has greater capability to respond than a developing country such as Malaysia.

The situation is quite different for local or national environmental issues. A company operating both in Malaysia and Australia should seek to reduce the production of carcinogens, radioactive wastes or noxious emissions. Yet, while ore may be mined in Australia, processing and waste storage takes place in Malaysia.

When sustainable development gained international prominence at the 1992 Rio Earth Summit, Malaysia advocated for a balanced approach between environmental and development objectives. This contrasted with the Global North's push for conservation despite their own histories of deforestation, climate pollution, and industrialisation-induced extinction. (Today's debates between the European Union and its trading partners over the former's deforestation policy treads familiar ground).

Over the past three decades, Malaysia's environmental and industrial policies have increasingly reflected the Global North's priorities, such as the focus on ESG standards and achieving net-zero greenhouse gas emissions. This shift is partly due to Malaysia's dependence on foreign direct investment (FDI) for industrialisation and its efforts to rise in global value chains (GVCs).

Malaysia participates in GVCs dominated by lead firms from China and the United States, it's two largest trading partners and sources of FDI, along with Singapore, Japan, and Europe. Recent disruptions in GVCs due to the COVID pandemic and rising US-China tensions benefited Malaysia's manufacturing sector as firms relocated supply chains to closer or friendlier partners, as seen with semiconductors and solar panel production.

This dependence on FDI and GVCs led policies on green industrialisation to be framed in terms of energy transition towards 'net-zero' greenhouse gas emissions. Although broadly in line with its Paris Agreement commitments, it is pitched as part of a quest for relevance in the struggle to participate in GVCs and attract FDI flows.

[1] Yin Shao Loong (2022)

1.1. Analytical Framework

This paper looks at Malaysia's green industrialisation journey primarily through the lens of industrialisation. The story of the rise of environmental concerns and policy has been told elsewhere[2].

This paper examines the innovation and production aspects of green structural transformation. The area of concern corresponds to Anzolin and Lebdioui's[3] third dimension of green industrial policies (and its corollary, green industrialisation) – a productionist innovation-driven approach – that focuses on the development and innovation aspects of low-carbon industries. This is in contrast to the first two dimensions, which focus on changing consumer behaviour and improving production and supply-chain resource efficiency, respectively.

Our focus on the innovation and production aspect is motivated not only by the fact that innovation in green technology will play a key role in environmental sustainability but also by the fact that it opens "green windows of opportunity"[4]. It has become increasingly crucial for Malaysia to take advantage of such windows of opportunity, given that there has been growing concern that its economy has stagnated at the upper middle-income level and has not created enough high-quality jobs[5].

This paper is structured as follows. Following this introduction, the history of Malaysia's industrial policies is discussed in the next section with a view of how they have contributed to developing green-related industries. The subsequent section looks at the development of green-related industries over the years, namely, the electrical and electronics (E&E), photovoltaic and resource-based industries. The choice of photovoltaics is obvious given its strategic role in producing renewable energy. The E&E and resources-based industries are selected for their prominent role in Malaysia's economy and their potential to contribute towards energy efficiency and renewable energy. The E&E industry plays a role in developing information and communication technologies (ICT), which can increase productivity and resource-use efficiency[6]. Meanwhile, resource-based industries such as palm oil can be a source of sustainable biofuels. Challenges in developing green industries are discussed in the subsequent section. This section also looks at the issues faced by a marginalised group, the Orang Asli – indigenous peoples of Peninsular Malaysia – to participate in green industrialisation, seeing that technological change tends to disadvantage vulnerable groups. This paper then concludes with policy recommendations.

[2] See for example Guha (2000); Hezri and Nordin Hasan (2006)

[3] Anzolin and Lebdioui (2021)

[4] Lema, Fu, and Rabellotti (2020)

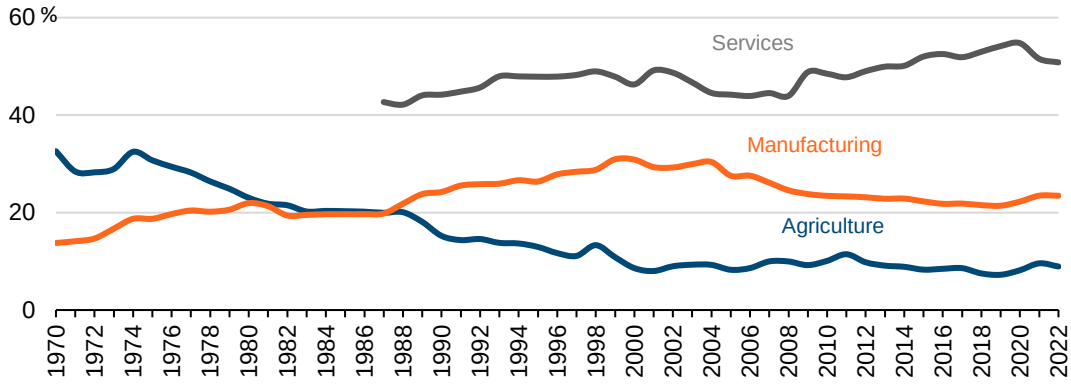
[5] Yusuf and Nabeshima (2009); Khazanah Research Institute (2020)

[6] Kaplinsky (2021)

2. A HISTORY OF MALAYSIA INDUSTRIAL POLICIES

The Federation of Malaya gained independence from Britain in 1957. Subsequently, Malaysia was formed in 1963 with the unification of the Borneo states of Sabah and Sarawak and, for a time, Singapore. Malaysia's economy has undergone a tremendous structural transformation from an agriculture-based economy to being an economy driven primarily by the services and manufacturing sectors (Figure 1). The transition was not simply the result of market forces, as claimed by the World Bank's East Asian Miracle report[7]; rather, the government played a commanding role in implementing appropriate policies and reforms[8]. Industrial policy, along with a controversial ethnic-based redistribution policy and an all-ethnic poverty reduction program under the New Economic Policy and its successors from 1970 onwards delivered reasonable success in driving economic growth and reducing overall poverty and inter-ethnic inequality. The recognition of these successes, however, must be tempered by the acknowledgement of higher vertical inequality compared to some regional peers. In 2022, Malaysia recorded a higher Gini coefficient of 0.40, compared to Indonesia at 0.38 and Thailand at 0.35 (2021 figure)[9]. The government's involvement in steering industrial policy until the beginning of the 2020s can be distinguished by five distinct phases characterized by different policy priorities discussed below[10].

Figure 1: Gross domestic product, by sector share, 1970-2022 (percentage)



Source: DOS (2023)

[7] Birdsall et al. (1993)

[8] Jomo KS and Wee Chong Hui (2013)

[9] World Bank Group (2024)

[10] The material in this section draws mainly on Jomo KS (1990, 2007) and Rasiah (2011).

2.1. Pre-Independence

Before World War II, the British administration in Malaya focused on exploiting the peninsula's natural resources, centred on tin and rubber production and export, with low-paid local or imported workers[11]. Industrial promotion policies only emerged with the establishment of the Malayan Union in 1946, reflecting varying degrees of British rule from exploitation to indirect governance.

The Malayan Emergency, beginning in 1948 as a communist insurgency, redirected colonial priorities towards safeguarding British rubber plantation and mining interests. Malaya, as Britain's most profitable colony, significantly contributed to post-war reconstruction funding in Britain[12]. Consequently, public development efforts concentrated on enhancing infrastructure to support the export-oriented primary commodity economy. Malaya's infrastructure, including railways, roads, ports, and utilities, was among the most advanced in British colonies, rivalling settler colonies[13].

Under colonial rule, local capitalists struggled to develop domestic manufacturing industries and instead found profit in commerce and usury. Malay elites barely participated in commerce and industry but were instead integrated into the colonial bureaucracy, while urban commerce was dominated by ethnic Chinese elites, who formed a comprador class linked to European capital[14]. The ethnic stratification of the colonial economy would affect industrial and socio-economic policies for decades to come.

Colonial-era industries aimed to lower international trade costs through ventures like bottling plants, tin refineries and transport and capital equipment services, particularly during periods of weak British control like the Great Depression and Japanese occupation[15]. British policies favoured imported goods to preserve duties and keep wages low, ensuring profitability for British-owned enterprises[16]. Consequently, manufacturing had a minor role in colonial Malaya, dominated by tin mining and rubber plantations under colonial management.

The legislative framework from this period shaped post-independence rural development and affirmative action policies in Malaysia.

2.2. Post-Independence

Following Malayan independence in 1957, Malaysia's economy diversified from colonial sectors like tin and rubber although primary commodities remained significant. New industries including palm oil and tropical hardwoods emerged alongside petroleum exports from the mid-1970s and

[11] Lafaye De Micheaux (2022)

[12] Jomo KS (1990)

[13] Jomo KS (2007)

[14] Puthucheary (1960)

[15] Jomo KS (2007)

[16] Edwards (1975) as cited in Jomo KS (2007)

cocoa production in the early 1980s. These industries have supported Malaysia's export-orientation since the 1970s.

Post-independence industrialisation can be divided into five phases: initial import substitution, export-orientation, heavy industry-based import substitution, second round of export-orientation and most recently, a green industrial turn. This green shift aims to complement export-orientation and attract investment influenced by Western ESG standards.

2.3. Import Substitution Industrialisation, First Round

Compared to the colonial era post-independence governments actively pursued industrialisation. Initially haphazard, this approach shifted to import-substitution industrialisation in the late 1950s, relying on tax exemptions, tariff protection, infrastructure support, industrial credit facilities, directly and indirectly subsidising new factories, and other incentives. The goal was to attract foreign investors to establish local production, assembly and packaging facilities for goods previously imported, mostly through foreign subsidiaries[17]. These industries aimed to process imported materials locally, substituting finished goods with semi-finished ones in a protected domestic market, albeit with limited employment benefits[18].

The government's support lacked targeted industry selection or performance monitoring, relying instead on ad-hoc tariff protection based on firms' applications. Industries included liquor, petroleum, tobacco and motor vehicles, expanding later to basic metals, electrical machinery, rubber and plastics. Additional policies emerged over time, including pioneer tax incentives from 1958 and protective measures such as tariffs and quotas by the Tariff Advisory Board from the early 1960s, which was more important to manufacturers than the former[19].

The introduction of protection created opportunities for rent-seeking, with companies lobbying influential Malaysians, often by offering directorship positions. Rent-seeking though did not dissipate all rents[20]. Still, profits did not reflect "social efficiency", and high profits mainly went to foreign companies who repatriated them. State intervention, despite its distortive effects, was seen as necessary for industrialisation and development. However, rent-seeking, lack of export pressure, focus on final consumer goods, benefits mainly to foreign firms and regional industry concentration were issues associated with import substitution industrialisation (ISI)[21].

Malaysia's small domestic market and skewed income distribution hindered ISI's growth. This is reflected in the rapid peak and subsequent drop in output growth of firms with pioneer tax incentives[22]. ISI's limited employment generation, due to poor economic linkages and its capital-intensive nature, further stifled success. By the mid-1960s, the limitations of ISI were acknowledged, leading to the establishment of the Federal Industrial Development Authority

[17] Jomo KS (2007)

[18] Ibid.

[19] Rasiah (2011a)

[20] Edwards (1975) as cited in Jomo KS (2007)

[21] Jomo KS (2007)

[22] Ibid.

(FIDA, now Malaysian Investment Development Authority, MIDA) in 1967 and the 1968 Investment Incentives Act to promote manufacturing exports. This marked a strategic shift towards export-oriented industrialisation (EOI).

ISI coexisted with EOI after 1968 but declined in importance. Effective rates of protection (ERP) for ISI industries fell dramatically between 1969 and 1987. For instance, ERP for basic industrial chemicals dropped from 160% to 16%[23]. Over time, import-substituting industries became more locally owned, except for tobacco and beverages.

2.4. Export-oriented industrialisation, First Round

The shift to export orientation began with the Investment Incentives Act of 1968. Export-oriented policies were also associated with the New Economic Policy (NEP) in 1970. The NEP aimed to modernise the economy, eliminate poverty and achieve balanced inter-ethnic redistribution. It emphasised local ownership of productive assets and reducing foreign ownership which was believed to be compatible with stronger and more profitable integration into the global economy.

Box Article: The New Economic Policy

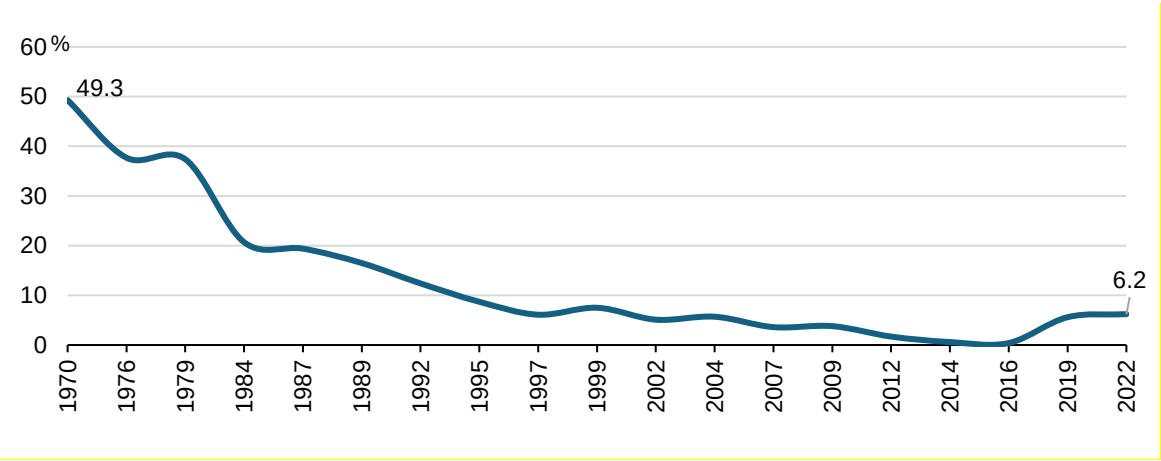
The NEP was a two-pronged redistribution program with the goals of disassociating the identification of ethnic groups from their traditional economic roles and eradicating poverty regardless of ethnicity. The policy was introduced as a response to ethnic riots in 1969, which the ruling Malay ethnic elite interpreted as arising from dissatisfaction with the persistent economic inequality between Malays and Malaysian Chinese. Effectively, the policy largely redistributed gains from growth favouring *Bumiputera* or "sons of the soil" - an umbrella term for native ethnicities including the Malays, the natives of Sabah and Sarawak, and indigenous peoples - through quotas in business permits, funds, privatisation contracts, shareholding in publicly listed companies, education placements and government jobs. As most of the poor belonged to the Bumiputera ethnic group in the wake of the country's founding, the ethnic-based redistribution program in their favour successfully contributed to poverty reduction. Job-creating economic growth also supported general poverty reduction (Figure 2). The NEP ostensibly expired in 1991. However, since similar redistributive considerations underpinned successive policies, the NEP moniker has been kept alive in the Malaysian public mind as a colloquial term to refer to such policies.

Although the policy has reduced poverty among Bumiputera and alleviated inter-ethnic inequality (Figure 3), it has not passed without severe criticism. Critics point out that the positive discriminatory policies towards Bumiputera alienate deserving yet underprivileged non-Bumiputera from opportunities, especially in tertiary education. The policy has also been blamed for fostering economic inefficiency as opportunities are not given primarily on merit. Furthermore, under the pretext of this redistribution policy, the government sought to create a "Bumiputera Commercial and Industrial Community"(BCIC) to ensure their inclusion in the commanding heights of Malaysia's economy. For this purpose, the government distributed

[23] Rokiah Alavi (1996)

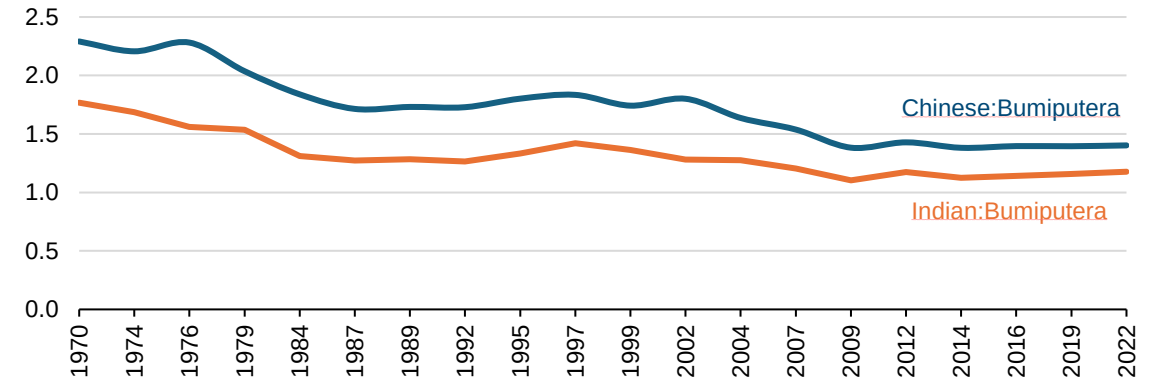
rents to a class of Bumiputera businessmen through several means, but most controversially through directly negotiated privatisation contracts. Thus, the beneficiaries tended to be a class of Malay businessmen who had connections with the leading ruling party politicians rather than the poor Bumiputera in general. As a result, the policy has been accused of being an excuse to further enrich the privileged sections of Bumiputeras rather than to address the plight of the poor Bumiputera appropriately[24]. A related criticism is that some ethnic groups within the Bumiputera, such as the Orang Asli, have not or have only marginally benefitted from this policy despite their supposed inclusion. A further discussion on the Orang Asli and their exclusion from development is discussed in a separate part of this paper.

Figure 2: Malaysian poverty rate, 1970-2022 (percentage)



Source: DOS (2023)

Figure 3: Interethnic Income Ratio, 1970-2022



Source: DOS(2023)

[24] Kua Kia Soong (2020) and the edited work of Gomez (2013) are some examples where these criticisms can be found.

Both resource-based and non-resource-based sectors expanded under export-oriented policies. Primary commodities like tin, rubber, timber and palm oil were processed for export, but non-resource-based sectors, particularly electrical and electronic components, along with textiles and garments, contributed more to economic growth and job creation since the 1970s.

Foreign investment surged after the establishment of FTZs in 1972 and licensed manufacturing warehouses (LMWs)[25]. Government officials' visits to potential investors also played a crucial role. Incentives included accelerated depreciation allowance, labour utilisation relief, infrastructural support and tax deductions and exemptions like investment credits, tariff exemption on raw materials and export tax exemption. Despite the gains in international competitiveness, these were often artificial, as multinational firms were incentivised to operate in enclaves.

To maintain cost-competitiveness in labour-intensive industries, the government kept labour cheap and amended labour regulations to favour transnational corporations, banning unionisation in electronics and allowing women to work night shifts. This unionisation ban was partially lifted in 1989.

Protectionist policies for import substitution industries continued but did not hinder export-oriented industries, as tax holidays and tariff exemptions in export-processing zones allowed them to bypass regulations. However, poor integration between export-oriented and import-substitution sectors led to limited domestic market engagement[26].

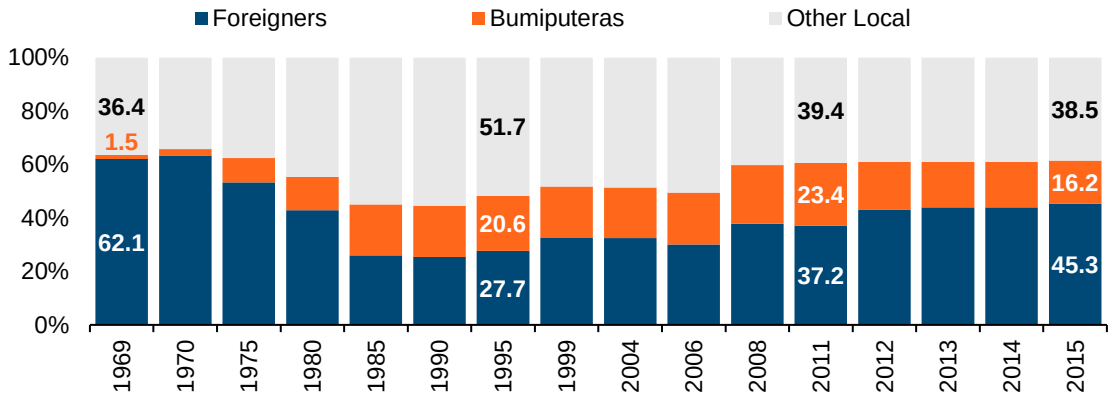
Malaysia's openness to foreign investment to drive industrialisation raised the share of foreign ownership in manufacturing industries and in gross fixed capital formation (GFCF) (Figure 4). The enclave nature of export-oriented firms was reflected in the structure of domestic demand in the 1970s by growing imports, which was partly a result of the firms' limited buying and selling in the domestic market. By the late 1970s, the government recognized the need to address weak linkages and dependency on a narrow range of export products, leading to plans for aggressive development of heavy industries[27].

[25] Rasiah (2011a)

[26] Rasiah (1995)

[27] Ibid.

Figure 4: Ownership of Share Capital of Malaysian Limited Companies, 1969-2015 (percentage)



Source: Government of Malaysia (various years) as compiled by ET Gomez (2013) and Ministry of Economy Malaysia (2019).

2.5. Second Round of Import Substitution

The shift to heavy industries during the Fourth Malaysia Plan (1981-1985) marked a return to import substitution industrialisation with increased government backing. Inspired by South Korea and Japan, and strained relations with Britain leading to a 'Look East' policy, Malaysia aimed not only to develop heavy industries but also to emulate cultural aspects contributing to the success of East Asia's newly industrialised economies, as emphasized by Prime Minister Mahathir Mohamad in 1983.

Before the 1980s, import substitution sectors faced limits due to a small domestic market, low local technology levels, inadequate protection, lack of linkages and little encouragement for international competitiveness. The dominance of ethnic Chinese in business further complicated matters as the government prioritised developing a Malay entrepreneur class.

The introduction of the heavy industries policy aimed to build domestic linkages, especially Malay enterprises, rectify trade imbalances and promote indigenous technology through initiatives led by the Heavy Industries Corporation of Malaysia (HICOM) from 1981[28]. Key ventures included PERWAJA Steel, PROTON and later PERODUA for automotive manufacturing, and petrochemical and cement plants. These industries benefited from import restrictions, price controls, duty exemptions, pioneer status tax benefits, subsidised capital, vendor development programs, controlled domestic competition, quotas, tariffs and other protective measures, with intermediate and capital goods seeing significant protection[29].

Despite these efforts, heavy industries faced challenges such as high costs, small market size and weak linkages with other sectors, exacerbated by economic downturns in the mid-1980s. Furthermore, even though the automotive sector required high initial protection rates due to high technical entry barriers, it was not paired with effective monitoring and appraisal like in South

[28] Jomo KS (2007)

[29] Rokiah Alavi (1996)

Korea and Japan[30]. Nevertheless, sectors like automotive and cement showed profitability by the late 1980s under strong protection, while PERWAJA Steel continued to struggle into the 1990s.

Economic pressures partly due to high heavy industry-related imports prompted a re-evaluation, leading the government to shift focus towards foreign investment and export orientation by the late 1980s amidst declining foreign investment and a global electronics downturn. Policy gradually moved away from emphasising heavy industries towards supporting export-oriented sectors, acknowledging the need for efficiency and competitiveness.

2.6. Second Round of Export Orientation

The first Industrial Master Plan of 1986 (IMP1) and external factors spurred manufactured exports growth from the mid-1980s onwards. The appreciation of currencies in Singapore and Northeast Asian industrialized economies following the Plaza Accord and increasing tariff costs following their withdrawal from the US Generalized System of Preferences (GSP)[31].

IMP1 prioritised 12 subsectors—seven resource-based and five non-resource-based—for development through strategic planning, policy measures and targeted emphasis. Resource-based industries included rubber, oil palm, food processing, wood-based, chemical and petrochemical, non-ferrous metal products and non-metallic mineral products. Non-resource-based industries encompassed apparel, ferrous metals, machinery and engineering products, transport equipment, and electrical machinery. IMP1's recommendations enhanced fiscal incentives, reinvestment inducements, improving domestic linkages and training initiatives significantly, with heightened support for research and development (R&D)[32].

Infrastructure development and incentives were pivotal in promoting export-oriented industries alongside streamlined investment approval processes. New incentives encompassed double deductions for export credit refinancing, training, and R&D expenses. Companies already operational received extended tax relief for five years, proving effective[33]. Additionally, the scope of double deductions widened to cover advertising in media and trade fair exhibits, benefiting manufacturing firms meeting ministry criteria.

By the early 1990s, the manufacturing sector grappled with labour shortages, escalating wages, and stagnant technological advancements due to limited local firm opportunities to upgrade into original design manufacturing (ODM) and original brand manufacturing (OBM) as MNCs engaged them for simpler tasks. In response, the government intensified domestic content regulations, introduced new policies and institutions to foster technological advancement, and encouraged higher value-added activities.

Initiatives such as the Action Plan for Industrial Technology Development (APITD) in 1990, the Human Resource Development Act in 1992, the second Industrial Master Plan in 1992 emphasizing cluster development, and the establishment of entities like the Malaysian

[30] Amsden (1989)

[31] Rasiah (1998)

[32] Rasiah (2011a)

[33] Ibid.

Technological Development Corporation (MTDC) in 1992 and the Malaysian Industry-Government Group for High Technology (MIGHT) in 1993 were pivotal. However, these efforts primarily supported local firms not yet prepared for technological innovation, which Rasiah believes slowed down structural advancement. Challenges, including rising costs, overheating, declining FDI due to emerging low-cost competitors like China and the Philippines, and pressures from the World Trade Organisation (WTO) and trade agreements to liberalise trade further compounded issues, prompting firms to internationalise[34].

2.7. Green Initiatives

While early industrial policies in Malaysia did not focus on green initiatives, a shift occurred in 2009 with the launch of several key, albeit unintegrated, policies. These are the National Green Technology Policy, the National Renewable Energy Policy and Action Plans, and the National Climate Change Policy.

The 2009 National Renewable Energy Policy and Action Plan, introduced under the 9th Malaysia Plan, aimed to develop the renewable energy industry and boost renewable energy's share in the energy mix through regulatory frameworks, business-friendly environments, human capital development, research and development, and outreach programs. However, initial targets were unmet due to financial constraints. **The Renewable Energy Act of 2011** established the Feed-in Tariff (FiT) system, increasing renewable energy capacity from 52MW in 2009 to 243MW in 2014, with biomass as the primary source. Despite these gains, the 2015 target of 985MW was not achieved[35].

In 2016, new measures like **Net Energy Metering (NEM)** and the Large-Scale Solar Program were introduced. The NEM, which replaced the FiT scheme, allowed solar panel users to export excess electricity to the grid, while the Large-Scale Solar Program awarded contracts to build substantial solar power plants. Additional programs in 2019, such as peer-to-peer energy trading and **the Supply Agreement for Renewable Energy (SARE)**, further supported the sector. SARE allows households to lease solar panels through a monthly fee, eliminating the need for upfront installation costs.

The 2009 **National Green Technology Policy** was also a significant step towards green industrialisation. It aimed to minimize energy consumption, develop the green technology industry, build innovation capacity, educate the public, conserve the environment, and promote sustainable development. The policy targeted four sectors: energy, water and waste management, building and transportation.

The government established the **Green Technology Corporation** under the **Ministry of Energy, Green Technology and Water**, which implemented projects like the National Green Technology and Climate Change Council (MTHPI), Green Technology Financing Scheme (GTFS), ASEAN Energy Manager Accreditation Scheme, and Green Township and Green Labelling. The GTFS

[34] Rasiah (2011a)

[35] Chandran Govindaraju (2016)

provided both demand- and supply-side assistance, offering a 1.5% interest rate rebate and a 60% guarantee of the financing amount for companies investing in green technology[36].

Fiscal incentives, such as tax exemptions and allowances, also supported the green industry. Between 2016 and 2019, 301 projects received the **Green Investment Tax Allowance (GITA)**, and 28 services were given the Green Income Tax Exemption (GITE)[37]. Foreign companies could retain full ownership of Malaysian operations. For the solar industry, the government removed tariffs for solar panel trade and operators within Export Processing Zones (EPZs) enjoyed import duty exemptions.

Despite these efforts, financing remains a significant challenge for the green industry due to financial institutions' lack of expertise in assessing green technologies and their low awareness of green technologies, resulting in uncertain financing availability[38].

Prior to the Paris Agreement of 2015, developing countries did not face mandatory greenhouse gas emission reduction targets. The absence of an overarching green policy direction contributed to a lack of urgency to mainstream these policies which were better seen as tentative steps. The energy policy in 2010 was still focused on fossil fuels for supply and cost reasons with an energy mix of 53% natural gas and 40% coal with hydro contributing the bulk of ”renewable” energies at 4.9%[39].

In 2023, the government launched the **National Energy Transition Roadmap (NETR) and the New Industrial Master Plan (NIMP)**. Reflecting a post-Paris direction the NETR aims to transition Malaysia's energy system to a lower-carbon model by 2050, with renewable energy usage increasing to 23%, electrification of the transport fleet to 80%, and public transport modal share to 60%. It also proposed incentives to develop hydrogen, bioenergy, and power storage facilities. The NIMP includes a mission to push for net zero alongside three other missions to advance economic complexity, enhance digital vibrancy, and ensure economic security and inclusivity. It targets 21 sectors, with six related to the green industry: electric vehicles (EV), renewable energy (RE), palm oil products, E&E, digital and ICT, and machinery. The NIMP also emphasizes building climate adaptation measures, such as safeguarding Port Klang against rising sea levels.

Publishing these policies promises to significantly shape the development of key Malaysian industries, including those related to the green sector. The next section examines the development of selected key green-related sectors and their challenges.

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[36] “Features of GTFS 4.0,” n.d.

[37] Chandran, Baskaran, and Selvarajan (2022)

[38] Ibid.

[39] “National Energy Balance 2010” (2010)

3. KEY-GREEN RELATED SECTORS IN MALAYSIA

3.1. The Electrical and Electronics Industry

The E&E industry has significantly contributed to Malaysia's economic growth and structural transformation post-independence, becoming the leading manufacturing industry since the 1980s[40]. The industry expanded rapidly since the opening of the first Free Trade Zone (FTZ) in 1972[41] and saw substantial growth after the 1984-1985 downturn, aided by the relaxation of upgrading requirements despite the latter being recently introduced in the first Industrial Master Plan (IMP1) of 1986[42].

Value-addition and exports surged until 2000, peaking at a 37.2% share of manufacturing value-added in 1999 and 72.5% of manufacturing exports in 2000. Growth was fueled by the Asian Financial Crisis, which depreciated the ringgit, reducing production costs amid an expanding US market[43].

However, with the global E&E industry's expansion into China and Vietnam in the 2000s, Malaysia's E&E industry's value addition and export contribution began to decline. This trend continued until the global financial crisis of 2008-9, which severely impacted exports to major markets like Europe and the United States. By 2013, the industry's contribution had dropped to 14.9% for manufacturing exports and 48% for manufacturing value-added.

The E&E industry encompasses semiconductors, equipment and parts, consumer electric, industrial and commercial, industrial machinery and equipment and household appliances. Its development in Malaysia can be divided into three phases: industrial promotion, first-round export orientation and second-round export orientation.

The first phase began in 1958 with the approval of the Pioneer Industry Ordinance (PIO) to stimulate import-substitution manufacturing. In 1965, Matsushita Electric relocated its manufacturing of electrical appliances to Malaysia. However, due to the small domestic market, there was minimal expansion in this period.

The second phase saw a significant turn in 1971 when the government promoted export-oriented manufacturing through the Second Malaysia Plan (1971-1975). Financial incentives such as FTZs, LMWs, tax holidays and tax credits were introduced to attract foreign investors. The government built infrastructure, directly approached potential foreign investors, simplified investment approvals and offered security within FTZs. The government essentially played only a regulatory role. By the mid-1970s major firms like Clarion, Texas Instruments, Intel and Motorola had moved operations to Malaysia. While this phase successfully attracted MNCs and created jobs, it failed to transition the industry to high-value-added activities due to a lack of focus on technological deepening. Consequently, the industry faced tremendous pressures towards the end of the phase.

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[40] This section mainly draws on Rasiah (2017)

[41] Lim (1978); Rasiah (1988b)

[42] Rasiah (2017)

[43] Rasiah, Xiao-Shan Yap, and Chandran Govindaraju (2014)

On the one hand, policy priorities shifted towards national heavy industries, resulting in delayed incentive renewals for large foreign semiconductor players[44]. On the other hand, overproduction and intense competition during the industry's downward cycle between 1984-7 led to the exit of some players and initiated a series of takeovers[45].

The third phase began with the introduction of the first Industrial Master Plan (IMP1) in 1986, following the recession of 1984-1985. Initially, IMP1 placed high demands on foreign players to increase local linkages, but these demands were relaxed due to the 1984-85 recession. The government devalued the currency and extended investment tax credits to foreign firms in the E&E industry, further boosted by the cyclical recovery in 1987. Currency appreciations of several Northeast Asian economies and Singapore following the 1985 Plaza Accord and their withdrawal from the Generalised System of Preferences (GSP) in 1988 also spurred FDI inflows into E&E subsectors in Southeast Asia[46]. During this period, the government continued to play a largely regulatory role.

Efforts to stimulate high value-added operations, such as chip design, wafer fabrication, and R&D, began in 1991 with the Action Plan for Technology Development (APITD). Silterra, a wafer fabricator based on a Taiwanese framework of buyer-supplier alliances, was conceived under the government-owned Malaysian Institute of Microelectronics Systems (MIMOS) in 1995 and launched in 2000. In 2005, the government extended previously exclusive grants to foreign firms for wafer fabrication, integrated circuit (IC) design and R&D.

This phase also saw the rise of private Malaysian firms such as Unisem, Globetronics, and Carsem specialised in testing, assembly and packaging. These firms were led by former employees of foreign semiconductor MNCs in Malaysia. Other foreign firms that have moved operations to Malaysia since the 1990s include Integrated Device Technology, ST Microelectronics, X-Fab (partly owned by the Sarawak state government), Onn Semiconductors, Osram, Infineon, Avago (Broadcom) and Alterra.

The Second Industrial Master Plan (IMP2) in 1996 and the Third Industrial Master Plan (IMP3) in 2006 did not significantly shift the government's role from regulatory to developmental even though they aimed to promote high-value-added activities. A call for financial incentives towards capital-intensive and strategic industries in IMP2 was halted by the 1997 Asian financial crisis. While IMP2 and IMP3 promoted a clustering approach, regulatory instruments did not deeply consider the supportive policy institutions, buyer-supplier firms, and value chains to create synergy in the targeted sectors[47].

Technologically, the industry has undergone limited functional and horizontal upgrading since its establishment in Malaysia. Functional upgrading refers to the movement to, or incorporation of, higher-value-added back-end or front-end processes in the value chain such as IC design, R&D, wafer fabrication, sales, and own-brand marketing. Horizontal upgrading refers to the deepening

[44] Rasiah (1988a)

[45] Rasiah (1988b)

[46] Ibid.

[47] Rasiah (2017)

of existing functional capabilities through best practices, adaptive engineering, and R&D support to upgrade functional activities to raise plant productivity. Global competition, rather than government inducement, drove non-Japanese firms to introduce automation and just-in-time (JIT) practices by the late 1970s and mid-1980s, respectively. All semiconductor firms in Malaysia have incorporated *kaizen* (continuous improvement) practices, including statistical process control, integrated material resources planning, quality control circles and small group activities[48].

A study by Rasiah[49] (Table 1) showed that no firms in Malaysia operate at the frontier of human resource (HR) competencies, process capabilities and product capabilities—key technology pillars of R&D. None of these firms conduct frontier R&D in-house or engage with frontier R&D facilities in local universities. Among the firms with mature R&D capabilities, all seven are foreign. While 20 of the 21 foreign firms reported conducting early R&D activities, only one of the four local firms did so. All firms surveyed reported conducting engineering-intensive activities.

Table 1: Technological Competency and Capability, Semiconductor Firms, Malaysia, 2015

Level	Type	HR		Process		Product	
		National	Foreign	National	Foreign	National	Foreign
4	Engineering	4	21	4	21	4	21
5	Early R&D	1	20	1	20	1	20
6	Mature R&D	0	7	0	7	0	7
7	Lead Technology	0	0	0	0	0	0
	N	4	21	4	21	4	21

Source: Rasiah (2017)

Most functional upgrades occurred after 2005, when the government allowed capital grants to foreign firms, encouraging the introduction of knowledge-intensive activities such as chip design, wafer fabrication, chip implant activities and R&D. Local firms Silterra and 1st Silicon have also benefitted from these grants since 2000 to set up wafer fabrication; however, the technologies acquired were not recent. Following the extension of R&D grants in 2005, the number of firms

[48] Rasiah (2017)

[49] Ibid.

engaged in wafer fabrication and chip design increased from none in 1999 to 10 in 2014. Four foreign firms and one local firm are involved in chip design, while five foreign firms are involved in wafer fabrication.

Challenges in the E&E industry

Despite functional upgrading since the mid-2000s, no firms are involved in R&D related to the enlargement of wafer diameter and miniaturisation, and no local wafer fabricators operate at the frontier. Rasiah attributes this to a shortage of research scientists and engineers and a lack of frontier research at Malaysian universities even with available R&D grants[50]. Furthermore, policy institutions such as MIMOS and the Malaysian Technological Development Corporation (MTDC), which provides venture capital, work in silos with minimal industry interaction due to a lack of leadership with connections to R&D centres and buyer-supplier firms or foresight in technological change. This disconnect has hindered Malaysian firms' ability to catch up in the manner achieved in South Korea and Taiwan. Additionally, the government's ineffective monitoring and appraisal has limited its ability to address resource inefficiencies in grant allocation.

3.2 The Malaysian Photovoltaic Industry

More central to green industrialisation is the semiconductor-associated solar photovoltaic (PV) industry. Malaysia, the world's third largest exporter of solar panels after China and Vietnam, has strong technological capabilities in manufacturing solar PV, benefiting from its established electronics industry; however, there is negligible domestic presence in this sector. The industrial base and existing skills in regions like Penang and Kulim attract MNCs to establish production facilities. Over 250 companies are involved in the entire value chain[51], from upstream processes like poly-silicon to mid-stream production of wafers, cells, and modules, and downstream activities such as inverters and system integration[52].

Malaysia has a competitive position in solar PV, as seen by its positive trade balance (Figure 5). Leading manufacturers such as Jinko Solar, First Solar, JA Solar, Flextronics, SunPower, and Hanhwa Q-Cells have plants in Malaysia, linking the country to the global environmental goods supply chain. However, with the exit of Malaysian Solar Resources (MSR) and TSR Solar Tech as of 2022, innovation-intensive upstream and mid-stream segments are now entirely foreign-owned, predominantly Chinese firms[53].

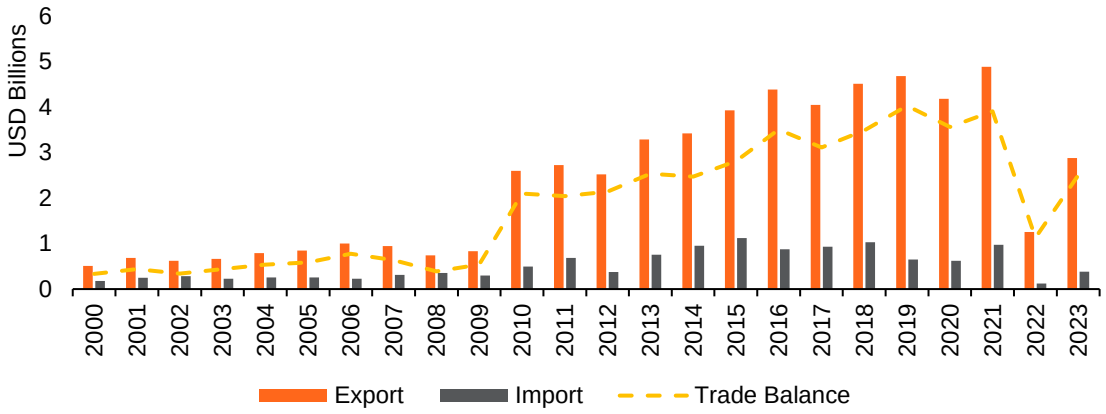
[50] Rasiah (2017)

[51] J. Lee (2017)

[52] Chandran Govindaraju (2016)

[53] Chandran, Baskaran, and Selvarajan (2022)

Figure 5: Malaysia – Trade Flows of Renewable Energy, 2000-2023, USD billion



Source: UNComtrade (2024), authors' elaboration

National green initiatives, as mentioned above, and to a greater extent investment and trade policies have been crucial in developing the industry. Recently, international political and economic developments have also played a significant role in shaping the mid-stream section of the value chain. While Chinese solar firms already take advantage of low costs in Malaysia, the US-China trade war further encouraged Chinese solar firms to relocate production to Malaysia and other Southeast Asian economies to evade rising US tariffs. This has not gone unnoticed, as Malaysia, along with Cambodia, Thailand, and Vietnam, have been accused by the US Department of Commerce of participating in circumventing US anti-dumping measures on solar cells and modules from China[54].

Despite the direct impact of US safeguard tariffs since 2018, Malaysian solar PV exports continued to grow until 2021. The temporary continued improvement in exports is likely due to exclusions of certain products from tariffs, like thin-film modules, exemptions for the first 2.5GW of imported solar cells, exemptions given to developing countries if US imports are less than 3% of the total import basket, and trade diversion to China[55]. However, in 2022 the trade balance of the product declined, likely reflecting the impact of the tariffs. Although in 2023 there has been a slight rebound, the future of this Chinese-firm-dominated industry remains uncertain as following a two-year waiver the US imposed countervailing duties and anti-dumping rates in late 2024. While three firms that did not respond to the US Department of Commerce investigations were slapped with an adverse inference rate of 124.78% the majority of solar firms assessed in Malaysia were levied a subsidy rate of 12.32%. One Chinese firm received a subsidy rate of only 9.92% whilst a Korean affiliate was levied at 14.72%[56]. Signs indicate Chinese firms might use other nations such as India to circumvent these restrictions[57].

[54] Bond et al. (2023)

[55] Tham Siew Yean, Kam Jia Yi, and Tee Beng Ann (2019)

[56] "Crystalline Silicon Photovoltaic Cells, Whether or Not Assembled Into Modules, From Malaysia: Amended Preliminary Determination of Countervailing Duty Investigation" (2024)

[57] Prasso (2024)

Challenges in the Photovoltaic Industry

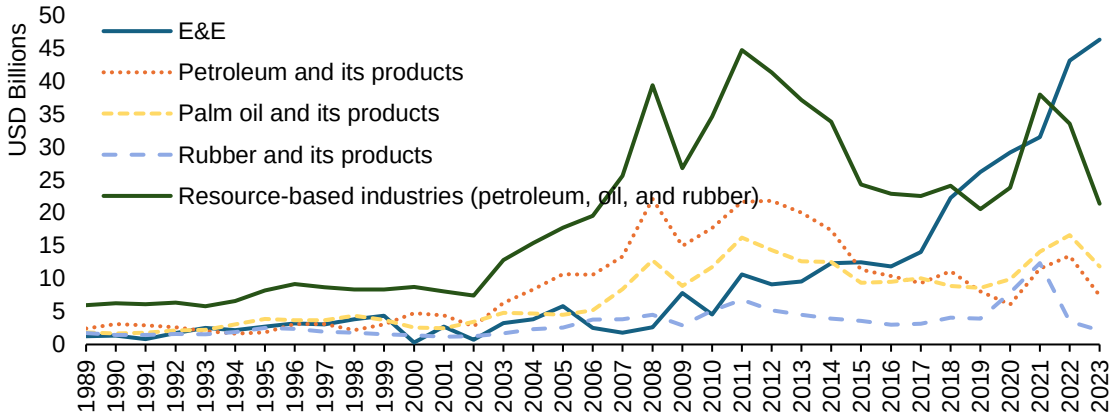
Despite Malaysia's complete value chain for modules, Chinese firms operating there prefer importing cheaper inputs from China. This preference has led to a significant rise in Malaysia's PV industry imports from China, increasing from USD35 million in 2010 to USD522 million in 2021. Chinese lead firms in the solar panel industry are generally vertically integrated and continue sourcing inputs cheaply from China even after setting up operations in Malaysia. The domestic sourcing of inputs by these firms in Malaysia ranges from none to 60%[58].

This global value chain (GVC) structure limits the potential for Malaysian firms to upgrade their capabilities. While MNCs dominating upstream and midstream segments of the value chain can move into downstream activities, local downstream players struggle to move into upstream and midstream segments. For example, local producers of innovative solar modules in the downstream segment cannot source components locally, even if MNCs produce them in EPZs. As MNCs in EPZs are not allowed to sell to the local market, local solar PV module makers must import costlier inputs from abroad, making their products less price-competitive.

3.3 Resource-based Industries

In addition to E&E, resource-based industries like palm oil, rubber and petroleum are crucial to Malaysia's economy and the energy transition[59]. Collectively, these sectors contribute significantly to the country's trade balance, surpassing the contribution of the E&E sector for most of the period between 1989 and 2023 (Figure 6).

Figure 6: Malaysia's Trade Balance by Sector, 1989-2023



Source: UNComtrade data, authors' calculations

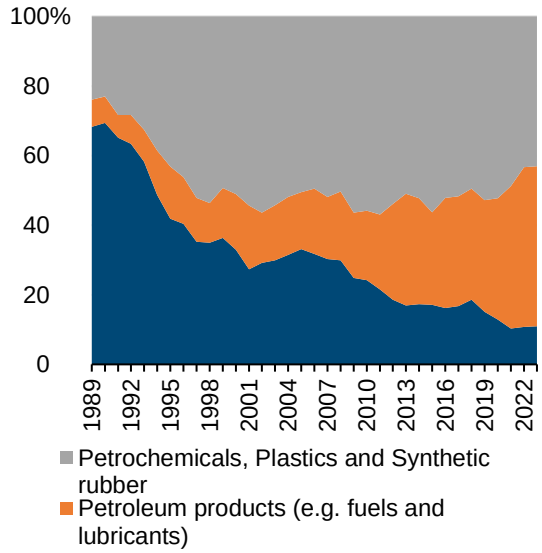
Malaysia not only exports raw commodities but also increasingly engages in value-addition processes (Figure 7 and Figure 8). In the 2000s, value-added commodity-based manufacturing

[58] Chandran et al. (2023)

[59] This section draws mainly on Lebdioui (2022)

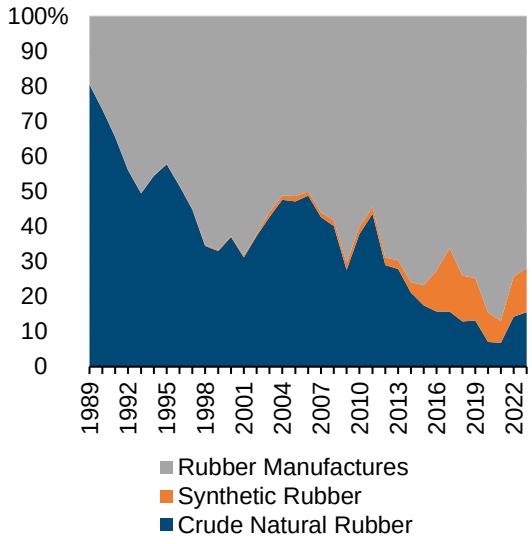
accounted for 12% of GDP, compared to 18% for raw commodities. About half of the commodity exports were processed[60].

Figure 7: Composition of Petroleum Industry Exports (1989-2023)



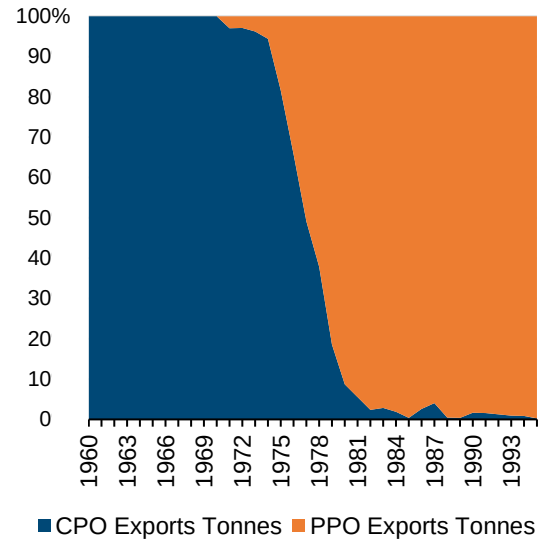
Source: UNComtrade, authors' elaboration

Figure 8: Composition of Rubber Industry Exports (1964-2018)



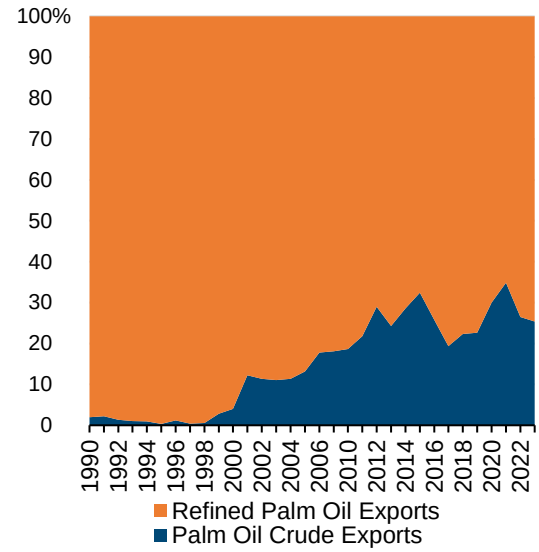
Source: UNComtrade, authors' elaboration

Figure 9: Composition of Malaysia's Palm Oil Exports, based on volume, tons, (1960-1994)



Source: Gopal (2001), authors' elaboration

Figure 10: Composition of Malaysia's Palm Oil Exports, based on Value, USD, (199*0-2023)*



Source: UNComtrade data, authors' elaboration

[60] World Bank (2013)

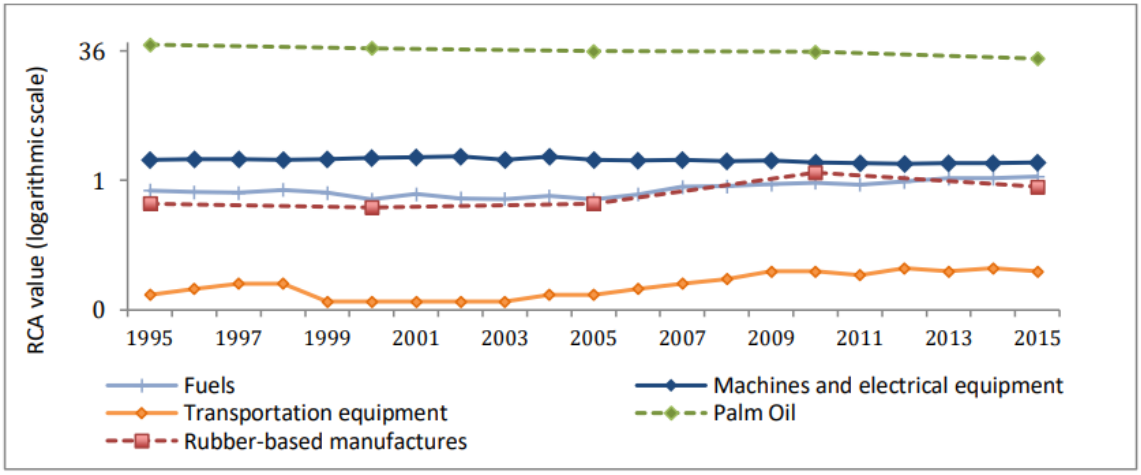
Malaysia transformed from an insignificant palm oil producer to a leading exporter of processed palm oil, with its share of total oil palm exports growing from 0% in 1974 to 99% in 1994 (Figure 9 and Figure 10). From the 1970s to the 1980s, Malaysian palm oil processing grew 34% annually, which was three times faster than the growth of other domestic industries and the global average[61]. The oil palm industry emerged as the second-largest contributor to exports, the fourth-largest contributor to gross national income and directly employs about 600,000 individuals[62].

The rubber industry has also evolved from raw rubber production to a nearly fully integrated sector. Since 2012, the value of manufactured rubber goods exports has more than doubled that of raw rubber exports.

The petroleum sector has integrated value-addition processes in both upstream and downstream activities since the 1990s. Domestic firms have accumulated capabilities in downstream production related to refined oil, petrochemicals and lubricants, reducing the share of crude oil exports from over 95% to 20% in the last 50 years[63]. The products of these industries also feed into the domestic synthetic rubber and plastic producers.

Malaysia's resource-based sectors are globally competitive. Palm oil consistently shows a high revealed comparative advantage (RCA) (Figure 11), while petroleum products and rubber-based manufactures have recorded an RCA of above one since 2007.

Figure 11: Malaysia's Revealed Comparative Advantage by Sector (1995-2015)



Source: Lebdioui, Lee and Pietrobelli (2020)

Several policies were important in developing these industries. These policies comprised fiscal incentives, trade protection and promotion, R&D support, as well as human capital promotion as listed in the table below (Table 2).

[61] Jaya Gopal (2001)

[62] Azhar AA (2009)

[63] Lebdioui (2020)

Table 2: Key policies towards value addition in commodity sectors in Malaysia

	Petroleum		Palm Oil		Rubber	
	Upstream	Downstream	Upstream	Downstream	Upstream	Downstream
Fiscal Incentives	Fiscal incentives for re-investment in resource-based industries The promotion of Investments Act (1986) offers tax breaks to petroleum firms if they contribute to industrial local linkages and knowledge transfers		Fiscal incentives for re-investment in resource-based industries Replanting subsidies	Preferential export duties between crude and refined palm oil Tax credits for downstream processing 7 years tax breaks for pioneer status refineries	Fiscal incentives for re-investment in resource-based industries, which include Pioneer Status (with income exemption) and Investment Tax Allowance Incentives for priority sectors (which include the rubber sector)	
Trade Promotion and Protection	Local content requirements for staff and the supply of goods and services Petronas Vendor Development Programme (1993)	Export taxes on crude oil (1993)	Malaysian Palm Oil Council for promotional efforts (since the 1980s) Barter trade and POPCA credit (since the 1990s) The sustainable palm oil certification scheme (MSPO) since 2015		The Malaysian Rubber Export Promotion Council promotes local products and identifies new export opportunities since 2000 The Malaysia Rubber Board (1998) offers product quality testing and compliant services for local firms to match changing international standards	Tariff protection on tires imports (1960s)
R&D Support	The Petronas Research Cess, an annual research contribution paid by partner companies to promote R&D		Oil Palm Genetics Laboratory (1960s) Malaysian Palm Oil Board (2000) (a merger of the Palm Oil Research Institute, 1997) and the Palm Oil Registration & Licensing Authority (1979)		The MRB (created from a merger the rubber R&D Board; Rubber Research Institute; Rubber Exchange & Licensing Board; Malaysian Rubber Producers Research Association; Tun Abdul Razak Research Centre)	
Human Capital	Institut Teknologi Petroleum of Petronas (1983) Universiti Teknologi PETRONAS (1997)		Universiti Putra Malaysia to train agro-industrial engineers and agro-business graduates			

Source: Lebdioui (2022)

Challenges in Resource-based Industries

While Malaysia's resource-based industries have advanced over the years, they continue to face significant challenges in transitioning to higher-value segments characterised by ownership of

critical assets such as brands, advanced technologies, logistics expertise, marketing capabilities and intellectual property. These high-value, profitable segments have become increasingly oligopolistic, dominated by firms in high-income countries due to a wave of mergers and acquisitions. This concentration of power makes it difficult for firms in developing countries to emerge as globally competitive "national champions" with cutting-edge technologies and strong brands capable of driving national development.

Firms from advanced economies have deeply entrenched operations and influence worldwide, including in developing countries. In contrast, firms from the Global South hold minimal assets in high-income countries and generate comparatively modest revenues. This disparity underscores the formidable barriers that firms in developing countries face in becoming globally competitive and breaking into high-value, technology-driven global markets.

The challenges faced by Malaysia's resource-based industries mirror those encountered by the E&E and solar PV sectors in their efforts to achieve functional upgrading within global value chains which remain dominated by firms from advanced economies. While there are opportunities for capability building and progression within these industries significant obstacles hinder their advancement to higher-value functions.

The continued growth and transformation of these sectors are essential for Malaysia's economic development and green industrialisation goals. A comprehensive understanding of the barriers these industries face, including their effects on vulnerable minority groups, is critical for charting a path forward. These issues and their implications will be explored in greater detail in the next section.

4. CHALLENGES AND BINDING CONSTRAINTS TO GREEN INDUSTRIALISATION

4.1. Climate Adaptation Gaps and the Risks of FDI-Centric Policies

Climate adaptation is a critical pillar of climate action because considerable anthropogenic warming has already taken place. The 12 months of 2023 saw the world hit 1.5°C warming over pre-industrial levels, which is the principal limit targeted by the Paris Agreement. Expectations are growing that the world will overshoot 1.5°C before any tapering or stabilisation is achieved via coordinated global action. The Intergovernmental Panel on Climate Change (IPCC) has documented extensively the dangers courted by 1.5°C warming in its special report. Failure of collective global action would invite runaway warming and significant economic impacts.

Responses to climate change therefore must include both efforts to prevent further warming (mitigation via emissions reduction) and measures to tackle existing and incoming physical risks (adaptation). Additional areas of action include mobilisation of the 'means of implementation' (finance, technology transfer and capacity building) and claims of losses and damages.

Ironically, one of the binding constraints on climate adaptation in developing countries can be a green industrialisation policy that is mitigation-centric. In a situation of scarce political and bureaucratic resources adaptation measures may appear less economically salient than greenhouse gas mitigation to meet the biases and expectations of developed country investment demands (such as ESG metrics).

In the Malaysian case, policy development from 2021 to 2023 saw a tremendous emphasis on climate and green industrialisation – framed as a "Net-Zero" ambition – with the following measures:

1. Revision of Malaysia's Nationally Determined Contribution (NDC) to the Paris Agreement in 2021 at COP26 to drop conditionality on the receipt of finance, technology transfer and capacity building towards achieving its target of a 45% reduction in the greenhouse gas emissions intensity of GDP by 2030 relative to a 2005 baseline;
2. The 12th Malaysia Plan (2021-2025) which articulated a national carbon neutral target as early as 2050, called on the corporate sector to achieve carbon neutrality by 2050 and was launched in Parliament with an aspiration for 'net-zero' GHG emissions as early as 2050;
3. The National Energy Policy 2022-2040 which placed emphasis on energy transition in light of climate imperatives;
4. The National Energy Transition Roadmap (2023, NETR) which charted out the transition to 'net-zero' GHG emissions as early as 2050;
5. The New Industrial Master Plan (2023-2030, NIMP)

These headline national policies have been complemented by the mandatory adoption of G20 reporting standards for the financial sector, namely the Taskforce on Climate-related Financial Disclosures (TCFD).

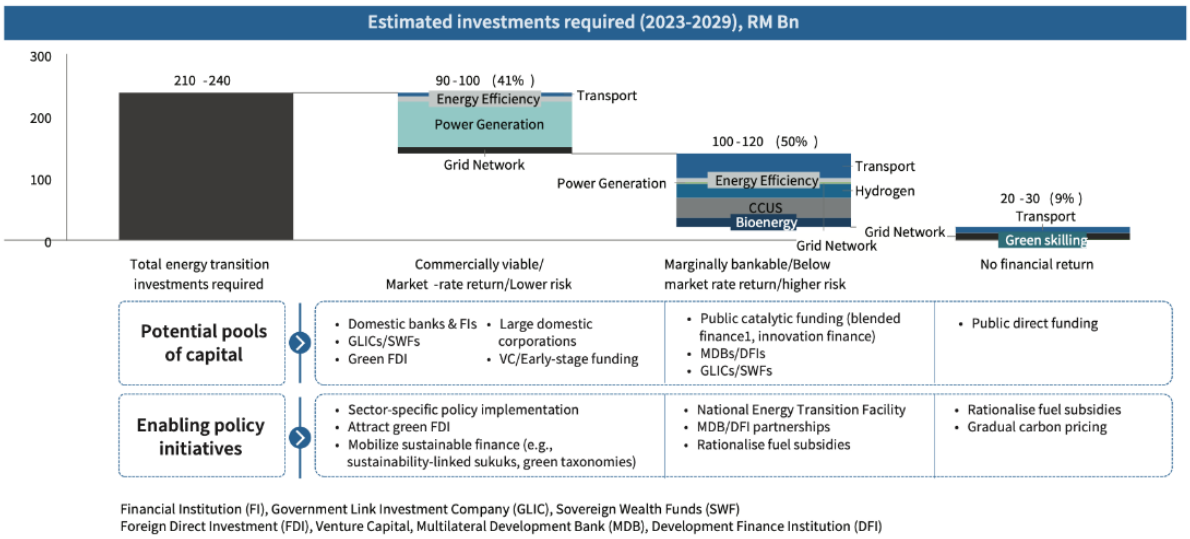
Work on a National Adaptation Plan (NAP) was delayed until late 2024 and is expected to take 2-3 years to complete. As of end 2024, 16 out of 55 countries (29%) in the Asia-Pacific region have filed NAPs with the UNFCCC. This populous and economically critical region as a whole is formally underprepared to respond to the physical risks of climate change.

The overall stance of the recent climate and energy policies above has been to showcase Malaysia's attractiveness as a destination for ESG-sensitive foreign investment, or "green FDI". The transition costs for the energy sector are considerable, with an estimated RM1.2 - 1.3 trillion for investment alone under the NETR, not including the cost of capital. This makes energy transition the largest single expense item currently in government plans. By comparison, the 2024 federal budget amounted to RM393.8 billion out of which the allocation for the then climate and energy ministry was a mere 1.7% of the total.

Low rates of return are a problem that haunts renewable energy transitions around the globe. The NETR indicates that out of the energy transition items for 2023-2029, only 41% are considered to be commercially viable or offer market rates of return (see below). 50% of investments are considered marginally bankable, below market rate, or higher risk, implying the need for public catalytic funding. 9% of investments with no financial return would require direct public funding[64].

[64] "National Energy Transition Roadmap" (2023)

Figure 12: Estimated investment needs under the NETR, 2023-2029



Source: NETR (2023)

The need for the state to make financial interventions in up to 59% of medium-term energy transition investments represents a form of de-risking for private capital and FDI in particular[65]. This shifts investment and borrowing costs from private sector to the state. An additional industrial policy risk presents itself whereby the Malaysian state could undertake expensive energy transition measures as a form of 'powershoring' service for transnational capital to decarbonise its GVCs. It does not necessarily follow that if such infrastructure is built, capital will come given the secular decline in global FDI flows, centripetal 'friendshoring'[66] dynamics, and multiple sites of decarbonisation efforts in the region, led by China.

The risk of such powershoring is that it does not represent a qualitative jump in production capabilities or greater value addition on the part of the host country. Rather, it is a more sophisticated form of providing a new level of 'basic' infrastructure for a climate-constrained age. Absent more sophisticated industrial upgrading measures, Malaysia could end up being a low-skill, labour-intensive global production site with a variety of green energy offerings. Notably, if such emissions-focused measures are not also paired with adaptation measures as part of a holistic climate policy, then physical climate disruptions such as floods, heat stress and sea-level rise can disrupt production in the near and long term.

[65] cf. Gabor (2020)

[66] Friendshoring refers to the act of moving manufacturing facilities or sourcing from countries that are geopolitical allies.

Conversely, the primary risk which policymakers appear to be responding to is that of divestment risk or investment diversion to third parties. Unless one ignores Malaysia's empirical emissions data – with only 0.37% of historical carbon dioxide emissions – there is no robust way in which Malaysia's achievement of 'net-zero' GHGs will have a decisive impact on reaching global Paris Agreement goals due to its small emissions footprint.

Attraction and domestication of clean energy industries such as batteries and electric vehicles would still require Malaysia to overcome the pre-existing challenges it faces in absorbing and indigenising technologies to generate spillovers.

In either case of responding to divestment risk or de-risking 'green FDI', the risk taken on by the state is a fiscal risk.

It is important to note that while at present climate-friendly (read: low emissions) growth is associated with green growth, it should not be taken as synonymous. While it is possible to deliver environmental health benefits through the phase-out or phase-down of coal (cutting down noxious emissions such as nitrous oxides and sulphur dioxide), there are still industrial processes without significant GHG emissions that also present environmental risks. For example, the processing of rare earths can produce radioactive waste, as does nuclear power generation. Furthermore, climate-resilient development that emphasises climate adaptation and resilience has yet to achieve mainstream recognition as green growth or green industrialisation though it is one of the more consequential forms for developing countries.

4.2. Industrialisation and Indigenous Peoples

Even though Malaysia's growth and industrialisation have been recognised to have successfully incorporated redistribution, some groups and communities have been left behind, namely the Orang Asli. The term Orang Asli translates to 'original people'. They are categorised as Bumiputera, along with the Malays, the natives of Sabah and Sarawak, the Malaysian Siamese, and the Portuguese-Eurasians. Orang Asli is an umbrella term introduced by the government in the 1960s to group three broad indigenous ethnic groups in Peninsular Malaysia: the Senoi, Semang and Melayu Asli[67]. They, in turn, are made up of 18 subethnic groups in total. The Orang Asli number around 207,000, comprising about 0.6% of Malaysia's population dispersed around the peninsula states except for Perlis and Penang. They have fallen through the cracks despite the NEP's target to uplift the Bumiputera in general.

Social indicators related to the group, such as poverty rate, educational attainment, health status, access to amenities, and access to economic opportunities, are all far worse than Malaysia's average. The data quoted in this section, though, is quite dated since the government has not made public recent data. Nevertheless, we believe the results have not drastically changed over the years. According to the Department of Orang Asli Affairs data, in 2008, 50% of Orang Asli were

[67] Andaya (2002)

poor, while 33% were hardcore poor[68]; that is, they earn incomes below what is required to purchase the minimum caloric intake of food for each household member. In contrast for the Bumiputera in general, only 5.4% were poor and 1.1% were hardcore poor, according to data reported in 2009. They also suffer from poor health outcomes due to resettlement as they have been displaced from the forest, their traditional source of food and natural resources[69].

In education, it was recorded that only 4.2% of Orang Asli were enrolled in upper secondary education in the year 2000. Recent information revealed by the Minister of Education in a 2021 parliamentary session showed that only 42.29% of Orang Asli completed the final year of secondary school[70]. The number of tertiary-enrolled Orang Asli is even lower. In 2000, only 0.8% were enrolled in tertiary institutions, and from 2000 to 2008, only 497 Orang Asli graduated at the tertiary level[71]. Their poor education performance is mainly due to poverty, exacerbated by the non-delivery of educational assistance and subsidies[72].

Modern economic development has generally been detrimental to the Orang Asli's welfare thus far. Large-scale industrial agriculture has encroached upon the Orang Asli's traditional territory and caused their displacement. The opening of large-scale rubber estates and oil palm plantations drove them further away from their ancestral territory, leading to the loss of their communal forest area important to sustain their livelihood. In addition to the plantations' economic impact, they also cause pollution through chemical run-off to rivers, while the fragmentation of forests poses a threat to the surrounding wildlife[73].

Experience serves to remind that economic development plans intended to advance Orang Asli welfare could have the opposite effect. In 2010, the government proposed introducing cash crop planting schemes for the Orang Asli that were modelled after past successful government programs to raise the income of rural peasants. In the proposed scheme, the Department of Orang Asli Affairs would be converted into a statutory body in charge of developing Orang Asli reserve lands. The Orang Asli households are expected to work this land and receive land titles after the crops mature.

There were several problems with the plan that ran against Orang Aslis' interests and rights. For one, although the Orang Asli would receive land titles, they could not freely transact them as they would require permission from the Department of Orang Asli Affairs. The proposal also was formulated without adequate consultation with the community. The government premeditated that the lands be developed for commercial agriculture regardless of what Orang Asli required and desired. Their communal forests, important sources of food and other resources, would be

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[68] Poverty is officially defined by the Department of Statistics Malaysia (2019) as household earning less than the monthly poverty line income (PLI), which is divided into two categories, food PLI and non-food PLI. A household is considered hardcore poor if its monthly income is less than the value of food PLI. Based on the 2005 definition, which was used until 2019, food PLI was determined according to the minimum caloric intake needed for each household member, taking into account the food pyramid and international best practices.

[69] Khor Geok Lin (1994); Nurfaizah Saibul et al. (2009)

[70] Kurniawati Kamarudin and Sakini Mohd Said (2022)

[71] Rusaslina Idrus (2011)

[72] Ibid.

[73] Ibid.

converted to monocultural crops vulnerable to global market swings. This also necessarily entails a lifestyle change and will likely lead to the loss of cultural practices and traditional knowledge. Additionally, the plan only designated less than half of the already recognised Orang Asli reserve land for development, leaving the status of the remainder uncertain.

The Orang Asli objected to the proposal and this was met with incredulity by the Department of Orang Asli who accused them of rejecting modernity and being misled by outsiders. The Department continued to insist the policy was in the best interest of the community. The clash between them highlights that development policies are value-laden and tend to be underpinned by a Eurocentric version of economic rationality[74], and what may be deemed good by planners might not be perceived so by the intended beneficiaries. Industrial agriculture prioritises maximising profits given factor inputs. This runs the risk of looking at the environment merely as economic resources to be fully exploited for profit and risks environmental depletion. Such an attitude goes against values prioritising living in harmony with the environment typically held by indigenous communities.

A conflict such as this underscores the need to consult indigenous communities before introducing development plans for the Orang Asli including opportunities related to green industrialisation. A sustainable palm oil industry producing biofuel, for example, can create job opportunities for the Orang Asli. But at the same time forcing it upon the Orang Asli infringes upon their rights. Furthermore, the notion of welfare might differ between the planner and the intended beneficiary. Participation by the indigenous community should be of their own volition rather than forced, and states must 'obtain their free and informed consent prior to the approval of any project affecting their lands or territories'[75]. Any proposal for their development should be guided by the United Nations Declaration of the Rights of Indigenous Peoples, to which Malaysia is a signatory, which states that "[i]ndigenous people have the right to determine and develop priorities and strategies for the development and use of their lands or territories and other resources".

The need to obtain prior informed consent notwithstanding, should Orang Asli choose to participate in modern development plans including in green industries, opportunities should be adequately provided to develop their capabilities. Part of the rationale for industrialisation is to provide high-income jobs for highly skilled workers who are expected to benefit more by virtue of their skills. The Orang Asli's generally low education level could see them fall further through the cracks in the coming sweep of green industrialisation if nothing is done to improve their educational outcomes.

Opportunities in education and jobs can be allocated through affirmative action policies targeting the group specifically. The problem with current affirmative action policies is that they target the Bumiputera in general without distinguishing the constituent ethnicities. Most government statistics also present the Bumiputera as one consolidated group, masking the true economic position of constituent ethnicities. As such, indicators showing the progress of the Bumiputera's position, in general, may not mean any progress for the Orang Asli at all since it is possible that

[74] Mehmet (2002)

[75] Nicholas (2000)

only particular subgroups are beneficiaries of that progress. Furthermore, Orang Asli households are typically excluded as statistical outliers in the household amenities surveys conducted by the government. Therefore, their socioeconomic deprivation in matters such as access to electricity, piped water and schools can be statistically invisible unless dedicated surveys are carried out.

4.3. Deindustrialisation

Among the concerns that have been highlighted in recent years is the possibility that Malaysia is facing deindustrialisation[76]. There are many definitions of deindustrialisation, but they all refer to some sort of decline or problems with the manufacturing sector[77]. In this section, we follow Tregenna's definition of deindustrialisation[78], which is defined as a sustained decline in manufacturing's share in GDP and its share in total employment. Among the concerns with deindustrialisation is that manufacturing jobs are declining much faster than manufacturing output, which has political and social implications and indicates the loss of opportunity to take advantage of the special properties of manufacturing for economic development, which mainly operates through employment. Additionally, not all declines in manufacturing employment should be considered deindustrialisation. Thus, Tregenna's definition distinguishes between a decline in manufacturing employment considered as deindustrialisation and that which isn't. If the share of manufacturing value-added does not decline at the same time, then it isn't deindustrialisation, while if it does then the reverse is true.

According to this definition, Malaysia is deindustrialising as both the manufacturing share of GDP and employment are declining. From 2000 to 2018, Malaysia experienced a fall in the manufacturing share of GDP by 7.8 percentage points and a fall in the manufacturing share of employment by 6.1 percentage points[79]. This decline is accompanied by the sector's deteriorating trade performance, a slowdown in productivity and an inability to move towards high-value-added activities[80], thus reinforcing the fact that Malaysia's deindustrialisation is a reality. On top of the inability to upgrade to high-value-added goods, the opening of new lower-cost sites such as Vietnam and China has also been cited as a reason for deindustrialisation.

As mentioned previously, the manufacturing sector has certain characteristics and advantages generally absent in other sectors, thus making an economy deindustrialising prematurely unable to capture these advantages. Classical development economists have argued that manufacturing positively triggers economic growth, productivity and inter-sectoral development[81]. The special properties of manufacturing particularly relevant in the context of developing green industries are higher learning opportunities compared to other sectors through which embodied and disembodied technological progress is generated.

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[76] See for example Rajah Rasiah (2011) and Tengku Mohamad Asyraf et al. (2019)

[77] See for example, Bluestone (1982), Singh (1977), and Rowthorn and Wells (1987)

[78] Tregenna (2009); (2013)

[79] Department of Statistics Malaysia (n.d.), authors' calculation

[80] Rasiah (2011b)

[81] See Szirmai (2012) for a list and discussion of these arguments

The embodied and disembodied knowledge generated within manufacturing sectors connects within and across sectors through spillover effects and is conducive to innovation. Firms within and across sectoral value chains should be seen as repositories of production and technological capabilities. Some capabilities and technologies can be applied in multiple sectors. For example, wafer-making capabilities in the semiconductor industry could also be applied in the solar PV industry[82]. Some other technologies might not have similar applications in other sectors, although they might have complementary capabilities that could be combined to create technologies that address environmental concerns. As observed by authors such as Arthur[83] and Andreoni, Chang, and Labrunie[84], most innovations in technologies are often a fusion of several existing, albeit incrementally improving, technologies. There is no reason to think the case is otherwise for upcoming green technologies. Furthermore, the existing industrial base of a country also provides a pool of highly skilled talent that new green industries could draw from to build their own human resources. It is from these pre-existing strengths that the solar PV and EV industries in China drew from to establish their dominant positions in these industries. A similar feat would be difficult to replicate from a deindustrialising industrial base as technological capabilities vanish and the talent pool shrinks.

4.4. Constrained Industrial Policy Space

Building new capabilities and developing competitive indigenous industries and sectors in developing countries requires strong support from the government. In other words, to implement industrial policies to close the gap in technology and other firm capabilities against developed countries' firms. As observed by Chang[85] and Reinert[86], governments intervened heavily to support the development of industries in the earliest industrialising countries, even among those that trenchantly criticised its use in recent times, such as the US and the UK. Likewise, the experience of newly industrialised countries such as South Korea and Taiwan showed that such industrial policies were crucial in strengthening their international competitiveness[87].

Instruments such as tariff sequencing, import licensing, duty drawbacks, subsidies for export, production and R&D, local content requirements for FDI, tech transfer, trade balancing, selective patenting, compulsory licensing, skills development and state-run firms were utilised by these newly industrialised countries to pursue industrial development. Since the WTO assumed governance of international trade from GATT in 1994 most of these instruments were rendered non-compliant.

Among the instruments Malaysia used during the GATT era were local content requirements, import controls, export incentives and export performance requirements. DiCaprio and Gallagher[88] observed that Malaysia has stopped using all these instruments in the WTO era,

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[82] "A Detailed Guide about Solar Wafers: Application And Types" (2022)

[83] Arthur (2009)

[84] Andreoni, Chang, and Labrunie (2021)

[85] Chang (2003)

[86] Reinert (2008)

[87] See for example the works of Amsden (1989, 2001) and Wade (1990)

[88] Dicaprio and Gallagher (2006)

except import controls. They also found that the WTO's dispute settlement mechanism effectively discourages countries from introducing new policies inconsistent with WTO rules (although it has been less successful in encouraging the removal of existing non-compliant policies). As such, it has proven to be effective in constraining policy space.

These WTO commitments should be seen as the baseline for policy space restriction. In addition to WTO commitments, Malaysia is also a signatory of seven bilateral and nine regional free trade agreements. These WTO+ commitments introduce more stringent intellectual property regimes and more onerous investor-state dispute settlements, allowing MNCs to sue governments for policy changes that supposedly caused a loss of profits[89], further tightening policy space.

The constriction of policy space does not simply derive from adopting multilateral and bilateral agreements such as WTO and the myriad of FTAs. Globally- dominant MNCs concentrated in the Global North constrain policy space indirectly by erecting barriers that prevent developing countries[90]. Using their dominant position, these MNCs also reinforce global rules which directly constrict policy space by applying political pressure on national governments and international bodies to introduce and enforce regulations that favour them. Four mechanisms have been important in facilitating value extraction or erecting barriers against firms from developing countries. These are intellectual property rights and copyrights, international standards and liberalisation of trade and capital flows[91].

4.5 Constrained Fiscal Space

The capacity to act, given the diminution of permissible industrial policies, has been further constrained by the limited fiscal space. In the last decade and a half, successive Malaysian governments have been trying to reduce the fiscal deficit after the 2008 Global Financial Crisis, only temporarily relenting during the Covid crisis in 2020 and 2021 (Figure 13). As a developing country, Malaysian sovereign debt papers are not as attractive as developed countries in international financial markets given the same level of indebtedness[92]. This is especially so compared to government debt papers issued by countries considered safe havens, such as the US, Germany, Japan and the UK. This means that the Malaysian government cannot deficit spend at the same level and build up debt levels similar to those of these countries, given Malaysia's balance of payments vulnerability to international finance and dependency on imports of capital and intermediate goods.

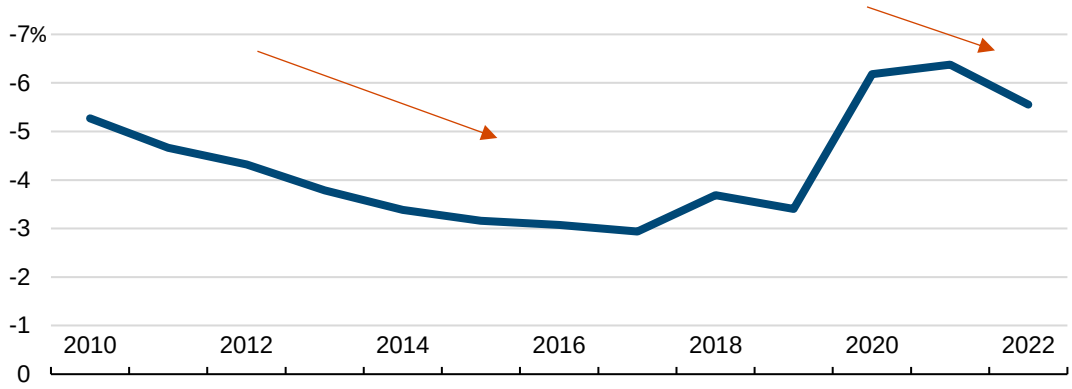
[89] Jomo KS (2024)

[90] Andreoni, Chang, and Estevez (2019)

[91] Ibid.

[92] De Paula, Fritz, and Prates (2017)

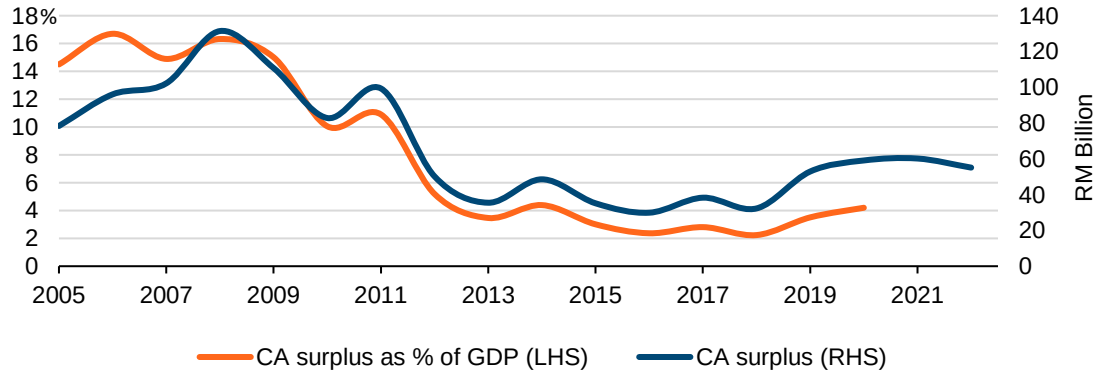
Figure 13: Malaysian Government's Fiscal Balance, 2010-2022 (percentage)



Source: Bank Negara Malaysia (2024)

Furthermore, reducing this dependency on foreign finance has become increasingly difficult as Malaysia's current account surplus, the longstanding provider of foreign currency, has weakened (Figure 14). Allowing foreign investors to purchase Malaysian sovereign debt is one of the ways to close the external financing gap, along with selling other capital market instruments and other inward foreign direct investments. Given the shrinking current account surplus, the role of foreign purchases of government bonds has grown in importance in providing foreign currency. Otherwise, the Malaysian ringgit foreign exchange rate is likely to suffer greater depreciation. Thus, firms that depend on capital and intermediate imports but cater mostly for the domestic market are at great risk of currency mismatch between liabilities and earnings.

Figure 14: Malaysia's Current Account Surplus, 2005-2022 (percentage of GDP and RM Billion)



Source: Bank Negara Malaysia (2024)

Additional bureaucratic constraints to fiscal expenditure were introduced in November 2023 in the form of The Public Finance and Fiscal Responsibility Act. The Act aims to reduce the fiscal deficit to 3% of GDP or less, government debt to 60% of GDP or less, and to limit financial guarantees to not exceeding 25% of GDP. Deviation from these targets arising from a sudden and unpredictable event posing a significant risk to human life, economy and fiscal position requires

cabinet approval and tabling in Parliament. The limited leeway to expand fiscal deficits and government debt further reduces the prospect of using fiscal expansion to finance industrial policy.

4.6 Talent Issues

The lack of sufficient high-skilled talent has been blamed for dragging the development of high-technology and high-value-added industries. This, for example, has been highlighted as a partial reason why the E&E industry was not able to upgrade to higher-valued-added functions in the value chain[93]. The example of Morris Chang of Taiwan Semiconductor Manufacturing Company's (TSMC) success shows that when key talent such as the CEO spearheads high technology industries they may be more successful if they are well-connected to R&D institutions and buyer-supplier firms and possess a vision to predict technological developments in the industry. Malaysia, on the other hand, lacked executives of the same calibre in local firms and supporting institutions, although now there are many Malaysian alumni of semiconductor MNCs including former board members of Intel. CEOs of foreign E&E firms have also cited a lack of engineering and R&D scientists as partly the reason why they do not invest in frontier wafer fabrication plants in Malaysia despite having access to government R&D grants[94]. The Minister of Investment, Trade and Industry has also implied that there is a talent shortage in the E&E industry owing to growing FDI, which claims a potential demand of 50,000 engineers, whereas Malaysia only produces 5,000 graduates each year[95].

Just by looking at the number of researchers and comparing it to a more successful technological catch-up economy like China, Malaysia has fewer researchers per million people, which might indicate a lack of talent. Data from UNESCO[96] (Figure 16) shows that China had 1,687 researchers per million (as of 2021), whereas Malaysia only had 726 researchers per million (as of 2020) (Figure 15). Notably, it was not long ago that Malaysia was ahead of China before being overtaken in 2020. China has achieved this not only by growing its number of researchers but also due to Malaysia's numbers declining since 2018. But why has Malaysia's number of researchers fallen? It might not be due to an insufficient number of graduates qualified to undertake research, but rather, it could be due to the smaller and declining amount of R&D spending compared to them. In other words, it could be a demand problem rather than a supply problem.

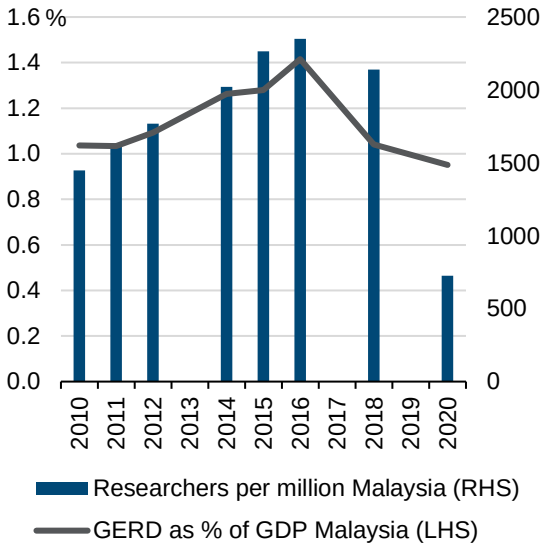
[93] Rasiah (2017)

[94] Rasiah (2017)

[95] Izzul Ikram (2024)

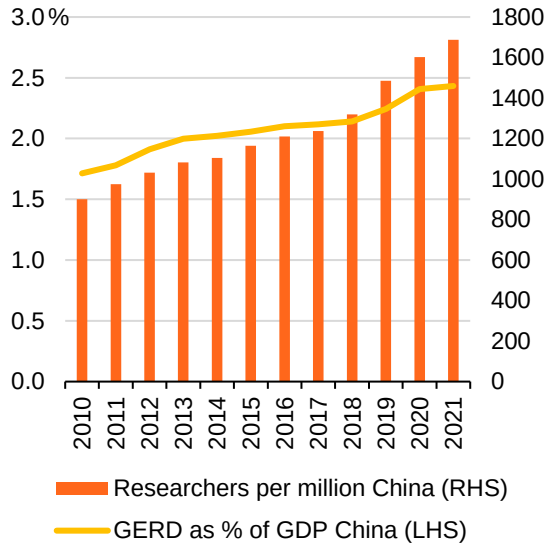
[96] "SDG9 Monitoring" (n.d.)

Figure 15: Gross Expenditure on R&D and Researcher Headcount, Malaysia, 2010-2020 (percentage and per million people)



Source: UNESCO (2024)

Figure 16: Gross Expenditure on R&D and Researcher Headcount, China, 2010-2021 (percentage and per million people)



Source: UNESCO (2024)

R&D spending is correlated to the number of researchers. For Malaysia, the number of researchers dropped drastically from 2016 to 2020, from 2,349 researchers per million to 726 researchers per million, while R&D, as a percentage of GDP, dropped from 1.4% to 0.95%. The 0.45 percentage point drop in R&D spending as a percentage of GDP between 2016 and 2020 was accompanied by a decline of 1,623 researchers per million, reinforcing the demand-driven view.

Table 3: Prevalence of Overqualified Graduates, by Study Field, 2010-2021

Field of Study	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	Average
Science, Mathematics & Computing	47.4	47.1	50.2	49.1	50.5	51.7	53.4	55.5	57.3	38.7	36.0	37.3	47.8
Engineering, Manufacturing & Construction	32.4	32.0	36.0	41.4	39.5	43.7	45.5	47.5	52.4	38.1	42.6	44.5	41.3
Health & Welfare	15.7	19.5	31.6	31.3	26.1	27.5	37.2	36.4	33.8	24.7	29.9	30.2	28.7
Agriculture & Veterinary	64.7	64.7	67.2	68.7	68.9	66.8	72.3	75.4	81.7	65.1	65.8	70.2	69.3
Social Science, Business & Law	55.8	54.0	56.6	57.6	60.0	61.8	60.9	61.8	61.6	50.9	51.6	54.9	57.3
Education	17.0	29.4	33.4	25.5	32.4	29.0	30.0	34.4	37.9	28.8	30.6	34.5	30.2
Arts & Humanities	45.5	45.5	49.4	46.8	47.0	51.0	51.6	53.8	58.8	41.7	45.9	47.6	48.7
Services & Others	70.5	67.7	67.2	67.1	68.9	73.9	73.4	76.1	77.5	70.3	70.9	70.9	71.2
Overall	42.3	43.2	46.6	48.0	50.0	51.9	54.0	54.0	55.4	44.3	46.2	48.6	**48.7**

Lowest — Highest

Note: Study fields shaded in grey indicate the three fields with the lowest overqualification rates across the years, while those shaded in blue represent the three fields with the highest overqualification rates. Similarly, in the "Overall" category, years with the three lowest overqualification rates and the three highest overqualification rates are shaded in grey and blue, respectively.

Source: KRI (2024), based on KRI calculations of MOHE, n.d., data

Table 4: Prevalence of Horizontal Mismatch (perceived by graduates), by Study Field, 2018-2021

Field of Study	2018	2019	2020	2021	Average
Science, Mathematics & Computing	47.7	48.3	47.3	44.3	46.9
Engineering, Manufacturing & Construction	38.6	39.5	42.7	41.2	40.5
Health & Welfare	25.8	24.4	26.2	18.0	23.4
Agriculture & Veterinary	56.5	60.2	57.1	56.6	57.8
Social Science, Business & Law	39.2	41.3	43.8	42.8	41.7
Education	26.6	28.5	31.6	31.3	29.6
Arts & Humanities	45.5	48.6	54.0	54.5	50.7
Services & Others	36.8	37.0	44.4	49.2	41.7
Overall	**39.1**	**40.4**	**43.3**	**42.0**	**41.2**

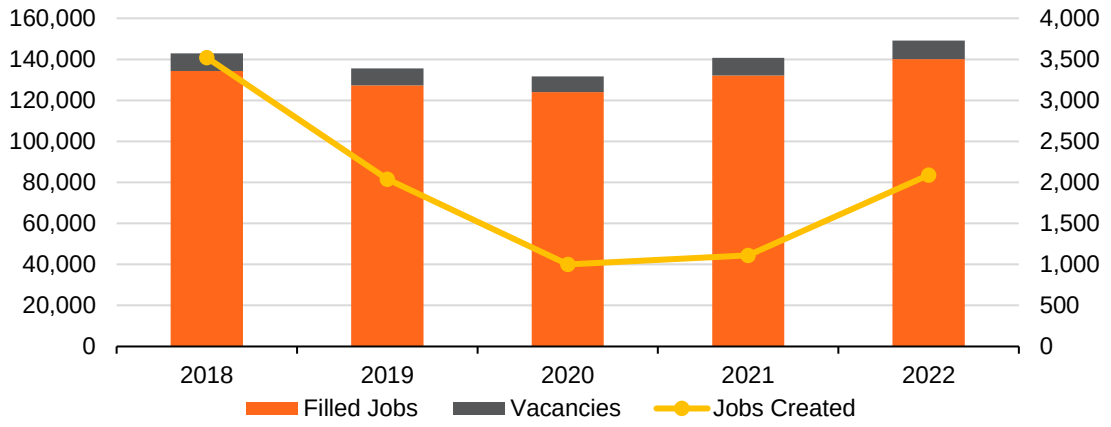
Lowest — Highest

Note: Study fields shaded in grey indicate the three fields with the lowest overqualification rates across the years, while those shaded in blue represent the three fields with the highest overqualification rates. Similarly, in the "Overall" category, years with the three lowest overqualification rates and the three highest overqualification rates are shaded in grey and blue, respectively.

Source: KRI (2024), based on KRI calculations of MOHE, n.d., data

The lack of demand rather than lack of supply view is also supported by other data. Skill-related underemployment figures show that supply exceeds demand significantly. According to MOHE data analysed by Khazanah Research Institution[97], in 2021, 37.3% of science, mathematics and computing graduates were overqualified for their jobs, while 44.5% of engineering, manufacturing, and construction graduates were overqualified (Table 3). Additionally, 46.9% of science, mathematics and computing graduates and 41.2% of engineering, manufacturing and construction graduates perceived that they were not employed in sectors directly related to their field of study (Table 4)[98]. The data clearly shows a lack of suitable jobs for STEM graduates in their field of study.

Figure 17: Breakdown of high-skilled jobs in the E&E sector, 2018-2022



Source: Mohd Amirul Rafiq Abu Rahim and Laventhen Sivashanmugam (2024), based on calculations of DOS (2023) data

More specifically in 2021, 20% of total E&E graduates did not obtain a job within their field of study despite claims of insufficient talent[99]. This is unsurprising given the relatively stationary number of high-skilled jobs created and the number of vacant positions between 2018 and 2022. From 2018 to 2022, the number of high-skilled jobs in the industry was relatively stationary at about 140,000, while the number of jobs created declined from about 3,500 jobs in 2018 to about 2,000 jobs in 2022 (Figure 17)[100]. So, is there a talent shortfall or is there a talent oversupply? Given ostensible oversupply, claims of shortfall have to be understood in the context of ambitions to progress to knowledge-intensive, high-value-added segments that require more high-skilled workers or from an optimistic projection of growing inbound investments in the same segments of the value chain.

[97] Khazanah Research Institute (2024)

[98] Mohd Amirul Rafiq Abu Rahim and Laventhen Sivashanmugam (2024)

[99] DOS (2023)

[100] Ibid.

Nevertheless, the more talent needed to staff potential moves to knowledge-intensive higher value-added functions and the fact that, at present, skilled graduates are underemployed points to a coordination problem. There is no guarantee that increasing the number of skilled graduates would lead current industry players to upgrade to higher value-added functions. For example, the government lacks the bargaining power to force MNCs that dominate Malaysia's E&E industry to establish frontier R&D centres or frontier wafer fabrication facilities here that would then absorb skilled graduates. Reasons to relocate or establish frontier R&D facilities or frontier wafer fabrication facilities do not depend only on a country's number of degree holders in E&E engineering. Malaysia's wages may be lower than other countries, but other factors, such as proximity to end-users, overall cost advantages, proximity to other foundries and existing company facilities, and various other reasons may factor in the decision of firms to relocate[101]. Similarly, it would be hard to force local E&E firms to enter into higher value-added segments if they cannot compete and make more profits. Therefore, there is still a risk that even if the number of graduates is sufficient to staff the work of higher value-added functions, firms will not establish said function due to other factors.

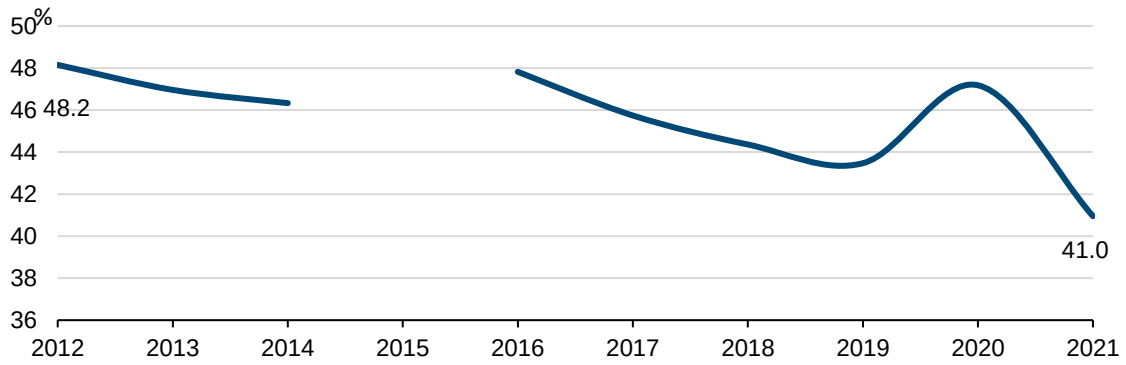
There is no easy way to solve this coordination problem. Even if the country produces more STEM graduates, there is no guarantee that MNCs will establish their knowledge-intensive and high-value-added functions in the country and this is also seen in Singapore[102]. How, then, do we solve this problem? One way is through establishing government-owned or -supported firms in the sector, which can absorb the talent produced, a strategy that Korea and Taiwan used as observed by Amsden[103]. Foreign firms can then tap into this talent base to initiate their own frontier R&D and knowledge-intensive functions. Malaysia had a government-owned firm in the E&E industry, Silterra. However, Silterra could not expand, upgrade its technology and absorb more and more talent due to limited finances and ambition. Therefore, it is likely that for Malaysia to have a big enough talent pool for MNCs or the local private sector to establish high value-added segments eventually, the government must first heavily invest in knowledge-intensive capabilities for their firms so that the growing number of talents produced are hired. These interventions cannot come quickly enough as school leavers have gradually become disinterested in applying for STEM subjects, as seen by the declining percentage of graduates in these courses (Figure 18), which may contribute to an actual supply problem if unaddressed. The talent issues faced by the E&E industry could be replicated in green industries since it is also a high-technology industry and some of the skills required are related to existing industries.

[101] Rasiah and Yap (2019); Brown and Linden (2005)

[102] Best (2007) observed that Singapore's higher value-added than Malaysia in the E&E industry is partly the result of their skilled talent, which allows them to participate in more sophisticated activities. However, as Rasiah and Yap (2019) observed, they were still excluded from frontier wafer fabrication, arguing that this was due to the lack of research support. However, Rikap and Flacher's (2020) findings showed that Singaporean research universities have become leading advanced manufacturing and engineering research centres globally, with semiconductor firms being one of their leading patent co-authors, putting doubt on the claims of lack of research support being the reason why frontier operations have not been established in Singapore.

[103] Amsden (2012)

Figure 18: STEM enrolment in Malaysian Universities, 2012-2021 (percentage)



Source: Ministry of Education (2023)

4.7 Weaknesses in Supporting Institutions

Weaknesses in R&D for catch-up development are not only limited to weaknesses in expenditure and talent but also how these were utilised. Previously, the government expended efforts to increase R&D capabilities through investments in higher education and government research institutions. However, Malaysia's science and technology policy related to these institutions has not emulated best practices in successful catch-up countries.

Successful catch-up countries like Taiwan have used these institutions as a 'collective entrepreneur' to venture into risky high-technology industries that large private firms avoid. Virtually all leading firms in Taiwan's semiconductor industry emerged from public-private collaboration. In the instances when government research institutions have produced success, they have worked closely together with industry. In Japan, Korea and Taiwan, government research institutions were crucial in identifying, assessing, and reverse-engineering imported technologies. Existing technologies were subjected to experiments on how they could be improved. These institutions also engaged in applied R&D to influence firms' technological development and created substitute technologies to lower the cost of foreign technology diffusion[104].

The success of these countries' technological development can also be attributed to an R&D policy focusing on technologies that private industry requires rather than R&D in mainstream scientific research and the fact that domestic firms also invest in R&D after adapting and integrating foreign technologies[105]. The focus on too much mainstream scientific research for economic development in developing countries may be insufficiently pragmatic. Kim and Lee[106] find that knowledge used in industries is derived mostly from firms' investment in R&D rather than from mainstream scientific research. As such, the policy emphasis should instead focus on encouraging corporate R&D that invigorates the industrial sector.

[104] Danaraj (2011)

[105] Kim and Lee (2015)

[106] Ibid.

In contrast, the concern of Malaysian government policies revolves more around the commercialisation of R&D output produced by government research institutions rather than encouraging corporate R&D[107]. The government does not prioritise the capability of institutions to solve industrial technology problems, although firms are encouraged to undertake contracted research. Unlike East Asian countries, Malaysian government research institutions are not designed to acquire new foreign technology and disperse it to local industries (except MIMOS for a time; more will be discussed below). The provision of such services is important as it may quickly improve the productivity of Malaysian firms as the technologies that they require are likely to have been invented by foreigners. Malaysian firms may need financial assistance to acquire or technically evaluate them. Thus, one of the policies that the government should focus on is encouraging government research institutions to seek appropriate foreign technology and adapt it for domestic use[108]. Additionally, there has been a lack of government institutional research support in rubber gloves, downstream palm oil products and furniture even though they have the highest chance for export growth[109].

Government research institutions have been involved in technology-push policies. MIMOS was established to acquire technology related to the E&E industry through internal R&D and external acquisition. Although MIMOS pursued these goals in its early years, a subsequent change in national leadership also changed the organisation's scope, which is currently less inclined to conduct internal R&D and acquire external technology[110]. MIMOS, as mentioned above, was involved in establishing a research-oriented wafer fabrication plant to stimulate IC design. However, its success has been limited and has not left any significant impact on the growth of the indigenous electronics sector. SIRIM, which, apart from conducting standards certification, has delved into R&D in areas such as automotive technology, industrial instrumentation and electronics, industrial automation, metal production, and others, but their output has not been adopted by industry[111]. These failures of commercialisation lend credence to Lee and Kim's[112] thesis that corporate R&D needs to take the lead for economic success.

R&D collaboration between firms, research institutions and the government has grown more significant in recent years. In 2012, the Malaysian government established Collaborative Research in Engineering, Science and Technology (CREST) to create closer collaboration between the government, universities and industry. The initiative has shown early signs of success in forging closer collaboration between institutions and industry to produce industry-relevant technology, with 74 projects worth RM61 million being approved and commissioned in the initiative's first phase which ended in 2014. CREST requires participating firms to provide partial funding, initially 50% of the total project cost, but this contribution has increased to 64%, which shows firms' interest in funding these R&D investments[113]. However, since a significant number of collaborators are MNCs, this raises the question of who would most benefit from such a collaboration. As shown by Rikap and Flacher[114] in the case of Singapore's university-MNC

[107] Danaraj (2011)

[108] Ibid.

[109] Ibid.

[110] Rasiah (2017)

[111] Danaraj (2011)

[112] Kim and Lee (2015)

[113] Chin et al. (2018)

[114] Rikap and Flacher (2020)

collaboration, the returns are mostly appropriated by the MNCs, yet at the same time MNCs still do not bring in frontier production processes[115].

Several other institutions were also established in the early 1990s, such as the Action Plan for Industrial Technology Development (APITD), which provided grants for chip manufacturers, and the Malaysian Technological Development Corporation (MTDC) to provide venture capital funds. The administration also established Silterra, a semiconductor foundry, in 1995, which was held by Khazanah until they divested in 2019 to a Chinese-Malaysian joint venture. However, even with all these institutional interventions, the E&E industry in Malaysia has not been successful in inducing functional upgrades to higher-value-added sections in the value chain, such as cutting-edge chip design and frontier semiconductor fabrication. Different reasons have been proposed for this failure, such as the lack of talent[116]. Whereas others have blamed continued dependence on foreign firms which only want to conduct low value-added activities in the country, which is encouraged by the ease of access to cheap foreign labour[117]. These two factors are related, but it remains debatable whether access to cheap labour is the cause of the industry being stuck in the low value-added segment of the value chain or its effect. Ultimately, the lack of indigenous success may be due to the absence of a strong policy to foster the growth of large innovation-driven local firms.

4.8 Lack of Big Indigenous Firms in Green Industries

The lack of big domestic businesses willing to invest in developing their own technology in environmental goods and services may also hinder Malaysia's participation in high-value-added segments of green product markets. Malaysian industry may still participate in global value chains of environmental goods as suppliers of global lead firms. However, it is limited to low-value-added segments of GVCs due to the endogenous asymmetry in market structure along the chain, a typical situation encountered by middle-income countries[118]. Malaysian firms participating in the E&E sector, such as Carsem, Unisem, and Globetronics are involved in packaging, assembly and testing, which is traditionally considered a low-value-added section of the GVC[119]. Oligopolistic lead firms at the top can limit markups and value-add by intensifying supplier competition. This lock-in at the low-value-added segment in GVCs is arguably why Malaysia has not graduated faster to being a high-income country[120]. Therefore, efforts to develop green industries should eventually account for plans to develop innovative capabilities among the local industry to avoid being locked in at the low value-added segment of the chain.

As Lee[121] observed, big businesses, typically organised around business groups, can serve as an organisational instrument to facilitate technological innovation and economic catch-up in place of or in tandem with industrial policy. This has historically been demonstrated by Japanese, Korean and now Chinese firms, although their initial growth and transformation into competitive firms was largely due to the government's industrial and competition policies[122]. In a limited

[115] Rasiah and Yap (2019)

[116] Best (2007); Rasiah (2017)

[117] Raj-Reichert (2020)

[118] Milberg and Winkler (2013)

[119] Rasiah (2017)

[120] Tan (2014)

[121] K. Lee (2019)

[122] Amsden (1989); K. Lee (2019); Amsden and Singh (1994)

number of cases absent significant government support, big businesses have the potential to enter new and competitive markets as they can rely on considerable resources to overcome barriers to entry. Such was the case of Samsung when they entered the memory chip business, which they did so on their own accord[123]. The Korean government assumed that Samsung would fail in the venture and did not provide support at first, only doing so at a later stage.

Business groups can share resources with new affiliates entering new markets or lines of business. Firms, as Penrose's[124] resource theory of the firm posits, are a bundle of resources or capabilities. Their growth thus depends on the different kinds and quantity of resources they command and can utilise for that purpose. Resources such as R&D units and brand power are "lumpy" in the sense that they can only be acquired with a minimum investment threshold. These assets are also an inseparable or indivisible input due to their tacit quality, especially knowledge assets since not all knowledge can be transformed into a codified form but rather can only be gained through practical experience. Their possession can give business groups a distinctive advantage over stand-alone firms. Moreover, these intangible assets cannot be acquired in the market, and firms must develop them themselves. Thus, firms that want to enter a new product market would be at an advantage if they were a part of a business group as the cost of building such intangible and indivisible assets can be shared.

Providing access to a pool of funds is a significant advantage afforded by a business group as developing countries tend to have weak external capital markets. Although Malaysia has a more developed capital market than other developing countries, there are still gaps in funding sources to finance investments in new technologies. For example, banks and financial institutions in Malaysia are reluctant to finance green sectors as they lack the knowledge to assess their risk[125]. Moreover, a significant advantage of the business group is that its financial resources may also subsidise initial losses due to high entry barriers and fierce competition when entering new or existing markets. Thus, the business group can "socialise" losses among affiliate firms in the same group and facilitate entry into a new market. Samsung pursued this strategy when it entered the memory chip business. Even though it is now a cash cow, its initial seven years were heavily loss-making and had to be subsidised by the business group[126].

Regardless of the size, firms' capabilities in developing countries at the early stage of catching up tend to be limited. They are unlikely to enter high entry-barrier markets at this stage. Thus, it is important to understand how firms in developing countries can acquire, develop and maintain different capabilities over time to eventually innovate and enter such a market. Teece[127] terms this process of integrating, building and reconfiguring internal and external competencies to address fast-changing environments as dynamic capabilities. Korean big businesses are a useful reference to demonstrate how such a feat was executed under conditions of state support since current big firms started off as resource-poor rent-seekers and diversified opportunistically with no necessary technological relation to existing businesses[128]. A key skill obtained in such diversification and contributing towards more future successes is the "project execution capability", referring to the skills, capabilities or resources to establish and expand operating and

[123] Shin (2017)

[124] Penrose (1959)

[125] Chandran, Baskaran, and Selvarajan (2022)

[126] Shin (2017)

[127] Teece (2007)

[128] K. Lee (2019)

other corporate facilities[129]. These include capabilities such as pre-investment feasibility studies, project engineering, project management, construction, procurement, and start-up of operations[130].

Korean firms such as Samsung underwent three stages of capability development before entering a stage with technological innovation capabilities[131]. Business groups had few competencies in the first stage and followed a rent-seeking strategy. Given those conditions, the firms' competitive position is often determined by how to build, maintain, and take advantage of their relationship with the government, which is responsible for substantial resource distribution. In Korea, this initial stage was facilitated by the government's receipt of US aid that Korean officials distributed to the nascent entrepreneurial class (often in exchange for a not-so-honest demand for campaign contributions)[132].

In the second stage, business groups diversified into related and unrelated industries depending on the profit opportunities provided by industrial policy or market demand. The government supported this stage through subsidised working capital credit for exporting firms, subsidised long-term credit for targeted industries and firms and credit guarantees for foreign borrowing[133]. Importantly, the government also implemented competition policies which improved the performance of these firms. Among these, price controls drove Korean firms to compete on non-price variables such as quality, merit-based subsidy allocation ensured firms competed to improve their productivity and acquire the best talent, and export targets increased production leading to possible Kaldor-Verdoorn growth, investment and productivity feedback effects[134]. The South Korean case has become a paradigmatic example of the combination of appropriate carrots and sticks to generate a competitive advantage.

With diversification already taking place, the third stage potentially sees the emergence of integration benefits from horizontal integration of distantly related sectors or through more sector-specific vertical integration. Compared to outsourcing, these kinds of integration can provide an advantage when externally sourced inputs face market deficiencies and may assist the business group in maintaining high quality, efficient coordination, and punctuality.

Finally, in the fourth stage, the business group has acquired sufficient capabilities to innovate in specific areas of technology and the output is usually represented by new products or patents. The vertical integration in the previous stage is helpful in technology development due to the increased interaction between buyers and sellers that creates learning opportunities. At this stage, the pursuit of technological development and innovation can benefit from the organisational arrangement of the business group where costs of development can be shared and lumpy intangible competencies unavailable in the market, such as R&D capabilities, can be utilised more fully as many affiliates could have access to it. This structure also encourages innovation by permitting a higher level of knowledge spillovers to within-group agents compared to arms-length market relationships among independent firms.

[129] K. Lee (2019)

[130] K. Lee and He (2009)

[131] K. Lee (2019)

[132] Amsden (1989)

[133] Ibid.

[134] Ibid.

Malaysian businesses have never gone through such a development. The problem is not so much that Malaysia has no big businesses. It does. However, it did not evolve from rent-seekers to eventual innovators due to the confluence of economic and social pressures that led to the failure of rents intended for learning and accumulation to create innovative companies[135]. Examples of such failures are the big corporations in heavy industries and nurtured Bumiputera capitalists that ascended in the 1980s under Prime Minister Mahathir's first administration.

During that period, the government encouraged the development of private capitalists, intervening in the market to alter incentives to target sectors believed to be important for industrialisation. There were also practically no Bumiputeras that held large firms, leading to the targeting of Bumiputera capitalists for corporate growth. As such, the government provided rents for capital accumulation to a group of Bumiputeras through preferential treatment in the form of licenses, privatised projects and directly negotiated contracts in the hopes of turning them into dynamic entrepreneurs. In this way, they would grow their businesses into well-diversified conglomerates[136]. The government also allocated rents for learning, for example, by protecting the domestic automobile industry and through vendor development programs to provide contracts for local companies as part of local content requirements.

However, these Bumiputera conglomerates financially collapsed during the 1998 Asian Financial Crisis. They were bailed out, and their holdings were renationalised, signifying the failure of rents for accumulation[137]. The failure of accumulation rents is also epitomised by the unwillingness and inability of Diversified Resources Berhad (DRB), the owner of Malaysia's first national car, Proton, to continue financing Proton's R&D due to more intense competition and high debt levels. DRB instead ventured into more protected, non-tradable sectors following Proton's renationalisation[138]. Proton's failure also highlighted the tension between the imperatives of accumulation and accommodating powerful social groups with rents for appeasement. Proton's attainment of success partly hinged on the efficiency of Bumiputera vendors from which they were obliged to obtain 80% of their components. These vendors are part of the intermediate Bumiputera class that increasingly comprised most of the former ruling party's (UMNO) membership. Individual UMNO leaders distributed the rents to their supporters through patron-client relationships and the increasing factionalisation of the party made it difficult for leaders to discipline rent recipients [139]. Such a scenario blurs the distinction between rents for learning and rents to accommodate powerful social groups. Proton's failure to develop technology, accompanied by continuing high costs associated with local content requirements, meant it continued to be uncompetitive. Proton's case symbolised the general failure of industrial upgrading and the state's incapability to ensure firms improve their efficiency through the rents for learning.

Malaysian capitalists found themselves in an increasingly competitive landscape in the 1990s resulting from external liberalisation pressure from the WTO, the Association of Southeast Asian Nations and Asia-Pacific Economic Cooperation. Developing countries had entered an era of "compressed development" forced upon them by international organisations and agreements

[135] Tan (2014); (2018); (2021); Sen and Tyce (2019)

[136] Sloane (1998)

[137] Tan (2007)

[138] Tan (2007); (2014)

[139] Tan (2007)

dominated by the leading geopolitical power the US and its allies[140]. A vital characteristic of this era is the shrinking of policy space resulting from such agreements. Thus, their lack of competitiveness in manufacturing and the forced removal of incentives and tariffs pushed Bumiputera capitalists towards more protected, unproductive and non-tradable activities, such as construction, real estate and share trading. With the state's lack of capacity to discipline capitalists the allocation of rents shifted towards these activities and away from manufacturing[141].

The existence of powerful domestic social groups preferring unproductive rents is not the only reason Malaysian business groups have not developed innovative capabilities compared to South Korea. One key advantage South Korean business groups had was the era in which its most crucial capability-building efforts occurred. Samsung, for example, had completed the first three stages of business group capability development mentioned above by the 1990s[142] and possessed technological innovation capabilities by the 1990s and 2000s (e.g. they were ahead of Japanese firms in the 16MB DRAM market in the 1990s, which before that the Japanese were incumbents in the DRAM market)[143], before the compressed development era under the WTO. In Malaysia, conversely, most family-owned business groups, Bumiputera or otherwise, were rent-seeking and just beginning to build up capabilities in the 1980s and they were only going through the diversifying stage in the 1990s. Even non-Bumiputera business groups, such as the Hong Leong Group which entered the E&E industry in the 1970s, still did not have high value-added technological innovation capabilities by the 1990s, a situation which persists until today. The lack of infant industry protection and the shrinking of policy space in the compressed development era, coupled with Malaysian firms' limited capabilities, prevented them from entering new markets centred on technological innovation with high entry barriers. Thus, they would be discouraged from investing present resources to acquire these new capabilities, especially when the state has less room to support them. Meanwhile, Korean business groups already possessing innovative capabilities by the 1990s could compete without government help.

[140] Whittaker et al. (2020)

[141] Tan (2018)

[142] K. Lee and He (2009)

[143] Shin (2017)

5. CONCLUSION AND POLICY RECOMMENDATIONS

Malaysia has developed green-related industries over the years through successive phases of industrial policies to promote import substitution, export orientation, and greening of the economy. These include the E&E industry, the solar PV industry and resource-based industries related to petroleum, palm oil, and rubber. All of them contribute significantly to Malaysia's exports. Free-trade zones and various tax incentives have been key in attracting E&E MNCs to establish factories since the 1970s while their ex-employees have gone out to establish their own local E&E firms, assisted by tax incentives. Similar incentives were also important in attracting and establishing the FDI-dominated solar PV industry, in addition to green industry-specific policies such as NEM and GTFS. Malaysia's resource-based industries, on the other hand, are dominated by local firms, whose growth was driven by various fiscal incentives. Importantly, however, they also received support through targeted duties to encourage more processed exports, protection to develop local firms, trade promotion efforts and fruitful R&D policies.

These green-related industries in Malaysia suffer from several problems. In general, they suffer from the problem of moving up the value chain, a common problem in middle-income countries. Several reasons identified and considered above include deindustrialisation, constrained industrial policy and fiscal space, talent issues, weaknesses in industry support institutions and the lack of innovation-ready big indigenous firms. Deindustrialisation erodes the country's technological capabilities regarding expertise and variety, leading to a lower stock of knowledge that could be used and combined for innovation in green industries. Industrial policy is constrained by multilateral agreements such as WTO and FTAs, and caution over fiscal deficits limits the scope and volume of state support for local firm development. The aspiration to move into higher value-added R&D requires more talent to be produced, yet at the same time, the current talent produced is underemployed. The government has established R&D institutions, but they have not been helpful enough in transferring foreign technology and facilitating its adoption by local firms.

In contrast, government-developed technologies do not address industries' concerns and face commercialisation problems. Local big businesses are needed to drive technological upgrading as foreign firms are unlikely to establish frontier R&D subsidiaries in developing countries. Although Malaysia possesses sizable business groups, they have not developed technologically oriented industries due to the state's lack of power to direct influential social groups towards that goal and Malaysia's short timespan for firms to develop innovative capabilities before international agreements (e.g. WTO and WTO+ FTAs) severely constrained policy space. All these challenges contribute to the inability of Malaysian industries, generally, and green industries specifically, to become technologically innovative and move into high-value-added segments in value chains.

Another challenge in Malaysia's green industrialisation arises from FDI-oriented policies that are too mitigation-centric without sufficient attention to unavoidable climate adaptation needs. In the case of energy transition projects, the government may still incur considerable costs with public financing since the returns may not be attractive enough for private capital. Additionally, such infrastructure-intensive decarbonisation is insufficient to induce industrial upgrading without addressing related issues in innovative big business development.

Importantly, the pursuit of green industrialisation may also continue to marginalise groups such as the Orang Asli. The pursuit of some green-related industries, such as palm oil, may, in fact, risk their current livelihoods and homes due to forest destruction. Many of their basic needs, such as income levels, healthcare, access to education and rights to their ancestral land, are not yet being met with current policies. This contributes to a vicious cycle of poverty and low levels of education, which excludes them from participating in knowledge-centric, high-skilled segments of green sectors. While a relatively small population, they share socioeconomic inclusion problems in common with marginalised groups across the country. Equitably resolving them can help make green industrialisation efforts more inclusive, which is an objective under Mission Four of the NIMP.

This paper closes with several policy suggestions.

1. **Industrial policies to address deindustrialisation -** Industrial and innovation policies that address gaps in current industrial capabilities can mitigate Malaysia's deindustrialisation. Malaysia's deindustrialisation occurred due to strong competition from lower-cost countries and from being technologically inferior to firms in advanced countries. Where the industry is not yet sunsetting, or capabilities within the industry could be useful for future industries, the government can use available policy tools under current international agreements to help firms upgrade technologically. Additionally, policy space may have been freed with the US Appellate Body blockage in WTO rendering WTO rulings not legally enforceable[144]. Given possible fiscal constraints, fiscally light tools such as trade protection should be considered. However, the fiscal constraint may not be as limiting as assumed, as discussed below. Tools such as local content requirements can be implemented indirectly and do not trigger WTO prohibitions as Proton's case shows. However, competition policies should be introduced to prevent firms from being uncompetitive, such as export targets and making subsidies conditional on competitive performance. It is beyond the scope of this paper to discuss the appropriate combination of policy tools to be deployed in respective industries.

2. **Expand and upgrade technology-related state-owned enterprises or implement policies to encourage firms to move into technology-centric industries to absorb skilled labour -** Reconciling the problem of talent undersupply to enter knowledge-intensive high-value-added activities with presently high rates of skill-related underemployment requires establishing firms that absorb currently produced graduates in STEM. If current prospects for employment are dim, students will avoid studying STEM in university, shrinking the talent supply. This can be addressed through state-owned firms, which have been tried before in the E&E industry (Silterra). However, it failed to expand and upgrade due to a lack of capital and ambition and thus could not continuously absorb talent. Any future attempts at such a venture require a greater willingness by the state to take risks. At the same time, if the problem of lack of competition arises, it can be mitigated by imposing conditionalities on the firm and adhering to meritocratic standards in hiring and firing, especially the leading executives. Another way to increase firm creation is by encouraging private local firms to enter the business through trade and industrial policies such as subsidies, procurement and managed competition, especially

[144] Hopewell (2024)

those already operating in a related business and might already have relevant capabilities. This method encourages multiple entries in the sector and avoids problems of a lack of competition, a common problem when relying on a single state-owned enterprise to drive the industry.

3. **Expand taxes or consider intelligent use of monetary financing to overcome fiscal constraints -** To address shrinking fiscal space, new taxes may be imposed, but fiscal constraints might be less severe than perceived. Modern Monetary Theory (MMT)[145] suggests countries with monetary sovereignty—those issuing their own currency—can finance deficits by printing money, with inflation being the key risk rather than a lack of funds. However, this approach must be adapted cautiously for developing countries, where monetary sovereignty is limited by foreign demand for local currency assets[146].
   Developing countries face risks of currency crashes from foreign sell-offs of local assets. Mitigation strategies include managing foreign exchange reserves and maintaining a current account surplus. Long-term resilience requires reducing reliance on foreign investors for local currency financing.
   Inflation risks in developing countries are more pronounced due to capacity constraints and import reliance. Increased government spending may strain resource limits, leading to inflation or currency devaluation if higher demand is met by imports. Thus, monetary financing policies must be strategic, prioritising trade balance, currency stability, and inflation control by strengthening export-oriented industries and developing self-sufficient industrial capacity. Development banks may be a useful tool to support these objectives.

4. **Reorient R&D policy to encourage firm innovation with universities as support and change the role of government research institutions to assist global technology transfer to firms -** University research institutions' weaknesses in supporting the creation of innovative industries can be addressed by orienting research policies towards industries' needs rather than solely focusing on mainstream science. However, this requires the establishment of local firms that are interested in entering technology-based segments first. Only then can university research be guided by industry to assist them in their innovation needs. Additionally, in the case of government research institutions, their role could be changed to scouting and assessing available technologies and know-how globally and facilitating their dispersion amongst local firms. Developing countries can leverage existing technologies without reinventing the wheel to establish capabilities in their local firms. These technologies, and more importantly, the know-how learned from foreigners, can act as important foundations for firms to begin innovating[147].

5. **Industrial policy to encourage the emergence of large firms that can innovate -** The industrial, trade and competition policy to prevent deindustrialisation discussed above may also facilitate the creation of big local firms with innovation capabilities. However, there is no easy solution to rein in powerful social groups to use allocated rents productively when ruling coalitions are vulnerable. A ruling coalition conducive to

[145] Wray (2024); Kelton (2020)

[146] De Paula, Fritz, and Prates (2017)

[147] Mathews and Cho (2000); Chung and Lee (2015)

development requires a ruling party that is not easily threatened by competing political forces and has strong implementation capabilities that powerful social groups cannot easily dismiss. Influential political parties and powerful social groups must agree to pursue developmental goals. Overarching industrial policies and policymakers must understand the qualitative differences in development outcomes from an FDI-focused manufacturing policy and one focused on raising innovative large local firms.

6. **Greater inclusion of climate adaptation policies in future climate policies -** Future iterations of green industrial policies must not only focus on climate mitigation to attract foreign investment but must also substantially focus on climate adaptation policies since an unavoidable minimum 1.5°C degree of global warming is locked in, likely higher given disappointing outcomes in climate finance following the COP29 climate summit in November 2024[148].

7. **Resolve the basic needs of Orang Asli and marginalised groups and implement specific affirmative actions so that they can benefit from job opportunities related to green industrialisation -** To provide opportunities for Orang Asli and structurally marginalised groups to benefit from green industrialisation, the state must resolve their longstanding issues related to poverty, low education levels and poor health. These three conditions likely cyclically interact with each other, with poor outcomes in one condition reinforcing poor outcomes in others and themselves. Without proper education, Orang Asli will continue to be excluded from modern development. State and federal governments must improve their access to education and healthcare by improving infrastructure, locating it nearer to Orang Asli settlements, and increasing the funding and staff that provide these services to the Orang Asli. Economic programs to raise their incomes must also respect their rights, especially rights to their land and way of life. It should also be done with their prior informed consent and without coercion.

[148] Yin Shao Loong and Nurul Farhana Abdul Shukor (2024)

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