MINISTRY OF
INVESTMENT, TRADE AND INDUSTRY

Chemical Industry Roadmap 2030

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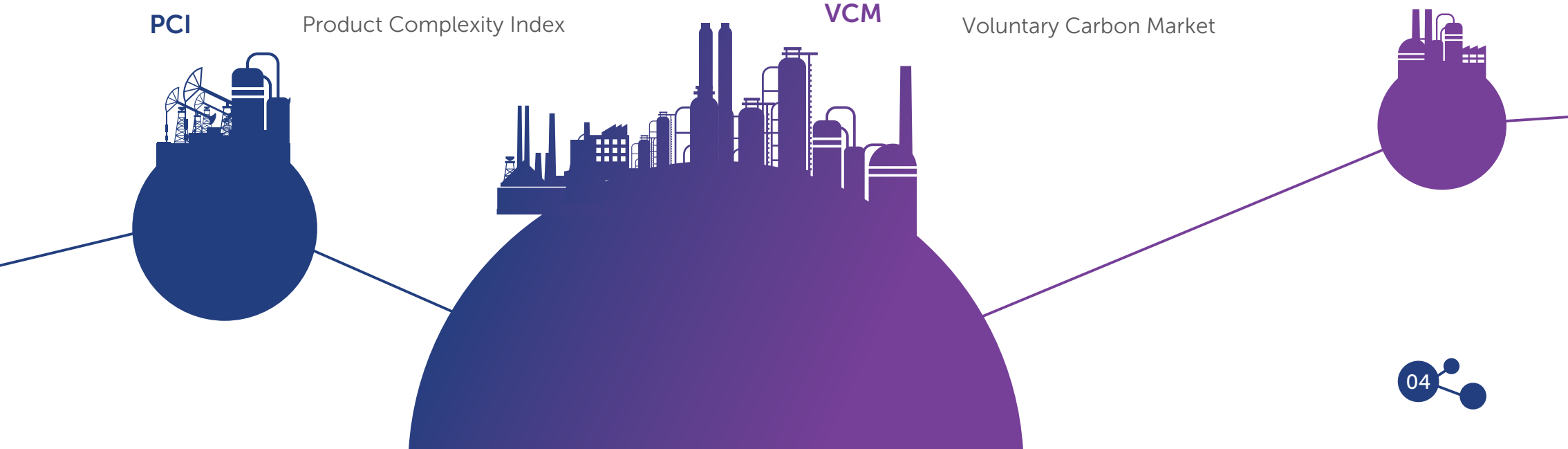
Glossary

ABS	Acrylonitrile Butadiene Styrene
APAC	Asia Pacific
CAGR	Compound Annual Growth Rate
CAPEX	Capital Expenditure
CFRP	Carbon-fibre-reinforced-polymer
CIR	Chemical Industry Roadmap
CNT	Carbon Nanotubes
CTL	Composite Testing Lab
DDI	Domestic Direct Investments
DETS	Domestic Emissions Trading Scheme
DICP	Domestic Investment Coordination Platform
EFF	Environmentally Friendly Fertilisers
EPR	Extended Producer Responsibility
EV	Electric Vehicle
FDI	Foreign Direct Investment
FTA	Free Trade Agreement
GDP	Gross Domestic Product
GITA	Green Investment Tax Allowance
GTFS	Green Technology Financing Scheme
GVA	Gross Value Added
HDPE	High-density Polyethylene

IC	Integrated Circuit
NIMP2030	New Industrial Master Plan 2030
IoT	Internet of Things
IR4.0	Industry Revolution 4.0
KTPA	Thousand Tonnes Per Annum
LCP	Liquid Crystal Polymers
LDPE	Low-density Polyethylene
MAREA	Malaysia Recycling Alliance
MCCP	Malaysian Chemical Collaborative Platform
MF	Melamine Formaldehyde
MSPO	Malaysian Sustainable Palm Oil
MTPA	Million Tonnes Per Annum
MVA	Manufacturing Value Added
NEP	National Energy Policy
NIP	National Investment Policy
PCB	Printed Circuit Board
PCI	Product Complexity Index
PEEK	Polyether Ether Ketone
PET	Polyethylene Terephthalate
PF	Phenol Formaldehyde
PIC	Person In Charge
PPS	Polyphenylene Sulphide
PTFE	Polytetrafluorethylene
PVA	Polyvinyl Alcohol
PVC	Polyvinyl Chloride
R&D	Research and Development
RMK-12	Twelfth Malaysia Plan
RPT	Residence Pass Talent
RSPO	Roundtable on Sustainable Palm Oil
SEA	Southeast Asia
SME	Small and Medium Enterprises
TVET	Technical Vocational and Educational Training
UF	Urea Formaldehyde
VCM	Voluntary Carbon Market



Foreword

The Ministry of Investment, Trade & Industry (MITI) is pleased to present the first dedicated Chemical Industry Roadmap 2030 (CIR2030), developed in collaboration with the Malaysian Investment Development Authority (MIDA), PETRONAS, Chemical Industries Council of Malaysia (CICM) and other key industry stakeholders.

As one of the target growth sectors in Malaysia's manufacturing industry, the CIR2030 is key towards the orderly and systematic development of the chemical industry. This is to ensure that increased investments in this sector will create not only the right type of employment but also a stronger commitment to Malaysia's Environment, Social and Governance (ESG) and sustainability targets.

The CIR2030 will complement and deliver on the targets of key national policies such as the Twelfth Malaysia Plan (RMK-12), the National Investment Policy (NIP), and the New Industrial Masterplan 2030 (NIMP2030). MITI has envisaged the chemical industry to emerge as a substantive engine of growth for the Malaysian economy over the next decade. To that end, the focused implementation of the CIR2030 is expected to add RM40 billion cumulative incremental value to the industry's Gross Value Add (GVA), estimated to be equivalent to 4.5% of our gross domestic product (GDP) by 2030, from the current 3.4%.

Subsequently, this anticipated contribution by the chemical industry is expected to increasingly grow within Malaysia's manufacturing sector, which continues to display its resilience in the face of many global challenges. Manufacturing was still the second largest contributor to the nation's GDP, accounting for about 24% in 2022. Its trade performance was equally commendable in 2022, with the export figures reaching RM1.6 trillion, exceeding RMK-12's projection for 2025 by 24%, and three years ahead of target. Employing over 2.6 million workers, or 17.1% of Malaysia's total workforce, the manufacturing sector is also poised to increase its contribution to the country's GDP through the upcoming NIMP2030.

There are massive opportunities domestically and globally, with Asia Pacific forecasted to be one of the fastest-growing regions for the chemical industry from 2023 – 2030. For Southeast Asia alone, the chemical industry is forecasted to grow from USD239 billion in 2022 to USD448 billion by 2030. The CIR2030's broad strategy is to capture these growth opportunities by ensuring the Malaysian chemical industry's proper integration and development, as well as its enhanced global competitiveness and sustainability. I believe the CIR2030 will serve as an impetus for the chemical industry to be developed as a significant engine of growth for the Malaysian economy over the next decade.

Finally, I would like to express my appreciation to all parties who have provided their valuable input and support in formulating this roadmap. The success of CIR2030 will require active contribution and collaboration from all chemical industry stakeholders. I look forward to the cooperation of all stakeholders to work together with the Government to implement the strategies and initiatives towards realising the CIR2030 aspirations.

TENGKU DATUK SERI UTAMA ZAFRUL TENGKU ABDUL AZIZ

Minister of Investment, Trade and Industry

Foreword

The Chemical industry remains amongst Malaysia's most valuable strategic industries, contributing 6% to the gross domestic product (GDP) in 2022 and employing 292,969 workers or 12.5% of the 2.6 million total manufacturing employment. The chemical and petrochemical sector alone is the third-largest contributor to Malaysia's trade of manufactured goods, with strong forward linkages to other sectors such as electrical and electronics, automotive, agriculture, and pharmaceutical. The industry has experienced a substantial shift in dynamics in recent years, catalysed by key global megatrends, and structural shifts brought about by COVID-19, which introduced changes in the demand patterns. The Chemical industry is also significantly exposed to the growing focus on Environment, Social, and Governance (ESG) in investment decisions, driving the industry to quickly adapt to remain globally competitive.

With this in mind, MITI has taken the proactive measure to develop this Chemical Industry Roadmap 2030 (CIR2030). This roadmap, in essence, outlines 5 aspirations, 11 priority segments, 22 strategic focus areas, and 10 key enablers for Malaysia to embark on a journey that will transform the chemical industry landscape over the next decade. The CIR2030 is positioned to move the industry towards producing higher value-add products and segments, which will substantially increase the competitiveness of our downstream industries. For example, one of the strategic focus areas of the Roadmap is to become leading manufacturer of Integrated Circuit packaging chemicals in Southeast Asia. This will strengthen the integration with the domestic semiconductor industry in supporting the larger global supply chain of the electrical and electronics sector.

Another significant impact that we expect to realise with the Roadmap is the ability for our domestic players to embrace sustainability and strengthen its commitment to the ESG goals. For example, a mandate that plastic packaging should include at least 15% recycled content will be promoted and the use of biodegradable plastics will also be encouraged. Both strategies will allow the country to achieve a 50% recycling rate for plastics by 2030.

All these opportunities are laid down upon us, both the Government and the industry players, to act proactively towards achieving the aspirations of increasing the chemical industry's value-add, enhancing industry integration, and improving global competitiveness and sustainability in production at the same time.

I would like to extend my appreciation to all stakeholders for working together with MITI. I hope the commitment and support will continue as we roll out the initiatives to achieve the objectives and targets that we have collectively identified in the Roadmap.

DATUK SERI ISHAM ISHAK
Secretary General

Acknowledgement

The Chemical Industry Roadmap 2030 (CIR2030) is developed and harmonised in line with other key national policies and strategies such as the Twelfth Malaysia Plan (RMK-12), the National Investment Policy (NIP), the New Industrial Masterplan 2030 (NIMP2030), Environmental Sustainability in Malaysia (2020-2030), as well as various other industry roadmaps that involve the chemical industry in the value chain.

The CIR2030 is co-created in collaboration with multiple stakeholders, spanning ministries, government agencies, industry associations, industry players, topic experts, and other stakeholders. We thank the active participation of all parties in jointly developing the CIR2030.

Ministries

1. Ministry of Agriculture and Food Security (KPKM)
2. Ministry of Education Malaysia (MOE)
3. Ministry of Energy and Natural Resources, Environment and Climate Change (NRECC)
4. Ministry of Plantation and Commodities (KPK)
5. Ministry of Human Resources (MOHR)
6. Ministry of Science, Technology & Innovation (MOSTI)
7. Ministry of Transport Malaysia (MOT)
8. Ministry of Youth & Sports (KBS)
9. Ministry of Public Works Malaysia (KKR)
10. Ministry of Local Government Development (KPKT)

Government Agencies

1. Academy of Sciences Malaysia (ASM)
2. Department of Environment (DOE)
3. Department of Occupational Safety and Health (DOSH)
4. Malaysian Agricultural Research and Development Institute (MARDI)
5. Malaysia Automotive Robotics and IoT Institute (MARii)
6. Malaysia External Trade Development Corporation (MATRADE)
7. Malaysian Green Technology and Climate Change Corporation (MGTC)
8. Malaysian Palm Oil Board (MPOB)
9. Malaysian Rubber Board (MRB)
10. SIRIM Berhad

Key Collaborators

1. Malaysian Investment Development Authority (MIDA)
2. Petroliam Nasional Berhad (PETRONAS)
3. Boston Consulting Group (BCG)

Acknowledgement

Universities & Research Institutions

1. Universiti Putra Malaysia (UPM)
2. Collaborative Research in Engineering, Science and Technology Centre (CREST)
3. NanoMalaysia Berhad

Associations

1. Chemical Industries Council of Malaysia (CICM)
2. Construction Industry Development Board (CIDB)
3. Federation of Malaysian Fashion, Textile and Apparel (FMFTA)
4. Fertilizer Industry Association of Malaysia (FIAM)
5. Federation of Malaysian Manufacturers (FMM)
6. Malaysia Aerospace Industry Association (MAIA)
7. Malaysia Automotive Association (MAA)
8. Malaysia Green Building Council (malaysiaGBC)
9. Malaysia Semiconductor Industry Association (MSIA)
10. Malaysian CropLife And Public Health Association (MCPA)
11. Malaysian Oleochemical Manufacturers Group (MOMG)
12. Malaysian Paint Manufacturers Association (MPMA)
13. Malaysian Petrochemical Association (MPA)
14. Malaysian Plastics Manufacturers Association (MPMA)
15. Malaysian Plastics Recyclers Association (MPRA)
16. Malaysian Rubber Gloves Manufacturers Association (MARGMA)
17. Malaysian Rubber Products Manufacturers Association (MRPMA)
18. FMM - Malaysian Cosmetics and Toiletries and Cosmetics Industry Group (FMM-MCTIG)
19. Master Builders Association Malaysia (MBAM)
20. National Farmers Organisation (NAFAS)
21. Real Estate & Housing Developers' Association (REHDA)
22. Semiconductor Fabrication Association Malaysia (SFAM)
23. The Electrical and Electronics Association of Malaysia (TEEAM)

Industry Participants

1. Agriculture Chemicals (M) Sdn Bhd
2. Allnex Malaysia Sdn Bhd
3. Ancom Bhd
4. Arkema Coating Resins Malaysia Sdn Bhd
5. Asta Chemicals Sdn Bhd
6. BASF (Malaysia) Sdn Bhd
7. CCM Chemicals Sdn Bhd
8. CEEBEE Chemicals Sdn Bhd
9. Chromaflo Technologies (M) Sdn Bhd
10. Composites Technology Research Malaysia (CTRM)
11. Dow Chemical (Malaysia) Sdn Bhd
12. Emery Oleochemicals (M) Sdn Bhd
13. FGV Holdings Sdn Bhd
14. First Win Marketing Sdn Bhd
15. FPG Oleochemicals Sdn Bhd
16. Henkel (Malaysia) Sdn Bhd
17. Hextar Sdn Bhd
18. Horizon Safety Sdn Bhd
19. Ingredients Plus Sdn Bhd
20. IOI Oleochemical Industries Berhad
21. Kaneka (Malaysia) Sdn Bhd
22. KC Chemicals (M) Sdn Bhd
23. KL-Kepong Oleomas Sdn Bhd
24. Lien Huat Group Sdn Bhd
25. Lotte Chemical Titan Sdn Bhd
26. MCI PAINT Sdn Bhd
27. Natural Oleochemicals Sdn Bhd
28. Nippon Paint (M) Sdn Bhd
29. Nufarm Malaysia Sdn Bhd
30. Optimistic Organic Sdn Bhd
31. Petrochemicals (M) Sdn Bhd
32. Polyplastics Asia Pacific Sdn Bhd
33. Pong Codan Rubber (M) Sdn Bhd
34. Poratha Corporation Sdn Bhd
35. Saiko Rubber (M) Sdn Bhd
36. Schaefer Kalk (Malaysia) Sdn Bhd
37. Seamaster Paint (Malaysia) Sdn Bhd
38. Safic-Alcan Necarbo (Asia) Sdn Bhd
39. Sumisaujana TCM Chemicals Sdn Bhd
40. Synthomer Sdn Bhd
41. Toray Plastics (Malaysia) Sdn Bhd

Preface

This report is developed with the aim of providing a practical, concise, and easily referenced roadmap. Additional details supporting this report can be referenced through supplementary documents, with extensive deep dives into the strategy development for each of the 11 priority sub-segments, as well as the enablers to propel the chemical ecosystem in Malaysia. The digital copy of these supplementary documents can be obtained from the Ministry of Investment, Trade and Industry (MITI).

Executive Summary

What is the Chemical Industry Roadmap?

The Chemical Industry Roadmap 2030 (CIR2030) represents the guiding industrial roadmap for the chemical sector, encompassing a ten-year time horizon from 2021 to 2030. It sets out the vision for the chemical industry as a continued engine of growth for the Malaysian economy over the next decade, outlining the goals and socio-economic benefits it aims to deliver for the rakyat.

The CIR2030 is positioned to propel the chemical industry in increasing its value contribution to the Malaysian economy, driving growth in key economic indicators such as gross domestic product (GDP), investments (FDI and DDI) and employment, as well as strengthening its commitment to sustainability.

The CIR2030 is developed and harmonised to work in tandem with other key national policies such as the Twelfth Malaysia Plan (RMK-12), the National Investment Policy (NIP), and the New Industrial Masterplan 2030 (NIMP2030), as well as other key policies such as the Environmental Sustainability in Malaysia (2020-2030) by the Ministry of Natural Resources, Environment and Climate Change (NRECC). It is founded on underlying principles of sustainability, technology and innovation, and integration with downstream as key drivers for success.

Why do we need a Chemical Industry Roadmap now?

This is Malaysia's first dedicated Chemical Industry Roadmap, and it is delivered at a time of utmost need for the industry. The nation is facing a critical juncture for Malaysia's chemical sector, as global forces and domestic ambitions define an important crossroads in the industry's evolution. Analysis of existing and emerging industry trends, compounded by increased scrutiny on industry operations in light of measures such as the United Nation's Sustainable Development Goals (SDG) 2030 and the Environment, Social and Governance (ESG) principles, mark a need for long-term strategic vision.

This landscape of transformation is framed by an ongoing energy transition and restructuring of global and national energy policies that directly impact the operations of the chemical industry. It is clear that a long-term strategic roadmap is needed in order to identify key gaps and opportunities within the chemical industry and provide a sustainable and value-adding path forward.

Acting quickly is a key imperative, as there is a clear window of opportunity for Malaysia to capitalise. Investors from other geographies are actively looking to invest in Southeast Asia to satisfy a growing need for chemicals in the region. Malaysia should seek to capture these investments to the benefit of its own national chemical industry.

Strategic focus for CIR2030

The CIR2030 has five stated aspirations:

1. **Increase the value add from building blocks** through diversification into higher value-add products such as specialty chemicals.
2. **Enhance industry integration** between upstream chemical production and downstream industries, building local advantage and resilience.
3. **Increase competitiveness of the chemical industry** to improve export potential, while positioning Malaysia as a strong chemical hub within the Asia Pacific (APAC) region.
4. **Improve the sustainability of the industry** from production processes to end product use, supporting Malaysia's overall climate ambitions to reduce the carbon intensity of the economy, and enhance the socio-economic contribution of the chemical industry to the Malaysian economy.
5. **Introduce new technology** to advance the state of the overall chemical industry, creating a large base of high-skilled jobs.

To achieve these aspirations, 11 chemical sub-segments have been prioritised across three categories: base chemicals and intermediates; plastics and polymers; and specialty chemicals, as seen in the figure below. The diversity of prioritised sub-segments across the chemical value chain, as well as its use cases (i.e., covering both local consumption and exports) ensures portfolio resilience amidst changing megatrends and economic disruptions.

Summary of priority of sub-segments

Base chemicals & intermediates

1. Fertilisers
2. Oleochemicals
3. C1 Intermediates

Plastics and polymers

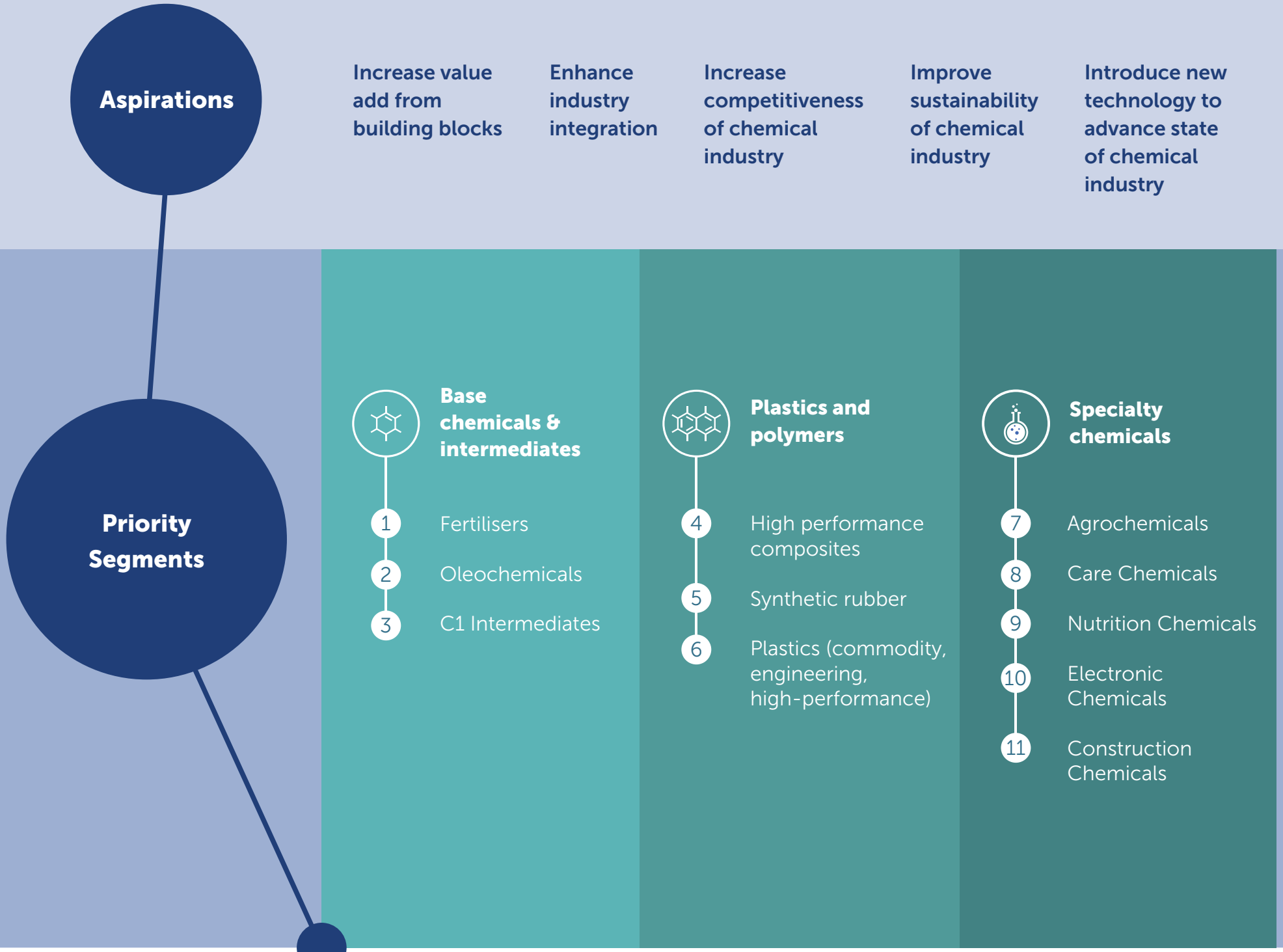
4. High performance composites
5. Synthetic rubber
6. Plastics (commodity, engineering, high-performance)

Specialty chemicals

7. Agrochemicals
8. Care Chemicals
9. Nutrition Chemicals
10. Electronic Chemicals
11. Construction Chemicals

Within the 11 priority sub-segments, strategic focus areas were then identified to further grow these sub-segments and help achieve the CIR2030 aspirations. To support these strategic focus areas, 10 enablers have been developed across four broad levers of policy and incentives; capabilities and technology; infrastructure; and sustainability. The strategic framework for the CIR2030 is illustrated below:

CIR2030 Strategic Framework



Strategic Focus Areas

- Increase local production of Environmentally Friendly Fertilisers (EFFs)
- Modernise current fertiliser manufacturing capabilities to be more productive and sustainable by leveraging new technologies
- Strengthen play in basic oleochemicals
- Increase share of specialty oleochemicals
- Boost sustainability of oleochemicals value chain
- Increase production of acetic acid derivatives to serve growing markets in Southeast Asia and Asia Pacific

- Develop composite manufacturing capabilities and competitiveness in pre-pregs/fabrics
- Develop fibres and resin precursors to allow composites backwards integration
- Develop local synthetic rubber capabilities
- Improve the circular economy for synthetic rubber with focus on tyres and gloves
- Diversify more into engineering plastics
- Establish Malaysia as a bioplastics hub
- Improve circular economy through new recycling technologies
- Selective expansion of commodity plastics production to satisfy regional demand

- Develop niche expertise in biopesticide technology
- Increase self-sufficiency in vegetables seeds
- Leverage oleochemical building blocks to expand into key personal care ingredients
- Leverage palm-related building blocks to further expand capacity to become one of the leading emulsifier hubs in Asia
- Expand methionine production capacity to maintain regional competitiveness and emerge as leading methionine exporters in APAC
- Become a leading manufacturer of IC packaging chemicals in Southeast Asia

Enablers

1. **Targeted chemical investment campaign**
2. **Ease of trade**
3. **Adoption of modernised operations**
4. **Enhanced capabilities to innovate and commercialise tech**
5. **Large base of skilled labor**
6. **Infrastructure improvements**
7. **Industrial parks**
8. **Regulatory framework for circular economy**
9. **Sustainability incentives for operations and innovations**
10. **Value chain consortia**

Enablers and initiatives for CIR2030

To achieve the ambitions of the CIR2030, 24 initiatives across the 10 enablers were detailed as presented in the illustration below. The CIR2030 strongly emphasises structural improvements in the form of improved collaborative mechanisms and enhanced governmental focus with strong regulatory and policy support, in addition to incentives to spur the industry in the formative years of CIR2030 implementation.

The 10 key Enablers will be delivered through 24 supporting initiatives

	Enablers	Initiatives
Policies & incentive	1 Targeted chemicals investment campaign	**1.1** Enhance chemicals investment portfolio to support chemical focus areas **1.2** Encourage domestic investments of key industry players into chemical adjacencies
	2 Ease of trade	**2.1** Establish FTAs with key export markets to boost competitiveness of domestic products; introduce expedited product approval process for agrochemical exports
	3 Adoption of modernised operations	**3.1** Establish innovation acceleration team to assist chemical players in modernising and adopting IR 4.0 technologies **3.2** Enhance financing support for adoption of sustainable technologies in operations **3.3** Increase private participation of technology providers (IR4.0, automation) in chemicals industry
Capabilities & Technology	4 Enhanced capabilities to innovate and commercialise tech	**4.1** Setup a Chemical Collaborative Platform (CCP) to create an ecosystem for cutting-edge research and promote commercialisation **4.2** Enhance R&D grants and reinvestment allowances for companies establishing new technologies, circular business models, and bio-based manufacturing **4.3** Setup a technical committee to govern and advise on technical standards for emerging technology
	5 Large base of skilled labor	**5.1** Review and update TVET and higher education training, relevant to industry needs **5.2** Ensure inclusion of performance criteria in evaluation of TVET contracting **5.3** Enhance chemical TVET apprenticeship quality assurance **5.4** Expand Residence Pass – Talent program to ease entry of foreign skilled labour

Enablers		Initiatives
Infrastructure	6 Improved infrastructure	**6.1** Introduce Extended Producer Responsibility (EPR) to improve end-life waste management for chemical products **6.2** Increase testing capabilities for chemicals intermediates and chemical products **6.3** Ensure adequate growth of chemical waste management facilities
	7 Industrial parks	**7.1** Improve chemical parks proposition holistically to attract foreign participation
Sustainability	8 Regulatory framework for circular economy	**8.1** Introduce mandate for plastic packaging to utilise increasing amounts of sustainable materials (biodegradable bioplastics or recycled plastics) **8.2** Implement emissions pricing mechanisms for the chemical sector **8.3** Enhance sustainable plastics and synthetic rubber labels for end-consumer products with clear standards
	9 Sustainability incentives for operations and innovations	**9.1** Develop digital platform to create circular economy market for local waste **9.2** Establish education support and best-practice guidance for chemical industry businesses to implement sustainability measures **9.3** Provide support for new technologies and innovative business models in recycling and production of end products with bio-based chemicals and recycled plastics
	10 Value chain consortia	**10.1** Establish sustainability consortia with businesses, knowledge institutes, NGOs and ministries for plastics, synthetic rubber, and oleochemicals

Implementation and next steps

The timely implementation of these initiatives is vital to enable Malaysia to unlock the greatest possible value from its chemical industry ambitions while maintaining a comparative advantage against regional peers. A dedicated governance team and task force—complete with details of key activities, milestones, KPIs, roles and responsibilities—has been established through a four-tiered governance structure to ensure that these enablers and respective initiatives are tracked, monitored, and implemented on time and that the aspirations laid out by CIR2030 are met.

Methodology

The CIR2030 is developed across six key steps, undertaken over a period of five months from June 2021 to October 2021.

The CIR2030 development process involved ongoing engagement with industry and public stakeholders to leverage expert views and insights. Throughout the process, close collaboration was established with relevant ministries, government agencies, associations, industry organisations, and academia to ensure the robustness of identified strategies. Key national roadmaps were referenced throughout, particularly the RMK-12, NIMP2030 and NIP, as well as other critical economic roadmaps such as NRECC's Environmental Sustainability in Malaysia 2020-2030 Roadmap to ensure complementary synergy that would contribute to sectoral end goals.


Step 1
Megatrends and chemical trends review
Step 2
Baseline of Malaysia's chemical sector
Step 3
Aspiration setting for CIR2030
Step 4
Market assessment
Step 5
Strategy development
Step 6
Roadmap development

Step 1

Megatrends and chemical trends review

Detailed analysis of global and industry megatrends was conducted in order to identify major shifts likely to influence the CIR2030 strategy. Findings provided an informed perspective on trends that would transform the operating environment or directly impact the chemical industry, including the effect of the COVID-19 pandemic.

Step 2

Baseline of Malaysia's chemical sector

A baseline of the current state of the Malaysian chemical sector was established, providing a starting point to identify potential gaps and opportunities within the ecosystem. This baseline ensured a robust understanding of the contribution of the chemical industry to the overall economy and a valuable comparison against peer nations. Key success factors were identified in leading markets, and best-in-class analysis was undertaken to guide recommendations.

Step 3

Aspiration setting for CIR2030

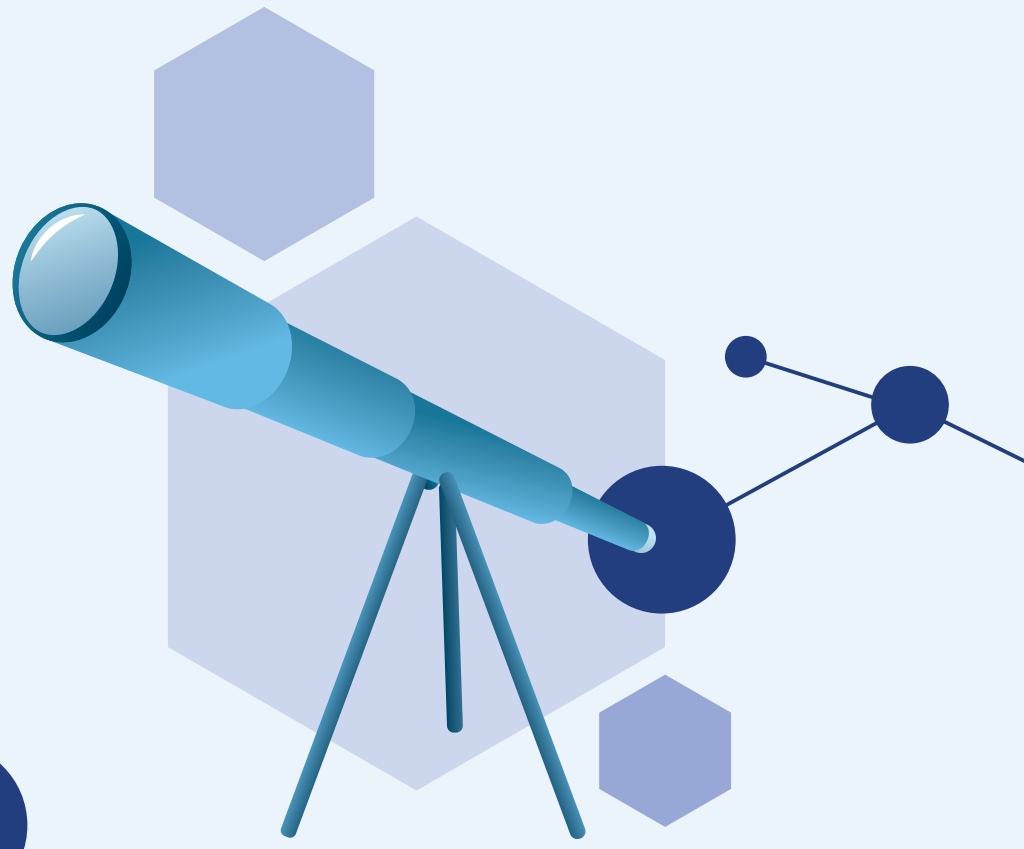
A comprehensive view of the aspirations for the CIR2030 was developed, taking an outside-in approach informed by the journeys of global chemical industry market leaders, regional peers, as well as countries at a similar stage of development. Underlying themes that captured these aspirations were established, then embedded into the learnings and aspirations Malaysia should seek to achieve.

Step 4

Market assessment

A comprehensive prioritisation exercise was conducted to identify the sub-segments of the chemical industry ecosystem which offered the most attractive development proposition for Malaysia. This prioritisation exercise was undertaken through the lens of a national, and not an individual company strategy, as such, prioritisation was assigned to a sub-segment rather than at the product level. In order to prioritise these sub-segments, CIR2030 looked at two key angles of analysis:

- Market attractiveness
- Strategic relevance and advantage



Market attractiveness

Demand	Five-year demand projections (pre-COVID 2019 to 2024 CAGR projections) incorporating both regional and global markets were assessed to provide a measure of the value of each product and an understanding of how industries may influence future market conditions. In addition, future supply forecasts to satisfy these demand projections were analysed to understand supply-demand balances.
Alignment to megatrends	Analysis of differentiation for each product was undertaken, framed against the potential value-add of the product for the product type. This provides a platform of understanding to prioritise higher value-add products.
Level of differentiation	An assessment of the environmental impact of the production process by product type was carried out, as well as the sustainability of the end product itself. This was done to ensure the roadmap aligns with the sustainability agenda whilst reflecting the transition towards more sustainable solutions.
Sustainability	Product segments were assessed against the key megatrends and chemical trends, ensuring products are prioritised in a way which is resilient to these active shifts.

Strategic relevance and advantage

Feedstock advantage:

Products were compared against Malaysia's domestic feedstock availability, ensuring stable long-term supply of precursors or feedstocks. This enhances resilience and ensures maximisation of local resources and domestic economic benefits based on competitive advantage.

Maturity of local production capabilities:

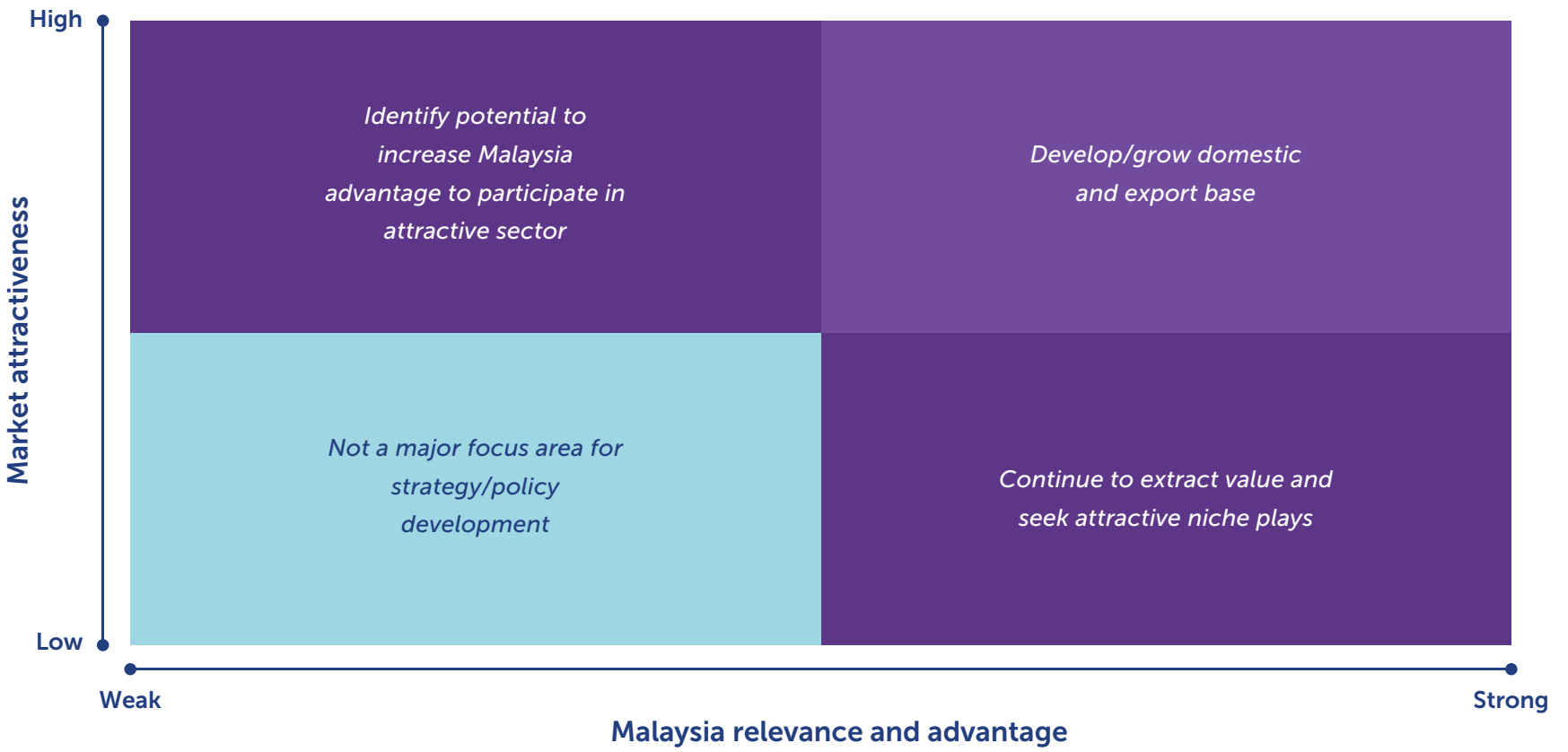
The presence of existing production facilities was analysed within a product segment, including infrastructure, workforce, R&D efforts, and companies, to determine the production starting point for the product sub-segment.

Strategic relevance:

The prioritisation of products that linked closely to the strategic aspirations of the country was assessed, as outlined in roadmaps such as the RMK-12, NIMP2030, NIP, and other sector-focus roadmaps to understand the national economic value to Malaysia. For example, the composites chemical sub-segment would score well in this dimension due to its necessity to support Malaysia's aspiration to grow its aerospace industry. Such prioritisation ensures alignment with other initiatives and aspirations while driving growth in parallel.

Each of these distinct variables was scored from 'Low' to 'High', and then aggregated to establish an overall score. The outcome of this assessment was then presented on three 2x2 matrices of the three different categories of base chemicals and intermediates, plastics and polymers, and specialty chemicals to assess the overall attractiveness of each sub-segment. Chemical sub-segments that were placed in the top three quadrants in the respective matrices were prioritised for strategy development in the CIR2030.

Prioritisation framework for attractive sub-segments



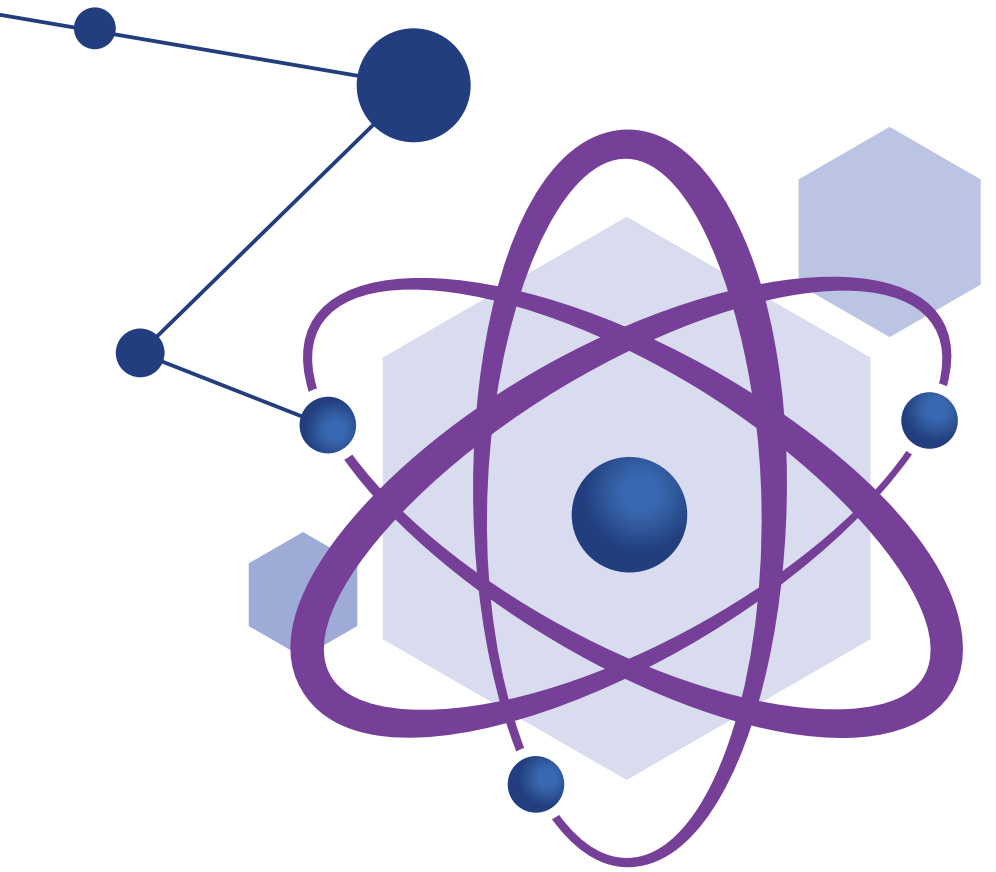
Chemical segments that lie in these quadrants will be prioritised for strategy development

Country

Companies are still encouraged to pursue their own strategies outside CIR2030's prioritised segments based on their ambitions and competitive advantage

Company

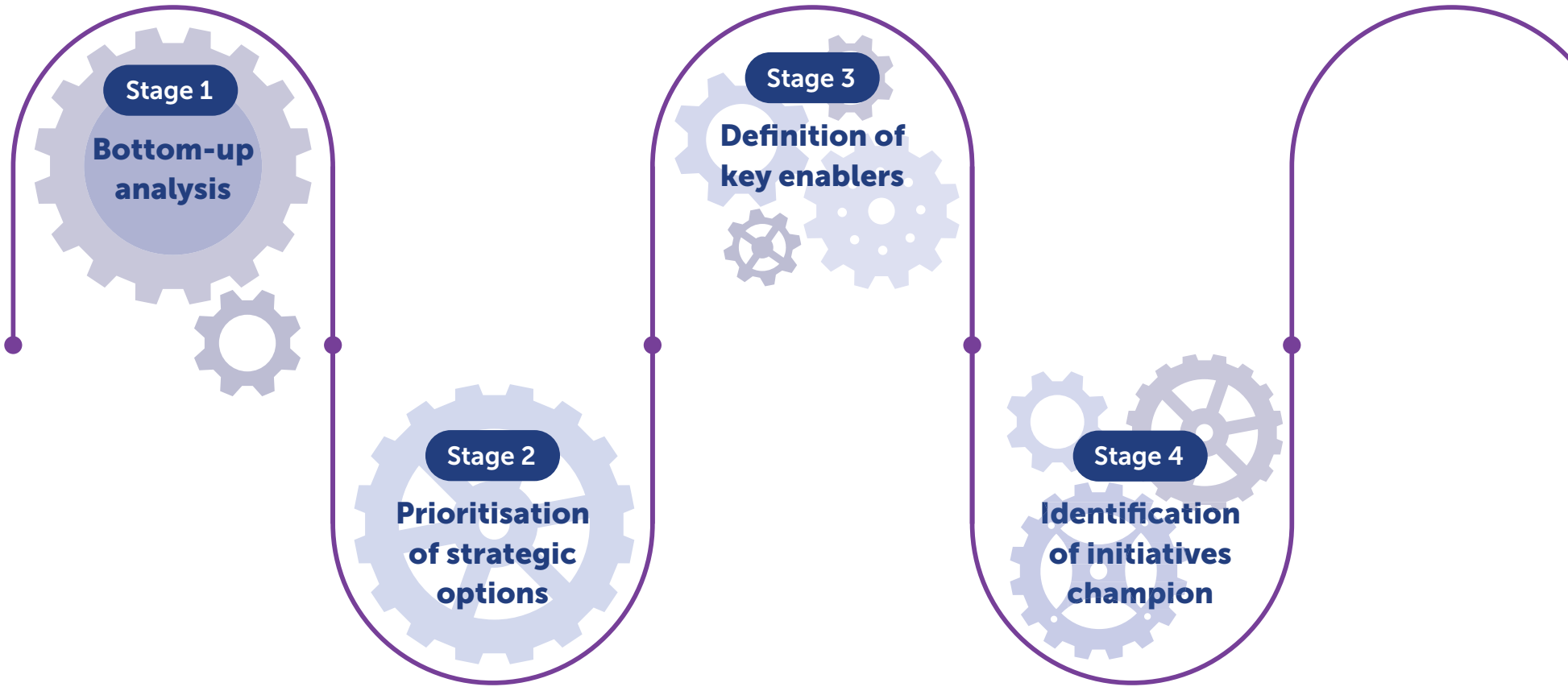
Chemical sub-segments that fall in the bottom left quadrant (i.e., weak relevance and advantage, low market attractiveness) will not be prioritised for strategic development at a country level through the CIR2030. However, industry players can continue to explore these opportunities based on their respective ambition and competitive advantage. Overall, 25 sub-segments were analysed in detail, of which 11 were prioritised for the chemical roadmap.



Step 5

Strategy development

Four stages of detailed analysis were conducted for the 11 identified priority sub-segments to develop a practical, actionable, and aspirational strategy for Malaysia's chemical industry.



Stage 1

Bottom-up analysis:

1a: Baseline:

A baseline was established to reference the scope and definition of the chemical segment and sub-segments by leveraging reports from reputable market research providers (e.g., IHS Markit, Nexant, ICIS), complemented by discussions with internal and industry experts. For example, within the plastics segment, the definition of the plastics ecosystem was developed to include commodity plastics, engineering plastics, and high-performance plastics, each with its own sub-segments (e.g., commodity plastics, polypropylene, polyethylene, polystyrene, PVC, and PET have been identified as sub-segments).

With a comprehensive understanding of the value chains and sub-segments, a detailed market research analysis was then undertaken. This analysis incorporated a wide range of research avenues, including data from the Department of Statistics Malaysia (DOSM), reputable third-party reports and databases, and press search to understand Malaysia's starting point from the perspective of key players and their respective strategies. This analysis helped us to understand potential white spaces within each defined sub-segment. UN Comtrade data was then assessed to build understanding of Malaysia's export strengths within each sub-segment and the level of dependence for imports. Discussions with industry experts were then arranged, informed by the existing research. More than 10 syndication sessions were undertaken to validate and enhance the analysis of each sub-segment in Malaysia, while also building out a depth of knowledge about the challenges apparent in the chemical ecosystem across both supply and demand. A final analysis of emerging activity within the sub-segment was then undertaken, including benchmarking against new and upcoming economic roadmaps.

1b: Global trends:

With a baseline established, efforts were undertaken to accurately assess global trends with the potential to transform or disrupt the sector. A wide range of transformative trends were established through the various syndication sessions to gather inputs from both internal and external experts in order to inform the forward-looking strategy. The implications for each sub-segment in Malaysia were then established through further trend analysis. For example, within the oleochemical sub-segment, the global push for certification of sustainably-produced palm oil was identified, indicating a need for Malaysia to enhance this aspect through its ongoing e-trace programs and Malaysian Sustainable Palm Oil (MSPO) certification push.

1c: Market landscape:

It is imperative to frame these recommendations against complex regional and global market dynamics. This necessitated a complex market analysis which incorporated a wide range of countries and industry players, backed by understanding of potential evolution and growth. Regional trade data was assessed across both Southeast Asia and the wider Asia Pacific, incorporating major players such as India and China, in order to understand the identified priorities and projections for each country. Key enablers were also assessed for best practice for each chemical sub-segment, benchmarked against exemplar nations and players, to analyse how and where to unlock the greatest opportunities for Malaysia. For example, undertaking this analysis identified that it would be challenging to grow the broader pesticides sub-segment within agrochemicals, with countries such as Indonesia commanding a strong formulation hub which had attracted significant global players such as BASF. However, an opportunity within the biopesticides product space was identified, with no Southeast Asian country yet providing sufficient focus or enablers to support this space.

Stage 2

Prioritisation of strategic options:

Several strategic options were explored within each priority sub-segment and an assessment was then undertaken to identify the best strategic options.

Stage 3

Definition of key enablers:

The relevant enablers and supporting initiatives required to accomplish the aspirations for each strategic focus area were identified, inclusive of policies and incentives, capabilities and technology, infrastructure, and sustainability.

Stage 4

Identification of initiatives champion:

The most suitable champions were identified to ensure appropriate ownership by relevant stakeholders to lead development, track progress, and execute enablers.
The entire process involved close collaboration with public and private stakeholders, relevant ministries, government agencies, associations, industry organisations, research institutes and universities, and academia to ensure the relevance and robustness of the identified strategies. Data was also sourced from reputable third-party sources, where relevant. Most importantly, this strategy was designed to ensure appropriate involvement and buy-in by champions to increase ownership, transparency, and execution certainty.

Step 6

Roadmap development

The roadmap was then developed to provide a clear strategy with detailed understanding of key enablers for the 11 priority sub-segments. This included an understanding of the current industry enablers in place to support growth and global best practices to identify potential gaps and recommendations for Malaysia across the different enablers. Through a further deep-dive into the enablers and initiatives identified in Step 5, sequencing of initiatives and respective guidelines were then developed to assist the implementation path. Key metrics and tracking structures were established to measure progress and maintain forward momentum for the CIR2030.

Chemical industry overview

The chemical industry is one of the most important global industries and has been instrumental to remarkable human progress over the last century. Products such as plastic food packaging, for example, have transformed our ability to preserve and ship foods across the globe, reducing food waste and improving sustainability. Strong and lightweight plastics have helped deliver increased fuel efficiency in vehicles while improving overall safety. The applications of chemical-derived products have been diverse and transformational.

Globally, the chemical industry is valued at approximately USD4tril[1], with projections that it will continue to grow at a sustainable rate of 4.5% CAGR in coming years. The industry will be shaped by significant emerging and evolving megatrends over the future decade, and it will be essential for companies to remain nimble and capture new opportunities that present themselves in this changing landscape.

[1]Oxford Economics

Importance of the Chemical Industry to Malaysia

Malaysia's chemical sector represents a critical engine of national growth, contributing 4.0% in total (RM55bil) to the national GDP in 2019 (including refined petroleum, rubber, and plastics). This contribution has been relatively stable at ~4% since 2015. The sector accounted for 5% of total export value in the same year, with a contribution valued at approximately RM50bil. The chemical sector also remains a major source for FDI and accounted for ~11% of Malaysia's total FDI over the five years from 2015-2019[2].

The chemical sector is also a major catalyst for national socio-economic development. The industry directly employs[3] over 430,000 Malaysians—5% of the total workforce—as well as delivering a positive ecosystem impact across other industries.

Chemical sector contributions

... of national **GDP contribution** from chemical, rubber, and plastic products

... of **total export value** from chemical products

... of total **FDI** accounted by **investments in chemical** industry

... of total **workforce employed** in chemical industry (430k Malaysians)

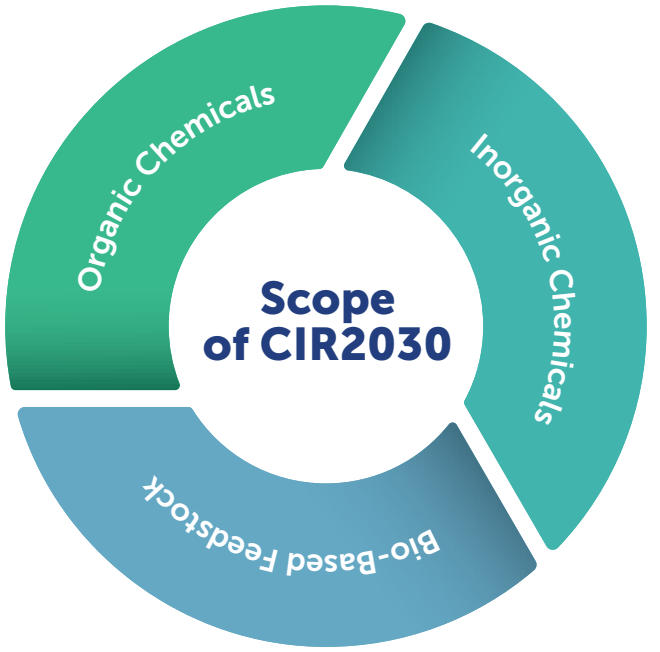
[2]*Department of Statistics Malaysia (DOSM), MATRADE*
[3]*Department of Statistics Malaysia (DOSM), Labour Market Review Malaysia Second-Quarter 2020*

A vibrant domestic chemical industry is paramount to competitive downstream industries within Malaysia. The automotive, construction, electrical, and electronics, as well as agriculture, are amongst the many industries that benefit from the adjacent success of Malaysia's chemical industry, with access to high-quality chemicals and solutions that drive global competitiveness. For example, the chemical industry's plastics and synthetic rubber sub-sectors provide products that are utilised for a range of applications within the automotive industry. Malaysia's key manufacturing industries also benefit from the presence of a strong domestic chemical industry, which acts as a critical raw material provider, sustainability enabler, and technology and innovation partner.

“Malaysia's key manufacturing industries also benefit from the presence of a strong domestic chemical industry, which acts as a critical raw material provider, sustainability enabler, and technology and innovation partner.”

Coverage of the Chemical Industry Roadmap

The chemical industry is highly complex and diverse, operating across several defined sub-sectors and with applications in a wide range of day-to-day products. Broadly speaking, the industry can be divided into three categories—organic chemicals, inorganic chemicals, and bio-based feedstock. Each category, in turn, has a value chain that extends from base chemicals/building blocks (e.g., methanol, ethylene, benzene, etc.), to specialty chemicals (e.g., care chemicals, nutrition chemicals, etc.), going directly into downstream consumption in areas such as personal care, automotive, and electronic industries.



The scope of CIR2030 covers the entire end-to-end chemical value chain. Organic chemicals consist of base chemicals, organic intermediates, agrochemicals, and specialty chemicals while fertilisers, polymers and plastics comprise both organic and inorganic chemicals. Inorganic specialty chemicals are also included in this roadmap except for inorganic building blocks and intermediates such as sulphur, phosphorus, and rare earth elements, which are covered under the purview of the National Mineral Industry Transformation Plan 2021-2030. Bio-based feedstock which consists of non-fossil fuel-based feedstocks such as oleochemicals and biochemicals is also included in this roadmap. Overall, the CIR2030 assessed over 25 industry sub-segments within the chemical industry.

Scope of CIR2030

Within scope of CIR2030

Chemical Industry segments

Feedstock → End-use

Organic chemicals

- **Base chemicals/ building blocks** (e.g., methanol, ethylene, propylene, benzene)
- **Organic intermediates** (e.g., acrylic acid, propylene glycol, phenol, MTBE, paraxylene)
- **Specialties** (e.g., care chemicals, coatings, plastic additives)
- **Fertilisers** (e.g., urea, ammonia phosphate)
- **Polymers/ Plastics** (e.g., commodity plastics, water-soluble polymers, engineering plastics)
- **Agrochemicals** (e.g., pesticides, seeds)

Inorganic chemicals

- **Inorganic building blocks and intermediates** (e.g., sulphur, phosphorus, chlorine, rare earth elements)
- **Inorganic Specialties** (e.g., electronic chemicals, catalyst)

Bio based feedstock

- **Oleochemicals, Biochemicals** (e.g., fatty acids, methyl esters, glycerin)

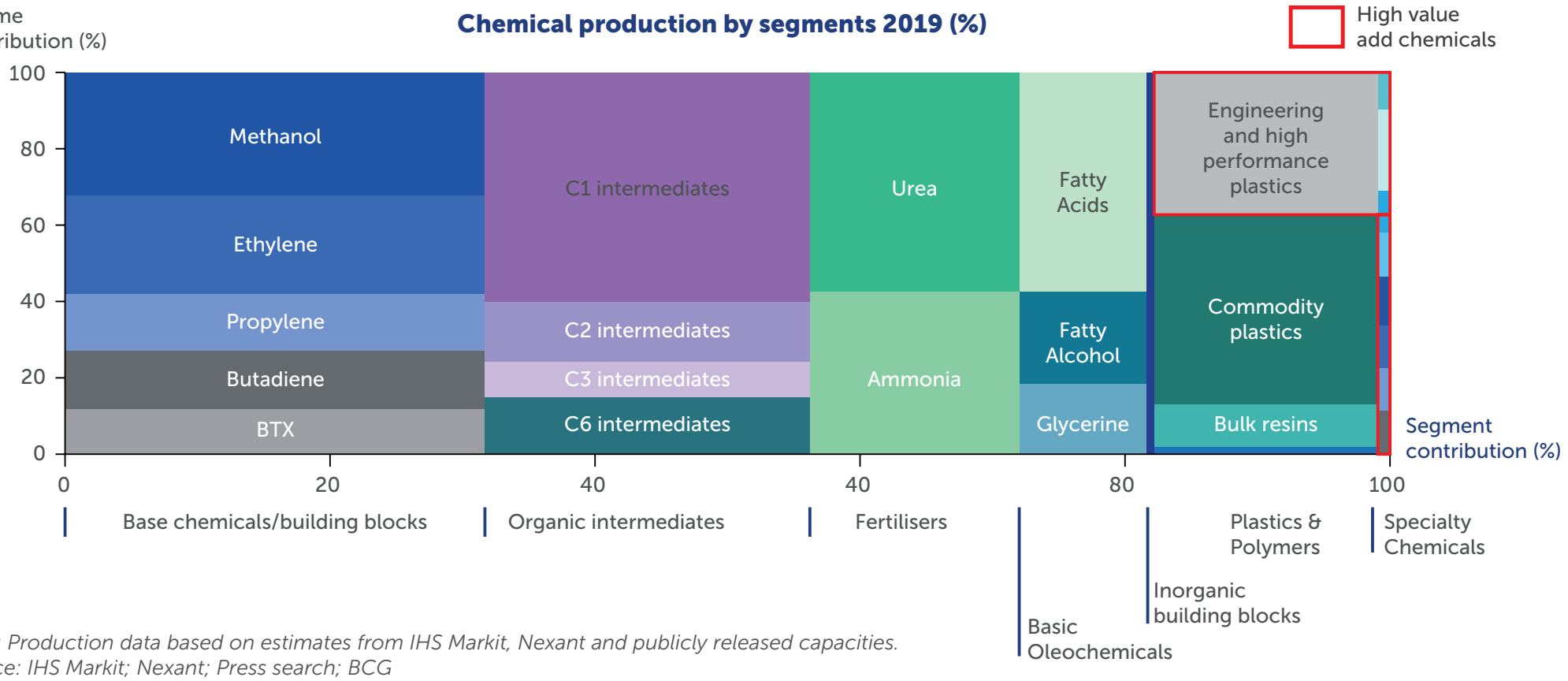
Overall industry performance

Malaysia's chemical sector has performed relatively well from a macroeconomic perspective, but there are significant opportunities for further growth if the right strategies are adopted. This roadmap aims to embrace the value potential of evolving domestic and global economic conditions to catalyse greater industry growth.

Current state of Malaysia's chemical industry

Malaysia has a sizeable chemical industry, with over 100 companies[4] producing a wide range of chemical products. Malaysia's current chemical production is primarily driven by base chemicals and intermediates, which are typically of lower value add, but there are strong ambitions to expand beyond the current focus on commodity products as industry players develop more complex, specialty downstream chemicals.

Volume breakdown by chemical segments



Note: Production data based on estimates from IHS Markit, Nexant and publicly released capacities.
Source: IHS Markit; Nexant; Press search; BCG

[4] *Aiche, The Malaysian Chemicals Industry: From Commodities To Manufacturing, November 2015*

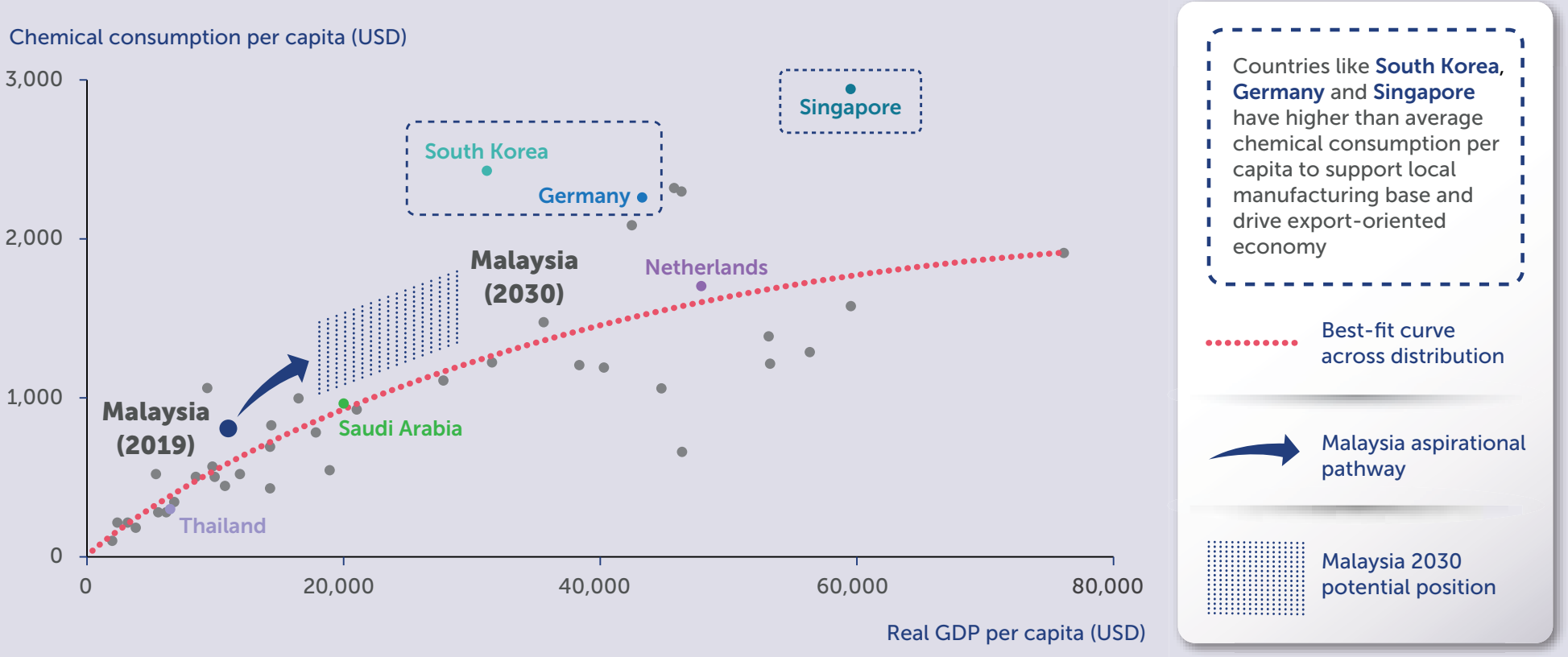
Chemical sector output has increased steadily over the last decade at a rate of 4.5%[5] per annum and represented ~0.6% of total global chemical output as of 2019[5]. The start-up of the Pengerang Integrated Complex will further boost the industry's gross output value, currently estimated at USD30bil[6].

Malaysia's broader economic development provides a positive environment for the growth of the domestic chemical industry. Historical trends demonstrate that highly developed countries with high manufacturing value added (MVA) and GDP per capita have higher average chemical consumption per capita.

[5]Oxford Economics; UN Comtrade data; BCG
[6]Oxford Economics

This shows that as countries become more affluent, they consume more chemicals. The red curve on the associated graph below demonstrates this trajectory, with those countries above the curve outperforming the typical chemical consumption in comparison to peers at a similar stage of development.

Chemical consumption per capita vs real GDP per capita



Source: Oxford Economics, German Chemical Industry Association (VCI), BCG analysis

Malaysia's chemical consumption per capita is at a higher level than peer countries with the same level of development[7]. Similar performance is observed in highly developed nations such as South Korea and Germany, largely driven by high chemical consumption in local downstream industries as well as exports for large automotive and electronics industries.

According to the latest World Bank analysis[8], Malaysia's real GDP per capita is projected to increase, setting Malaysia on the course to achieve developed nation status between 2024-2028, in line with RMK-12. Malaysia is expected to continue to increase its chemical consumption as income grows in line with global trends.

[7]*Oxford Economics; German Chemical Industry Association (VCI); BCG*
[8]*World Bank, Aiming High Navigating, the next stage of Malaysia's development, March 2021*

Comparing Malaysia's chemical industry to others

Malaysia performs well in comparison with peers across several factors. However, there are opportunities to expand on this performance and leverage greater value moving forward, in line with the ambitions laid out by strategic documents such as RMK-12, NIP, NIMP2030 and the CIR2030 itself.

Gross value added (GVA) contribution

Malaysia has high GVA contribution from its chemical sector at 3.4%[9], comparable to other large chemical producing countries such as Saudi Arabia (3.5%) and Germany (3.5%). However, there are potential for further growth when compared against regional peers such as Thailand (4.1%) and South Korea (4.4%).

Export value

Malaysia exported USD28bil of chemical-derived products in 2019[10], with ethylene-based polymers being a primary export. This export value was however, lower than regional peers[7], Thailand (USD41bil) and Singapore (USD56bil), indicating room for substantial growth.

[9]Oxford Economics; BCG

[10]UN Comtrade data; BCG analysis; Department of Statistics Malaysia (DOSM)

Foreign direct investment (FDI)

Malaysia's chemical industry attracted USD9.1bil of inflows between 2010-2020[11] and a significant proportion of these investments was attributed to megaprojects such as the Pengerang Integrated Complex (PIC). This value was about three times the inflows of Thailand (USD3.2bil) across the same period and compared favourably to established chemical-producing countries such as Germany (USD6.0bil) and Netherlands (USD6.5bil). Malaysia's FDI inflow was captured across 81 individual chemical projects, compared to over 100 projects in Thailand and over 300 in Germany. While the overall FDI trend is positive, it demonstrated an overreliance on megaprojects, hence, a sustainable pipeline of fresh chemical projects is required to ensure continued positive FDI inflows over the coming decade.

[11] *Department of Statistics Malaysia (DOSM)*

Labour productivity

Labour productivity by workers in Malaysia's manufacturing industry compares favourably on a regional stage but is much lower than developed peers. Average manufacturing labour productivity stands at USD31,000[12] per worker. That places Malaysia second to Singapore in productivity amongst Southeast Asian peers, significantly higher than the Philippines (USD19,000), Thailand (USD18,000), and Indonesia (USD11,000), with relatively comparable labour costs. However, the average manufacturing labour productivity in Singapore sits at USD190,000, while other developed countries such as South Korea and Germany are also significantly higher at USD97,000 and USD82,000 respectively. Moving towards higher value-add products and segments will substantially improve labour productivity within Malaysia's manufacturing industry and chemical industry specifically.

The performance in the areas highlighted above demonstrates both the importance and further potential for Malaysia's chemical industry. However, there are two areas where clear improvements can be made:

Trade

Malaysia accounts for 1.1%[13] of global chemical-derived exports by value, below Thailand (1.6%) and Singapore (2.2%). With Malaysia's well-established industry and abundance of chemical feedstock as well as raw materials, there is a strong potential to further develop and expand its global share.

[12]Economist Intelligence Unit, BCG analysis

Product differentiation

Product Complexity Index (PCI) is a globally recognised indicator to assess the value-add provided by specific chemical products, where a higher PCI score indicates a more differentiated product. This is an important factor as higher differentiation leads to greater value-add for the country. Currently, the level of product differentiation in Malaysia's chemical industry is relatively low. For Malaysia's top chemical-derived exports[13] (e.g., ethylene-based polymers, fatty acids), the PCI scores range from below zero to 0.13. In contrast, the PCI scores for Singapore's top five exports range from 0.13 to 0.91. This signifies a strong push for Malaysia to diversify into more specialised, differentiated products in order to improve its global competitiveness and enhance the value-add of the chemical industry.

While Malaysia demonstrates relatively strong performance across the factors highlighted above, there is a clear opportunity to close the value gap with leading developed chemical markets and high-performing regional peers. Moving towards more specialised, high-value production will not only increase the value of Malaysia's productivity, but also significantly boost trade and product complexity. The CIR2030 provides a strategic roadmap to achieve these goals and uplift Malaysia's chemical industry.

[13] UN Comtrade data; Atlas of Economic Complexity; BCG analysis

Key trends impacting the chemical industry

Megatrends and chemical trends

The chemical industry operates in a connected international landscape, and the right strategic roadmap will need to recognise and respond to significant global megatrends which have the potential to shift the global landscape. The four classes of megatrends are:

Terra trends

Economic trends

Tech trends

Meta trends

The four classes of megatrends are:

Terra trends

Socio-geographical transformations including changing demographics, human health, as well as evolving consumer trends. Transportation, and health and beauty movements are likely to be the biggest terra trends moving forward, impacting the need for various chemicals in end-use categories such as electric vehicles (EVs) and nutri-care.

Economic trends

Macro and microeconomic transitions spanning across business ecosystems, productivity and performance, financial flows and investment, trade flows and investment sentiments, wealth creation and disparity, and globalisation. The most significant trends include the shifting centre of the global economy moving from west to east and rising global middle class and affluent consumers triggering increased consumption of chemical products.

Tech trends

Shifts triggered by the rapid Fourth Industrial Revolution (IR4.0), evolution of technology and trends in areas such as cloud computing, artificial intelligence, and expanding digitisation. Also includes emerging innovations in areas such as 3D/4D printing, 5G technology, and miniaturisation of integrated circuit chips, all of which could have a significant impact on chemical operations as well as alter the demand for products.

Meta Trends

Changing global paradigms in areas such as climate and sustainability, waste and environmental stewardship, as well as human-centric concerns in realms of governance, security, and ethical conduct. This includes shifting consumer attitudes towards green products, growth in carbon credits and environmental reporting, and potential carbon taxes, all of which have major implications for the chemical industry and increase pressure for continued innovation.

It is critical that an effective CIR2030 takes these trends into account as it seeks to catalyse the future of the industry by 2030. Careful analysis of these megatrends will allow us to develop a strategic roadmap that is both resilient and fit for the future.

Terra trends

Demographics
- Population
- aging population
- Obesity & diet (Lifestyle illness)
- Urbanisation
- Human mobility

Consumer Trends
- Customisation
- Sport & fitness (Leisure trends)
- Organic
- Time compression/ Convenience
- Health & Wellness
- Beauty Imperative

Other Terra Trends
- Transportation

Economic trends

Economy & Employment
- Value Migration (Rise of services)
- R&D/Innovation imperative
- Business model innovation
- War for talentt
- Productivity/Performance
- Focus
- Demand for infrastructure
- Small business/ enterpreneurship
- Sharing economy

Financial flows and investments
- Socially responsible investing

Trading Blocks & Flows
- E-trade & e-commerce
- Regional trade blocs

Globalisation
- Rapidly developing economic challengers
- Rise of China
- Rise of India
- Rise of the Middle Class
- Next Billion consumers

Tech trends

Technology Trends
- Nanotechnology
- New materials/substitutes
- Mobile electronic devices
- RFID & sensor networks
- Smart devices
- Robotics
- 3D/4D Printing
- Data explosion/data mining
- Rise of autonomous vehicles
- Rise of AI machine learning

Life Sciences/Healthcare
- Healthcare spending
- Biotech & proteomics
- Nutraceuticals & functional food

Energy & Power
- Energy volatility
- Rise of alternative energy sources
- More sustainable forms of transport

Meta trends

Scarcity vs Abundance
- Waste & waste management services
- Water scarcity

Environmental Crisis
- Green products & markets
- Global warming awareness
- Carbon credits

Risk & security
- Risk and Security Concerns
- Global pandemic risk

Five trends have been identified to have a substantial impact on the chemical industry:

Evolving consumer trends and lifestyle

Fundamental shifts in consumer behaviour driven by lifestyle choices and sustainability concerns are impacting the demand for various materials and changing the purchase patterns for end products, spanning from automotive to health and nutrition. These trends are broadly favourable, which will support long-term demand for chemicals and chemical-derived products.

Geostrategic shifts

Global geopolitical tensions and trade flow shifts remain a challenge to the global supply chain. Asia now accounts for more than two-thirds of global growth, and roughly one-third of global trade, as well as almost half (45%) of FDI inflows[16]. Access to markets based on trade agreements and political tensions is shifting supply-demand chains eastwards.

Shift in key demand markets

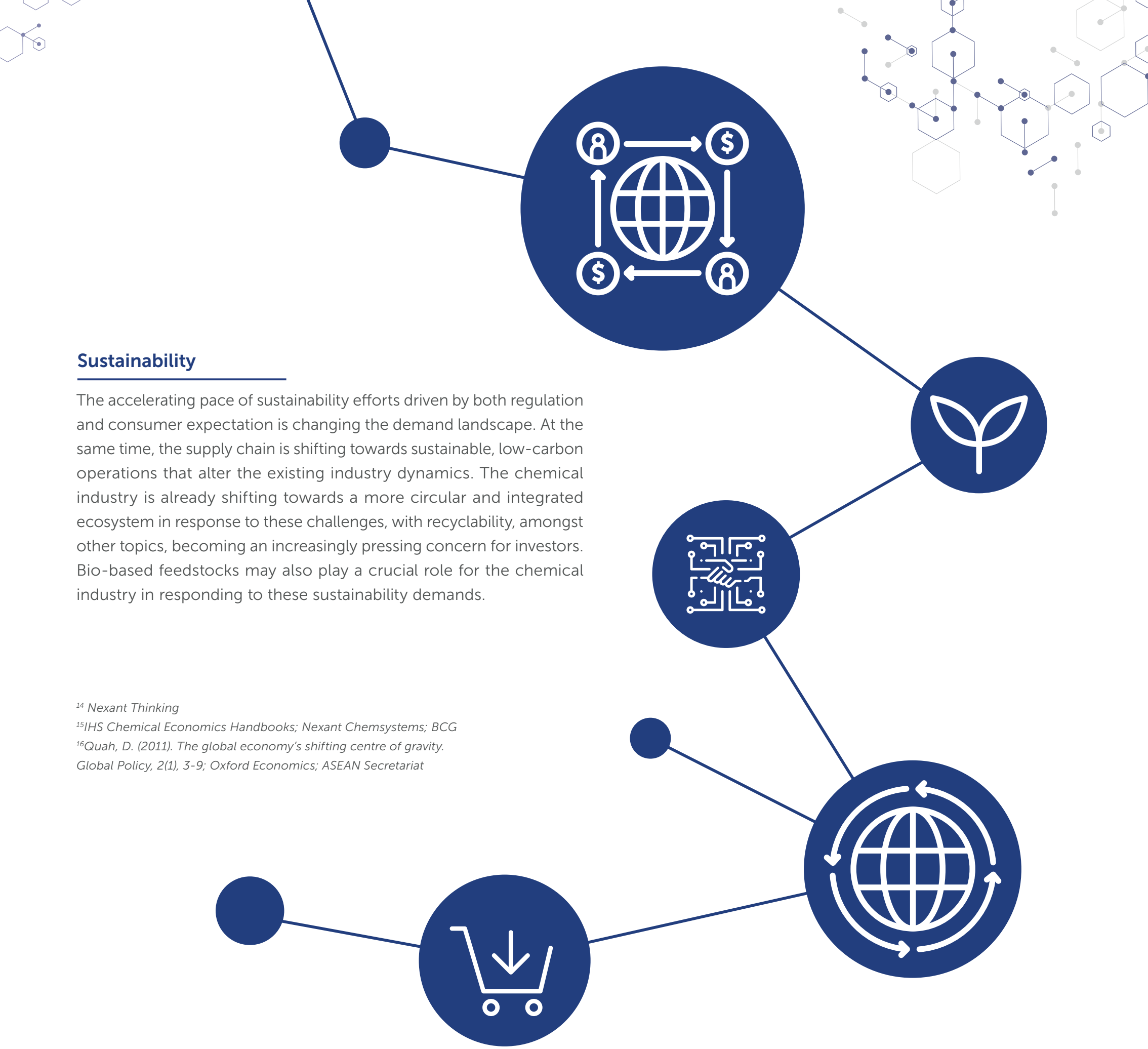
Continuous growth in the commodity markets of developing countries is shifting the global demand pattern for chemical-derived products and is expected to contribute more than 75% of global demand by 2030. China is a major driver of current demand, accounting for ~40% of the market[14] , albeit with a slightly weaker growth outlook in the coming years. Major emerging markets in South Asia, Latin America, the Middle East and North Africa, and Southeast Asia are set to drive the future growth while Southeast Asia's petrochemical demand is also expected to grow faster than the global average, with Vietnam and Indonesia accounting for 60% of the demand volume increase by 2025[15] .

Digitalisation

Digital penetration and technology expansion are providing new capabilities and expectations for the chemical industry. This results in increasing transparency of operations, providing an unprecedented end-to-end scope, granularity, and pace of data-driven decision-making and analysis. Digitalisation can create value across the chemicals value chain by reducing time to market, improving efficiency and productivity, reducing costs, and, most importantly, enhancing the safety of workers. Major global companies are in the process of accelerating efforts to leverage this potential.

Sustainability

The accelerating pace of sustainability efforts driven by both regulation and consumer expectation is changing the demand landscape. At the same time, the supply chain is shifting towards sustainable, low-carbon operations that alter the existing industry dynamics. The chemical industry is already shifting towards a more circular and integrated ecosystem in response to these challenges, with recyclability, amongst other topics, becoming an increasingly pressing concern for investors. Bio-based feedstocks may also play a crucial role for the chemical industry in responding to these sustainability demands.



[14] Nexant Thinking
[15]IHS Chemical Economics Handbooks; Nexant Chemsystems; BCG
[16]Quah, D. (2011). The global economy's shifting centre of gravity. Global Policy, 2(1), 3-9; Oxford Economics; ASEAN Secretariat

The breadth of this transformation is illustrated as follows:

Disruption of transportation industry

The transportation industry is undergoing a global transition with notable implications for the chemical industry. Autonomous mobility, lightweight vehicles, electrification, and alternative fuels will drive growth in chemical-derived products such as battery and electronic chemicals, engineered polymers, and high-performance plastics.

Food, nutrition, and preventative medicine

Rising populations and growing focus on nutrition and healthy lifestyles are triggering a shift in consumption that is likely to benefit the nutraceuticals and food ingredients market. In addition, an aging population is creating an increased demand for preventative medicines within the pharmaceutical sphere.

Decreasing productivity growth in agriculture

Decreasing productivity in agriculture alongside growing resource pressures will boost demand for agri-science applications such as crop protection, production, and seed health. The chemical industry will have an important role in meeting these demands, alongside potential unmet needs that include enhanced seed solutions, mitigation of toxic ingredients, customised formulations and increased shelf life for products.

Urbanisation and increased mobility

Shifting demographics and growing urbanisation are changing the transportation dynamics in many nations. Testing in cities such as Boston, Singapore, and Gothenburg demonstrates the growing focus on autonomous vehicles, which will likely unlock a greater role for chemicals in technology fundamental to the future urban environment. EV adoption will also alter the chemical landscape through increased demand for lightweight materials and parts. Urbanisation increases the need for rapid development of new housing in the cities, which includes high-rise buildings. The construction industry, which is a major consumer of chemicals, will create greater demand for newer materials and technologies to support this growing segment.

Industry 4.0

The Fourth Industrial Revolution is defined by connected and data-driven opportunities such as the Internet of Things (IoT) and 3D printing technologies. This will increase the need for multi-functional sensors such as carbon-based sensor technologies, requiring new material development for better sensitivity and miniaturisation. This will drive increased consumption of chemical-derived products such as carbon nanotubes (CNT), graphene and silicon. The global 3D-printed polymer market is also expected to grow by USD29bil by 2025[17], impacting industries such as automotive, medical, and aerospace, triggering further demand for 3D printing-compatible chemicals to support the industry's needs.

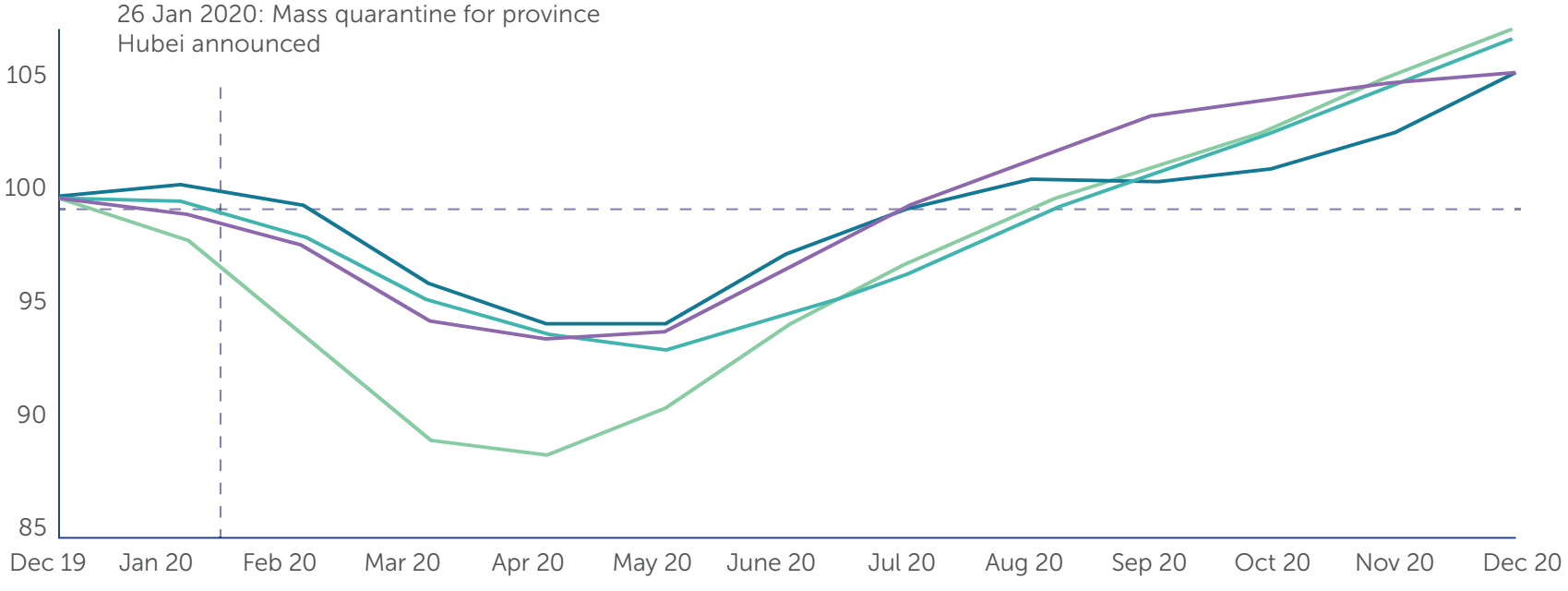
[17] BCG

Impact of COVID-19 on the Chemical Industry

COVID-19 disrupted the global chemical industry in 2020, but the disruption was diverse and disaggregated across the industry's sub-sectors due to specific demand patterns and supply chain dynamics. While all segments saw a dip in the first half of 2020[18], the effects were not prolonged, with analysis revealing a broad industry recovery by the end of 2020.

Taking the example of the specialty chemicals segment, the impact was particularly pronounced in the first half of 2020, but a significant recovery was evident in the second half of the year. All sectors demonstrated year-on-year production growth between December 2019 and December 2020, with agricultural chemicals witnessing an increase of 5%, consumer products by 5%, basic chemicals by 7%, and specialty chemicals by 7%. This growth is likely influenced by an unleashing of pent-up demand following the COVID-19 disruption and focused efforts by industry to make up for lost production experienced in the first half of the year. The surge reflects a rebalancing of supply and demand in the face of global megatrends and chemical industry trends.

Global Chemical Production Index[1]



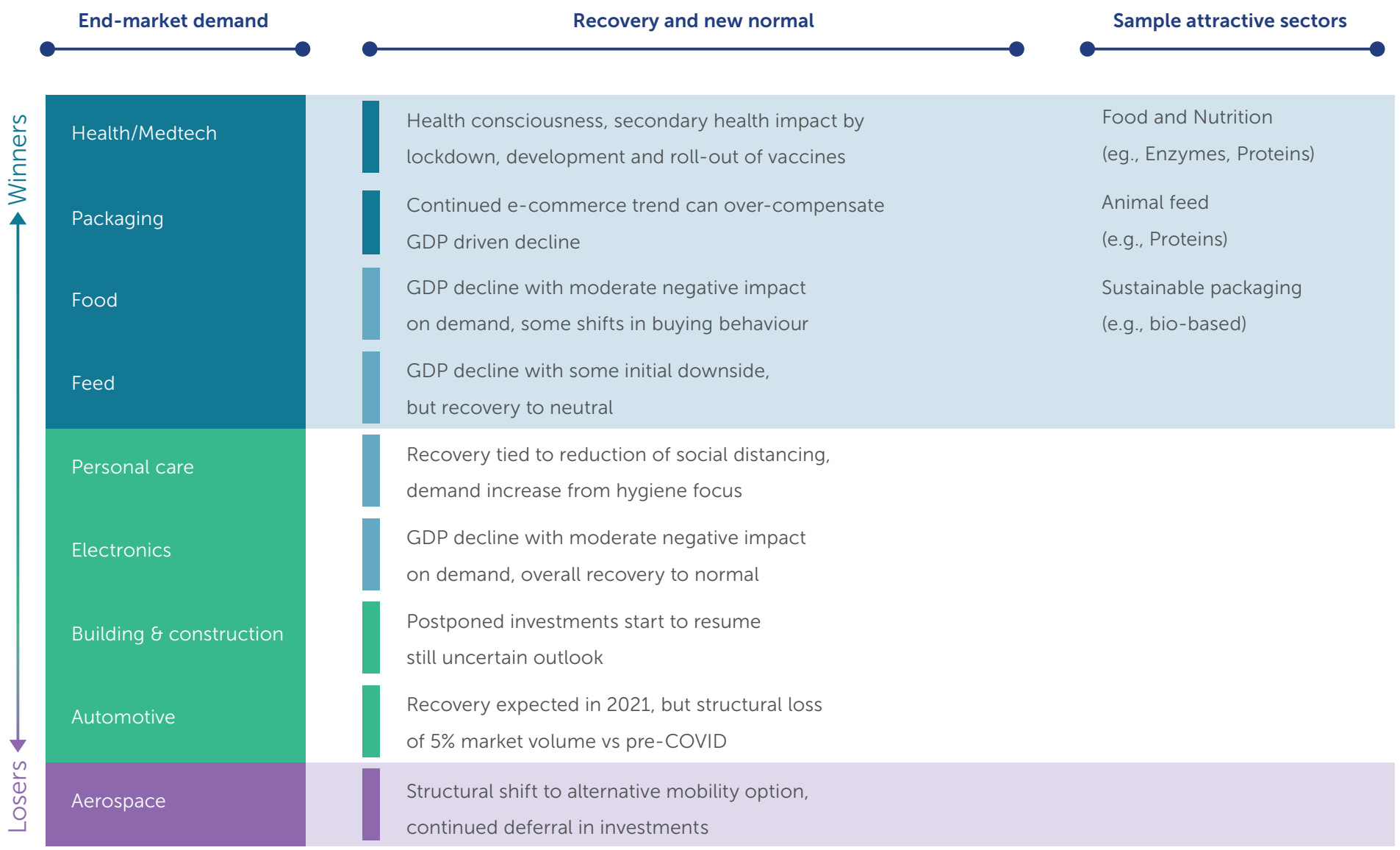
Segment	Agriculture Chemicals	Consumer Products	Basic Chemicals	Speciality Chemical
% GCPI change Dec-19 to Dec-20	+5%	+5%	+7%	+7%

1.Currently, data only available until Dec 2020; Index base set to Dec 2019 = 100
Source: American Chemistry Council; BCG

[18] American Chemistry Council, BCG

COVID-19 impact on end-market demand

COVID-19 disruption has also resulted in divergence of end-sector in the near term. Recovery in areas such as health and medical technology, packaging, food, and animal feed is expected to be more resilient compared to areas such as automotive and aerospace. While this creates likely winners and losers, projections indicate that this will normalise over the longer term.

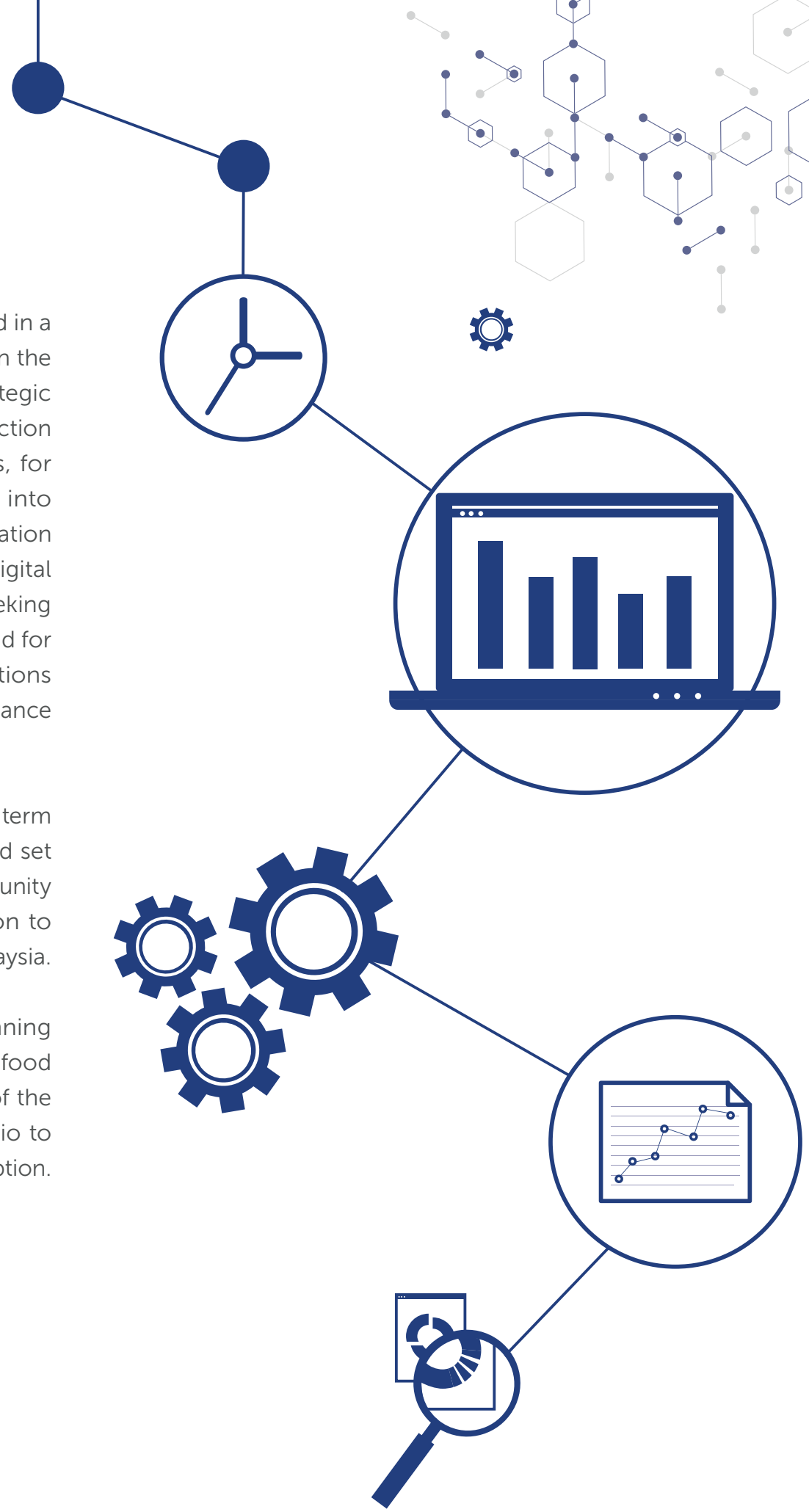


Note: Financials for Year ended March 2021-2020
Source: Press research (12th March 2020- 14th January 2021), BCG analysis

The COVID-19 pandemic and its widespread impact have resulted in a need for chemical companies to readjust to remain competitive in the era of the new normal. A review of existing portfolios and strategic projects will be needed to ensure no over-capacity or over-production in low-demand product areas. To capitalise on demand shifts, for example, increasing portfolio resilience through transitions into diversified sectors will be important. Regionalisation and simplification of the global supply chain, as well as increasing emphasis on digital growth will likely provide valuable strategies for organisations seeking to win in the rebound. At the same time, adapting to meet demand for new technologies and increased demand for sustainable solutions through a circular economy approach will demonstrate the importance of agility in fostering resilience.

The COVID-19 pandemic represented a period of significant short-term disruption for the chemical industry, triggering an unprecedented set of supply and demand challenges. It also provided a unique opportunity to reflect on the trajectory of the industry and a fresh horizon to reimagine the role and contribution of the chemical sector in Malaysia.

Malaysia is presented with an opportunity to capitalise on winning sectors highlighted by the pandemic in areas such as health and food and nutrition. It can also reinforce its commitment to key parts of the chemicals value chain while strategically diversifying its portfolio to enhance resilience in the face of any further major periods of disruption.



Aspirations for the Chemical Industry Roadmap

The CIR2030 is designed to reinforce Malaysia's chemical industry, enhancing resilience and unlocking greater value to the nation's socioeconomic performance. It aims to accelerate Malaysia's efforts to achieve long-term economic goals while providing a holistic uplift to workforce opportunities and living standards.

Malaysia's chemical industry is critical in boosting competitiveness in several key customer industries in Malaysia, including automotive and electronics, and will be a fundamental enabler of growth for large segments of the national economy.

To set the aspirations for CIR2030, industry journeys adopted by several leading and peer countries with large chemical industries were analysed. In parallel, insights from more than 60 stakeholders in Malaysia, both from the public and the private sector, were syndicated and assessed. This process allowed us to identify the factors that best capture and realise these aspirations. Five major themes that define a successful chemical industry were identified:

- Industry value-add
- Industry integration
- Competitiveness
- Sustainability
- Technology and innovation

1

Industry value-add

A higher proportion of downstream value-added chemical products, which includes a focus on specialised, high-margin, and niche segments

2

Industry integration

Strong linkages and synergy between the chemical sector and high-end downstream industrial and manufacturing sector as a captive demand base

3

Competitiveness

Regional/global competitiveness in chemicals, often defined by a large domestic market and strong export-oriented industrialisation

4

Sustainability

An ability to meet environmental, economic, and social needs without compromising the progress and success for future generations

5

Technology and innovation

Domestic technology capabilities in areas such as research and development (R&D) which support cutting-edge product development

Benchmarks and metrics

Global success stories of the aforementioned countries typically focus on several of the five key themes identified in this report. While each country is unique in how and where it implements these measures, it is clear that a commitment to these factors is a major part of global success.

Themes of benchmark countries' chemical aspirations

Dominant themes

	Industry Value-add	Industry Integration	Competitiveness	Sustainability	Technology & Innovation	
Saudi Arabia	✓		✓		✓	• 2X **industry value-add** from Chemical sector by 2030 • Global **competitiveness** through leadership in C2 value chain
South Korea	✓	✓			✓	• **Industry integration** driven investment– focus on 5 demand industries • **Industry value-add** through massive investments into specialty chemicals • USD4Bil investment to back R&D to achieve **technology** self-sufficiency
Thailand	✓	✓	✓	✓		• Increased competitiveness, asset integration, and strategic alliances • Production of chemicals derived from **bio-feedstocks** • Specialty and **value-added** plastics for automotive, medical equipment
Netherlands				✓	✓	• Initiatives to achieve **sustainability** (aspiration to remove GHG emissions) • R&D and **technological innovation** (home to key R&D labs of DSM, SABIC, AkzoNobel, Shell, Avantium, Corbion)
Germany	✓	✓	✓		✓	• Focus on **high tech & high margin chemical segments** with €32Bn export surplus • Strong **enabling ecosystem** (€4.4Bil R&D spend, 350k skilled workforce etc.) to strengthen **global competitiveness**
Japan		✓	✓	✓	✓	• New advanced materials for industrial sector (automotive, construction, electrical and electronics) • **Sustainability-linked** change by focusing on products that help to reduce GHG emissions

Source: AIChE; InvestSaudi; JCIA; Chemistry for Climate–Roadmap for the Dutch Chemical Industry towards 2050 (2018); German Trade and Invest; Nexant; News reports; government websites; World Bank; KOTRA

Country Spotlight: South Korea

South Korea's chemical industry is currently ranked 3rd globally in terms of the value of chemicals produced. Their competitiveness in the chemical industry worldwide is built on the following three factors.

1 Industry development

Promoting the establishment of large industrial complexes for the chemical industry through financial incentives to expand the building blocks capacity in supporting the demand for downstream industries, e.g., automotive and electronics. Alongside the growth of industrial complexes, the government invested in developing infrastructure, e.g., ports and railways to support the industry.

2 Innovation and R&D

Strengthening R&D by providing tax incentives, easier access to global experts and encouraging clusters of industry-academia-research centers. There is a strong focus on high-performance specialty chemicals for fast-growing applications such as lithium-ion batteries, optical films and solar films. The government is also promoting an investment plan to develop 100 core technologies domestically with the strong involvement of private companies such as LG Chem, Hanwha Chemicals and Honam Petrochemical actively investing in these technologies.

3 Ease of doing business

South Korea aligned policies around the chemical industry to global benchmarks to improve trading efficiency (e.g., The Act on Registration and Evaluation of Chemicals of Korea (K-REACH)) set up in 2015 along the lines of Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) regulations in Europe. South Korea has also signed multiple FTAs to grow its export volumes and launched a strong investment campaign (Invest Korea) to attract foreign investments in the chemical sector.

Country Spotlight: Thailand

Thailand has introduced a number of initiatives in order to stimulate the development of its domestic chemical industry. These transformations have been led by local players such as PTT Global Chemical (PTTGC), benefiting from government support initiatives and competitive industry positioning.

Thailand's transformation master plan focuses on increased competitiveness, asset integration, and strategic alliances. This has resulted in the nation's chemical industry reaching a chemical production capacity of 26 mtpa with 50-60% of production marked for exports[19]. Thailand's chemical industry also accounted for around 7% of total domestic FDI between 2015-2019[20].

1 Industry development

The industry took an end-to-end approach to upstream, intermediate, and downstream petrochemical development. This included a goal to increase R&D investment from 0.6% to 1.0%[21] as a share of industry value. More stringent environmental impact assessments were also introduced by defining stricter criteria for chemical sector investment, resulting in increased sustainability of operations.

2 Government support

A range of government support measures and incentives were targeted at chemical industry beneficiaries. These include tax incentives such as up to eight years of exemption from corporate income tax, exemption of import duties on raw materials and machinery for producing chemical-derived exports and introducing special economic zones with additional incentives.

3 Ecosystem boosts

The chemical industry has been identified as a key linkage for domestic industrial clusters in areas such as automotive, packaging, electrical appliances, and telecommunications. Thailand was able to leverage captive demand from these industries to further grow the chemical industry.

4 Sustainability drive

Thailand has identified biofuels and biochemicals as key national growth engines under its industrial transformation Thailand 4.0 policies.

[19]BCG; Aiche, Thailand's Petrochemical Industry, May 2019
[20]FDI Markets
[21]Aiche, Thailand's Petrochemical Industry, May 2019

Overall aspiration

Malaysia's aspiration to become a leading chemical player in the APAC region is framed by understanding important global benchmarks and expanding untapped potentials. Against these two principles, Malaysia should aim to:

Increase industry value-add from building blocks:

Increase the overall value add to the economy by expanding the overall size of the industry and diversifying to increase the share of high-value and specialty segments in overall production.

Enhance industry integration:

Transition to become the primary supplier for downstream industries, boosting the share of domestic content and reducing imports, and increasing linkages with high-priority sectors identified as engines of growth in other key roadmaps.

Increase competitiveness of chemical industry:

Position Malaysia as the leading market for chemical exports in Southeast Asia, serving the fast-growing regional and broader APAC market, and establish Malaysia as the top investment destination for the chemical industry in Southeast Asia.

Improve sustainability of chemical industry:

Support Malaysia's overall climate ambitions and contribute to reducing the carbon intensity, while enhancing the socio-economic contribution of the industry to the Malaysian economy through the creation of new high-skilled jobs.

Introduce technology to advance state of chemical industry:

Establish regional leadership for selected high-technology products through in-country innovation and technology development.

In order to measure the success of Malaysia's chemical industry and evidence progress on the path to 2030, the CIR2030 will track key metrics across these five themes, inclusive of mid-term targets.

Key metrics to track progress towards aspirations

Themes	Metric	2019	2025	2030	Comments
Industry Value Add	GVA[1]	>3.4%	>3.7%	>4.5%	• Increase share of high-value add chemicals (i.e., production of composites, Engr. Plastics, Care Chemicals, Electronic Chemicals, etc.); will help counteract the impact of commoditisation/margin erosion in basic chemicals
Industry Integration	Import-export ratio[2] (%)	<96%	<90%	<70%	• Reduced import dependence in key industries (e.g., rubber for gloves, vegetable seeds for agriculture, composites value chains for aerospace)
Competitiveness	FDI Inflow ($)	#2 in ASEAN	#2 in ASEAN	#1 in ASEAN	
	Export value ($)	#3 in ASEAN	#2 in ASEAN	#2 in ASEAN	
Sustainability	Carbon emission reduction (%)		10%	45%[5]	• 2030 target aligned to NRECC's targets
	% Recycling rate[3]	24%	>30%	50%	• Recycling or use of bio-based feedstock for plastics and synthetic rubber in line with circular economy practices
Technology & Innovation	# Hubs for high tech products[4]	0	>1	>5	• ASEAN hub for bioplastics, biopesticides, EFF, IC Packaging chemicals, etc.

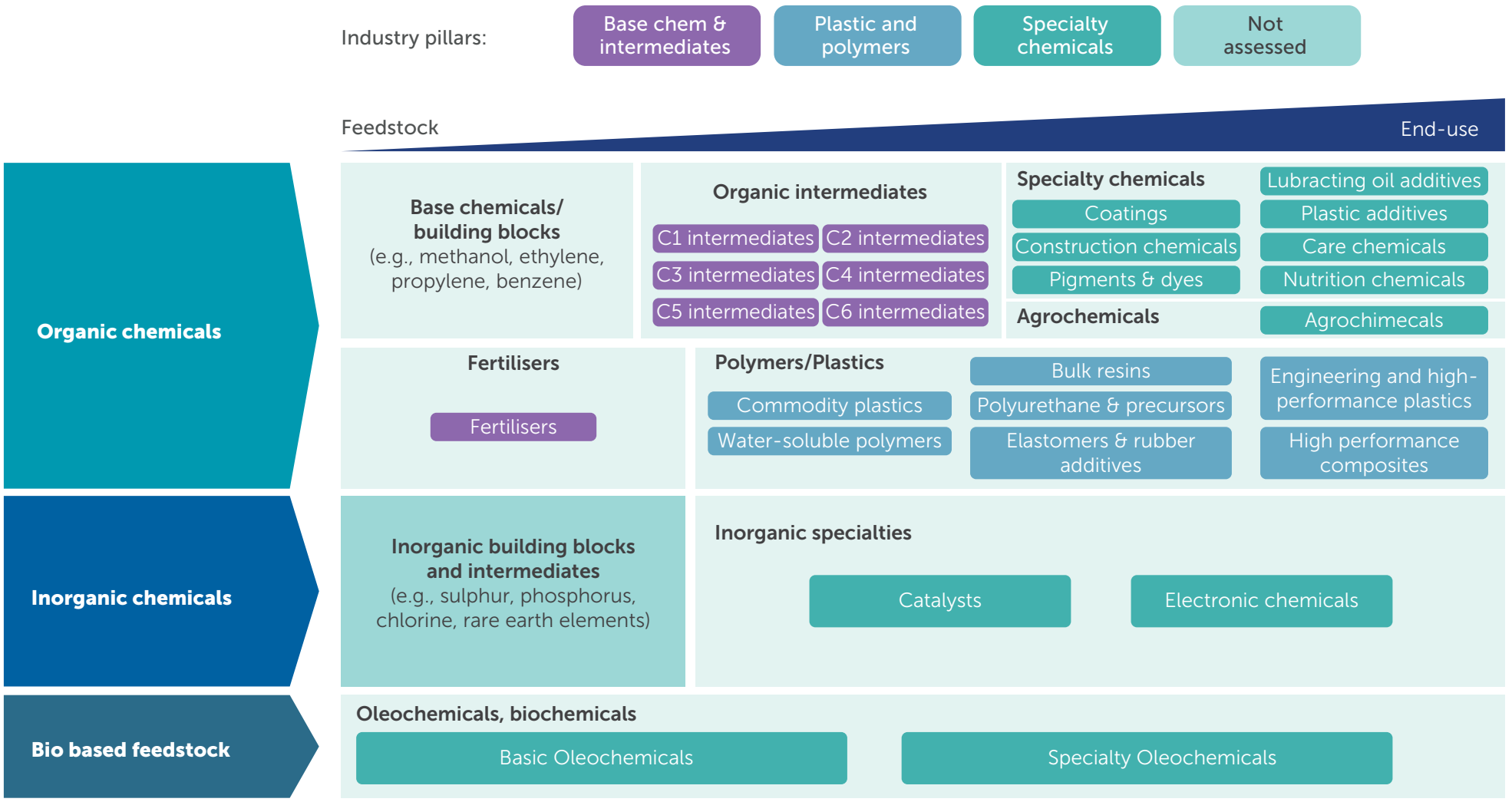
1. Gross value add of industry 2. Calculated as chemical import value/chemical export value. 3. For plastics 4. Top 2 producer in ASEAN for products that are highly technology intensive (e.g., specialty chemicals) or still nascent in commercialisation (e.g., biopesticides, bioplastics) 5. Versus baseline of 2005, includes 15% carbon emission reduction from carbon credits

Strategy for the Chemical Industry Roadmap


Competitive feedstock
Long-term view
Diversification
Cross-sectoral approach
Aligned outcomes

The chemical industry is a vast global industry and one in which Malaysia is already established across several distinct value chains and product areas. This report covers over 25 sub-segments of the industry, spanning from feedstock to end-use product segments, encompassing organic chemicals, inorganic chemicals, and bio-based feedstock.

Market assessment segments



In identifying the most attractive segments to serve as the foundation for the CIR2030 strategy, it was evident that no country could realistically seek to achieve rapid development across all segments. As such, efforts were focused on a prioritisation approach to provide a path to unlock value in a targeted, effective, and practical manner for the domestic chemical industry. While the CIR2030 focuses on several prioritised segments, an industry segment not prioritised by the CIR2030 may still be developed by companies based on their own unique strategies and business focus.

In developing a comprehensive strategy for the CIR2030, five principles for assessment were established:

1 Long-term view

Assess megatrends and other viable technologies which may be nascent today but offer ample potential to mature over the timeframe up to 2030.

2 Competitive feedstock

Assume sustainable, market-based pricing of feedstock and utilities to ensure the industry is positioned to compete over the long run.

3 Diversification

Prioritise development across the chemical spectrum, inclusive of base chemicals and intermediates, plastics and polymers, and specialty chemicals. It incorporates a wide range of use cases covering both local consumption and exports, to ensure portfolio resilience.

4 Cross-sectoral approach

Take a cross-sectoral view on impacts of critical enablers that cut across the key strategic focus areas.

5 Aligned outcomes

Tie desired outcomes to overall aspirations for the chemical industry, ensuring alignment of goals to deliver a positive socio-economic benefit to Malaysia.

Priority segments

Leveraging our established principles of assessment, a comprehensive prioritisation exercise based on market attractiveness, strategic relevance and advantage was conducted to identify the sub-segments of the chemical industry ecosystem which offer the most attractive development proposition for Malaysia.

These sub-segments were then clustered into three distinct categories of base chemicals and intermediates, plastics and polymers, and specialty chemicals. In summary, across the three categories of the ecosystem, 11 segments were prioritised for strategic development.

Summary of priority of sub-segments

Base chemicals & intermediates

1. Fertilisers
2. Oleochemicals
3. C1 Intermediates

Plastics and polymers

4. High-performance composites
5. Synthetic rubber
6. Plastics (commodity, engineering, high-performance)

Specialty chemicals

7. Agrochemicals
8. Care Chemicals
9. Nutrition Chemicals
10. Electronic Chemicals
11. Construction Chemicals

Category 1

Base chemicals and intermediates

Fertilisers

Composed of nitrogen, phosphorus, and potassium compounds. Commonly applied to soil or to plant tissues to supply plant nutrients.

Oleochemicals

Chemicals derived from natural sources such as plant fats, i.e., palm oil, palm kernel oil, and other palm products as major feedstocks. These are core building blocks for personal and home care products such as shampoo, detergent, toothpaste, and moisturisers. Oleochemicals have particularly strong synergies with care chemicals.

C1 intermediates

Chemical intermediates originating from the methane (C1) chain with methanol, urea, and formaldehyde as building blocks. Major chemicals include acetic acid, polyvinyl acetate (PVA), formaldehyde, and urea formaldehyde (UF) resins, used for various industrial purposes such as base materials for acrylic plastic, paints, clothing fibres, and agrochemicals.

Category 2

Plastics and polymers

High-performance composites

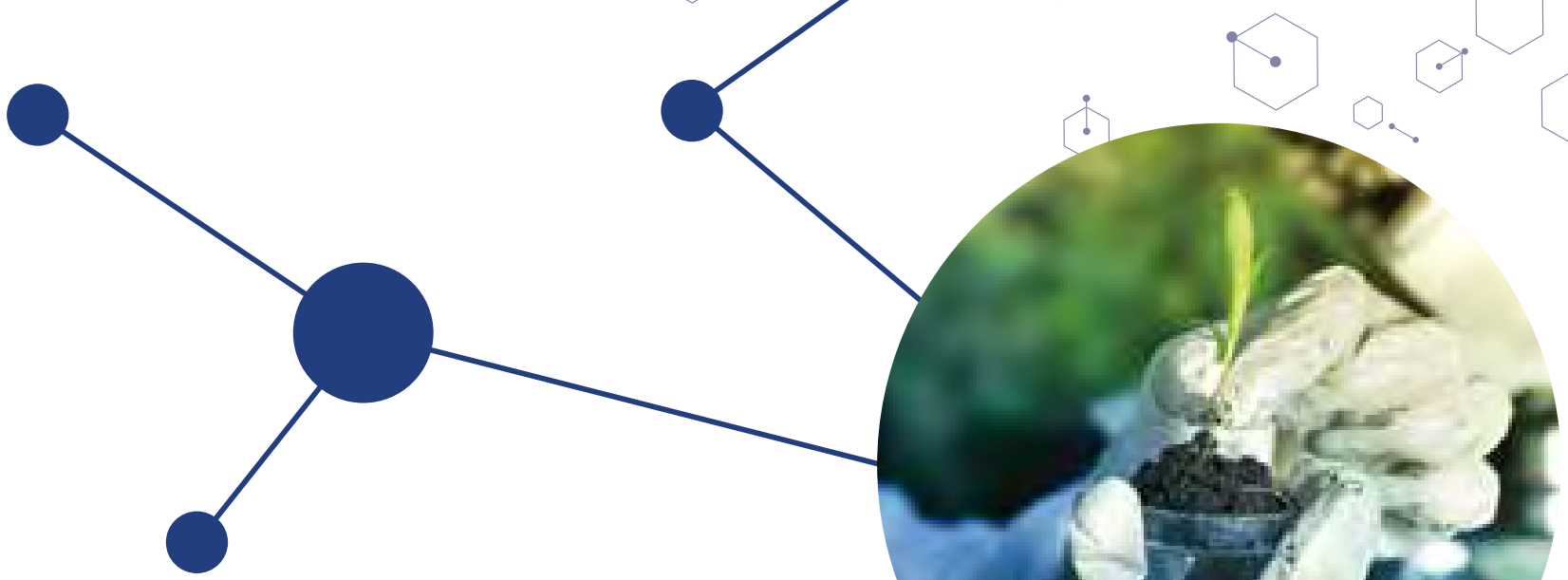
Composite materials include reinforcement, such as fibres and fillers, alongside matrix polymers and metals. Primarily, they are used as advanced materials for the aerospace, high-end automotive, and construction industries.

Synthetic rubber

Polymers with high viscoelasticity are synthesised from petroleum by-products to manufacture tyres, automotive parts, as well as medical equipment such as gloves.

Plastics

An enabler in the supply chain that provides support to many other major sectors, including electrical and electronics, food and beverage, automotive, and construction. There are three major types—commodity plastics, engineering plastics, and high-performance plastics—all of which have distinct mechanical and thermal properties that dictate their applications.



Category 3

Specialty chemicals

Agrochemicals

Chemical products utilised in agriculture to improve crop yield and control populations of agricultural pests and divided into two areas of crop protection, i.e., pesticides such as herbicides, insecticides, fungicides and seeds.

Care chemicals

Chemicals are used to make various home care, personal care, and industrial cleaning products such as soaps, detergents, moisturisers, etc. Care chemicals such as surfactants and emollients use oleochemicals as feedstock, creating strong synergies with Category 1.

Nutrition chemicals

A wide range of formulated food-related chemicals, including flavour and fragrances such as aroma chemicals, food additives such as emulsifiers and sweeteners, feed additives such as parasite removers and digestion enhancers, and nutraceuticals such as probiotics and liver supplements.

Electronic chemicals

Chemicals are used in the electronic industry to manufacture semiconductor-related components. It includes chemicals used in wafer production, such as silicon and specialty gases, integrated circuit packaging with various resins, and printed circuit board manufacturing, such as ceramic substrates and epoxy-based encapsulants.

Construction chemicals

Chemical formulations are used for cement, concrete, or other construction materials to increase durability, improve performance and reduce the use of the natural resources. Key sub-segments include concrete admixtures, adhesives, and sealants. Typical precursors include carboxylic acids, polyurethane, and various epoxies.

Strategic focus areas

For each of the 11 prioritised sub-segments, strategic focus areas have been identified through a four-step analysis process in order to design a practical, actionable, and aspirational strategy for Malaysia's chemical industry.

Base chemicals and intermediates

Priority sub-segment 1: Fertiliser

Malaysia has a mature and significant presence within the fertiliser sub-segment today, producing 4.5 mtpa annually[22]. Major Malaysian producers such as PETRONAS Chemicals Fertiliser Kedah, PETRONAS Chemicals Fertiliser Sabah, Agrifert, and ASEAN Bintulu Fertilizer are focused on nitrogen-based fertilisers due to domestic feedstock availability. There is a limited presence currently in mineral-based potassium and phosphorus fertilisers due to a lack of inorganic feedstock. Small volumes of synthetic environmentally friendly fertilisers (EFF) are being produced by niche fertiliser companies such as SK Specialties and Greenfeed Agro.

Fertiliser production baseline in Malaysia

	Nitrogen based					Potassium-based			Phosphorus-based		NPK compound	Synthetic EFFS[1]
	Urea	Ammonia	Ammonium Nitrate	UAN Solutions	Ammonium Sulfate	Potassium Chloride	Potassium Sulfate	Potassium Nitrate	Ammonium Phosphate	Super Phosphates		
Gurun, Kedah											✓	
Bintulu, Sarawak, Pasir Gudang, Johor Port Klang, Selangor Sandakan, Sabah	✓										✓	
Pasir Gudang, Johor	✓					✓					✓	
Bintulu, Sarawak Gurun, Kedah Kertih, Terengganu Sipitang, Sabah	✓	✓										

Produced by 6 smaller players with individual capacity of up to 30ktpa (e.g., SK Specialties, Greenfeed Agro, Nufarm)

1. Environmentally friendly fertilisers
Source: IHS, Company websites

[22] *IHS Markit*

Malaysia's fertiliser industry today faces several challenges, including a need for improved fertiliser, technologies such as slow-release fertilisers to reduce labour shortage issues in the downstream agriculture industry. Aligning research between industry and academia would also enable greater commercialisation.

In the regional market landscape—except for Malaysia and Indonesia—Southeast Asian countries are currently net importers of fertilisers. Forward-looking projections for 2025 indicate that Thailand, the Philippines, India, and South Korea are potential export targets for Malaysia. However, margins for urea and ammonia globally are being challenged due to overcapacity, with global operating rates expected to be below 75% by 2025[23].

Globally, several trends are emerging that will continue to shape the future of the fertiliser industry. Sustainability remains high on the agenda both in processes of application (e.g., precision agriculture to optimise inputs and minimise waste) and in products (e.g., adoption of EFFs). EFFs are fertilisers that can reduce environmental pollution from nutrient loss by retarding, or even controlling the release of nutrients into the soil. EFFs are typically coated with a polymer and release fertilisers in a controlled manner. Regulators and consumers are increasingly focused on sustainable farming, and expanding population and growth in affluent middle-class demographics will also drive demand for protein, hence increasing agricultural output.

[23] *Nexant – Profitability and Price Forecasts*

Strategic focus area 1

Increase local production of EFFs

Increase the local production of EFFs with an export-focused outlook. This strategy is in line with Malaysia's overall sustainability agenda and taps into the value potential of technology and innovation enablers. This also leverages the synergies between the fertilisers sub-segment and formaldehyde (C1 intermediate) and polyethylene (plastics). EFFs are still nascent in the industry with no leading player in Southeast Asia, presenting an opportunity for Malaysia to develop a niche competitive advantage in this area. Demand for EFFs is also rapidly growing, with CAGR up to 1.5 times higher than that of typical NPK fertilisers, and thus, presents an opportunity for Malaysia to participate in a fast-growing sub-segment of fertilisers.

Baseline	Aspiration
Less than 0.1 mtpa of EFFs (e.g., controlled-release fertilisers, slow-release fertilisers and bio-composts) produced today, or about 2% of Malaysia's total fertiliser production.	Aim to achieve at least 10% of all fertilisers produced in Malaysia as EFFs, increasing production from < 0.1 mtpa to 0.5 mtpa and growing this production base as the overall domestic production grows.

Strategic focus area 2

Modernise manufacturing capabilities to be more competitive and sustainable by leveraging new technologies (e.g., green ammonia)

Aligned with the sustainability megatrend, the deployment of new technologies opens the opportunity for the fertiliser industry to diversify the application of ammonia into a premium market of hydrogen fuel while building long-term sectoral resilience amidst shrinking margins and swiftly changing trends. In addition, this will also reduce the high energy consumption and carbon emissions of this sub-segment, supporting Malaysia's sustainability aspirations.

Baseline	Aspiration
No commercial scale production of blue and green ammonia with several companies evaluating its feasibility.	Establish Malaysia as a top opportunist regional player of blue and green ammonia.

Priority sub-segment 2: Oleochemicals

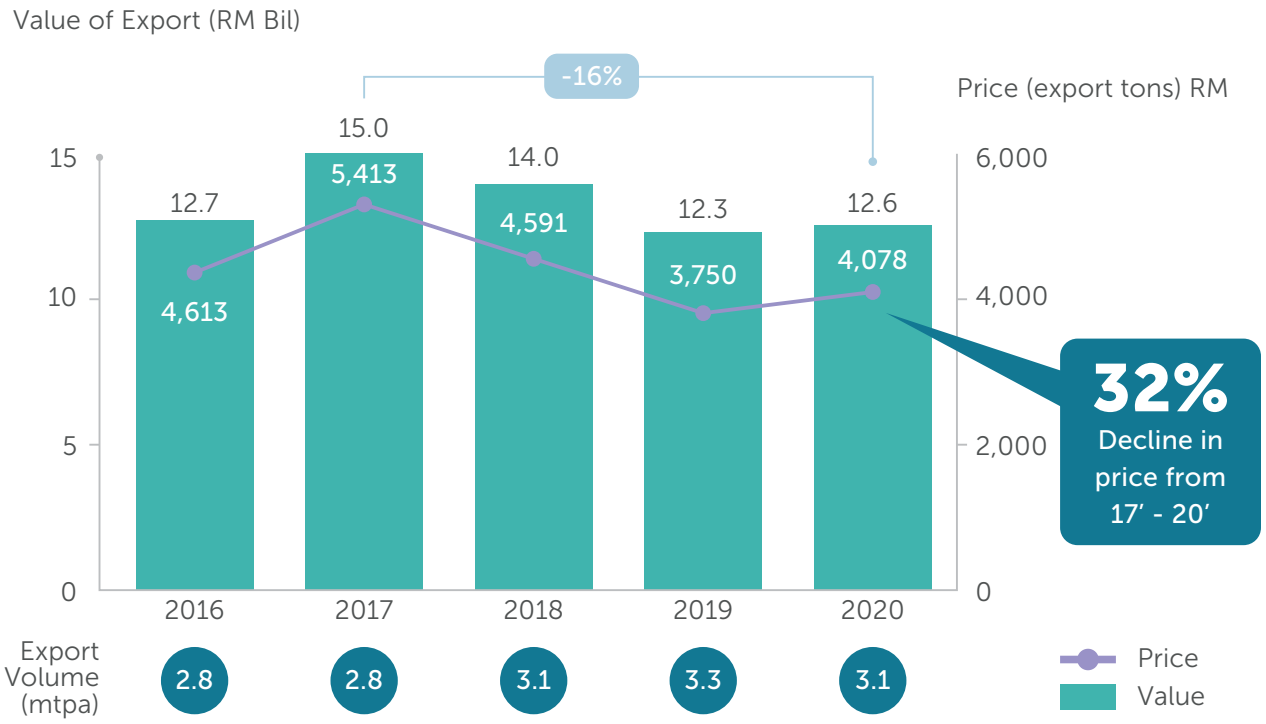
Malaysia is blessed with abundant palm oil reserves, contributing to its position as the second largest oleochemical producer in the world today, behind Indonesia. Malaysia is capable of producing close to 3.5 mtpa[24], approximately 20-25% of the total global demand for oleochemicals, but is highly focused on basic oleochemicals such as fatty acids, fatty alcohol, and glycerine. There are several players in the downstream oleochemical specialty derivatives, producing methyl salts and bienzymatic processes for detergent, which include sulphates, ethoxylates, and olefins.

A number of world-class oleochemical players have established their bases in Malaysia, some of which have high levels of vertical integration (e.g., KLK, IOI Group), enabling such companies to be actively involved in the downstream value chain, such as specialty oleochemicals and care chemicals. These companies are also highly automated and modern, enabling stronger cost efficiencies.

Despite this favourable position, there remain some notable challenges moving forward. Indonesia has the advantage of supportive fiscal policies (e.g., export tax and levies) benefiting its palm oil and finished oleochemical exports, making it difficult for Malaysian players to compete in certain sub-segments. Oversupply of oleochemicals is also leading to shrinking margins of basic oleochemicals. In the four years from 2017 to 2020, Malaysia's export value decreased by approximately 16%, largely due to margin erosion.

Oleochemical exports in Malaysia

Total Export Value and Average Price of Oleochemical Exports Per Ton (RM)



Source: ICIS, MPOB, MPOC

Commentary

- **Export value** has **decreased by 16%** strongly driven by **price decrease of 32%** across past 4 years
  - **Margin erosion trend to persist** with oversupply/capacity build up in Indonesia
- **Volume** – apart from 2020 - continues to **grow due to demand in end markets** in personal/home care
- **Key export markets** for Malaysia include:
  - China (18%)
  - EU (15%)
  - USA (10%)
  - India (7%)
  - Japan (6%)

[24] *Malaysian Oleochemical Manufacturers Group*

Global shifts and public perception regarding sustainability create additional new challenges, with restrictions in the EU for certain palm oil-based products creating potential export issues. Malaysia is currently undertaking actions to improve this aspect of its domestic ecosystem, pushing to promote the Malaysian Sustainable Palm Oil (MSPO) certification, as well as making strides to embed traceability within the value chain via the e-trace program, estimated to be launched by 2023.

Oleochemicals represent a USD21bil global market and are growing at 3.9% CAGR[25], driven by strong demand from sectors requiring plant-based chemicals such as personal care and home care, coupled with the global movement towards more environmentally friendly and sustainable products. Oleochemicals remain a more sustainable alternative to petrochemicals in many product use cases.

Sustainability will be a persistent megatrend with far-reaching impact over the next decade, reflected in oleochemicals in areas such as certification, end-to-end traceability, and regulatory drives towards more sustainable produce in markets for end users.

[25] IHS Reports; Grand View Research; expert interviews; BCG

Strategic focus area 1

Strengthen play in basic oleochemicals

Build Malaysia's competitiveness in basic oleochemicals, using this strong foundation to then expand into more downstream specialty oleochemical products with greater value-add (see Strategic Focus Area 2 below). This strategy ensures that Malaysia is recognised globally as a top oleochemical producer and continues to capitalise on strong export revenue. This strategy also allows Malaysia to capture the most value of its abundant natural resources (e.g., palm oil).

Baseline	Aspiration
Malaysia has a current capacity to serve 20-25% (~3mtpa) of global demand for basic oleochemicals.	Supply 30% of global basic oleochemical demand by 2030.

Strategic focus area 2

Increase share of specialty oleochemicals (e.g. sulphates, esters, ethoxylates)

Capitalise on the success of the established oleochemical industry within Malaysia, and leverage this as the building blocks to further develop downstream specialty chemicals. This will mitigate the margin pressures on basic oleochemicals while enabling further technology development within the sub-segment. It will also enhance differentiation versus other countries, carving out potentially lucrative niches within the specialty space. Increased production of specialty oleochemicals can be offloaded in both local downstream markets, as well as in EU and USA markets. Cross-sectoral collaboration (e.g., between oleochemical and petrochemical industries) will also be required to drive this agenda forward as some of the downstream industries, like personal care, typically require formulations that are derived from both oleochemicals and petrochemicals.

Baseline	Aspiration
The share of specialty oleochemicals today is less than 5% of the overall Malaysia's oleochemical portfolio.	Develop 30% share of specialty oleochemicals within Malaysia's oleochemical portfolio by 2030.

Strategic focus area 3

Boost sustainability of oleochemicals value chain

Closely aligned to the national sustainability agenda whilst ensuring products remain relevant to global markets, this strategy offers the potential to improve the margin of Oleo products through a sustainability premium. Malaysia is already on the right track toward improving the sustainability of the end-to-end value chain through increasing MSPO certification and the upcoming e-trace programme. Malaysia should also aim to promote recognition of MSPO certification in global markets, particularly with key trading partners. Any further revamp or enhancement of MSPO certification should take into consideration best practices adopted by global standards such as the RSPO certification.

Baseline	Aspiration
While 88% of total oil plantation areas have been certified, only 40% of smallholders in Malaysia are certified.	Achieve 100% sustainably produced and certified palm oil and related value chain.

Priority sub-segment 3: C1 intermediates

C1 intermediates cover a wide range of chemicals, with the largest global markets in acetic acid, PVA, formaldehyde, and UF resins. Malaysia's chemical industry incorporates a number of these key derivatives and is a net exporter of acetic acid, PVA, and UF resins. Trade in formaldehyde is limited globally due to stability concerns with storage and transport, and it is instead consumed captively in UF, phenol-formaldehyde (PF), and melamine-formaldehyde (MF) resins.

Malaysia has several domestic and global players to meet both local and export demands. Both acetic acid and polyvinyl acetate, with low local consumption of 80 ktpa and 29 ktpa[26], respectively, are served by local major producers respectively—INEOS PCG Acetyls, which offers 500 ktpa production capacity of acetic acid, and Dairen Chemical Corp offering 60 ktpa in production capacity for polyvinyl acetate[26]. This is sufficient to meet local demand and enough to fulfill most of Southeast Asia's total demand.

In the area of formaldehyde and UF resins, Malaysia's relatively higher local consumption of 134 ktpa and 510 ktpa[26], respectively, is met by a number of smaller players. These products are primarily used as adhesives in the lumber industry and served by companies such as Hexza, Hexion and Bintulu Adhesives and Chemicals.

Consumption and exports for C1 intermediates in Malaysia

Key commentary

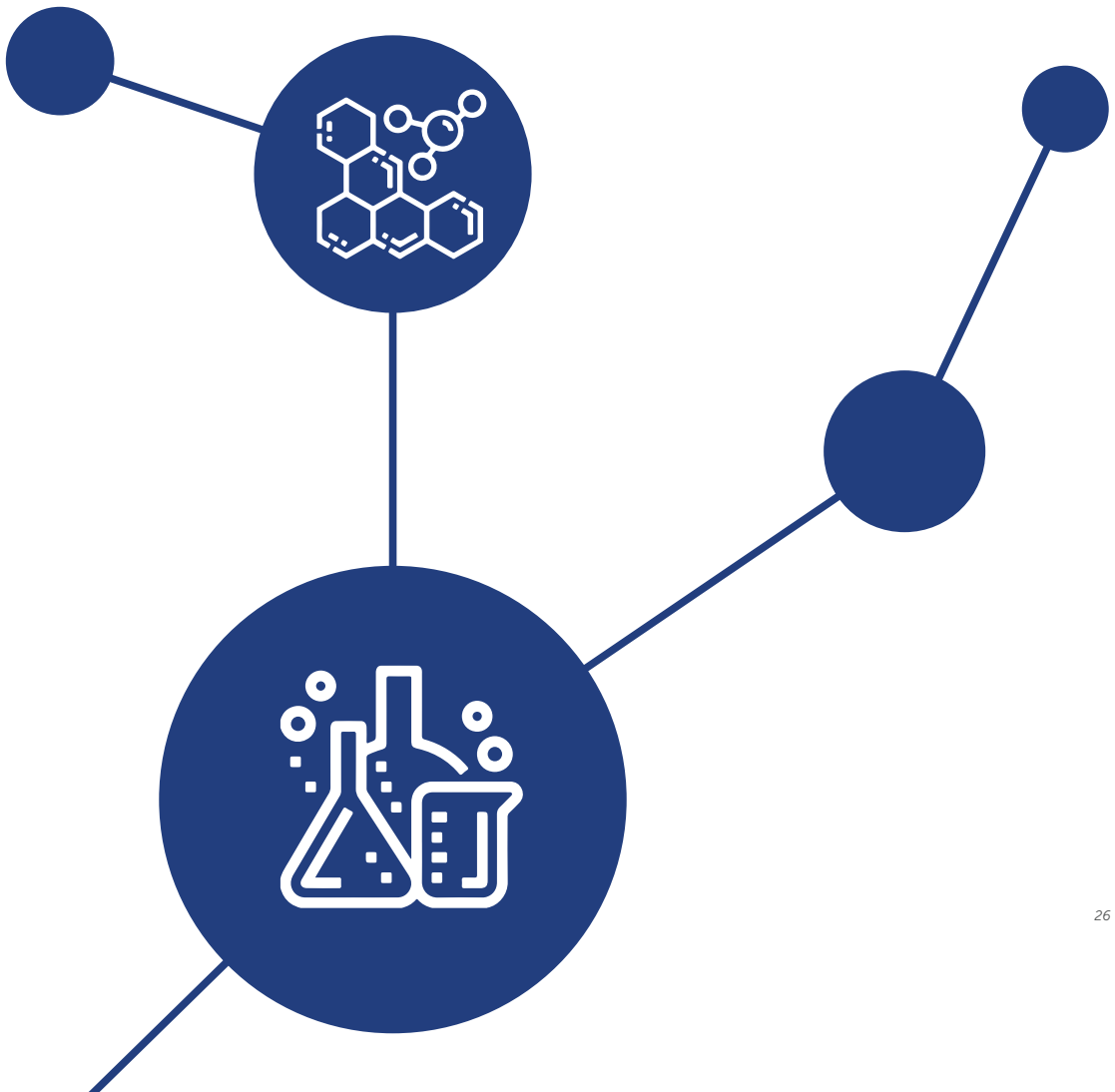
- Malaysia is the **largest exporter of acetic acid in SEA**, with **primary destinations being India, Thailand and Indonesia;** during 2019-2020, it exported > 80% of domestic production
- **Thailand is the key export destination** of Malaysian UF resins; in 2019, it accounted for 70-80% share of total exports volume
- Malaysia is a net exporter of PVA with key destinations being **India, Vietnam and Indonesia**
- Formaldehyde **trade is limited across globe** due to stability concerns with storage and transport, and higher expense of shipping commercial aqueous solutions
  - Majority of production is located close to consumption centres; **in Malaysia, it is largely consumed captively** in production of UF, PF and MF resins

1. Denotes gross weight; Polyvinyl acetate includes aqueous and nonaqueous PVA, and vinyl acetate copolymers
Source: Nexant; IHS Markit; UN Comtrade

[26] *IHS Markit; Nexant*

Globally, acetic acid is a fairly consolidated market, requiring technology licenses to manufacture. The top 15 players control 75% market share[26], with majority of the market (>65%) concentrated in China and Northeast Asia. Given Malaysia's access to feedstock and central location to serve fast growing markets in Southeast Asia, India and beyond, there is a growing interest from players to establish plants in Malaysia. Formaldehyde, on the other hand, has a highly fragmented market due to its localised nature. Meanwhile, PVA is heavily concentrated in China, home to over 65% of the total global market[26].

There are two key trends in C1 intermediates worth highlighting. Formaldehyde is highly carcinogenic, and as such, there are increasingly strict regulations of usage and for trade, limiting future opportunities for this product. UF resins are also at risk of substitution by MF resins as a result of sustainability concerns, with UF resins potentially causing fugitive formaldehyde carcinogenic emissions.



Strategic focus area 1

Increase production of acetic acid derivatives to serve growing markets in Southeast Asia and Asia Pacific

Capitalise on Malaysia's existing momentum in acetic acid investments to venture into high-technology and higher value-added derivatives (e.g., ethylene-vinyl acetate (EVA)). This will enable the country to tap into the growth of a market with a projected CAGR of 4.9% while serving key growth markets in India and Thailand.

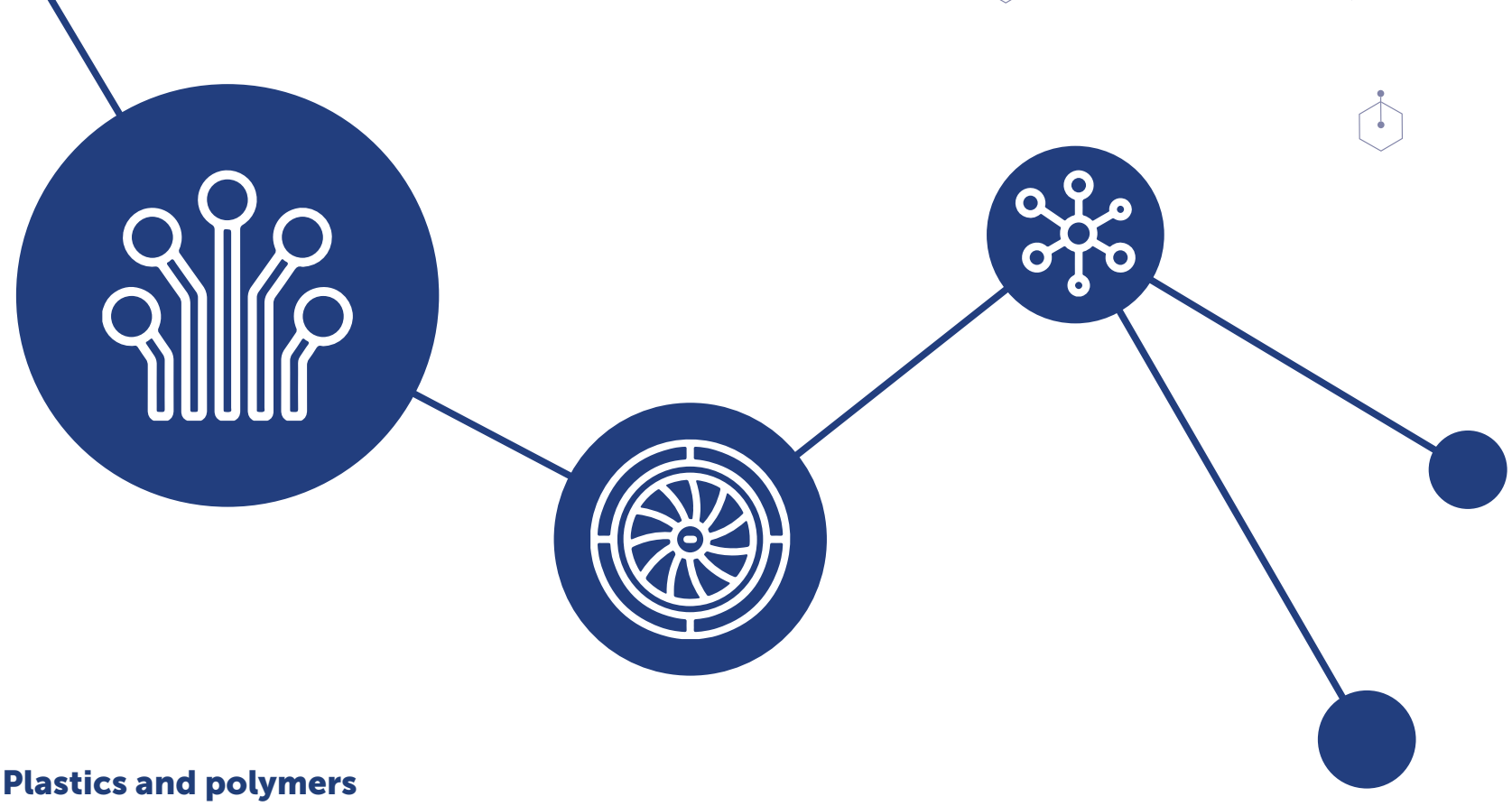
Baseline

Malaysia is already the leading exporter of acetic acid in Southeast Asia but with less play in derivative products relative to acetic acid.

Aspiration

Maintain Malaysia as the leading exporter of acetic acid and establish its derivatives production base for Southeast Asia's demand.

[26] IHS Markit; Nexant



Plastics and polymers

Priority sub-segment 4: High-performance composites

Malaysia has made significant strides in recent years to boost penetration in the high-performance composites sub-segment, aligned with national aspirations to become a leading downstream aerospace hub in Southeast Asia. Companies such as Composites Technology Research Malaysia (CTRM), Aerospace Composites Malaysia (ACM), and Nippon Electric Glass are established and expanding domestic players that produce various composite product parts such as glass fibre. These products are frequently used to manufacture wing surfaces and other aerospace parts.

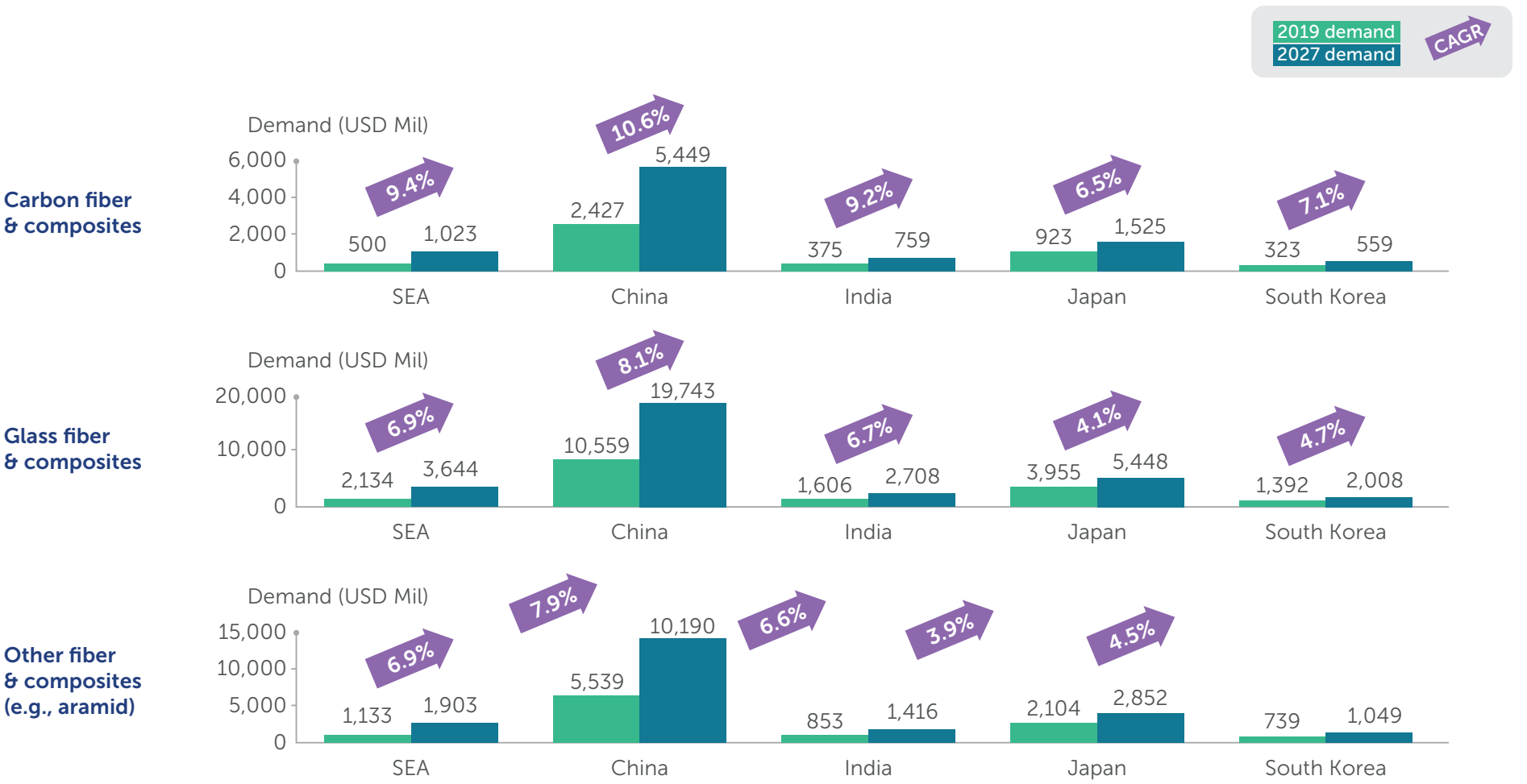
Despite recent expansions in production, Malaysia is still highly dependent on imports to meet its overall high-performance composite needs for glass fibre, carbon fibres and other fibres, with a significant share of those imports relying on China, amongst other countries. The nation's net export deficit in these high-value products stood at around 5ktpa in 2019[27], driven by the needs of large manufacturing sectors such as aerospace and automotive, as well as construction.

There are several challenges which are hampering efforts to accelerate growth. Malaysia has limited capabilities, with just 1,000 specialists[28] with a composite skillset lower than the ecosystem requirements for extensive building of composite materials and parts. Suppliers also reveal notable gaps in capabilities and standards, meaning they are unable to adequately service the more complicated composites space. Equally, the ecosystem lacks integration and competitiveness from materials (i.e., pre-preg) standpoint, which is required to ensure sufficient standards of products. Another limitation is the lack of precursor industries, such as fibre production, which are fundamental components to composite production. Improving these sub-segments would help improve value-chain integration and competitiveness of the composites industry.

[27] UN Comtrade
[28] Composites internal syndication session

Currently, most countries within Southeast Asia are net importers of key composites. The wider Asia Pacific market is valued at USD3.8bil as of 2019[29], and is projected to see a significant 7.2% CAGR[30] over the next five years, representing a substantial market opportunity. Large pockets of emerging plays are likely to be established within the composite space to tap into this high-growth market.

Composites consumption in Asia Pacific



Source: Allied Market Research

In terms of global trends, several key themes have emerged. Carbon-fibre-reinforced-polymer (CFRP) is still too costly—at least two times more expensive than glass-fibre-reinforced-polymer (GFRP)—to be widely utilised in the automotive sector and hence is limited to high-end vehicles segments. This means there is little room for Malaysia to tap its large downstream automotive sector until CFRP prices become more competitive. Composites are also increasingly penetrating wind manufacturing and construction, providing potentially lucrative plays for Malaysia in the future. This will rely on Malaysia developing and boosting domestic capabilities through the aerospace-composite value chain.

[29] *Allied Market Research*
[30] *IHS Markit*

Strategic focus area 1

Develop composite manufacturing capabilities and competitiveness in pre-pregs/fabric value chain with focus on aerospace composites

Malaysia is positioning itself to be a global leader in aerospace manufacturing through the Malaysian Aerospace Industry Blueprint 2015-2030. This goal will be significantly enabled by the presence of a mature local composite industry. Strengthening local composite capabilities will provide a cost and quality advantage to the aerospace industry. Given the strong inter-linkages between various steps of the composites value chain, it is critical to localise as much of the value chain as possible.

Baseline	Aspiration
Malaysia is currently a net importer of approximately 5 ktpa of composites.	Develop the local composite production industry to increase self-sufficiency inclusive of the needs of the expanding aerospace market.

Strategic focus area 2

Develop fibres and resin precursor industries to allow composites backwards integration

Malaysia has established local capabilities in resin production (e.g., polyethylene, polypropylene), but further efforts are needed to build capabilities in fibre manufacturing, providing a precursor to enable backward integration of composites. Malaysia currently imports glass fibers and carbon fibers from APAC countries. Domestic production of these high-value fibers will increase the competitiveness of the local composites industry, as well as support downstream use of locally-produced resins. Local production of fibers can also be used to serve the fast-growing regional demand in Southeast Asia (> 9% per annum for carbon fibers and > 6% per annum for glass fibers).

Baseline	Aspiration
No development of glass fibres and carbon fibres today for pre-preg manufacturing.	Increased self-sufficiency of local fibres and resins for pre-preg demand.

Priority sub-segment 5: Synthetic rubber

Synthetic rubber has broad applications in Malaysia, ranging from tyres for the automotive industry to pipes for construction, as well as gloves for healthcare and floor covering for sports venues. The sub-segment's downstream applications generate an estimated cumulative GDP contribution of RM173bil[30], inclusive of all four major types of rubbers—SBR, polybutadiene, nitrile elastomers, and polyisoprene.

Downstream applications of synthetic rubber in Malaysia

	Automotive	Construction	Home appliances	Healthcare	Sports
GDP contribution of manufacturing sector (RM)[1]	~40 Bn ~40 Bn	~17 Bn	~7 Bn1	~56 Bn2	~14 Bn
Selected current applications	• Tires (mainly) • Hoses in the engines • Gaskets and covers	• Joints, seals and gaskets • Sound, vibration and impact absorption • Roofing and flooring • Pipes and cabling	• Gasket and tubing • Electrical insulation wiring • Bumpers, tips and appliance feat • Angle extrusions	• Medical gloves • Catheters • Diaphragms • Blood pressure • cuffs • Tubing and cords Rubber rollers	• Sports footwear and clothes • Protective padding (i.e., helmets, knees and elbow padding) • Sports equipment (i.e., balls, orthopedic bandages, diving suits, booties, etc.) • Rubber floor covering
Rubber utilised	• Nitrile elastomers • SBR • PBR • Polyisoprene	• Polychloroprene (neoprene) • SBR	• SiR	• BR • EPDM • Nitrile elastomers • SBR • SiR • Polyisoprene	• SBR • Nitrile elastomers • Neodymium butadiene • Butyl rubber • Ethylene vinyl acetate synthetic

1.Electronics industry, including home appliances; 2. 2017 data SBR = Styrene Butadiene Rubber; PBR = Polybutadiene rubber; SiR = Silicone rubber; BR = Butadiene rubber; EPDM = Ethylene Propylene Diene Monomer
Source: IHS, BCG analysis

Malaysia will soon be able to capitalise on large feedstock availability of ~ 200ktpa[31] of butadiene produced by local player Pengerang Refining and Petrochemical (PRefChem) in Johor. There are other major producers of synthetic rubber in Malaysia today, namely, Lotte Ube, a subsidiary of Lotte Chemical and Synthomer, as the main producers of polybutadiene and nitrile elastomers, respectively.

[31] *PETRONAS*

Malaysia is currently relying heavily on imports of synthetic rubber across all four major rubber types, with particularly high reliance[32] on polybutadiene (327 ktpa net imports) and nitrile elastomers (655 ktpa net imports). The majority of imports come from Asia Pacific countries such as South Korea and Japan.

Malaysia's trade position is mirrored by other regional markets, with most Southeast Asian countries positioned as net importers of synthetic rubber. Expanding synthetic rubber production will enable Malaysia to tap into significant export demand as well as domestic needs for local tyre and rubber glove manufacturing.

Globally, three major trends are influencing the market growth. Firstly, the downstream tyre and automotive sectors are requiring higher quality synthetic rubber. Secondly, the demand for synthetic rubber has structurally increased post-pandemic, with major shifts in consumer attitudes towards health, driving increased demand for synthetic rubber for glove production beyond healthcare settings. Thirdly, rising sustainability concerns are also incentivising the development of eco-friendly synthetic rubber and promoting circular economy practices through the recycling and recovery of useful chemicals from both dry and latex rubber waste.

[32] UN Comtrade

Strategic focus area 1

Develop local synthetic rubber capabilities to reduce downstream industry reliance on imports

Malaysia's significant feedstock availability provides a platform to enhance synthetic rubber production and tackle import demands, including polybutadiene (~950 ktpa) and nitrile elastomers (~760 ktpa)[32]. Leverage the major domestic production from PRefChem to strengthen polybutadiene styrene-butadiene rubber, and nitrile elastomer production. Import substitution with local production will ensure more competitive and resilient downstream rubber markets, such as glove manufacturing which have sizable contributions to Malaysia's GDP.

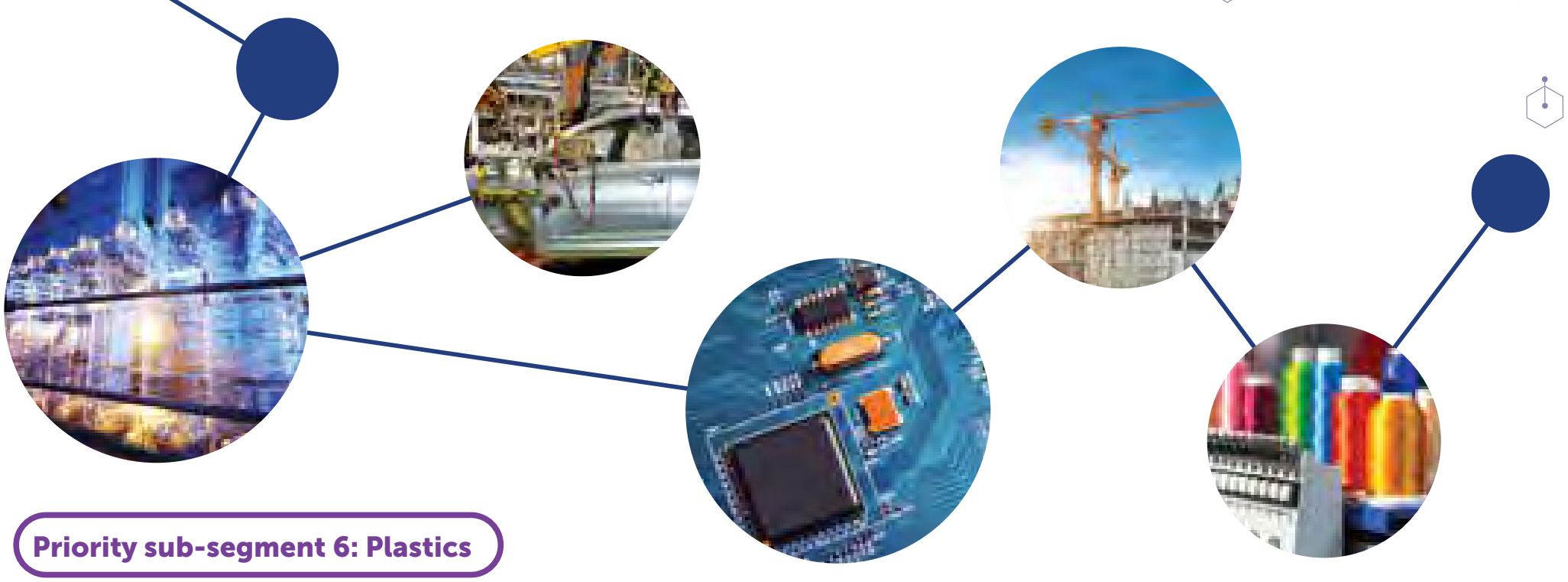
Baseline	Aspiration
84% dependence on imports with total local production capacity of 360 ktpa.	Reduce import ratio to 50% by 2030, requiring increase in local production by more than 700 ktpa.

Strategic focus area 2

Improve circular economy practices for synthetic rubber with focus on tyres and gloves

Enhance the sustainability characteristics of synthetic rubber through improvements to circular economy practices for this product. This will ensure products of the future are aligned with shifting industrial and end-user demands around sustainably produced elastomers while also complementing Malaysia's own aspirations for a strong circular economy.

Baseline	Aspiration
No circular economy practices in place today for synthetic rubber, but emerging R&D with opportunity to create products from recycled gloves (e.g., manufacturing of footwear soles).	Ensure 50% of synthetic rubber products that are manufactured by 2030 are either recycled or reused.



Priority sub-segment 6: Plastics

Plastics and polymers offer the opportunity for broad downstream applications in Malaysia. The top five applications include consumer packaging, automotive, electronics, construction, and textile industries, with the industries consuming a range of commodities, engineering, and high-performance plastics.

Established producers of plastic resins in Malaysia today include Lotte Chemical, PETRONAS Chemicals Group (PCG), Kaneka, and Toray. These companies focus largely on commodity plastics (~4 mtpa)[33], such as polypropylene and polyethylene, as well as certain niche products within engineering plastics, such as ABS and high-performance plastics, such as PPS.

From a trade standpoint, Malaysia is an overall net exporter of key commodity plastics but a net importer of some engineering plastics and high-performance plastics.

The trend towards circular supply chains, both globally and domestically, is inspiring recent shifts in focus, with Malaysia taking initial steps into recyclable products. The nation achieved a 24%[34] recycling rate in 2019, with targets to achieve 40% by 2025, as defined in various initiatives and roadmaps, such as Malaysia's Plastics Sustainability Roadmap 2021-2030. In parallel, the National Biomass Strategy 2020 targets an increased production of bioplastics to strengthen the circular economy.

Two main challenges remain in Malaysia's plastics industry today. Firstly, a shortage of low-skilled workers and an inability to recruit and retain suitable volumes of local workers, thus creating a talent gap. Only 49% of recruited workers within this sector remain in employment after six months, according to a survey by the Malaysian Plastics Manufacturing Association (MPMA). Secondly, shifting consumer perception and rising sustainability concerns are also creating an anti-plastic trend in many markets, including bans on single-use plastics emerging in some countries. These trends are forcing plastic producers to reposition supply chains and product portfolios.

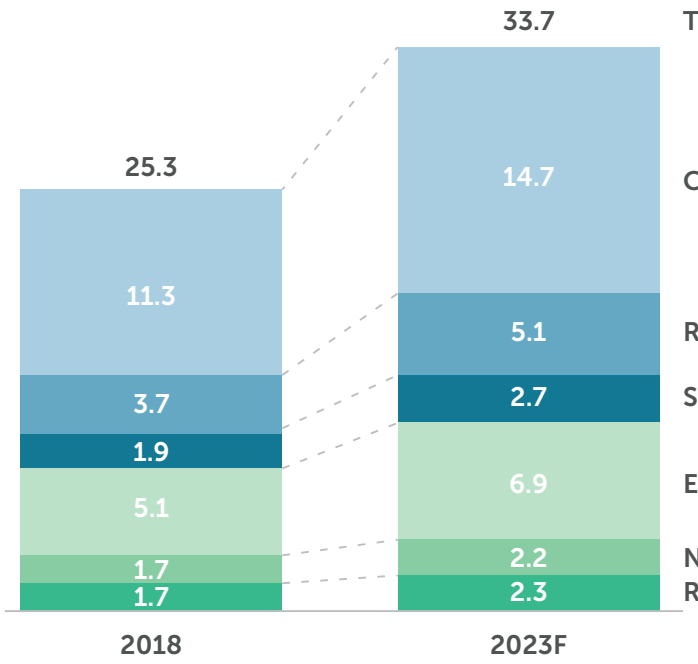
[33] *IHS Markit; Nexant; Company websites*
[34] *World Bank, Market Study for Malaysia: Plastics Circularity Opportunities and Barriers, March 2021*

Higher value-add plastics are commanding strong growth within the plastics ecosystem, with this product segment growing at 4.5%[35] CAGR globally. Within Asia Pacific, there are large demand pools for commodity, engineering, and high-performance plastics, especially in China, Indonesia, India, and Vietnam. Changing demographics and a rising middle class are also expected to drive up demand for disposable goods and packaging. Light vehicle sales present another area of opportunity in Southeast Asia, expected to grow 1.5 times[35] by 2030. Demand for engineering plastics will continue to increase at or higher than the current 4.1%[35] CAGR projections.

Three key trends will shape the plastics industry in this decade and beyond. Improvements to recycling ecosystems and technologies are being driven by global companies such as Indorama, BASF, Shell, as well as start-ups like Agilyx. These companies are testing efficient mechanical and chemical recycling technologies to achieve their sustainability goals, and continue to drive the growth of the plastic recycling market. For example, efforts are underway to develop economically feasible depolymerisation technologies. Secondly, bioplastics, which are currently less than 1%[36] of the total plastics market, are being explored as sustainable feedstock for both food and non-food packaging. Major consumer brands such as Unilever have pledged to use 25% recycled content for their packaging needs by 2025. Plastic product design has also seen some significant improvements in sustainability in recent years. For example, upstream stakeholders (i.e., petrochemical companies, specialty chemical companies, and packaging suppliers) are developing recyclable mono-material structures to replace non-recyclable multi-material structures and other plastics. Companies such as Nestle are using thinner, innovative material to reduce plastic use in packaging.

Global plastic recycling market size

Global recycled plastics[1] market size forecast (USD Bil)



	CAGR% 2018 - 2024F
Total	5.9%
China	5.4%
Rest of Asia	6.8%
SEA	**7.1%**
Europe	6.3%
North America	4.5%
RoW	5.6%

Global growth driven by commitments on sustainability from major corporations

SEA positioned to capture global growth with increasing government focus on plastic use, and a shift away from China's 'National-Sword' policy[2]

1. Recycled plastics include PET, HDPE, LDPE, PP, PS, PVC and others; 2. China strengthened restrictions on waste quality and blocked most of imported wasted in 2018
Source: BCC Research, BCG

[35] *IHS Markit*
[36] *European Bioplastics, Bioplastics market data*

Strategic focus area 1

Diversify more into engineering plastics to support downstream industries and Asia Pacific demand

Improve Malaysia's technology play in plastics through diversification into engineering plastics, at the same time increasing production of high-value-added products. This will also protect Malaysian petrochemical producers from the volatile margins of commodity plastics. In addition, this strategy also capitalises on the strong 4.5% CAGR of engineering plastics to build a growing plastics industry. It will be critical to ensure that local market demand for engineering plastics for industries such as automotive are adequately served.

Baseline	Aspiration
Malaysia produces more than 200 ktpa of engineering plastics (mostly ABS), with Southeast Asia's consumption of 1.3 mtpa. This places Malaysia's current supply of consumption at around 15% of the total Southeast Asian market.	Supply 30% of Southeast Asia's demand for engineering plastics by 2030.

Strategic focus area 2

Establish Malaysia as a major bioplastics manufacturer in Southeast Asia, capitalising on rich bio-feedstock

Leverage Malaysia's substantial feedstock from agricultural industries such as palm oil to establish Malaysia as a major bioplastics manufacturer. Align with Malaysia's sustainability agenda and journey towards improved technologies by growing synergies with the oleochemicals sector. Build on existing R&D efforts in the space from companies such as Rhodomaxx and SECOS Group, with emphasis on improving commercialisation of these technology and products.

Baseline	Aspiration
Asia currently produces ~1.3 mtpa of bioplastics with more than 40% going into the packaging industry. Malaysia already has pilot projects generating more than 10 ktpa of production.	To become one of the leading producers of bioplastics in Asia by 2030.

Strategic focus area 3

Improve circular economy through new recycling technologies and ecosystem of innovative players

Focus on expanding the recycling and reuse of plastics in line with circular economy goals, ensuring both improved technology offerings within the chemical industry and enhanced sustainability. Leverage this journey to build out a rich ecosystem of innovative players.

Baseline	Aspiration
Malaysia is currently at 24% plastics recycling rate with a 2025 target of 40%.	Achieve a 50% recycling rate for plastics by 2030. This is in line with recycling rates of countries with developed chemical ecosystems such as South Korea, Germany, and Netherlands, which all command recycling rates of more than 50%.

Strategic focus area 4

Selective expansion of commodity plastics production to satisfy regional demand and instil sustainable practices in plastics lifecycle

Increase the value-add to Malaysia's economy through selective expansion of commodity plastics production, addressing growing regional demand. Build up the sustainability practices within the plastic lifecycle in line with the overall sustainability agenda.

Baseline	Aspiration
Malaysia produces more than 4 mtpa of commodity plastics (inclusive of production volume from PRefChem), or about 15% of total SEA consumption.	Supply 20% of Southeast Asia's commodity plastics demand by 2030.

Specialty chemicals

Priority sub-segment 7: Agrochemicals

Malaysia's agrochemical industry is relatively modest, with a value of USD250mil[37] today. It is driven by crop protection products which make up approximately 90% of the market, with the other 10% comprised largely of vegetable seeds.

Import dependence and consumption for agrochemicals in Southeast Asia

	Pesticides		Vegetable Seeds	
	Import Dependence (% of total local production)	2019 Consumption (USD mil)	Import Dependence (% of total local production)	2019 Consumption (USD mil)
Vietnam	60% - 70%	600 - 700	25% - 30%	60 - 70
Indonesia	40% - 45%	550 - 600	10% - 15%	120 - 140
Thailand	60% - 70%	200 - 220	0% - 5%	75 - 90
Philiphines	85% - 90%	230 - 270	40% - 45%	40 - 50
Malaysia	90% - 95%	200 - 220	80% - 85%	10 - 15
Singapore	N/A - export only	Minimal	99%	Minimal

Source: Expert interview; BCG Analysis

Local production capabilities are limited, with a notable lack of global players currently present in the market. In crop protection, the market is dominated by three local players, ANCOM, Hextar, and Agricultural Chemicals (M) (ACM), companies with capabilities more towards sales and distribution of finished products rather than formulation of the pesticides themselves. In vegetable seeds, there are only two producers in the domestic landscape, with foreign player Enza Zaden entering in 2018, making Malaysia its Southeast Asian hub. As a result of low production capabilities, Malaysia is highly dependent on imports[37], with 90-95% import dependence on crop protection and 80-85% import dependence on seeds.

[37] *Estimates from agrochemical industry players*

Some pressures faced by the agrochemical industry include challenges competing with regional peers, who boast large markets which attract significant FDI. Thailand is the third-largest seed hub in Asia behind Japan and China, and Indonesia boasts a strong pesticide formulation industry. Local capabilities in Malaysia are also limited, lacking key auxiliary services such as testing labs for private players. Alongside this, the lengthy time taken to approve new product registration (upwards of 3-4 months) presents challenges to the ecosystem, with new market entrants unable to extensively export pesticide products and associated chemicals. While our research facilities have established R&D in areas such as biopesticides, efforts should be made to enhance the commercialisation of these technologies.

Sustainability-related products are a large opportunity in this market sub-segment, reflected in the 15% CAGR[38] of biopesticides, more than 2.5 times the growth of other products in the market. Southeast Asia's biopesticides market is still at a nascent stage, and none of these countries have yet to explicitly state the focus and provide the incentives to grow this market sub-segment, leaving a potential area of opportunity for Malaysia.

The growing importance of food security driven by rising populations also indicates that the need for agrochemicals will become increasingly strategic and important for nations in Southeast Asia and around the globe.

[38] *Allied Market Research*

Strategic focus area 1

Develop niche expertise in biopesticide technology to serve Southeast Asian markets

Develop valuable niche expertise by building out infrastructure and support for existing biopesticide research in Malaysia, driving increased speed to market for innovative new biopesticides. Ride on the strong growth of the biopesticides market which commands a CAGR of 15.1%, more than 2.5 times higher than other product segments. Leverage this shift to position Malaysia as a high-technology chemicals producer, filling the gap in Southeast Asia's biopesticide market.

Baseline	Aspiration
Existing R&D from academia, research institutes, and universities but lacks commercialisation of these new products and technologies. The is no large producer of biopesticides in Southeast Asia presently.	Establish Malaysia as an early-mover of biopesticide production in Southeast Asia by 2030.

Strategic focus area 2

Increase self-sufficiency in vegetables seeds

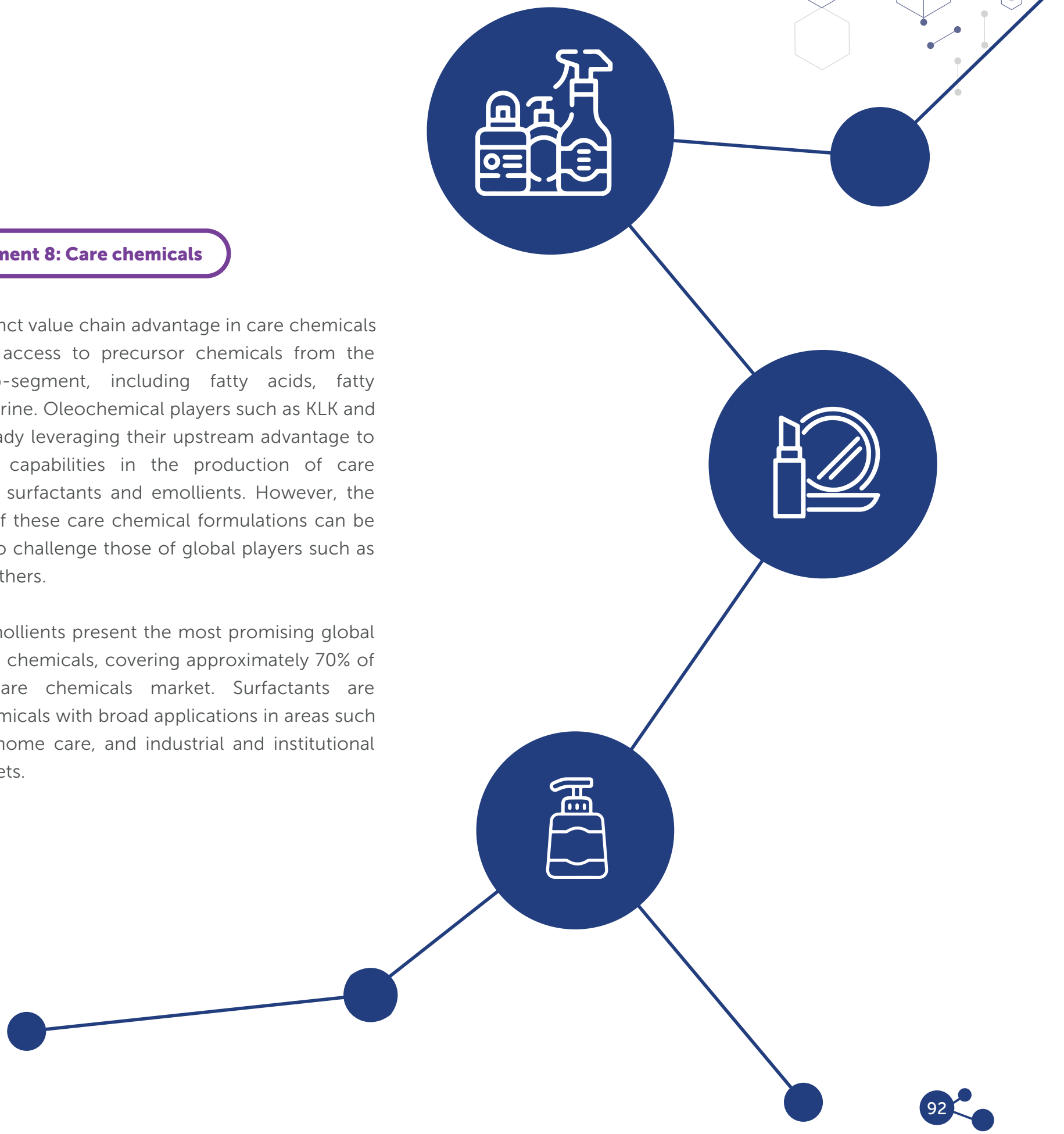
Address the significant need for self-sufficiency framed by growing global food demand through vegetable seed production. Provide a foundation to assure the domestic supply of vegetable production and enhance the resilience of Malaysia's food chain.

Baseline	Aspiration
Malaysia was around 90% dependent on imports of vegetable seeds in 2019 and is now around 80% import-dependent in 2021.	Produce 80% (i.e., 20% import-dependent) of Malaysia's required vegetable seed demand by

Priority sub-segment 8: Care chemicals

Malaysia has a distinct value chain advantage in care chemicals due to its strong access to precursor chemicals from the oleochemical sub-segment, including fatty acids, fatty alcohols, and glycerine. Oleochemical players such as KLK and IOI Group are already leveraging their upstream advantage to grow formulation capabilities in the production of care chemicals such as surfactants and emollients. However, the scale and quality of these care chemical formulations can be further increased to challenge those of global players such as BASF, Evonik and others.

Surfactants and emollients present the most promising global opportunity in care chemicals, covering approximately 70% of the USD13.2bil care chemicals market. Surfactants are multi-purpose chemicals with broad applications in areas such as personal care, home care, and industrial and institutional (I&I) cleaning markets.



Growth projections for the global downstream care market indicate an 80% expansion[39] by 2030, driven by megatrends, including the rise of the middle class, growing consumer awareness of health and beauty, and COVID-19 increasing awareness and demand for cleaning functions. Asia will drive significant demand growth, capturing one-third[40] of the global market, with trends in personal care, natural, and sustainable products fundamentally shaping the future of the care chemicals market.

Megatrends driving downstream Care markets

Five key megatrends driving Care markets

- Increasing demand from developing economies due to **increase in middle class population** with **higher disposable income**
- **Aging population** leading to demand for more health products like anti-aging etc.
- Rising consumer awareness regarding **wellness and health**, pushing demand for **more beauty products**
- Market segregation, such as strong interest towards ethnic, male grooming and age-specific products, driving **new market opportunities**
- **Covid-19 impact** to fundamentally shift consumer behaviour to be more hygiene focused

Source: IHS Markit; Mordor Intelligence

Care markets to increase 80% in the next decade

There is a need to enhance capabilities in innovation and research, regulatory know-how, and go-to-market skills to allow Malaysia to capitalise on opportunities in this sub-segment. While costly, Malaysia could also potentially look to acquire some of these capabilities in order to expedite its progress within the care chemicals market.

[39] *Mordor Intelligence Report*
[40] *IHS Markit*

Strategic focus area 1

Leverage oleochemical building blocks to expand into key personal care ingredients, then acquire capabilities to develop formulations for care products

Strengthen the integration between palm kernel oil, oleochemicals and care chemicals by leveraging the output from upstream production as input to downstream production (e.g., fatty acids and fatty alcohol serve as key ingredients for care chemicals formulation). This will enable the industry to offload any excess upstream capacity into the downstream care chemicals market in order to create higher margin products.

Baseline

Net importer of personal care ingredients, with moderately high levels of import dependence.

Aspiration

Net exporter of personal care ingredients in Southeast Asia and APAC.

Priority sub-segment 9: Nutrition chemicals

Malaysia has large downstream nutrition industries in food and feed markets, with a value of RM83bil[41] and RM6.1bil[42], respectively. The nutraceuticals and flavour and fragrance (F&F) markets are smaller in comparison at just RM1.8bil[43] and RM0.7bil[44].

Malaysia's production capabilities are stronger in feed and food additives, with only moderate import dependence in this area. There is an array of international companies established in Malaysia in this area. While production capabilities are more limited in nutraceutical ingredients, and flavour and fragrances, the import dependence on the latter is projected to fall over the coming years. This is particularly due to BASF and PETRONAS Chemical Group's (PCG) joint venture, opening a world-class aroma plant in Gebeng Industrial Park, Malaysia. The plant is already in operation, producing citral and its precursors, as well as other aromas.

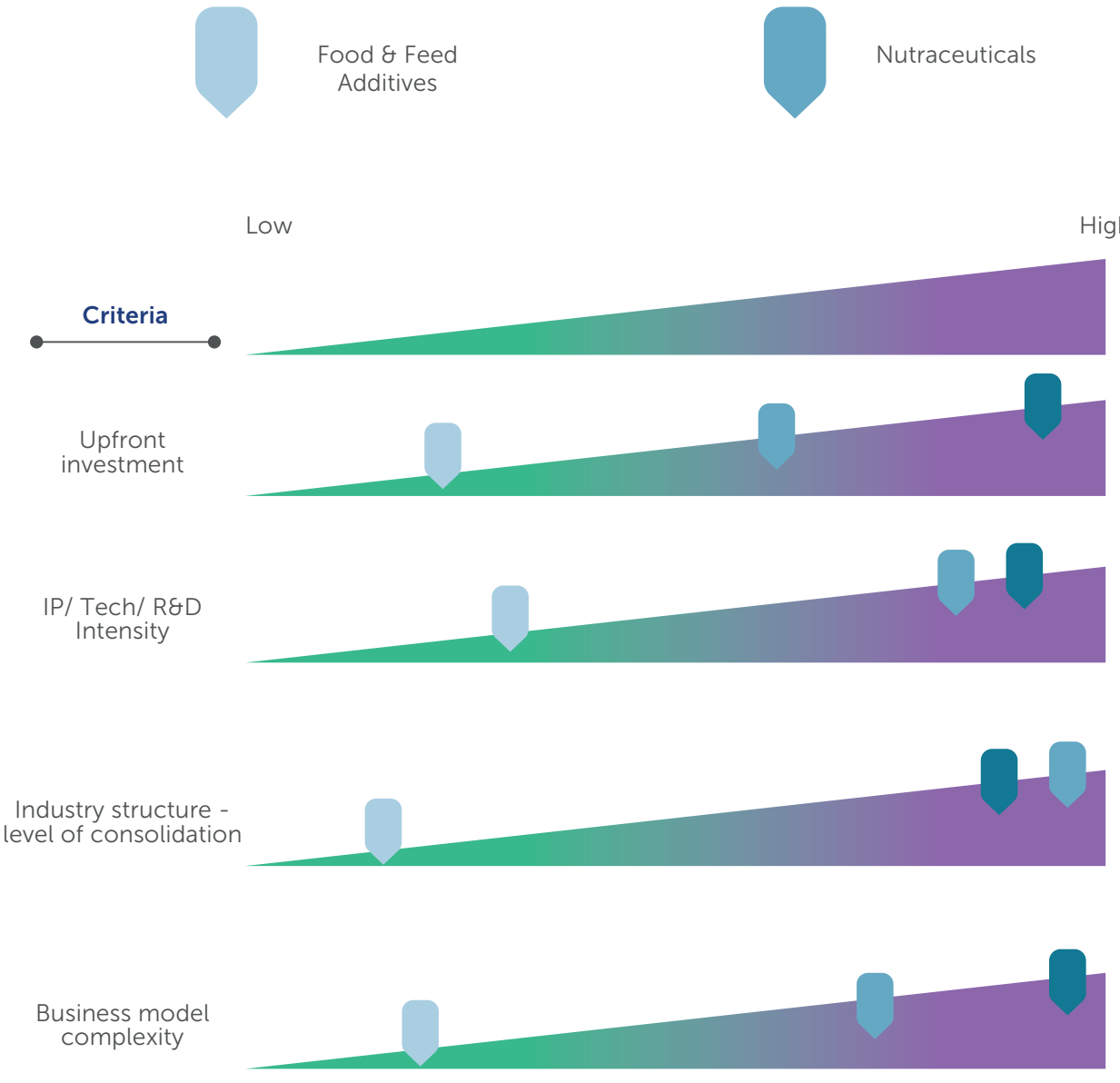
Malaysia also has strong niche plays in certain large sub-segments of the nutrition chemicals market. For example, Malaysia is the leading producer in Southeast Asia of food emulsifiers, valued at USD2.7bil globally[40], enabled by its ample supply of palm oil and glycerine. Malaysia also has a notable feed methionine market, part of the USD8.1bil[45] global market, with a total domestic capacity equal to approximately half of total Southeast Asian demand.

Flavour and fragrances, feed, and food additives account for over 90% of the USD93bil[45] global market. These products have high-value adds due to the downstream nature of these chemicals, with EBITDA margins of 15-30%. As a result, countries in Southeast Asia are striving to improve production capabilities in this area. Thailand is a major feed additives producer, while Indonesia is a leading nutraceutical producer, highlighting the importance of Malaysia enhancing its own efforts in key niche segments based on local advantage.

[41] Department of Statistics Malaysia 2017
[42] Statista 2019
[43] Research CMFE Report 2020
[44] IHS Markit 2018
[45] IHS Markit

There are several potential challenges for Malaysia moving forward. The nutraceuticals and flavour and fragrances products continue to present a difficult play for Malaysia's domestic industry, requiring high upfront investment, strong technology and research intensity, and a need to overcome an entrenched and consolidated industry. At the same time, competition continues to be fierce as regional peers increase production capabilities. Singapore, for example, has increased its methionine capacity five-fold in the past six years to become the leading producer in Southeast Asia.

Ease of play in Nutrition chemical sub-segments



Comments

- Flavours & Fragrances has very **high investment** (can be USD500 Mil+); M&A targets expensive
- Nutraceuticals **medium investment** (USD300 Mil)
- Food & Feed additives **Lower investment** (USD100 Mil)

- High R&D needed in Flavours & Fragrances and Nutraceuticals – **product development game**
- Relatively low R&D, IP required in emulsifiers – **products less differentiated**

- **High Consolidation** in Nutraceuticals and Flavours &
- Fragrances with 4 players having ~60-70% share; Largely global play
- Food and Feed Additives are more **fragmented** with **regional** play possible

- Supply Chain in Flavours & Fragrances is **make to order** (small batch sizes)
- Supply chain in Nutraceuticals are typically **make to stock**, but increasing personalisation/make to order
- Supply chain in Food & Feed additives is **make to stock** (Asset utilisation driven)

Source : BCG Analysis

Strategic focus area 1

Leverage palm-related building blocks to further expand capacity to become one of the leading emulsifier hubs in Asia

Capitalise on synergies with the mature palm oil industry, expanding the capacity for emulsifier production while adding value to excess palm and glycerine production. This offers a path to higher-value products based on a strong domestic supply chain.

Baseline	Aspiration
Malaysia is the largest producer of emulsifier in the Southeast Asia region, with approximately 30 to 50 ktpa capacity, meeting > 15% of Asia's demand.	Establish Malaysia as a top-three hub in Asia for emulsifiers, increasing production capacity to meet >25% of Asia's demand.

Strategic focus area 2

Expand methionine production capacity to maintain regional competitiveness and emerge as one of the leading methionine exporters in Asia

Expand methionine production capacity to ensure Malaysia's continued competitiveness in the export market, leveraging on an existing strong market position to become a leading regional producer. Enhance Malaysia's status as a large base supplier of animal feed additives, and continue to support domestic growth of downstream animal feed markets.

Baseline	Aspiration
Malaysia is the second-largest methionine producer in Southeast Asia and within the top five in Asia.	Establish Malaysia as a top three in Asia for methionine exports.

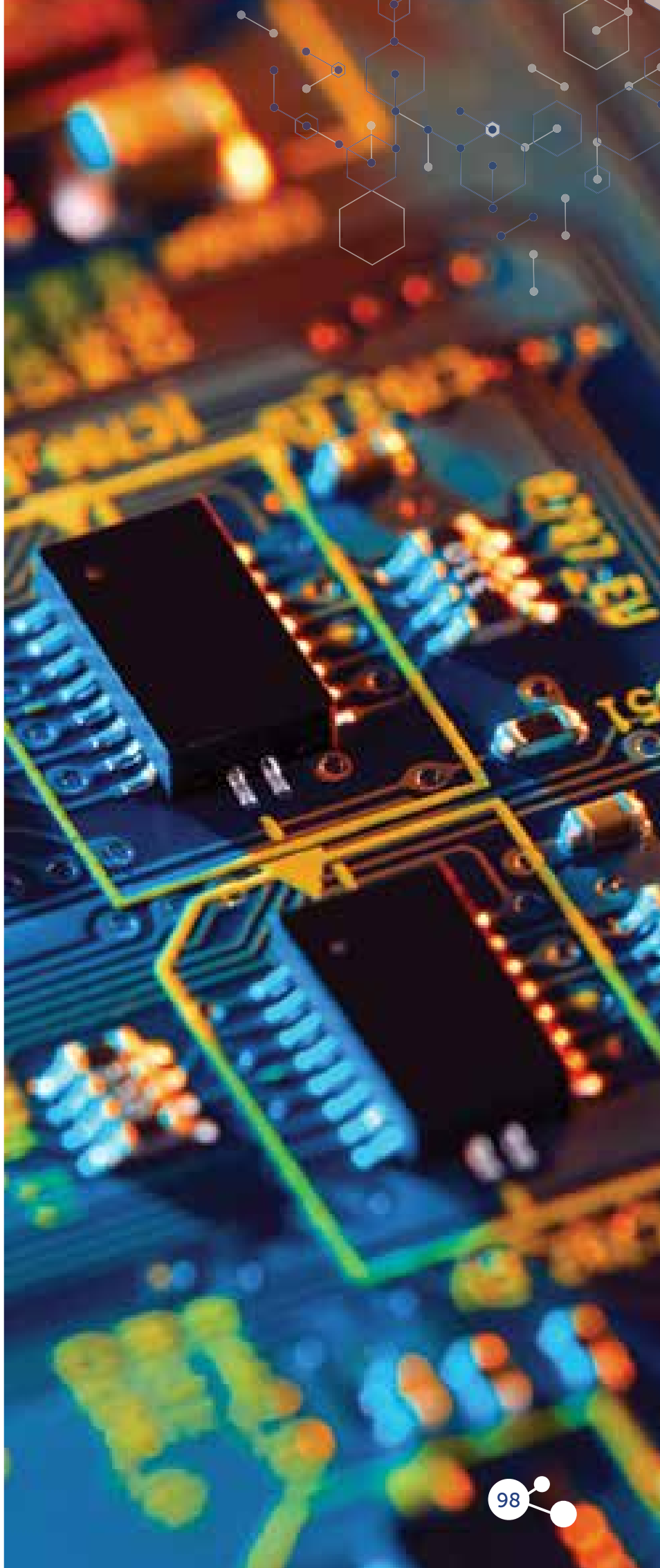
Priority sub-segment 10: Electronic chemicals

Malaysia's electronic chemicals sub-segment enjoys strong linkages to the nation's globally important semiconductor industry. Malaysia is responsible for 7%[46] of global semiconductor trade flow, with a market value of USD24bil[47] and employs over 580,000[48] workers in the wider electrical and electronics industry. This combined industry accounts for close to 40%[49] of Malaysia's total exports.

Malaysia is integrated within the global semiconductor value chain, but its capabilities today primarily focus on areas such as packaging, assembly, and testing, as opposed to higher value-add areas of pre-competitive research, integrated circuit (IC) design, and wafer and IC manufacturing.

In order to produce electronic chemicals to support wafer manufacturing, IC packaging, and printed circuit board (PCB) manufacturing, Malaysia largely relies on three Japanese electronic chemical players—Shin Etsu, Ibiden, and Showa Denko (formerly Hitachi Chemicals). These three players produce the specialty chemicals in limited quantities for wafer manufacturing, IC packaging, and PCB manufacturing but formulate more IC packaging chemicals, with all three producing either substrates or encapsulates.

There are several challenges facing the industry, most notably the critical lack of access to high-skilled talent. As a result, Malaysia lacks the specialised skills to develop new formulations and compounds to satisfy the ever-changing industry demand.

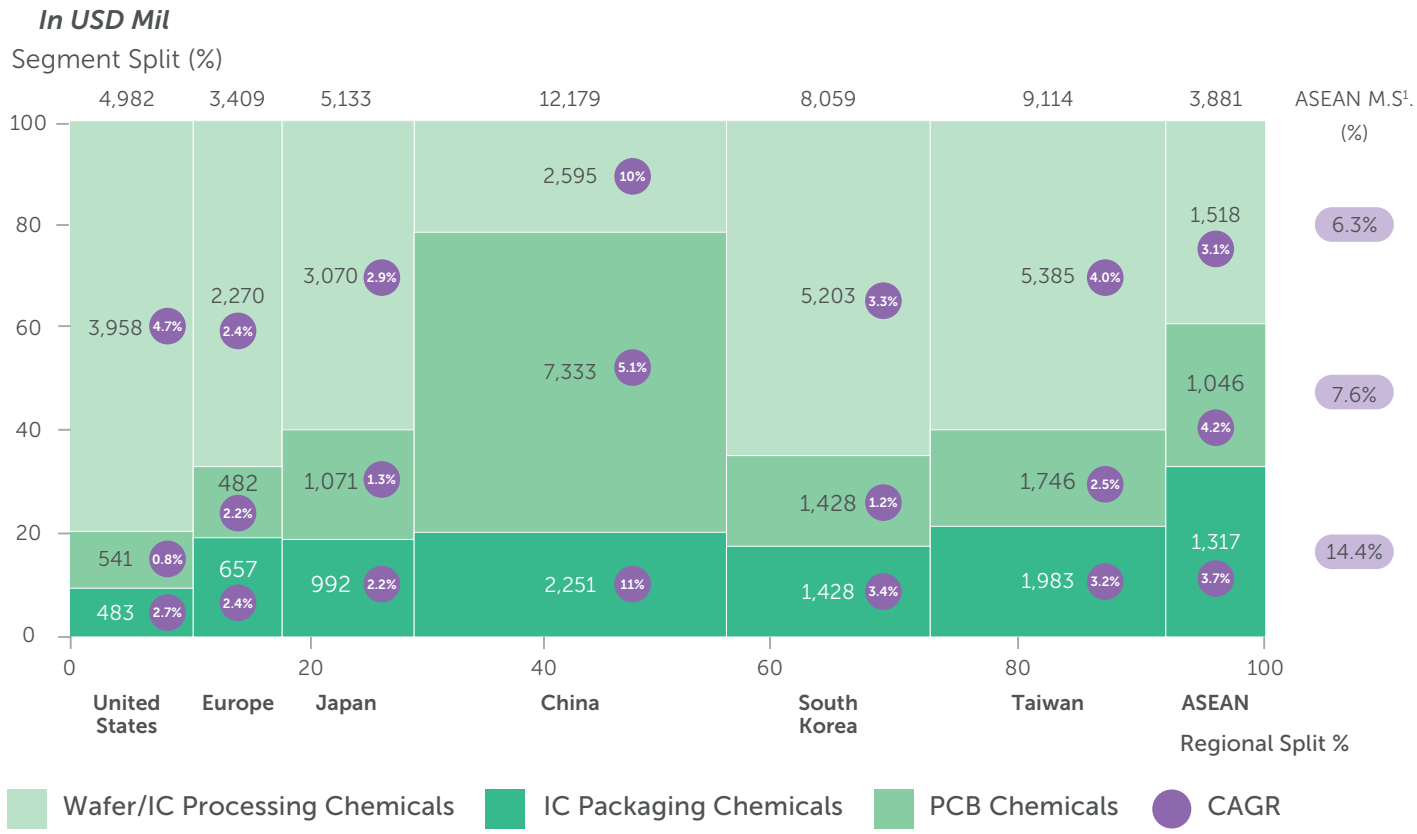


[46] Malaysia Semiconductor Industry Association
[47] IHS Markit
[48] Department of Statistics Malaysia (DOSM), Labour Market Review Malaysia Second-Quarter 2020
[49] MITI Trade and Economic Information Booklet 2019

Globally, the production of PCB chemicals is concentrated in China due to several factors, such as government policies that champion self-sufficiency, fast-growing end markets, feedstock advantage and low-cost labor. At the same time, Southeast Asia has a disproportionately higher global share of IC packaging chemicals consumption[50], making up 14% of production versus just 6-7% for other segments.

Global consumption of Electronic chemicals

Breakdown of Global Electronic Chemicals Consumption by Region 2019



Key Commentary

IC Processing Chemicals

- The market is highly **dominated by Taiwan and South Korea** due to large foundry industries.
- **China growing quickly to increase self-sufficiency;** policies in place to support growth

PCB Chemicals

- Global **production for PCBs shifting from ASEAN to China** due to low cost

IC Packaging Chemicals

- **Higher potential in ASEAN** (2X M.S.1 in and IC Packaging Chemicals vs other segments)

1. Market Share
Note: CAGR denoted are from 2019-2024
Source: IHS; BCG analysis

Malaysia and Singapore are the main consuming countries of electronic chemicals within Southeast Asia. Singapore has a significant advantage in high-technology segments such as wafer and IC processing chemicals due to its high vertical integration, strong infrastructure, and highly developed R&D capabilities. Thailand and Vietnam, meanwhile, are continuing efforts to grow their own PCB chemical industries, with growth rates of 4.9% and 5.9%, respectively, versus Malaysia's 2.9%. This highlights the challenge for Malaysia in maintaining its competitive edge in the long run, given current growth trajectories.

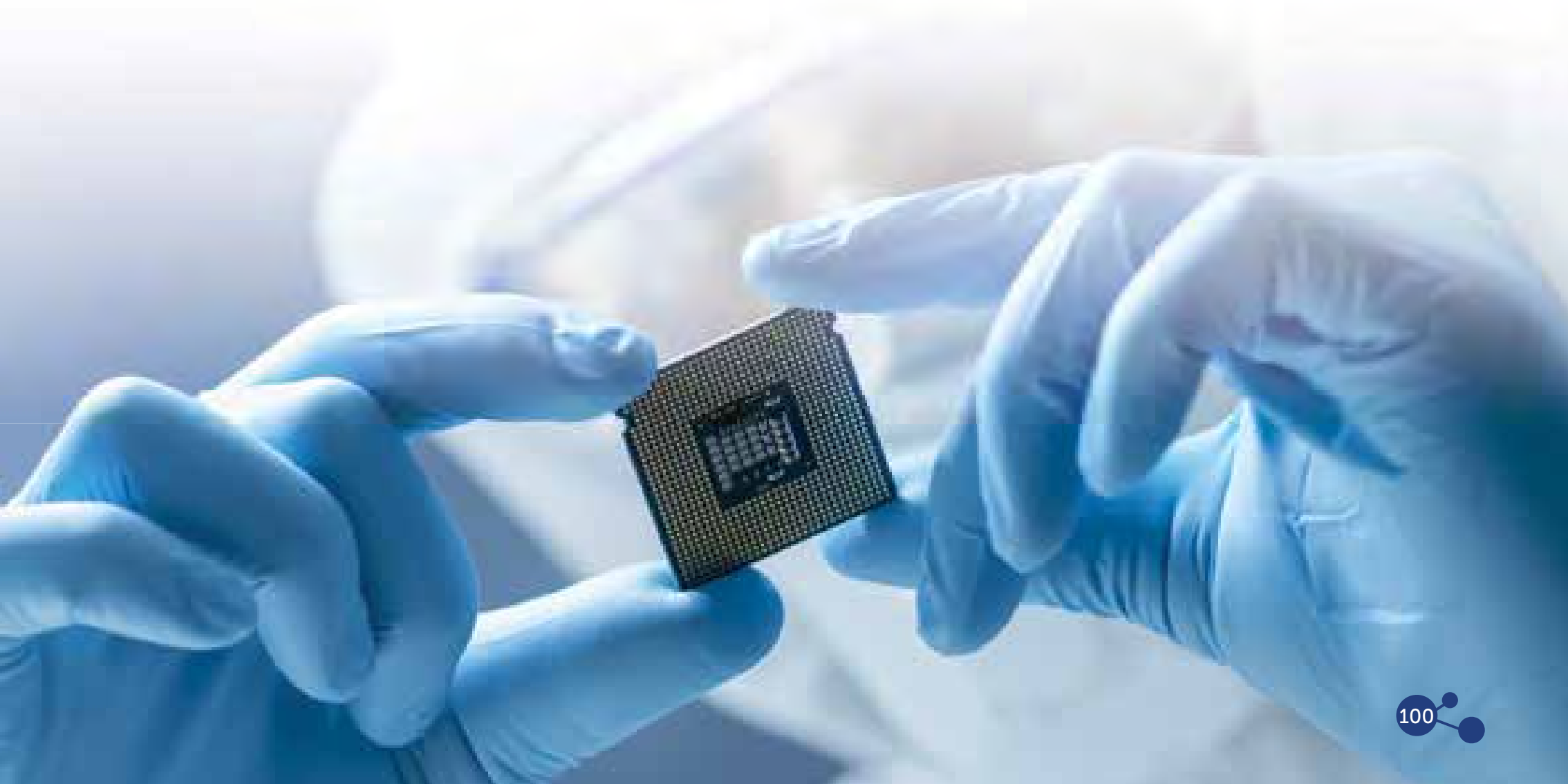
[50] *IHS Markit*

Strategic focus area 1

Malaysia as a leading manufacturer of IC packaging chemicals in Southeast Asia

The strong importance of the IC packaging chemical industry in Southeast Asia—reflected by its relatively higher market share in IC packaging chemicals (14%) versus other segments (6-7%)—provides a strong platform for Malaysia to increase its production base in this segment. This will strengthen integration with the domestic semiconductor industry and boost Malaysia's global role in the high-tech semiconductor industry.

Baseline	Aspiration
Malaysia is the 2nd largest consumer of IC packaging chemicals but is highly dependent on imports from global players or Japanese chemical manufacturers.	Position Malaysia among the top three producers of IC packaging chemicals in Southeast Asia to reduce import dependence and serve Southeast Asian markets.



Priority sub-segment 11: Construction chemicals

Malaysia's construction industry is a major economic engine, contributing USD34bil[51] to GDP and employing over 1.4mil people[51]. The nation has ambitions to further develop the industry through the Ministry of Public Works Malaysia (KKR) Organisation Strategic Plan (2021-2025), which aims to make Malaysia a leading Construction 4.0 industry in Southeast Asia, with emphasis on smart construction and sustainability. This goal will mean construction chemicals are an increasingly important part of national growth.

Construction chemicals are today USD200mil[52] market in Malaysia and heavily feature global players such as Sika, Mapei, Saint-Gobain, MBCC Group, and Fosroc. The industry leverages raw material imports from China and South Korea to locally formulate the relevant chemicals needed in Malaysia from various concrete admixtures, adhesives, and sealants. As a result, Malaysia has very low import dependence in this sub-segment, at below 5%[52] across concrete admixtures, adhesives and sealants. Imports tend to be only for select low-volume specialty niche products such as hot melt from the USA and Europe.

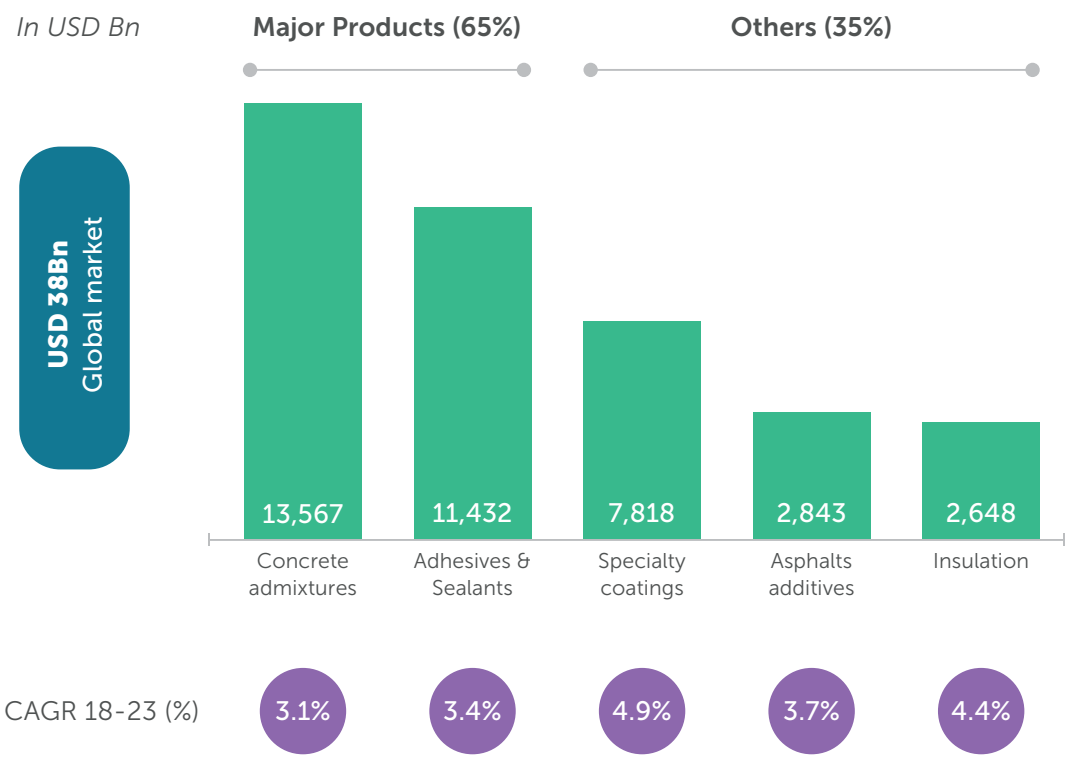
Most major countries within Southeast Asia are already formulating their own construction chemicals, with the exception of Singapore, which imports more than 80% of its construction chemical needs. Due to geographic proximity and the localised nature of construction chemicals, Malaysia already plays a strong role in exporting to Singapore.

Concrete admixtures, adhesives and sealants continue to drive the most value within the construction chemicals sub-segment, accounting for 65% of the USD38bil global market. The demand for these products correlates strongly to the expanding industrialisation and modernisation of buildings, which requires strong concrete admixtures to strengthen concrete performance, alongside adhesives and sealants to build and maintain new buildings.

[51] Statista
[52] Estimates from industry players

Value of Construction chemicals sub-segments

Breakdown of Global Construction Chemicals Consumption by Sub-Segment 2019



Note: Market size refers to only highly specialty products; total market size including slightly less specialty products is $60B.
Source: IHS; BCG analysis

Commentary

Concrete Admixtures
Used to enhance performance of concrete; growth primarily driven by demand for super strong concrete in skyscrapers/megaprojects

Adhesives & Sealants
Adhesives bind materials together, sealants seal gaps between materials; growth primarily driven by new building construction & maintenance

Specialty Coatings
Improves protection and aesthetics of surfaces (floor, roof, waterproofing); Growth primarily driven by high end building maintenance

Asphalt Additives
Enhance workability of asphalt; Growth primarily driven by road construction

Insulation
Creates thermal envelope or reduces thermal transfer for building; Growth primarily driven by building construction and maintenance in colder climates

With local demand already formulated within the region and a lack of significant export opportunities due to the localised nature of construction chemicals, there is limited potential to add further value to the construction chemical industry. The major opportunities then lie within the downstream construction sector. It will be critical for Malaysia to materialise the KKR Organisational Strategic Plan 2021 - 2025, which will, in turn, benefit the construction chemical industry.

Strategic focus area 1

Prioritise high-value niche products within concrete admixtures or adhesives and sealants with an export-oriented outlook

If market dynamics and product trends shift in Southeast Asia, there may be a potential to increase exports to meet future opportunities. Malaysia's construction chemical industry should be poised to develop expertise in niche products with these emerging high-volume needs. This strategy should be revisited in 3-5 years.

Baseline	Aspiration
No local production of select niche products such as hot-melt adhesives.	Opportunistically develop export-oriented production in niche products such as hot-melt adhesives.

Strategic focus area 2

Replace imports with local production for upstream raw materials such as polyurethane and acrylics to strengthen the end-to-end value chain

There is opportunistic potential for companies in Malaysia to explore the commercial viability of upstream raw materials used in construction chemicals such as polyurethane, acrylics, and carboxylic acids.

Baseline	Aspiration
Malaysia has limited domestic production of acrylics and several polyurethane foam producers but no local production of upstream polyurethane precursors such as toluene diisocyanate (TDI) and methylene diphenyl isocyanate (MDI).	Opportunistically, increase self-sufficiency in upstream raw materials for the construction industry.

The strategic focus areas highlighted in the CIR2030 offer a wide range of opportunities for Malaysia's chemical industry as illustrated across the 11 priority sub-segments.

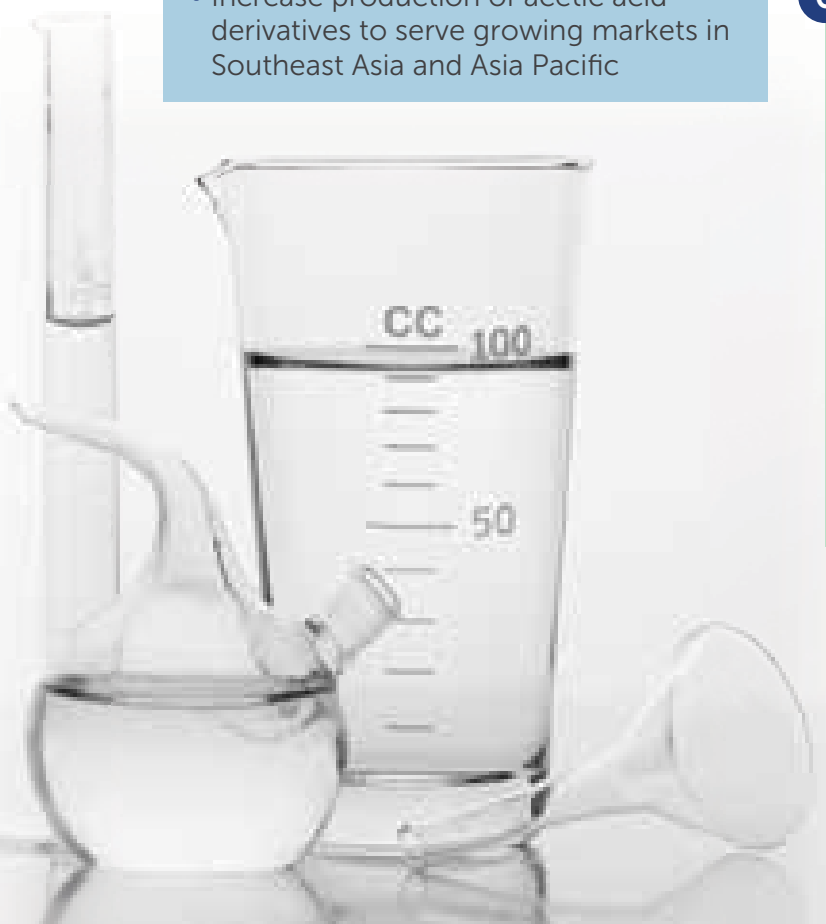
Strategic focus areas

Base chemicals & intermediates

1 Fertilisers
- Increase local production of EFFs
- Modernise manufacturing capabilities to be more competitive and sustainable by leveraging new technologies (e.g., green ammonia)

2 Oleochemicals
- Strengthen play in basic oleochemicals
- Increase share of specialty oleochemicals (e.g., sulphates, esters, ethoxylates)
- Boost sustainability of oleochemicals value chain

3 C1 - Intermediates
- Increase production of acetic acid derivatives to serve growing markets in Southeast Asia and Asia Pacific



Plastics and polymers

4 Composites
- Develop composite manufacturing capabilities and competitiveness in pre-pregs/fabric value chain with focus on aerospace composites
- Develop fibres and resin precursor industries to allow composites backwards integration

5 Synthetic Rubber
- Develop local synthetic rubber capabilities to reduce downstream industry reliance on imports
- Improve the circular economy for synthetic rubber with focus on tyres and gloves

6 Plastics
- Diversify more into engineering plastics to support downstream industries and Asia Pacific demand
- Establish Malaysia as a major bioplastics manufacturer in Southeast Asia, capitalising on rich bio feedstock Improve circular economy through
- new recycling technologies and ecosystem of innovative players Selective expansion of commodity
- plastics production to satisfy regional demand and instill sustainable practices in plastics lifecycle

Specialty chemicals

7 Agrochemicals
- Develop niche expertise in biopesticide technology to serve Southeast Asian markets
- Increase self-sufficiency in vegetable seeds

8 Care Chemicals
- Leverage oleochemical building blocks to expand into key personal care ingredients, then acquire capabilities to develop formulations for care products

9 Nutrition Chemicals
- Leverage palm-related building blocks to further expand capacity to become one of the leading emulsifier hubs in Asia
- Expand methionine production capacity to maintain regional competitiveness and emerge as one of the leading methionine exporters in SEA and APAC

10 Electronic Chemicals
- Become a leading manufacturer of IC packaging chemicals in Southeast Asia

11 Construction Chemicals
- Continue to track potential to prioritise high-value niche segments and replace imports with local production for upstream raw materials (e.g., polyurethane, acrylics)

Phasing of focus areas across priority sub-segments

These strategic focus areas are designed to achieve the five aspirations of the CIR2030, working to increase the value-add of Malaysia's chemical industry, enhancing downstream integration, increasing competitiveness, improving sustainability, and introducing new technology to provide a more resilient industry that unlocks greater value for Malaysia's socio-economic wellbeing.

Linkage between priority sub-segments and aspirations

	Increase Value Add	Enhance Downstream Integration	Increase Competitiveness	Improve Sustainability	Introduce New Technology
1 Fertilisers	✓		✓	✓	
2 Oleochemicals	✓	✓	✓	✓	✓
3 C1 Intermediates	✓				
4 High performace composites		✓			✓
5 Synthetic rubber		✓	✓	✓	
6 Plastics			✓	✓	✓
7 Agrochemicals		✓		✓	✓
8 Care chemicals	✓	✓			✓
9 Nutrition chemicals	✓	✓	✓		
10 Electronic chemicals		✓	✓		✓
11 Construction chemicals		✓			

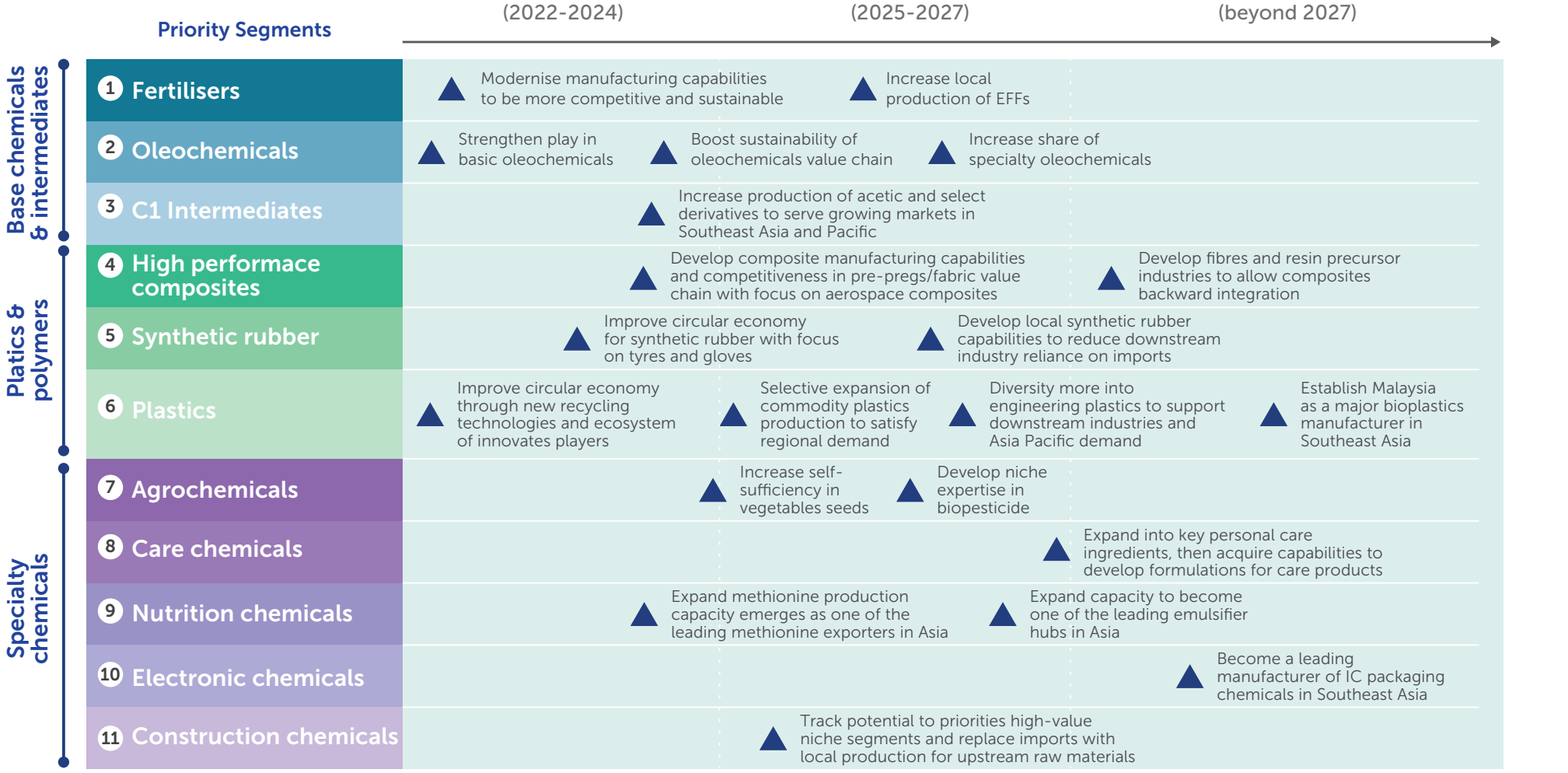
The CIR2030 strategies of the respective priority sub-segments will be rolled out across a 10-year period.

1 In the short term (2022 – 2024), well-established value chains such as oleochemicals and plastics will be strengthened to become more competitive. Circular economy and sustainable practices will be enhanced, especially for plastics and synthetic rubber.

2 In the medium term (2025 – 2027), value chains will be further integrated, enabling a more resilient industry, such as through the increased production of fibres and matrix precursors to enable composites backward integration. In addition, downstream industries will now be served more sufficiently by the chemical industry (e.g., higher share of automotive materials will be produced domestically). Within this time period, Malaysia will also begin to move further down the value chain towards higher value-added products, such as through diversification into engineering plastics.

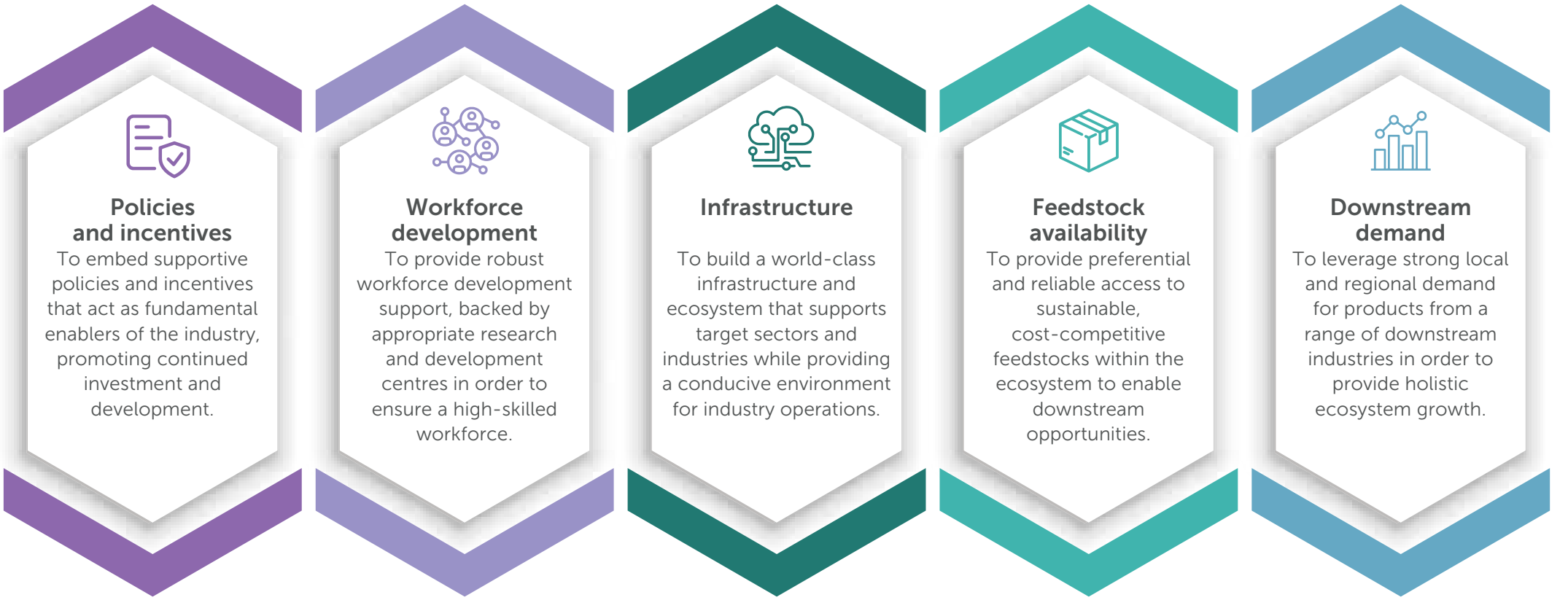
3 In the long-term (beyond 2027), Malaysia will emerge as market leader for selected high value products such as bioplastics, EFFs, and electronic chemicals. As a result, the share of high value-added chemicals within the overall chemical production in Malaysia will become significantly higher.

Phasing of focus areas across priority sub-segments



Enablers for the Chemical Industry Roadmap

There are five key success factors and corresponding enablers that are typically found to be crucial in building a competitive and resilient chemical industry



Sustainability has emerged as an increasingly critical sixth enabler over recent decades. Shifting global trends and end-user demands have promoted sustainability as a major factor of a successful chemical industry value chain, positioning it as a strong source of competitive advantage as countries and companies shift towards a more sustainable end-to-end approach.

Malaysia enjoys a favourable starting position compared to many regional neighbours, as well as other exporting countries across the success factors highlighted. The nation's thriving domestic chemical industry offers a robust foundation for further growth and comes as a result of committed work undertaken by all chemical actors, from the public sector to industry players, research institutes, and academia. Investment in world-class ports in Malaysia, excellent domestic logistics development, ample feedstock availability, and favourable policies for a conducive business environment all reflect the joint efforts of the players in the chemical industry ecosystem.

These key enablers act as a platform for future progress and will be enhanced through the implementation of the CIR2030 in order to achieve the roadmap's ambitions by 2030.

A benchmarking exercise was undertaken to identify best practices from leading chemical-producing countries around the world in order to chart the enablers. This was further complemented by direct inputs from domestic chemical industry stakeholders, allowing us to develop an understanding of enablers and how to enact them in achieving the goals of the CIR2030.

CIR2030 Strategic Framework

	Increase value add from building blocks	Enhance industry integration	Increase competitiveness of chemical industry	Improve sustainability of chemical industry	Introduce new technology to advance state of chemical industry
Aspirations					
Priority Segments	**Basechemicals &intermediates** 1 Fertilisers 2 Oleochemicals 3 C1 Intermediates		**Plastics and polymers** 4 High performance composites 5 Synthetic rubber 6 Plastics		**Specialty chemicals** 7 Agrochemicals 8 Care Chemicals 9 Nutrition Chemicals 10 Electronic Chemicals 11 Construction Chemicals
Strategic Focus Areas	• Increase local production of Environmentally Friendly Fertilisers (EFFs) • Modernise current fertiliser manufacturing capabilities to be more productive and sustainable by leveraging new technologies • Strengthen play in basic oleochemicals • Increase share of specialty oleochemicals • Boost sustainability of oleochemicals value chain • Increase production of acetic acid derivatives to serve growing markets in Southeast Asia and Asia Pacific		• Develop composite manufacturing capabilities and competitiveness in pre-pregs/fabrics • Develop fibres and resin precursors to allow composites backwards integration • Develop local synthetic rubber capabilities • Improve the circular economy for synthetic rubber with focus on tyres and gloves • Diversify more into engineering plastics • Establish Malaysia as a bioplastics hub • Improve circular economy through new recycling technologies • Selective expansion of commodity plastics production to satisfy regional demand		• Develop niche expertise in biopesticide technology • Increase self-sufficiency in vegetable seeds • Leverage oleochemical building blocks to expand into key personal care ingredients • Leverage palm-related building blocks to further expand capacity to become one of the leading emulsifier hubs in Asia • Expand methionine production capacity to maintain regional competitiveness and emerge as leading methionine exporters in APAC • Become a leading manufacturer of IC packaging chemicals in Southeast Asia
Enablers	1 Targeted chemicals investment campaign 2 Ease of trade 3 Adoption of modernised operations		4 Enhanced capabilities to innovate and commercialise tech 5 Large base of skilled labor 6 Infrastructure improvements		7 Industrial parks 8 Regulatory framework for circular economy 9 Sustainability incentives for operations and innovations 10 Value chain consortia

Malaysia's 10-point enabler plan and 24 supporting initiatives

Malaysia has introduced a number of positive enablers for the chemical industry in the past—tax incentives, investment programs, and supportive trade policies—but overall success remains varied. Implementation of these enablers has been hindered by two main challenges. Economic turbulence, such as the 2020 Oil Price Crash created significant global headwinds, while the COVID-19 pandemic represents another major macroeconomic challenge that has undermined efforts to boost the sector, with a wider negative impact on the national economy. Changes in the political landscape have also impacted the execution of initiatives, as changing priorities have hindered the focus on delivery.

The understanding developed from the benchmark analysis has been incorporated across the five key factors identified as precursors to industry success. A sixth critical lever of sustainability will be introduced, reflecting the changing global landscape while meeting Malaysia's own commitments to the sustainability agenda.

These six success factors were then narrowed down into four priority success factors. While developing downstream demand remains a pivotal enabler, this will be delivered through the NIMP2030, and federal and state government efforts, as such, will not be within the direct remit of the CIR2030. Feedstock availability has a big impact on the chemical industry but is heavily driven by market dynamics and hence is largely beyond the control of the Government. The discussion around feedstock is also covered under the purview of the new National Energy Policy.

The CIR2030 will work in parallel with the national agenda, continuing to leverage existing and emerging opportunities in the chemical industry and capitalising on the wider efforts of the Government to drive socio-economic growth within Malaysia. This provides a synergy with roadmaps such as RMK-12 and NIMP2030, aimed at incentivising investment and growth, attracting FDI inflow, modernising industries such as the chemical sector, and building a robust ecosystem of industrial parks and special economic zones which will boost economic potential.

Overall, the CIR2030 will also aim to improve the coordination of approaches in the chemical sector. Greater cross-sectoral collaboration will strengthen the chemical industry and provide an improvement to ease of doing business for chemical companies.

With this framework in mind, 10 key enablers and 24 supporting initiatives have been identified to support the Malaysian chemical industry. The enablers will uniquely benefit each priority sub-segment based on their starting positions, the needs as well as the aspirations for each sub-segment.

The 10 key Enablers will be delivered through 24 supporting initiatives

	Enablers	Initiatives
Policies & incentives	1 Targeted chemicals investment campaign	**1.1** Enhance chemicals investment portfolio to support chemical focus area **1.2** Encourage domestic investments of key industry players into chemical adjacencies
	2 Ease of trade	**2.1** Establish FTAs with key export markets to boost competitiveness of domestic products; introduce expedited product approval process for agrochemical exports
	3 Adoption of modernised operations	**3.1** Establish innovation acceleration team to assist chemical players in modernising and adopting IR 4.0 technologies **3.2** Enhance financing support for adoption of sustainable technologies in operations **3.3** Increase private participation of technology providers (IR4.0, automation) in chemicals industry
Capabilities & Technology	4 Enhanced capabilities to innovate and commercialise tech	**4.1** Setup a Chemical Collaborative Platform (CCP) to create an ecosystem for cutting-edge research and promote commercialisation **4.2** Enhance R&D grants and reinvestment allowances for companies establishing new technologies, circular business models, and bio-based manufacturing **4.3** Setup a technical committee to govern and advise on technical standards for emerging technology
	5 Large base of skilled labor	**5.1** Review and update TVET and higher education training, relevant to industry needs **5.2** Ensure inclusion of performance criteria in evaluation of TVET contracting **5.3** Enhance chemical TVET apprenticeship quality assurance **5.4** Expand Residence Pass – Talent program to ease entry of foreign skilled labour
Infrastructure	6 Improved infrastructure	**6.1** Introduce Extended Producer Responsibility (EPR) to improve end-life waste management for chemical products **6.2** Increase testing capabilities for chemicals intermediates and chemical products **6.3** Ensure adequate growth of chemical waste management facilities
	7 Industrial parks	**7.1** Improve chemical parks proposition holistically to attract foreign participation
Sustainability	8 Regulatory framework for circular economy	**8.1** Introduce mandate for plastic packaging to utilise increasing amounts of sustainable materials (biodegradable bioplastics or recycled plastics) **8.2** Implement emissions pricing mechanisms for the chemical sector **8.3** Enhance sustainable plastics and synthetic rubber labels for end-consumer products with clear standards
	9 Sustainability incentives for operations and innovations	**9.1** Develop digital platform to create circular economy market for local waste **9.2** Establish education support and best-practice guidance for chemical industry businesses to implement sustainability measures **9.3** Provide support for new technologies and innovative business models in recycling and production of end products with bio-based chemicals and recycled plastics
	10 Value chain consortia	**10.1** Establish sustainability consortia with businesses, knowledge institutes, NGOs and ministries for plastics, synthetic rubber, and oleochemicals

Mapping between Enablers and Priority Segments

Enablers	Fertilisers	Oleo-chemicals	C1 intermediates	Plastics	Synthetic rubber	Composites	Agro-chemicals	Care chemicals	Nutrition chemicals	Electronic chemicals	Construction chemicals
1 Targeted chemicals investment campaign		✓		✓		✓	✓	✓	✓	✓	✓
2 Ease of trade	✓	✓		✓							
3 Adoption of modernised operations	✓			✓	✓						
4 Enhanced capabilities to innovate and commercialise tech				✓		✓	✓	✓	✓	✓	✓
5 Large base of skilled labour	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6 Improved infrastructure	✓	✓	✓	✓	✓						
7 Industrial parks		✓		✓		✓		✓			
8 Regulatory framework for circular economy				✓	✓						
9 Sustainability incentives for operations and innovations	✓			✓	✓						
10 Value chain consortia	✓	✓		✓	✓		✓				

These enablers and initiatives represent the starting point for the CIR2030 implementation and are expected to be further refined and detailed by identified workstream owners over the coming years based on market dynamics, changes in the external environment, and feedback from launched programs.

Policies & Incentives

Enabler 1

Launch a targeted chemicals investment campaign

Malaysia has a strong supportive investment landscape, with a number of incentive levers provided by the Government across manufacturing industries. Existing incentives tend to take a broad-based approach with blanket incentives stretching across the manufacturing ecosystem.

Malaysia also has a well-founded reputation for its conducive business environment, and is ranked 12th out of 190 countries in the World Bank Doing Business Report 2020. In this report, Malaysia's strong performance is also highlighted, particularly in its protection of minority investors, formation of regulatory reform committees, and its reliable electricity supplies.

Despite these strong foundations, Malaysia still has room to improve its investment landscape. This will aid Malaysia to improve its competitiveness to be on par with leading regional peer Singapore, which has an attractive landscape for business process, start-up support, as well as strong access to credit facilities.

Domestic direct investments (DDI) in Malaysia stood at RM28.84bil[53] in 2019, accounting for 35%[53] of total investment into the manufacturing sector. This sum is attributed to three factors:

Dedicated supporting services

The Domestic Investment Coordination Platform (DICP) was established in 2018, adding to dedicated investment support services within Malaysia. DICP works closely with stakeholders to facilitate the growth of SMEs, boosting DDI. These initiatives form part of a broader landscape of ministries and public agencies engaging with industry stakeholders to support businesses in the country.

Financial incentives

A range of financial incentives are in place to support business investment and growth. These include the Investment Tax Allowance, which provides a 60% to 100% allowance on qualifying capital expenditures for a defined period, as well as Pioneer Status, which offers companies a five-year 70% to 100% exemption from corporate income tax. The Domestic Investment Strategic Fund (DISF) was also introduced to provide matching grants to companies to accelerate the shift in targeted industries to high value-added, high technology, knowledge-intensive and innovation-based industries. The fund aims to encourage industry players to enhance and upgrade their technological capabilities. The Automation Capital Allowance (ACA) supports companies in quick adoption of automation, especially in labour-intensive industries.

Awareness campaigns and promotions

MIDA offers various programmes to attract and support domestic and foreign investments in the country. This includes a range of domestic seminars and conferences to enhance business education and build networking potential.

[53] *MIDA Malaysian Investment Performance Report 2019*

Malaysia's investment landscape compares well to regional neighbours in terms of support for FDI, with a number of established incentive levers in place designed to stimulate foreign investment. This includes corporate income tax exemptions for qualifying investments, import duty exemptions on raw materials, and research and development incentives. The presence of Pioneer Status incentives offers a five-year 70% to 100% tax exemption on statutory income to enable early growth for promising companies. Investment allowance offers further tax relief for qualifying companies in order to encourage investment. Malaysia's intellectual property incentives also set it apart in the region, with a full tax exemption on intellectual property income for a ten-year period.

Incentive levers of Malaysia versus other Southeast Asian countries

	Malaysia	Singapore	Indonesia	Vietnam	Thailand
Corporate income tax exemption	✓	✓	✓	✓	✓
Raw material import duty exemption	✓	✓	✓	✓	✓ Up to 90% for products made for domestic use
Pioneer status for companies in emerging sectors	✓ 5-year partial exemption. 70% to 100% on statutory income	✓ 5-year exemption. 5% or 10% on statutory income	✓ Up to 70% exemption on income between 5 - 15 years	✗	✓ 3–8-year exemption for selected sectors
R&D Incentives	✓ Double deduction on R&D expenditure	✓ Up to 250% deduction on eligible R&D expenditures	✓ Up to 300% deduction for R&D activities	✓ Up to 10% deduction on annual income	✓ 100%-300% deduction on R&D expenses
Intellectual Property Incentives	✓ Full tax exemption on IP income up to 10 years	✓ 5% or 10% off IP income	✗	✗	✗
Investment Allowance	✓ Allowance of 60% on qualifying capital expenditure	✓ Up to 100% allowance on qualifying capital expenditure	✓ 30% allowance on investment value	✓	✓

Source : Press search

In order to further stimulate the investment landscape and foster innovation in Malaysia, two key initiatives will be launched to drive investment growth.

Initiative 1.1

Enhance chemicals investment portfolio to support chemical focus areas

The chemicals investment portfolio will be enhanced to provide focused support for chemical industry investment. This will include sourcing, engaging, and nurturing investor relations relevant to the identified strategic focus areas of composites, engineering plastics, synthetic rubber, agrochemicals, care chemicals, nutrition chemicals, and electronic chemicals. It will also develop strong external sensing capabilities to assess the offerings of other nations, particularly those with geographical proximity within the Southeast Asia region.

Targeted promotions and marketing campaigns that promote and champion Malaysia as a destination of choice for chemical industry investment will be formulated, including establishing a prominent presence at major chemical trade events. This team will also develop and maintain a dedicated website for chemical industry investments in order to facilitate information flow to investors while signposting relevant incentives and communication channels to potential investors.

Initiative team: MITI (lead), MIDA, MATRADE,

Initiative 1.2

Encourage domestic investments of key industry players into chemical adjacencies

The chemicals investment portfolio team will establish discussion channels with key local chemical players to support this journey, and develop interest in emerging high-value sectors such as engineering plastics, bioplastics, specialty chemicals, and high-performance composites.

Feedback channels will be developed between industry stakeholders and key domestic investors in order to address investment challenges and encourage business builds. Clear, frequent communication around the incentives on offer will underpin this initiative, promoting the benefits and support for focus chemical sectors.

A Corporate Venture Launchpad initiative will also be explored with the objective to inspire established corporate businesses to branch into new areas of growth, leveraging venture studios to support research and development pathways. MOSTI's Startup Development Roadmap provisions, such as MyStartup platform will be leveraged to help connect start-ups, corporations, and agencies.

Initiative team: MITI (lead), MIDA

Enabler 2

Establish free trade agreements with key export markets to boost competitiveness of domestic products; introduce expedited product approval process for agrochemical exports

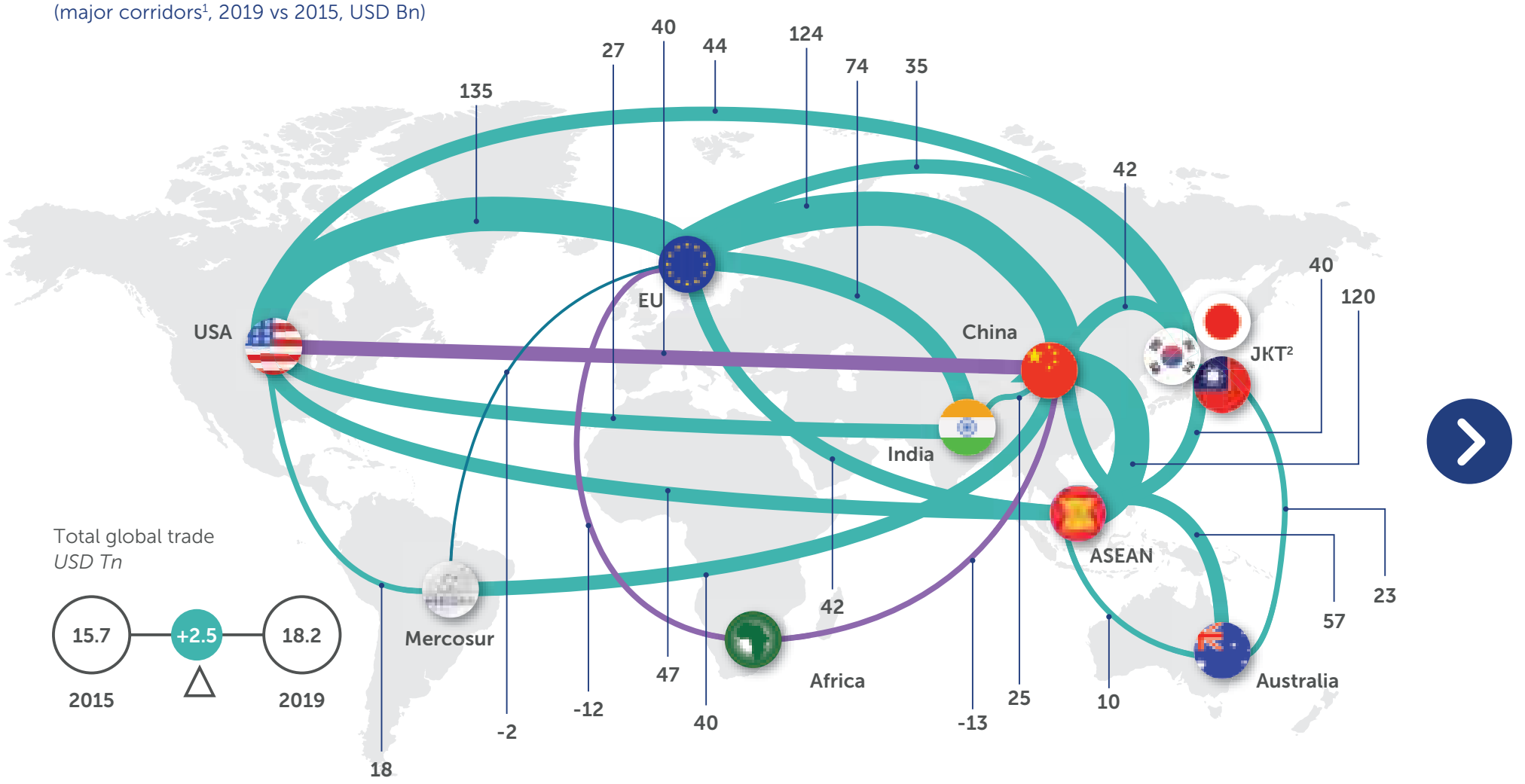
Free-trade agreements offer a major boost to the competitiveness of Malaysia's chemical exports and are a critical enabler for the growth of the industry.

Malaysia's three largest export sub-segments today include oleochemicals, fertilisers, and commodity plastics. The nation currently has 15 FTAs in place, split equally between bilateral and regional trade deals, but these are largely centred on the Asia Pacific region. Malaysia is highly active in this area and is constantly working to establish new FTAs, as demonstrated by the recently agreed Regional Comprehensive Economic Partnership (RCEP) in 2020, which includes membership by all major Asia Pacific countries. Given significant ongoing geopolitical trends, it is expected that there will be major shifts in trade corridors in upcoming years which will have a substantive impact on local and regional trade focus. The Association of Southeast Asian Nations (ASEAN) is expected to be a major winner of these shifts, capitalising on growing trade corridors between USA-ASEAN and EU-ASEAN.

Shifts in trade corridors

Change in trade of goods

(major corridors[1], 2019 vs 2015, USD Bn)



1. Corridors in the map above represent ~30% of global trade – missing: Intra EU=~20%, NAFTA=~8%, China/Hong Kong=4%, ASEAN=3%, RoW=~35% 2. Japan, Korea, Taiwan
Source: BCG Trade Finance Model 2020, UN Contrade, OECD, WEF, IHS, TradeAlert, Team Analysis

With regional peers such as Singapore benefiting from existing FTAs with both the European Union (EU) and the United States of America (USA), and Indonesia having an FTA with the EU, it will be essential for Malaysia to establish FTAs with these major markets in order to ensure the competitiveness of its exported chemicals. Malaysia is currently exploring potential FTAs with the European region.

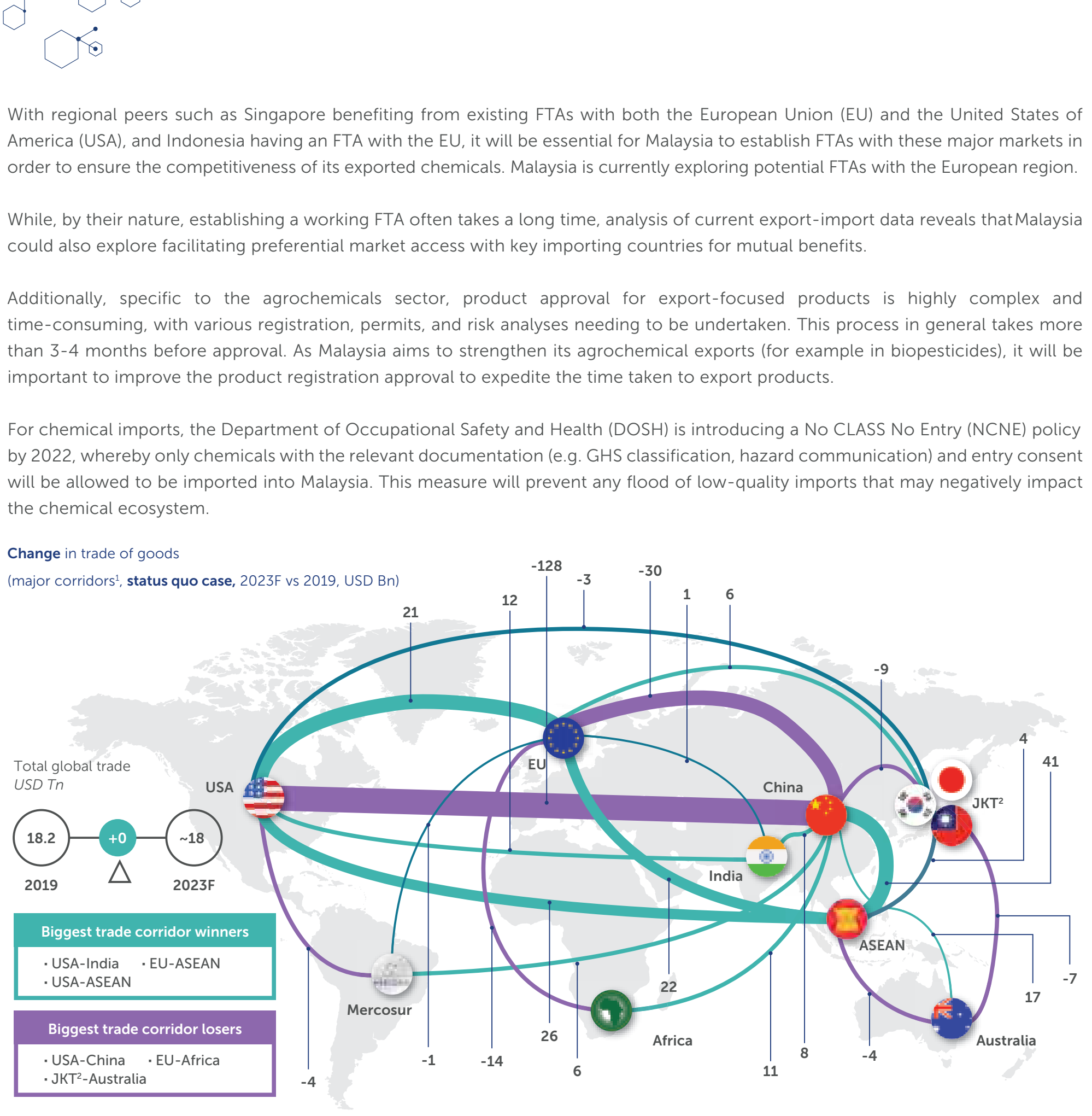
While, by their nature, establishing a working FTA often takes a long time, analysis of current export-import data reveals that Malaysia could also explore facilitating preferential market access with key importing countries for mutual benefits.

Additionally, specific to the agrochemicals sector, product approval for export-focused products is highly complex and time-consuming, with various registration, permits, and risk analyses needing to be undertaken. This process in general takes more than 3-4 months before approval. As Malaysia aims to strengthen its agrochemical exports (for example in biopesticides), it will be important to improve the product registration approval to expedite the time taken to export products.

For chemical imports, the Department of Occupational Safety and Health (DOSH) is introducing a No CLASS No Entry (NCNE) policy by 2022, whereby only chemicals with the relevant documentation (e.g. GHS classification, hazard communication) and entry consent will be allowed to be imported into Malaysia. This measure will prevent any flood of low-quality imports that may negatively impact the chemical ecosystem.

Change in trade of goods

(major corridors[1], **status quo case,** 2023F vs 2019, USD Bn)



Initiative 2.1

Establish FTAs with the Western Hemisphere on key potential export markets of fertilisers, oleochemicals, and plastics; introduce accelerated product registration approval for agrochemical exports

Major developed European nations, such as Germany, France, and the UK tend to be large importers of Malaysia's key export products of oleochemicals, plastics, and fertilisers. While discussions will continue to develop a beneficial FTA with the EU group as a whole, preferential market access with select trading partners will also be explored as a matter of priority.

An express registration process for export-oriented agrochemicals (including fertilisers) will be introduced in parallel to strengthen the ease of exports for the sector.

Initiative team: MITI (lead)

Enabler 3

Improve and expedite adoption of modernised operations in the chemical industry (automation, IR 4.0)

Malaysia has introduced a range of incentives and ambitions around the Fourth Industrial Revolution (IR 4.0), seeking to leverage the benefits of automated and next-generation technologies to improve productivity and boost growth.

The Industry4WRD Domestic Investment Strategic Fund (DISF) was established in 2019, designed to support companies seeking to adopt next-generation IR4.0 technologies and strategies on a 60:40 investment reimbursement basis. It provides financial support for modernisation, automation, upgrading of facilities and skills, licensing or purchasing of new high-technology enablers, as well as supporting efforts to gain international certifications. This is further supported by the Industry4WRD Intervention Fund, which is targeted specifically for SMEs, with matching 70:30 grants designed to improve technology, processes, and talent towards IR4.0.

Alongside these initiatives, automation capital allowances have been introduced to encourage manufacturing companies to engage in innovative processes and production, boosting the adoption of enabling technologies to enhance productivity in the manufacturing sector. That includes a category of automation capital allowance of 200% on the first RM2mil expenditure incurred between 2020 and 2023, with companies in the chemical industry covered under Category 2 of this scheme.

Despite these support initiatives, further modernisation efforts to unlock value from the value chain will be encouraged, and some top chemical players are already proactively taking steps to increase their digital maturity. For example, supply chains can leverage advanced track and trace systems to boost visibility, allowing real-time data insight to enhance the efficiency of operations and eliminate blind spots in scheduling and logistics. Advanced analytics in engineering and maintenance operations can be used to enhance predictive maintenance. Business-to-business (B2B) e-commerce solutions can increase sales, lowering marketing and sales costs while improving customer service.

Initiative 3.1

Establish Innovation Acceleration Team to assist chemical players to expedite adoption of IR4.0 and optimise processes

A dedicated Innovation Acceleration Team will be designed to accelerate the adoption of IR4.0 and advanced technologies within the chemical sector and to act as a catalyst to the industry, providing a driving force to push forward operational improvements. It will transform expectancy into action, ensuring the adoption of IR4.0 is supported and expedited within the chemical sector. This enabler will leverage industry association networks to build strong connections with chemical companies.

The Innovation Acceleration Team will work closely with Industry4WRD Readiness Assessment teams to provide a complementary synergy on technology transformation and further accelerate the transition process for chemical industry players. The team will also act in an advisory capacity to assess, diagnose and recommend appropriate improvement steps. These efforts will seek to catalyse positive relationships between chemical manufacturers and local/regional IR4.0 technology providers.

Initiative team: MITI (lead), MIDA, MATRADE, MPC

Initiative 3.2

Enhance financing support for adoption of sustainable technologies in operations

A ring-fenced Chemicals Energy Efficiency Fund will be explored to support energy efficiency improvements in the industry. The Fund will co-finance a variable percentage of qualifying costs for companies implementing energy efficiency solutions in their operations. Continuous monitoring of the impact of implemented technologies will ensure energy efficiency outcomes are achieved as targeted.

Initiative team: MITI (lead), MIDA, MOF

Initiative 3.3

Increase private participation of tech providers (IR4.0, automations) in chemical industry

The chemicals investment portfolio team will act to engage further private participation by technology providers in the chemical industry, evaluating opportunities for key technologies such as automation. This will drive modernisation of local players while identifying which technology providers should be encouraged to enter Malaysia.

Initiative team: MITI (lead), MIDA

Enabler 4

Enhance capabilities to innovate and commercialise technologies

Technology enablers in Malaysia's chemical ecosystem need to be enhanced, with large room for improvement on current standards. This is especially true in the chemical production technology space with high value-add areas such as specialty chemicals formulation. Developing enhanced commercialisation capabilities is also a priority, streamlining existing fragmented research studies and academic disconnects, which often fail to achieve market entry due to funding and integration issues. It will be essential to enhance these two levers in order to unlock further value in the chemical industry. One area of encouragement, however, is Malaysia's chemical industry research and development and IP ecosystem, with relatively high levels of maturity, especially in niche areas such as bioplastics and recycled synthetic rubber.

Leading chemical producing countries invest heavily in R&D capabilities, with nations such as Germany and Japan spending 2.6% and 8.6% on R&D[54] as a percentage of chemical production. In comparison, Malaysia currently spends just 1.0%[55].

Innovation is an area which requires both public and private sector commitment in order to deliver the greatest possible benefit. Germany is a one such example of this imperative, boasting a wide range of research initiatives, including five clusters of excellence, 18 collaborative research centres, and 52 non-university research centres with successful levels of implementation to promote research and to facilitate training. In addition, a third of chemical companies in Germany have established local and international university partnerships to ensure relevance and continued access to appropriate talent.

Beyond ecosystem development, it is also critical to ensure that the chemical industry enjoys suitable fiscal and monetary support to ensure global competitiveness. Tax benefits, accelerated depreciation of R&D assets, cash grants for R&D projects all offer positive fiscal attraction to global R&D with wider ecosystem and technology transfer benefits.

[54] CEFIC, The European chemical industry facts & figures: 2020
[55] BCG estimate from MASTIC MOSTI 2018 GERD

Initiative 4.1

Setup a Chemical Collaborative Platform (CCP) to create an ecosystem for cutting-edge research and promote commercialisation

An overarching body will be established with a mandate to promote collaboration to improve cutting-edge research and enhance commercialisation in the industry. It will be designed to tap unique areas of advantage in Malaysia's ecosystem, bringing together leading industry experts and academic researchers, scientists, and entrepreneurs under one roof.

It will also establish forums for frequent dialogue between academia and industry to ensure opportunities are quickly realised. The focus will be on key clusters with high value-add potential, such as biodegradable bioplastics, aerospace pre-pregs, care chemical formulations, and biopesticides.

The Malaysian Chemical Collaborative Platform (MCCP) spotlight

The Malaysian Chemical Collaborative Platform (MCCP) will create an ecosystem for cutting-edge research, driving R&D development within the industry. It will serve as a steering platform and central authority on upcoming technologies and chemistries and act to catalyse industry collaboration in research to unlock further value to the industry by bringing together leading industry stakeholders.

MCCP will be established in locations near major chemical hubs, incorporating both standalone hubs and in collaboration with academic institutions. An R&D Steering Council will be established to steer development of the MCCP. Financial incentives to support the development of the MCCP will also be explored.

Initiative team: CICM (lead), MITI, MIDA, MOSTI, MOF

Initiative 4.2

Enhance R&D grants and reinvestment allowances for companies establishing new technologies, circular business models, and bio-based manufacturing

A program to provide grants and reinvestment allowances to local companies seeking to establish new technologies, circular business models, and bio-based manufacturing will be explored. These incentives can further support research in optimising the qualities of synthetic rubber, composites, and specialty chemicals.

Initiative team: MIDA (lead), MITI, KE, IRB, MOF

Malaysian Chemical Collaborative Platform (MCCP)

To serve as a steering platform for upcoming technologies & chemistries to tap into Malaysia's unique strength to bring together leading industry entrepreneurs & university researchers/scientists/doctorates under one roof.

Focusing on biodegradable bioplastics, aerospace prepregs, care chemical formulations, and biopesticides

Locations

- Ideal setup to be near major chemical hubs as standalone centers or in conjunction with universities

R&D Steering council

- Setup an "R&D Steering Council" to facilitate setting up of MCCP
- Co-chairs from industry and academia to balance the focus of commercialisation and deep R&D research

Financial Incentives

- Chemical Innovation Fund, to be used for supporting MCCP (comprising of industry CSR spending[1])

Collaborative research

- MCCP to partner with domestic & international universities/research institutes/industries for knowledge/infra/equipment sharing

1.Chemical industry to contribute a percentage of CSR corpus and matched by the government to create a Chemical Innovation Fund

Initiative 4.3

Setup a technical committee to govern and advise on technical standards for emerging technology

A committee will be established to support the development of emerging technologies. This committee will govern and advise local manufacturers on key technical standards, such as those for the global aerospace high-performance composite industry.

Initiative team: MITI (lead), MIDA, Department of Standards Malaysia

Enabler 5

Develop a large base of skilled labour to grow the industry and support downstream use of products chain

There are 564 public and 690 private TVET institutions in Malaysia, with more than 1,000 agreements in place with industry for student placements. There are also 79 National Occupational Skills Standards (NOSS) related to the chemical industry, covering priority segments such as Fertiliser, Plastic, Rubber, and Composites, as well as NOSS related to overall management in the chemical industry. In some cases, these programs have become dated over time, creating headroom for improvement to make them more relevant to modern industry demands. The lack of standardisation of entrance requirements and accreditation bodies also creates some challenges, hampering the industry's efforts to encourage and engage appropriately qualified talent.

Attracting and retaining talent is also a major challenge in a globally competitive marketplace. Some regional peers with mature ecosystems exert a strong pull on global talent, offering extremely competitive salaries of up to three times those offered in Malaysia for key roles such as chemical engineers.

This combination of issues makes for a challenging dynamic for Malaysia's industry in the short and medium-term. Improving ease of entry for foreign skilled labour, alongside enhancements to the educational ecosystem, could help improve this scenario.

Analysis of global leaders in TVET education has allowed us to identify several key success criteria. Clearly assigning owners and roles across the educational ecosystem is one key area. Defined champions and decision bodies in areas such as planning, evaluation, policy, standards, training, etc., could streamline TVET education and improve outcomes for students and industry. This should come with clear definitions of the roles and responsibilities of decision-makers across the end-to-end educational landscape.

Industry involvement is a vital part of a fit-for-purpose ecosystem, ensuring the vocational training programs remain relevant to changing industry trends and needs, inclusive of chemical safety education. It is important to move away from a regulator-led TVET development model towards one built on industry collaboration across curriculum development and endorsement. Regulator-led models suffer challenges related to lack of alignment and collaboration with industry, resulting in curriculums being outdated and failing to appropriately reflect industry needs.

Efforts must also be undertaken to increase apprenticeship programs led by industry players, backed by appropriate support such as mentorships and relevant titles of accomplishments upon completion. Largely funded by industry, these TVET programs provide invaluable hands-on learning opportunities for TVET graduates.

The TVET system should also be backed by a strong quality assurance system, with a single industry body designed to oversee the development and implementation of TVET programs. This will operate in close collaboration with various other government bodies, such as state governments to develop an appropriate qualifications framework, licensing/registration system, accreditation, and institutions for assessments.

Beyond TVET, institutions of higher learning, such as universities should also be empowered as a source of local talent expertise. As of 2018, Malaysia ranked 25th in the world in QS' Higher Education System Strength Rankings, indicating high quality of higher education. Internationally recognised universities such as Universiti Malaya (UM), Universiti Teknologi PETRONAS (UTP), Universiti Kebangsaan Malaysia (UKM), Universiti Sains Malaysia (USM), and numerous others can look to improve the relevance of their curriculums through engagement with industry leaders to equip the upcoming workforce with the skills of the future.

In order to enhance attractiveness to foreign talent, it will be critical to have a strong visa-related programme for skilled labour. Today, Malaysia's Residence-Pass Talent (RPT) programme is focused more on retaining existing foreigners in sectors such as energy, IT, and financial services. Given the specific needs of the chemical industry, especially with regard to niche talent in high value adding specialty chemicals, efforts will be undertaken to further enhance this program. This will include continued evaluation and review of the possibility of devising high-skilled visas to attract top global researchers and executives.

Initiative 5.1

Review and update TVET and higher education training, relevant to industry needs

Industry representation in TVET and higher education course design and evolution will be increased, ensuring industry-specific needs are constantly assessed and built into training and education programs. Industry councils will be established to provide advice and the latest information especially related to skills training. The NOSS and TVET curriculum will be further developed through the increased involvement of industry, experts and other TVET practitioners. National Dual Training System Division (NDTS) will be implemented and based on developed standards and aligned towards industry needs. A Technical Advisory Committee (TAC) will also be formed to assist TVET institutions in accessing the latest information and trends for training. Industry representatives will also be included in discussions of high-level policy formulation through the National Skills Development Council (MPKK) platform. Centres of Excellence (CoE) will also be co-developed by industry and academia to further build up capabilities. The relevance of training and education will be measured through monitoring of trainees and fresh graduate employment rates.

Initiative team: MOHR (Lead), MITI, Consortium of Industry Associations

Initiative 5.2

Ensure inclusion of performance criteria in evaluation of TVET contracting

Government contracts to provide TVET services will be selected based on competitive contracting with well-defined performance measures. This will improve the sufficiency of financial assistance for TVET and ensure such support correlates strongly to industry needs and suitability of training programs.

Initiative team: MOHR (lead), MITI, MOF

Initiative 5.3

Enhance chemical TVET apprenticeship quality assurance

Quality assurance for TVETs will be assured through the NOSS, co-defined by chemical industry associations, players, and regulators. Apprenticeship training through NDTS will be executed, supported by industry participation and well-trained coaches familiar with the chemical industry. Certification for apprenticeship is based on Sijil Kemahiran Malaysia (SKM), Diploma Kemahiran Malaysia (DKM) and Diploma Lanjutan Kemahiran Malaysia (DLKM) for full program.

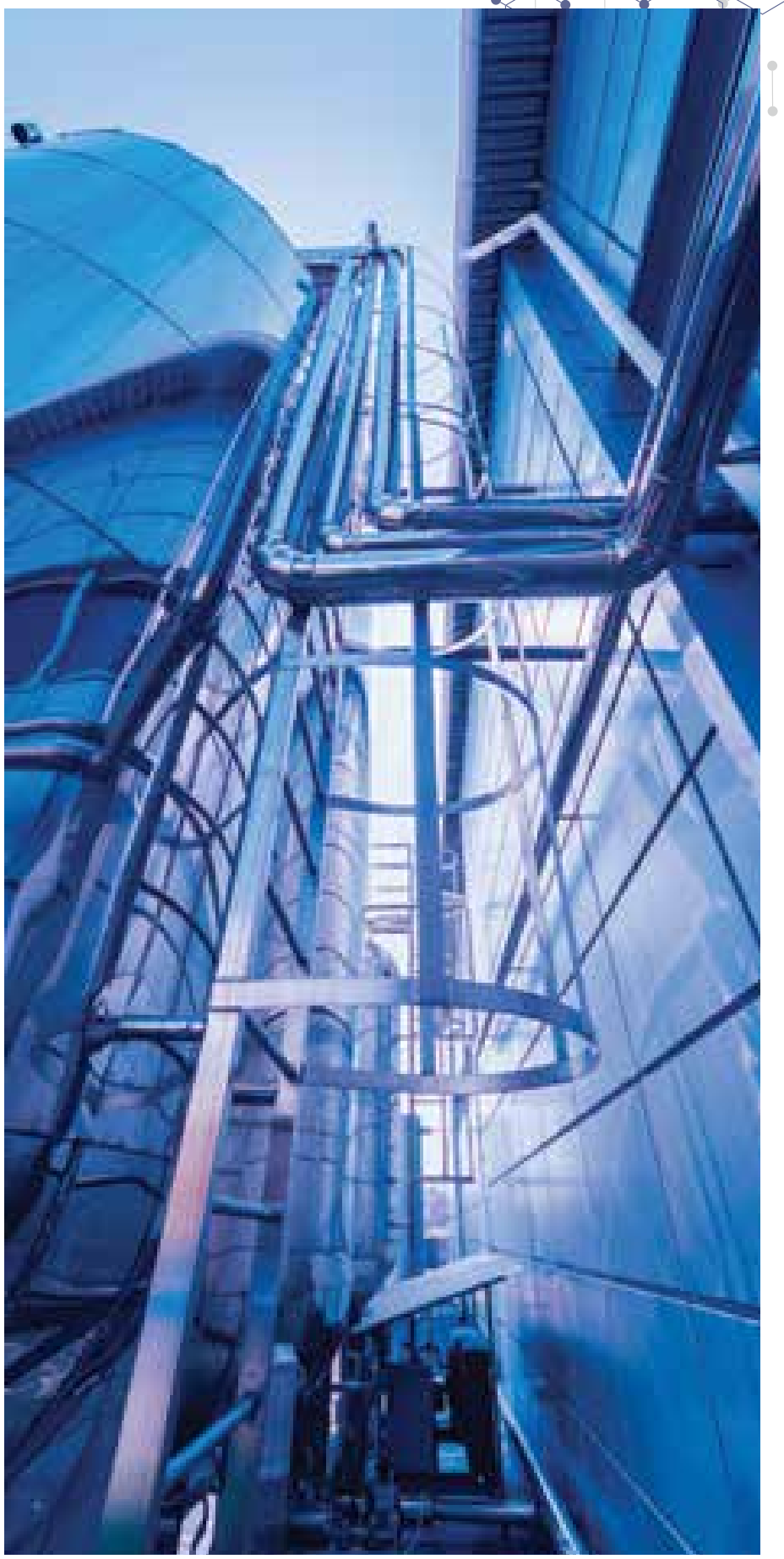
Initiative team: MOHR (lead), MITI,
Consortium of Industry Associations

Initiative 5.4

Expand RPT programme to ease entry of foreign skilled labour

The RPT programme will be extended to target talent relevant to catalytic sectors such as the chemical industry. The stringency of eligibility will be adjusted to ensure qualification of relevant talent.

Initiative team: MOHR (lead)



Infrastructure

Enabler 6

Improve chemical ecosystem infrastructure

Malaysia's chemical sector is supported by strong infrastructure provision, with electricity, transportation and utilities all performing well on a regional level.

Analysis and benchmarking of physical infrastructure reveal solid foundations. Electricity is currently dominated by fossil fuel generation in Peninsular Malaysia, but the National Energy Policy places renewed focus on the role of renewables and less carbon-intensive gas in the energy transition. Large-scale greenfield opportunities are expected to predominantly rely on co-generation. Energy prices are competitive against regional peers, offering a significant advantage to willing investors.

Malaysia is also home to one of the most extensive natural gas pipeline networks in Asia and has a well-developed gas infrastructure. Water supply is also reliable, and greater funding is being secured to improve efficiency and reliability. There is a strong network of petrochemical complexes and associated infrastructure, which offers an attractive proposition to investors who have a broadly favourable outlook towards the mature nature of the sector.

Transportation infrastructure is robust, with the Malaysian Government committing considerable effort and investments in developing integrated highways and railway networks. Logistics efforts benefit from major container terminals, with key ports positioned among the top twenty ports globally in terms of volume handled. Both road infrastructure and ports are supported by a strong transport and logistics ecosystem with many mature providers.

Supporting auxiliary services is one area where improvement is required, in both testing facilities and waste management. Lack of capabilities in testing facilities for niche chemicals such as agrochemicals can hamper industry efforts, with Malaysia currently having no private research institutions, advanced vegetable seed testing labs, or similar services. CTRM and EU-based Composite Testing Lab (CTL) have developed testing facilities for final product structural testing but still lack upstream pre-pregs material testing. SIRIM provides product testing services for plastic end products, but lacks capability in material property testing for areas such as engineering plastics.

In waste management, over 50% of chemical waste is disposed through special management systems such as sanitary landfills, off-site of physio-chemical waste treatment facilities for waste stabilisation, or solidification for final landfilling. This is primarily undertaken by government operations, with low involvement from the private sector. A lack of enterprise resource planning (ERP) facilities is a major hurdle.

While it is clear that strengthening existing auxiliary services for the chemical industry is necessary, Malaysia can also leverage the Department of Standards Malaysia's 784 accredited laboratories and Mutual Recognition Arrangement (MRA) testing agreements with Asia Pacific partners in order to boost this area of the ecosystem.

Initiative 6.1

Introduce Extended Producer Responsibility (EPR) to improve end-life waste management for chemical products

Chemical manufacturers will be encouraged to be responsible for the cost of managing products at end of life, and develop a responsible waste disposal ecosystem. This initiative will focus heavily on plastics and the synthetic rubber sub-sectors. The Ministry of Local Government Development (KPKT) is currently looking at introducing EPR in overall waste management as part of the national circular economy agenda. NRECC is also supporting this effort, specifically looking at the EPR scheme for plastics.

Initiative team: MITI (lead), KPKT, DOSH

Initiative 6.2

Increase testing capabilities for chemicals intermediates and chemical products

In collaboration with the private sector, testing laboratories will be established for vegetable seeds, composite pre-pregs, and engineering plastics to support industry development. Certifications and standards will be aligned with globally recognised standards such as Good Laboratory Practice (GLP), with development governed by local technical committees.

Mutual Recognition Arrangements (MRAs) will also be explored with agencies in other countries to support the recognition of local standards and certifications for chemical products.

Initiative team: MITI (lead), MIDA, SIRIM

Initiative 6.3

Ensure adequate growth of chemical waste management facilities

Support for adequate effluent management is key to sustainability and needs to be developed in parallel to focus on growing the scale of chemical manufacturing in Malaysia. Incentives to encourage increased involvement by private companies in chemical waste management will be explored.

Initiative team: MIDA (lead), KE, MITI, DOSH, DOE

Enabler 7

Develop industrial parks to increase value-chain integration and extract value from synergies

Malaysia is already home to a number of world-class chemical parks that drive the competitive advantage of the domestic chemical industry. Notable chemical parks such as Gebeng Integrated Petrochemical Complex (GIPC), Kerteh Integrated Petrochemical Complex (KIPC), and Pasir Gudang continue to attract top chemical companies such as BASF, Lotte Chemical Titan, Synthomer, INEOS, Eastman, and many others. While efforts will continue to enhance these parks, opportunities will also be sought to create new parks to support the next wave of new chemical products growth.

Global benchmarking reveals three key success factors to develop an attractive park. Location is critical, taking into account proximity to final markets, presence of adjacent businesses, security of raw materials, and intermediate supply. Park features are also important, with benefits from complementary shared services, on-site energy and utilities production, free trade zone regimes, and centre of excellence characteristics. Additional supporting factors such as infrastructure and connections, support from external bodies, and presence of dedicated entities are also valuable.

For Malaysia to maximise the potential of both existing and new chemical parks, it is critical to evaluate these factors for all parks to understand the areas for improvement to increase overall park attractiveness and to drive higher utilisation. In parallel, identification of potential new chemical parks, including green chemicals park, polymer parks, and high-performance composites parks, will be undertaken.

Initiative 7.1

Improve chemical parks proposition holistically to attract foreign participation

The value proposition of chemical parks will be enhanced through focus on higher value-added parks. This will include the potential of exploring three focus parks. Firstly, a green chemicals park which will bring together oleochemicals, bioplastics and care chemicals. Secondly, a polymer park with focus on automotive, bringing together synthetic rubber and engineering plastics. Finally, a high-performance composites park, localising the value chain of fibre production, resin, pre-pregs and composites manufacturing with an aerospace focus.

This will be supported with the enhancement of the chemicals investment portfolio scope to promote and gauge foreign interests prior to gazetting of land. This strategy will ensure execution certainty for full value chain presence before park implementation. Key success factors will also be introduced to chemical parks in order to attract more foreign participation such as commodity traders, proximity to key molecular and precursor providers, vocational schools, academic collaboration, shared services for utilities, security, and energy, and centre of excellence criteria to enable digitalisation and IoT implementation within the development.

Initiative team: MITI (lead), MIDA, State Governments

Enabler 8

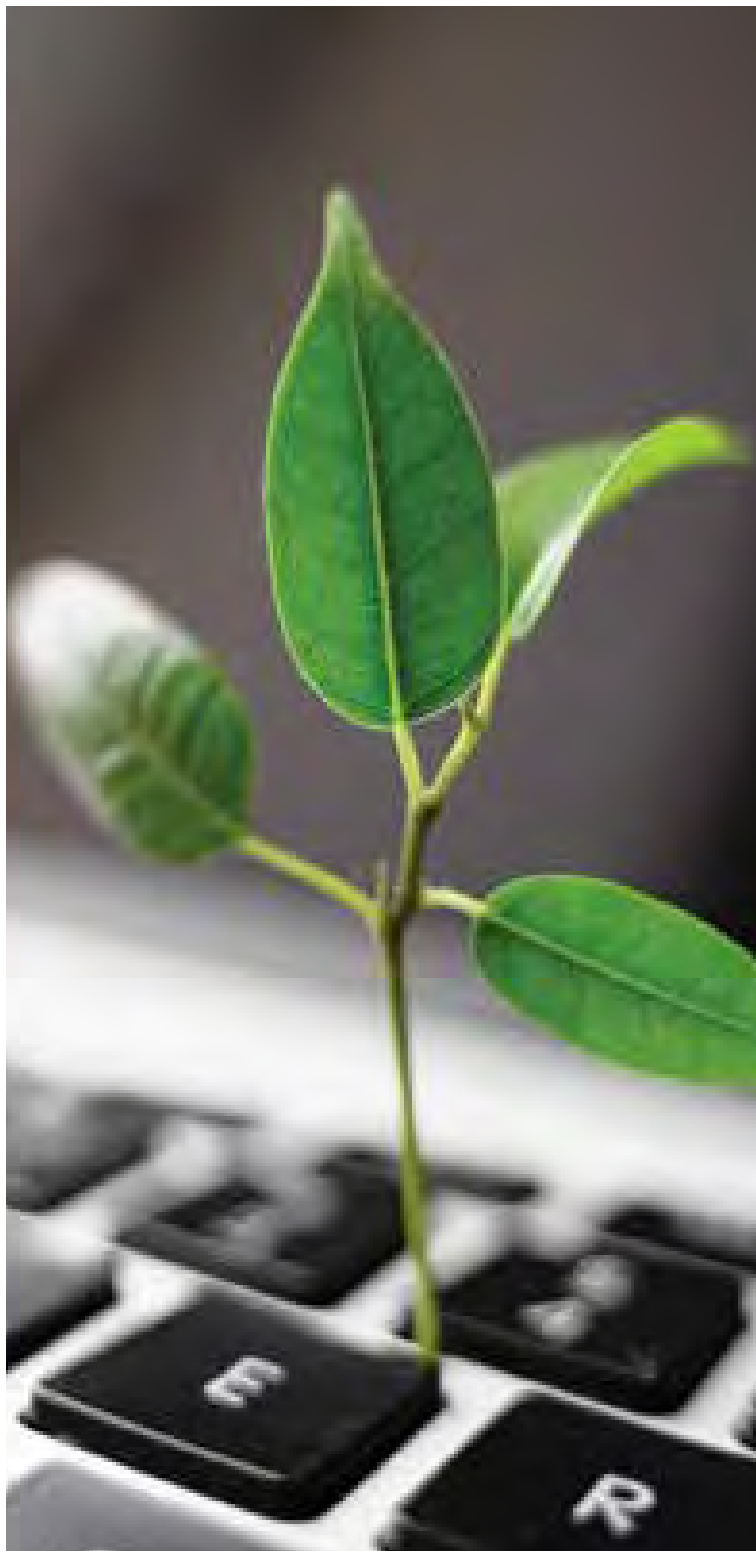
Develop regulatory support for development of circular economy of chemicals

Malaysia has established ambitious circular economy goals, with numerous broad-based regulatory roadmaps and legislation in place to steer towards a more sustainable usage cycle. These include plans developed by NRECC under the Environmental Sustainability in Malaysia 2020-2030 Roadmap and the Domestic Emissions Trading Scheme. Such initiatives are designed to improve the circular use of resources and reduce Malaysia's resource intensity.

While these plans offer an important vision for the future, Malaysia currently lags behind leading global countries when it comes to issues such as recycling. While higher than regional peers such as Singapore (4%)[56] and Indonesia (10%)[57], Malaysia's 24%[58] plastics recycling rate today is significantly lower than nations such as Germany (49%)[59] and the Netherlands (47%)[60].

The National Roadmap Towards Zero Single Use Plastics (2018-2030), Malaysia Plastics Sustainability Roadmap 2021-2030, and Malaysia Sustainable Plastics Alliance all reveal the strong regulatory push towards improved sustainability. These strategies cover a wide range of goals that impact the chemical industry, including grants for waste management improvement, fines for poor practices, and pollution charges. Tackling single-use plastics will also continue to be a priority, with plans to ensure 100% of packaging will be recyclable, reusable, or compostable by 2030.

Despite this, there remains clear room for improvement within the Malaysian ecosystem, and efforts are underway to further promote that agenda. This could put Malaysia on par with leading developed nations in areas of sustainabilty and waste management. NRECC is in the process of developing further plastic reycling policies, as well as looking at carbon reduction across the industry. The Domestic Emissions Trading Scheme (DETS) and Voluntary Carbon Market (VCM) will be an important catalysts to enhance Malaysia's carbon trading and carbon efficiency ecosystem. The adoption of alternative materials is also encouraged through various roadmaps.



[56] Channel News Asia, New association launched to help enhance rate of recycling plastic waste in Singapore, August 2021: https://www.channelnewsasia.com/sustainability/pras-association-plastic-recycling-waste-2118121
[57] World Economic Forum, Radically Reducing Plastic Pollution in Indonesia: A Multistakeholder Action Plan National Plastic Action Partnership, April 2020
[58] Market Study for Malaysia: Plastics Circularity Opportunities and Barriers - World Bank
[59] DW, Plastic waste and the recycling myth: https://www.dw.com/en/plastic-waste-and-the-recycling-myth/a-45746469
[60] Postcollection Separation of Plastic Recycling and Design-For-Recycling as Solutions to Low Cost-Effectiveness and Plastic Debris, School of Business and Economics and Tinbergen Institute, Raymond Gradus

Sustainability policies and regulations of Malaysia versus benchmark countries

	Malaysia	Singapore	Indonesia	Germany	Netherlands
Renewable energy	✓ Renewable Energy Act 2011	✓ Strong governmet support and policies in place for solar energy	✓ Policies in place, but ineffective. New presidential orders underway	✓ German Renewable Energy Sources Act	✓ Netherlands Offshore Wind Energy Act
Carbon reduction	✗ Long-Term Low Emission Development Strategy (LT-LEDS) in development by NRECC; expected to be finalised by the end of 2022	✓ Carbon Pricing Act 2018 imposes a $5 fee per tonne of GHG emissions	✗ Plans are underway for a carbon tax	✓ Carbon pricing through Fuel Emissions Trading Act	✓ Climate Act 2019 sets binding GHG reduction goals for businesses
Plastic recycling	✗ Under development by NRECC	✓ Resource Sustainability Act 2019 mandates reporting of packaging imports	✗ Comprehensive regulations being developed	✓ Packaging Act imposes a recycling fee on new plastic packaging	✓ General rules established in the Environment Act, but plastics recycling is managed independently by respective municipalities
Adoption of alternative materials	✗ Roadmaps are available. General recommendations for all industries	✗ Roadmaps are available. General recommendations for all industries	✗ Roadmaps are available. General recommendations for all industries	✓ German Federal Environment Agency produces Guide on Sustainable Chemicals	✓ National Policy on Substances of High Concern suggests alternatives for certain materials
Chemical waste management	✗ No chemical specific legislation. Only general legislation for proper disposal of materials	✗ No chemical specific legislation. Only general legislation	✗ No chemical specific legislation. Only general legislation	✗ Only general legislation. Strong government push	✗ Only general legislation. Strong government push
Water management	✓ Environmental Quality Act & Standards	✓	✓	✓	✓

Source : Press search

Globally, sustainability within the chemical sector is being looked at from three broad angles. The first is improving the recycling ecosystem, where, as noted, Malaysia lags behind global leaders.

The second key area of improvement is on circular economy initiatives. Japan, for example, has both an established Plastic Resource Circulation Strategy, which outlines a 25% reduction in one-way plastic emissions by 2030, and also a Roadmap for Bioplastics Introduction established in 2021, which aims to achieve 2 mtpa of bio-based plastics by 2030. Netherlands was home to over 85,000 circular economy initiatives by 2018, supporting over 420,000 jobs, and it has also introduced the Dutch Plastics Pact that incorporates private and public organisations to reduce plastic use and boost recycling. France has introduced EPR by setting targets and entering into voluntary agreements with eco-organisations, as well as adapted its tax system to reduce the cost of waste recovery.

Labels are also being utilised to spur consumer demand for sustainable products across Southeast Asia and around the world. The Thai Green Label is awarded to plastic packaging products in Thailand that are shown to have minimal environmental impact. The Singapore Green Labelling Scheme is available for plastic products that are degradable or compostable based on specific criteria for each product type. Germany's Blue Angel label considers the entire lifecycle of a product with strict criteria for awarding. Malaysia's SIRIM Eco-labelling Scheme follows a similar approach and is awarded for taking into account the full lifecycle of plastic products.

Initiative 8.1

Introduce mandate for plastic packaging to utilise increasing amounts of sustainable materials (biodegradable bioplastics or recycled plastics)

A mandate that plastic packaging should include at least 15% recycled content will be promoted. In addition, the use of biodegradable plastics will also be encouraged, with increasing expectations throughout of the CIR2030. The sustainable share of content will be targeted at 25% by 2025 and 50% by 2030.

Initiative team: MITI (lead), NRECC

Initiative 8.2

Implement emissions pricing mechanisms for the chemical sector

NRECC is currently working with MOF and Bursa Malaysia to develop the Domestic Emissions Trading Scheme (DETS) in phases. The DETS will operate as a single trading platform for carbon credit at the domestic level. Early phase of the DETS will involve the development and implementation of voluntary carbon market before undergoing transition into a compliance-based market where chemical industry will be one of the potential industries in DETS. Voluntary Carbon Market (VCM) will provide incentives and mechanisms to reduce the total carbon emissions intensity of operations for the industry.

A task force is being established to ensure appropriate adoption and enforcement of these carbon pricing mechanisms in the chemicals sector. It will include active engagement with key chemical industry players and experts to design a robust and practical strategic response to emissions.

Initiative team: MITI (lead), MIDA, NRECC, MOF

Initiative 8.3

Enhance sustainable plastics and synthetic rubber labels for end-consumer products with clear standards

Enhance current standards to define sustainable products, plastics, and synthetic rubber (Green Labels), taking into account both the feedstock sources and energy intensity of operations. Education and marketing to consumers on the Green Label will be included to drive the national sustainability agenda and inform and steer consumer demand.

Initiative team: MITI (lead), MGTC (NRECC), Department of Standards Malaysia

Enabler 9

Incentivise more sustainable operations and innovation for sustainable products

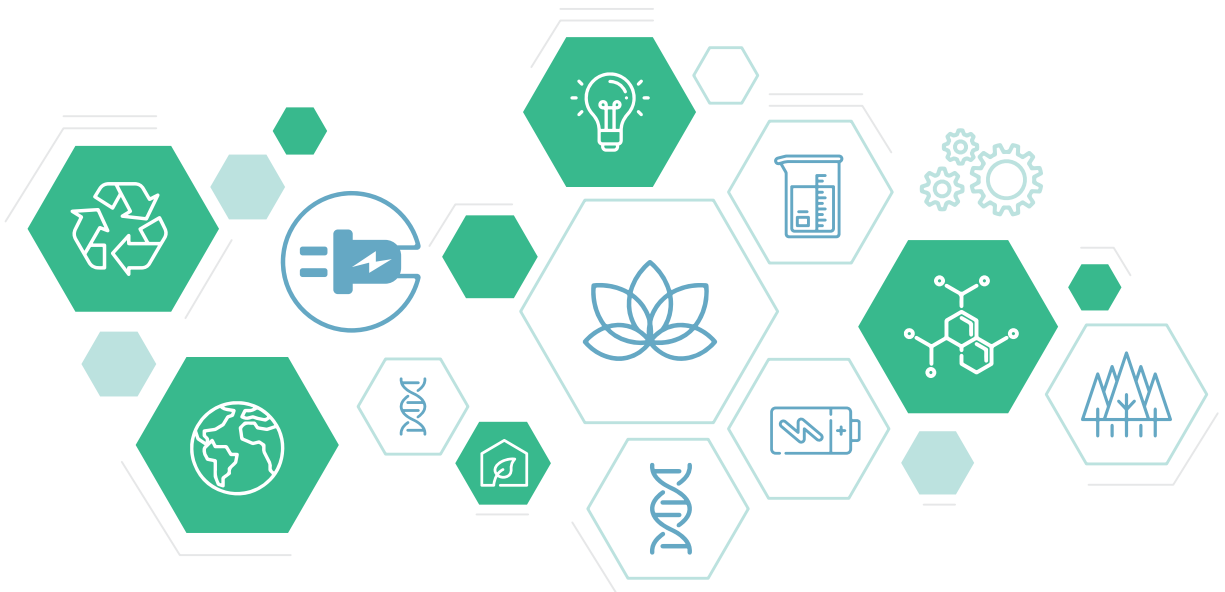
Malaysia currently offers a number of incentives to promote sustainable operations. There are three distinct angles to consider when enhancing the ecosystem of sustainable operations and innovations for sustainable products.

From an incentive perspective, the Green Investment Tax Allowance (GITA) encourages and supports companies to acquire and invest in green technologies via tax benefits. The Green Technology Financing Scheme (GTFS) meanwhile provides subsidies to ease the financial burden of green technology investment.

Efforts to scale up the use of sustainable feedstock are also in place, with the National Biomass Strategy promoting the use of Malaysia's plant-based feedstock to create downstream bio-based products. A limited number of SMEs and start-ups are currently engaged in the development of sustainable products from these feedstocks, offering clear room for growth. However, many sustainable feedstock projects remain in pilot phases and are not yet scaled up to full manufacturing capabilities.

Green product sourcing and design is also an industry priority, and one such initiative is Malaysia's green recognition scheme MyHIJAU which aims to promote green products and services. The Malaysian Green Technology and Climate Centre also act to educate, support, and champion the green ecosystem, providing directory management, promotions, and business advisory for certified green products and services.

There remain some key opportunities for Malaysia to further incentivise sustainability, many of which are outlined in the National Energy Efficiency Action Plan (NEEAP). Green investment tax allowances are available for businesses such as those in the chemical industry who invest in activities such as energy efficiency. This covers 100% of qualifying capital expenditure incurred on green technology projects for three years. The Green Technology Financing Scheme offers green technology producers funding of up to RM100mil, while green technology users can receive up to RM10mil in assistance. Energy audits of operators can also enhance sustainability, and the active campaign to offer free audits could identify valuable cost and energy savings for companies in the chemical industry.



Energy efficiency initiatives remain a key focus of enhancing sustainability in the manufacturing sector globally, including the chemical industry. Germany offers a range of such initiatives, including the Energy Efficiency Fund, which reimburses up to 30% of investment costs for qualifying projects; SME support funds that cover up to 80% of advisory services for energy efficiency improvements; the STEP Up fund for corporate energy efficiency improvements, and the Energy Efficiency Networks which provide ongoing audits and review of efficiency. Singapore offers similar initiatives, with Energy Efficient Singapore providing a wide range of fiscal and technical support, including up to SGD600,000 investment on a 50:50 energy efficiency investment basis, and the Resource Efficiency Grant for Energy, which supports industrial facilities to become more efficient, with higher grant support for smaller companies or companies which deliver significant efficiency improvements.

Malaysia has substantial room for improvement around scaling up the use of sustainable feedstock to boost energy efficiency in the ecosystem. Strong ambitions around bio-based sector development offer a good foundation for these efforts, and the various roadmaps and projects could deliver real efficiency improvement opportunities for the chemical sector. The Bioeconomy Corporation under the Ministry of Agriculture and Food Security (KPKM) is targeted at assisting biotechnology-based companies and attracting FDI into the sector. BioNexus Status offers a 70% tax exemption for qualifying companies for income derived from new business or expansion projects. Sarawak Biohub Port offers an RM20bil[61] expanding infrastructure opportunity that will benefit downstream companies within the sector. Meanwhile, MIDA offers a range of incentives and support to promote industry development.

[61] MIDA, Sarawak Biohub Port project to kickstart in Q1 2021, August 2020: http://www.mida.gov.my/mida-news/sarawak-biohub-port-project-to-kickstart-in-q1-2021/

Malaysia is also positioned to leverage its strong research in bio-based products such as bioplastics and biopesticides. The Malaysia Palm Oil Board, for example, received RM2.85mil[62] for a range of bioplastics research, leveraging the significant palm oil feedstock availability and working with companies such as SIRIM. Rhodomaxx is expected to expand capacity for bioplastics to over 756,000m^2 after pilot machinery is delivered, moving towards commercialisation and leveraging Southeast Asia's expansive seaweed feedstock. Australian-based SECOS Group has also begun manufacturing bioplastics in Malaysia with a new plant offering 12,000 tonnes capacity per annum[63] and utilising renewable sustainable raw materials from agriculture alongside traditional plastics.

However, the majority of projects are still in pilot phases and not yet geared up for full-scale manufacturing, and will require additional support to succeed. While the economic viability of green-based chemicals is at an early stage, it is important for Malaysia to begin expanding its engagement in this niche segment and benefit from the 10% CAGR projected growth of this USD30bil market[64] in order to ensure it is commercially ready once the market and margins become more attractive.

Malaysia has an encouraging landscape for companies designing products that are recyclable and reusable, offering a good framework for evolution. The introduction of the MyHIJAU recognition scheme has offered a valuable catalyst to this sector by promoting green products and services. The Malaysian Green Technology and Climate Change Centre also acts as a valuable champion for sustainable product design and development.

[62] The Star, Malaysia's pioneer bioplastics pilot plant is operational, July 2011: https://www.thestar.com.my/business/business-news/2011/07/13/malaysias-pioneer-bioplastics-pilot-plant-is-operational
[63] The Fish Site, The Malaysian startup that aims to take the seaweed sector by storm, August 2020: https://thefishsite.com/articles/the-malaysian-start-up-that-aims-to-take-the-seaweed-sector-by-storm
[64] BCG

Private companies across the globe are also leveraging digital ecosystems to divert waste from landfills. In Australia, Aspire operates in partnership with the Australia National Science Agency and municipal authorities to provide a matchmaking tool for recycling needs, diverting over 45,000 tonnes from landfill. India's Recykal offers an online platform for buying and selling recyclable items, processing over 10,000 tonnes of materials each month. Materials Marketplace is a US-based platform that links over 2,200 businesses across the US to scale new reuse and recycling market opportunities and has diverted over 5,300 tonnes from landfills.

In the West, circular economy think tanks such as the Ellen Macarthur Foundation, Green Alliance, and Institute for European Environmental Policy (IEEP) are being established to aid the acceleration of the circular economy model. These think tanks conduct research projects, policy design, pilot studies, education initiatives and other activities to support government agencies with their sustainability agendas. Malaysia would benefit from the presence and expertise of similar think tanks, enabling a sharpened focus on the creation of a circular economy.

Initiative 9.1

Develop digital platform to create circular economy market for local waste

A task force will be established to identify the potential for a digital platform solution to promote a circular economy, working to onboard SMEs and corporations into this circular ecosystem. A study will be undertaken to prioritise sector participation based on the potential sustainability benefits of each sector.

Initiative team: MIDA (lead), MITI

Initiative 9.2

Establish education support and best-practice guidance for chemical industry businesses to implement sustainability measures

Circular economy think tanks will be invited to provide innovative solutions to shape the circular economy agenda for the chemical industry, together with the Government and industry. The Malaysian Chemical Collaborative Platform (MCCP) can also support this initiative by running sustainability workshops to educate the industry about sustainable practices and encourage the implementation of sustainability measures.

Initiative team: MITI (lead), MGTC (NRECC), Chemical Industry Associations

Initiative 9.3

Provide support for new technologies and innovative business models in recycling and production of end products with bio-based chemicals, recycled plastics, and synthetic rubber

Support for new technologies and innovative business models will be introduced via a new policy framework that promotes circular economy and ESG principles.

Initiative team: MITI (lead), IRB, MOF

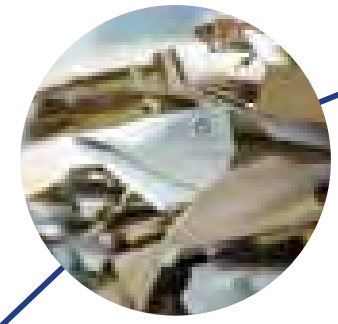
Enabler 10

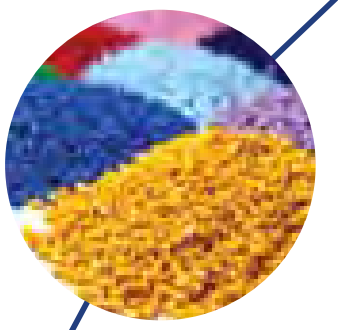
Establish value chain consortia for holistic sustainability implementation

Collaboration will be critical to delivering an effective sustainability agenda. Establishing key consortia in order to share knowledge, transfer technology, and collaborate on initiatives will help improve outcomes. This will inspire a holistic approach that will boost the efficacy of these actions.

Malaysia Recycling Alliance (MAREA), established in January 2021, brings together ten leaders in the consumer goods industry to act as an interface between industry needs and key stakeholders within the Government in areas of recycling. Initiatives include supporting the recycling value chain, policy, and infrastructure development. There is significant room to mirror this kind of initiative to ensure the informed development of circular economies within the chemical industry.

A consortia approach can help engender industry engagement with the circular economy while providing valuable insight into how and where such efforts should evolve. Germany hosts a range of such consortia, including the New Consortium for a Circular Carbon Economy which brings together key actors in energy, chemical, and waste management sectors, amongst other initiatives. Netherlands operates Plastics Pact NL which includes almost 100 private and public sector organisations for responsible use of plastics and products, as well as Nutrient Platform NL consortia in waste management and Advanced Research Centre Chemical Building Blocks Consortium designed at developing more sustainable chemical processes and ecosystems. In Singapore, the Alliance to End Plastic Waste (AEPW)—which partners with Nanyang Technological University (NTU)—and the Singapore Chemical Industry Council operate to improve sustainability across plastics and chemical industry operations.





Initiative 10.1

Establish sustainability consortia with businesses, knowledge institutes, NGOs and ministries for plastics, synthetic rubber, and oleochemicals

Initiatives will be developed to address issues of energy efficiency, carbon emissions, greenhouse gas emissions, and waste management for key chemical value chains such as plastics, synthetic rubber, and oleochemicals. The sustainability consortia will also look to assist businesses in their transition towards more ESG-friendly practices through joint training workshops, capability and product development projects. Additionally, collaborative funding will be leveraged to promote a sustainability innovation platform to foster startups to build in this space.

Initiative team: CICM (lead), MITI, NRECC, KE

Sustainability in the chemical industry

Sustainability is an increasingly vital part of both the national and industrial agenda. It is a critical pre-requisite for nations as they seek to future-proof the global economy, reflecting both persistent changes in consumer expectations, and the responsibility to provide socio-economic growth while mitigating the impact on the planet.

The chemical industry accounts for 13%[65] of the global share of industrial CO_2 emissions. The industry's sustainability impact is also highlighted by the 973mil tonnes[66] of plastic waste projected to be in the world's oceans by 2050. Without intervention and adoption of appropriate measures, the growing demand for chemicals in everyday life will lead to an even greater impact on the planet through an expanding chemical industry footprint. The CO_2 intensity of the industry grew by 4.4% CAGR[67] between 2013-2017, and energy intensity grew by 2.9% CAGR[67] over the same period. The use of water resources is also a major area of concern, growing at 0.2% CAGR, while waste intensity grew at 1.2% CAGR. A dramatic response is needed to improve the sustainability of our economies.

While investing in a transition to enhance sustainability undoubtedly comes with initial upfront costs, it will ultimately unlock significant long-term economic value[68] for companies and the country, particularly those that move quickly to capture market opportunities. Companies that achieve sustainability targets ahead of regulations could benefit from a ~5% revenue equivalent uplift, avoiding potential carbon tax costs at an assumed USD50/tonne of CO_2. Increasing the reuse and recycling of plastics could also provide a pathway to extracting significant value, with an estimated USD60bil profit pool over the next 10 to 15 years generated in the petrochemical sector by investing in circular plastic practices.

[65] *International Energy Agency, Chemical Industry analysis*
[66] *World Economic Forum, The New Plastics Economy Rethinking the future of plastics, January 2016*
[67] *Refinitiv*
[68] *AISI; BCG*

Enhancing sustainability credentials also places businesses in favourable positions with investors, who are increasingly looking for more socially, environmentally, and economically positive investment opportunities, offering a potential 12% value premium for chemical companies with lower carbon intensity. These sustainability credentials also feed into changing customer demand in growing markets, with ~15% CAGR expected in 2016-2050 for recovered and recycled plastics, far above the 1% expected in virgin plastic products.

Investing in adaptability has a further ecosystem benefit of boosting flexibility through innovation, generating significant potential R&D benefits. There is an estimated five-fold cost-benefit ratio through investing in more resilient infrastructure and water management, aside from the broader benefits around competitiveness and market attractiveness.

Malaysia has a strong history of supporting the sustainability agenda, with a number of policies present and planned aimed at tackling the resource intensity of the economy. The new National Energy Policy identifies the optimisation of energy resources and enhancement of the energy sector's contribution to environmental sustainability as two of four key strategic thrusts. It sets out a vision to boost macroeconomic resilience and energy security while enhancing social equitability and affordability at the same time as respecting environmental sustainability. Other contemporary efforts are outlined in NRECC's Plastics Sustainability Roadmap 2021-2030 and Roadmap Towards Zero Single-Use Plastics 2018-2030. These roadmaps offer a positive vision of a greener Malaysia, working to reduce the resource burden of the economy and ensure sustainable growth for the benefit of all.

Malaysia's commitment to the sustainability agenda is also apparent in its Nationally Determined Contributions to the Paris Climate Agreement, in which it committed to a reduction of greenhouse gases by 35% by 2030 relative to the emissions intensity of 2005, or up to 45% conditionally to international support[69]. In August 2021, Malaysia increased its ambitions under this agreement, targeting unconditional reductions of 45%[70], again demonstrating its commitment to the sustainability agenda. In September, Malaysia further announced its goal to become carbon neutral as early as 2050.

Major companies based in Malaysia have also taken proactive steps to improve sustainability in line with this agenda. PETRONAS recently pledged to achieve net-zero carbon emissions by 2050. Similarly, Tenaga National Berhad (TNB) launched its sustainability pathway setting out its ambitions to expand the installed capacity of renewable energy within its energy portfolio. It is clear that the sustainability agenda is actively being adopted by both private and public organisations.

The CIR2030 will aim to enhance the sustainability of the chemical sector in parallel with these wider evidenced commitments to improve sustainability in Malaysia.

The aspirations defined in this roadmap will be twofold. Firstly, the chemical industry will play a pivotal role in increasing the plastics and synthetic rubber recycling rate to 50% by 2030. Secondly, the chemical industry will play a leading role in the targeted reduction of greenhouse gas emissions by 2030, acknowledging that this target may be revised depending on Malaysia's ongoing progress.

[69] United Nations Framework Convention on Climate Change
[70] The Edge Markets, Malaysia updates NDC to reduce intensity of unconditional greenhouse gas emissions by 45%, August 2021: https://www.theedgemarkets.com/article/malaysia-updates-ndc-reduce-intensity-unconditional-greenhouse-gas-emissions-45

Key targets have been established within the CIR2030 in order to support Malaysia's aspirations. First and foremost, to build up the sustainability ecosystem across the chemical industry and second, to become champions for key strategic bio-based products by leveraging Malaysia's natural resources.

To strengthen the sustainability ecosystem, efforts will focus on improving the circular economy opportunities for plastics through new recycling technologies backed by an ecosystem of innovative players. Meanwhile, a focus on circular economies for tyres and gloves will improve sustainability in the synthetic rubber area.

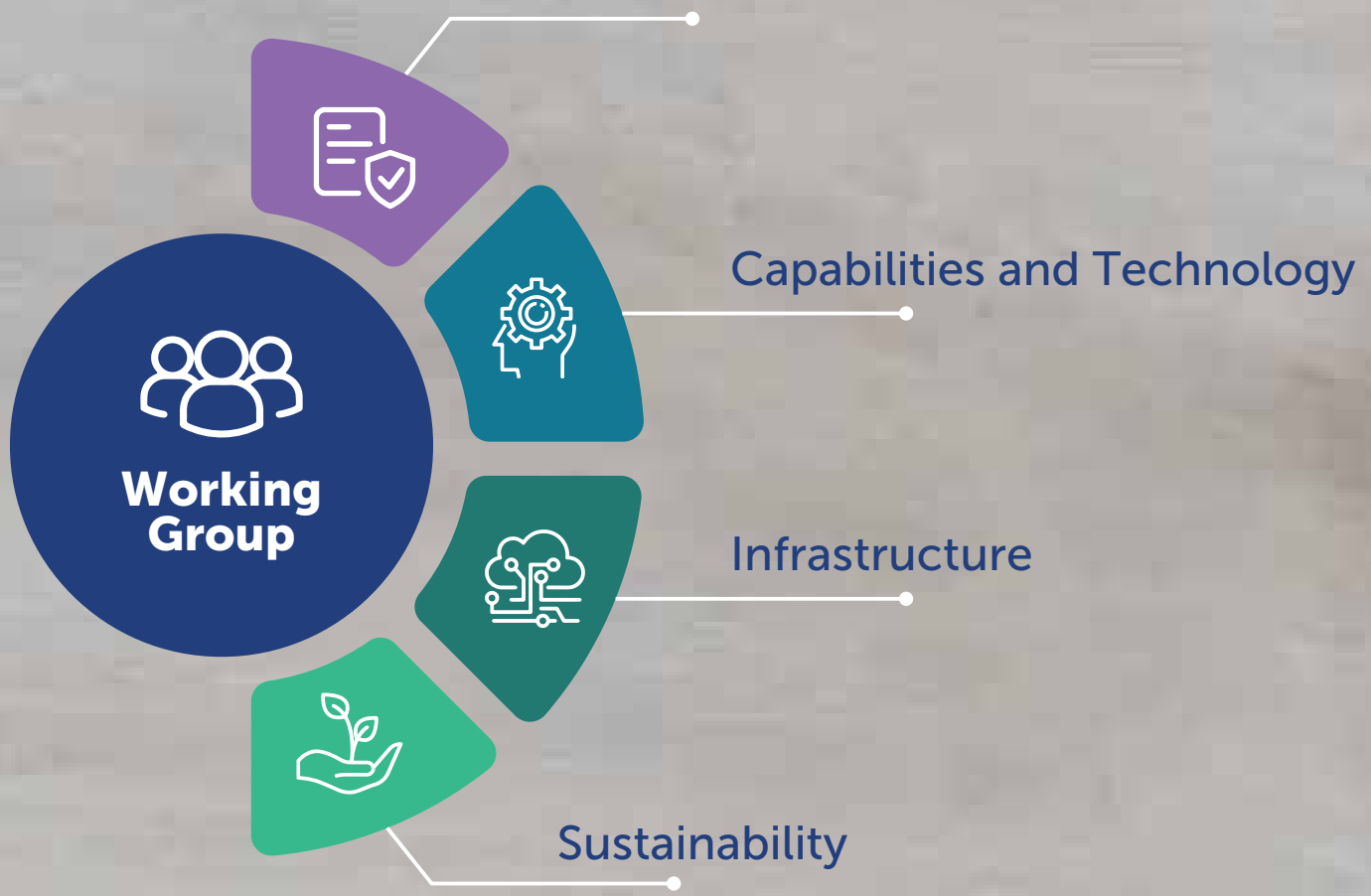
In bioplastics, the CIR2030 will build on our strong oleochemical base to establish Malaysia as a top-five bioplastics manufacturer in Asia, enhancing sustainability while creating new high-value areas of opportunity for the industry. In biopesticides, the CIR2030 will leverage strong R&D to lift the nation to a position as one of the largest producers of these products in Southeast Asia. Sustainability will also be improved in the fertiliser product segment, increasing environmentally friendly fertilisers to 10% of total fertiliser production.

Sustainability will also play a key role across all 11 selected focus areas. There is a clear mandate to seek opportunities that improve sustainability through the modernisation of the chemical value chain and industry operations, alongside the adoption of innovative new methods, processes, and technologies, while strengthening commercialisation through the proposed Malaysian Chemical Collaborative Platform (MCCP).

Achieving these aspirations will not be easy, but in doing so, the CIR2030 has the potential to unlock substantial value generation for the nation. The CIR2030 will support the realisation of these outcomes through three key enablers.

Firstly, regulatory support will be enhanced to promote the successful development of the circular economy for chemicals. Secondly, incentive mechanisms will be enhanced and optimised to encourage more sustainable operations and ensure greater innovation for sustainable products. Thirdly, a value-chain consortium will be established to inform sustainability targets and ensure a holistic implementation of these goals. These enablers will span across the entire value chain and provide end-to-end support for the chemical industry's push towards improved sustainability while spurring greater growth in the sector that drives widespread socio-economic benefits for Malaysia.

Implementation & governance

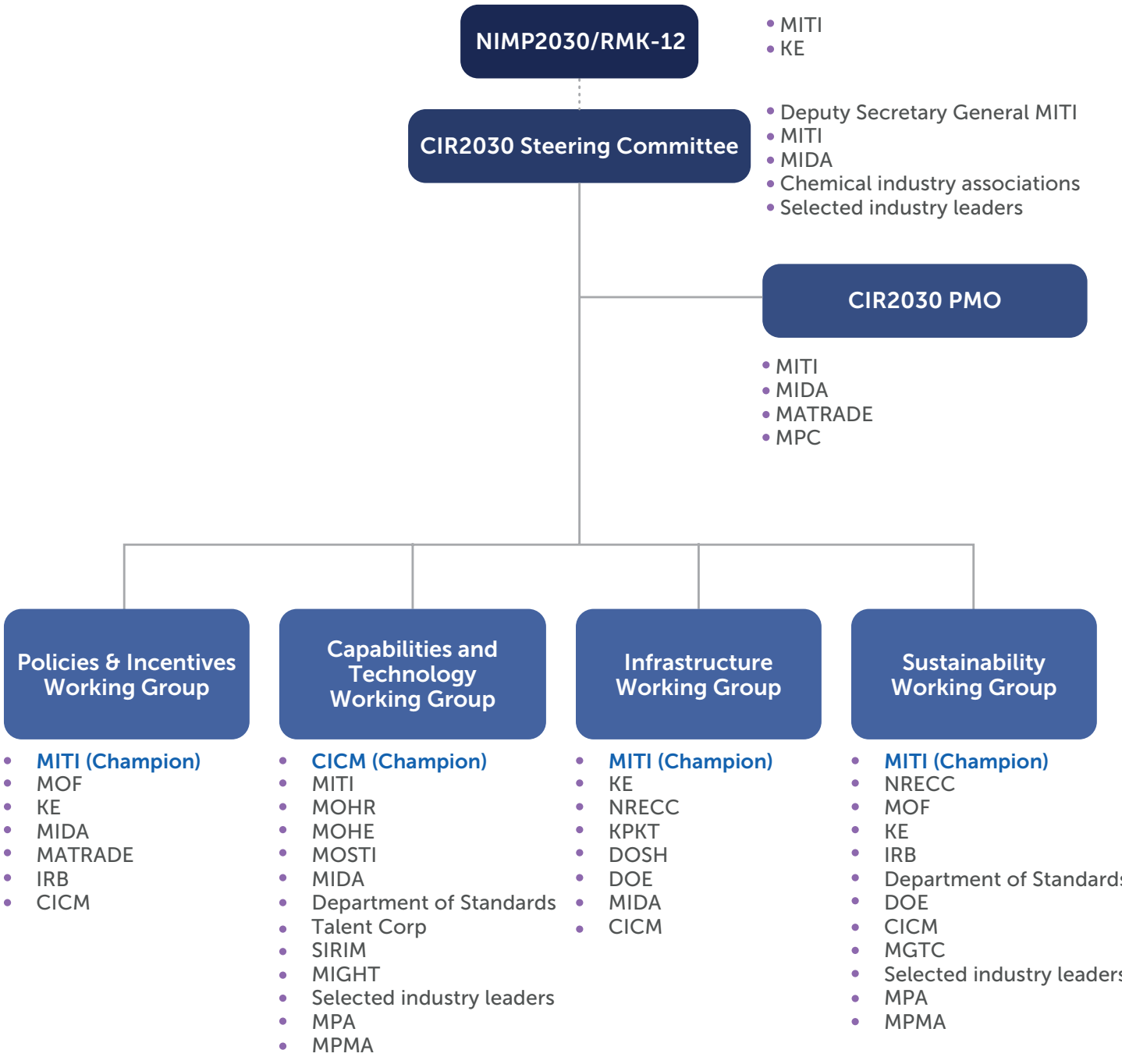


Successful implementation of this ambitious roadmap will require strong governance, enabled by collaboration across the various chemical industry stakeholders—Government ministries and agencies, chemical associations, industry players, research institutes and others. Agility in implementation and ways of working will also be essential, to ensure expedited processes and harmonisation of key outcomes.

At the core of this implementation team will be four identified working groups, spanning across key enablers of (1) policies and incentives, (2) capabilities and technology, (3) infrastructure, and (4) sustainability. These working groups will be empowered by respective champions in order to provide leadership on overall efforts to implement identified initiatives within their purview. Furthermore, they will be designed to function in close collaboration among various chemical industry stakeholders to ensure continuous expert feedback on changing industry conditions. This will allow swift response to meeting industry needs, innovating new solutions to overcome roadblocks, and other enabling efforts and support mechanisms for an effective implementation. Progress will be monitored and reported to the Project Management Office (PMO) every quarter.

The PMO team will consist of MITI, MIDA, MATRADE, and MPC, and will actively work with the four working groups to ensure implementation of initiatives. Alongside this, the PMO will undertake continuous top-down assessment exercises to understand shifting needs, trends, and priorities within Malaysia's chemical sector, and offer updated recommendations, as required, to the Steering Committee. A comprehensive mid-term review in 2025 will also be conducted by the PMO team in order to perform a detailed analysis of megatrends, priority sub-segments, enablers, and initiatives required to ensure the CIR2030 is on track to achieve its targets.

Governance structure for CIR2030 implementation



Responsibility

- Provide overall guidance and set expectations on deliveries
- Review and approval of new initiatives and recommendations
- Monitoring of milestones and outcome KPIs of working groups

- Solution-oriented and activity participate in resolving implementation challenge with working group
- Provide quarterly reports on progress, achievements and challenge to Steering Committee
- Continuous assessment of global best practices on developing chemicals industry and develop new recommendations to SC
- Re-assess prioritisation of enabler initiatives annually
- Re-visit CIR2030 strategies and focus areas at 5 years or when deemed necessary
- **Quarterly updates with working group**

- Execute proposed CIR2030 initiatives
- Provide expert opinion on Malaysia landscape and best way to implement propositions
- Develop constant feedback loop and actively engage with industry players
- Propose new initiatives based on relevant industry needs
- **Regular ad hoc sessions** on implementation discussions and obstacle resolutions
- **Quarterly reporting** of progress, achievements and challenges to PMO team

The CIR2030 Steering Committee will provide overall guidance on the deliverable goals of the CIR2030, reflecting the importance of clear targets and measurable improvement. It will monitor key milestones and performance indicators of various working groups and ensure that actionable targets are both established and achieved. The Steering Committee will meet based on agreed annual planned schedule.

Analysis of CIR2030 performance, inputs, progress, update and success will also feed into recommendations and insight for the NIMP2030 and RMK-12 Steering Committees, ensuring close harmonisation and synergistic development across the respective roadmaps.

Conclusion

The CIR2030 represents a definitive and guiding industrial roadmap for the chemical sector, encompassing a ten-year time horizon from 2021 to 2030. Successful implementation of the CIR2030 will ensure that the chemical industry remains a globally competitive engine of growth for Malaysia and continues to expand the value it adds to Malaysia's socio-economic well-being over the next decade.

Delivering on the ambitions outlined in the CIR2030 will allow the industry to further increase GDP contribution, support and create numerous high-skilled jobs, and reinforce Malaysia's position as a world-class chemicals hub supported by a thriving ecosystem of downstream industries. It will also place Malaysia at the forefront of sustainable chemical production, ensuring that the industry remains resilient and able to deliver continuing benefits for the nation. These benefits will also unlock greater opportunities for the rakyat in the form of a stronger job market, national economic prosperity, and ultimately an improved standard of living.

The execution of this roadmap cannot be done in isolation. It will require active contribution and collaboration from all chemical industry stakeholders. The CIR2030 puts in place both the ambitions and the mechanisms to build that successful partnership, aligning Government, chemical associations, industry players, research and academic institutions. We urge all parties to come together to realise the aspirations of the CIR2030.