



NanoMalaysia Berhad

STRATEGIC REPORT 2022





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This Strategic Report is available online at www.nanomalaysia.com.my

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About The Report

Purpose of The Report

The purpose of the NanoMalaysia Strategic Report 2022 is to offer our stakeholders a comprehensive and consolidated assessment of Malaysia's expanding nanotechnology sector. By means of this report, our primary goal is to showcase the value we generate through diverse programs and initiatives, all of which are aligned with our strategic direction.

Reporting Scope and Boundaries

The Strategic Report showcases the achievements of NanoMalaysia's value-creating activities up until December 31, 2022, unless specified otherwise. It encompasses data from all NanoMalaysia business units and highlights the primary activities of our nanotechnology core programs. Our reporting principles and methodology adhere to the prescribed requirements that govern NanoMalaysia's mandated activities:

- Act as a business entity entrusted to focus on the commercialisation and development of nanotechnology.
- Plan and coordinate the commercialisation of research and development (R&D) of nanotechnology in high-impact areas of focus such as electrical and electronics, food, and agriculture, energy and environment, and health and medicine.
- Plan and manage activities that contribute to the development of nanotechnology-based industries.
- Strategise the positioning of the nanotechnology industry of Malaysia in the global supply and value chain.
Facilitate investment nanotechnology commercialisation.
- Facilitate the development of human capital (scientists and engineers, researchers, and professionals) in the nanotechnology industry.

Board of Directors Approval

The Board assumes responsibility for upholding the integrity of this Strategic Report during the approval process. It acknowledges its duty to oversee the preparation and presentation of the report and confirms that it has collectively reviewed the contents of the Integrated Report. The Board is content that the report provides a fair representation of NanoMalaysia's performance, demonstrating our unwavering commitment to maintaining the utmost standards of governance and ethics.

Forward Looking Statements

This report includes forward-looking statements that do not guarantee future developments and results as described within. These statements are subject to various risks and uncertainties and rely on assumptions that may not be accurate. They can be identified by keywords such as "estimates," "believes," "intend," "will," "plans," "outlook," and similar words when discussing future operational or financial performance. We are under no obligation to update these forward-looking statements or the historical information provided in this report. However, as time progresses, we will be able to report with more comprehensive data on our focal area.

Feedback

We welcome all constructive comments, thoughts and remarks. These can be directed to:

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Chairman's Statement

Dear Stakeholders,

It is with great pleasure that I share NanoMalaysia Berhad's achievements and milestones for the year 2022.

NanoMalaysia Berhad has remained steadfast in its commitment to driving nanotechnology, EV components technology, and leading the charge in the hydrogen economy. Our overarching goal is to empower entrepreneurs, particularly those with limited resources, by offering unparalleled access to expertise, resources, and government recognition. In 2022, our dedication and collaborative efforts have resulted in remarkable achievements:

We have supported and facilitated the creation of 119 joint ventures and startup companies, fostering innovation and entrepreneurship within the nanotechnology sector. Identifying significant potential, we anticipate the creation of 6,443 direct and 32,219 indirect high-value job opportunities over the next five years, contributing substantially to economic growth and employment prospects.

Our initiatives are poised to contribute RM 3.97 billion directly and RM 19.8 million indirectly to the Gross National Income (GNI) over the next five years, as acknowledged and projected by industry experts. A total of 119 products have been successfully certified under NANOVerify, affirming their adherence to stringent nanotechnology standards and quality.

Our relentless pursuit of innovation has led to the development of numerous projects resulting in the filing of 187 Intellectual Properties, including 57 patents, 44 copyrights, 18 trademarks, and 5 utility innovations, all registered with MyIPO.

These accomplishments signify our unwavering commitment to nurturing innovation, creating employment opportunities, and contributing to Malaysia's economic growth. None of this would have been possible without the dedication of our management team, staff, partners, and stakeholders, whose collective efforts continue to drive NanoMalaysia forward.

As we progress into the future, NanoMalaysia remains resolute in its mission to be at the forefront of technological advancement, fostering a vibrant ecosystem for nanotechnology-based enterprises and solidifying our position as a key player in shaping the nation's high-tech landscape.

I extend my heartfelt gratitude to everyone involved for their steadfast support and commitment to NanoMalaysia's vision.

Prof Emeritus Dato' Ir Dr Mohamad Zawawi Bin Ismail,
Chairman of NanoMalaysia Berhad



CEO's Statement

As we reflect on the strides made in 2022, NanoMalaysia continues to redefine the startup landscape through our innovative Venture Builder model. Our commitment extends beyond mere financial investments—we offer comprehensive support throughout the developmental and commercialisation phases, revolutionising the startup ecosystem.

NanoMalaysia Berhad stands resolute in its commitment to advancing nanotechnology, EV components technology, and spearheading the hydrogen economy. Our innovative Venture Builder model continues to redefine the startup landscape, offering unparalleled support to budding entrepreneurs in commercializing nanotechnology-based products while transcending traditional venture capitalism.

Collaboration remains the cornerstone of our success at NanoMalaysia. We strategically invested in a diverse array of projects and initiatives, forging partnerships with business owners, universities, research institutes, and various industries. Together, we pool resources to drive collective success.

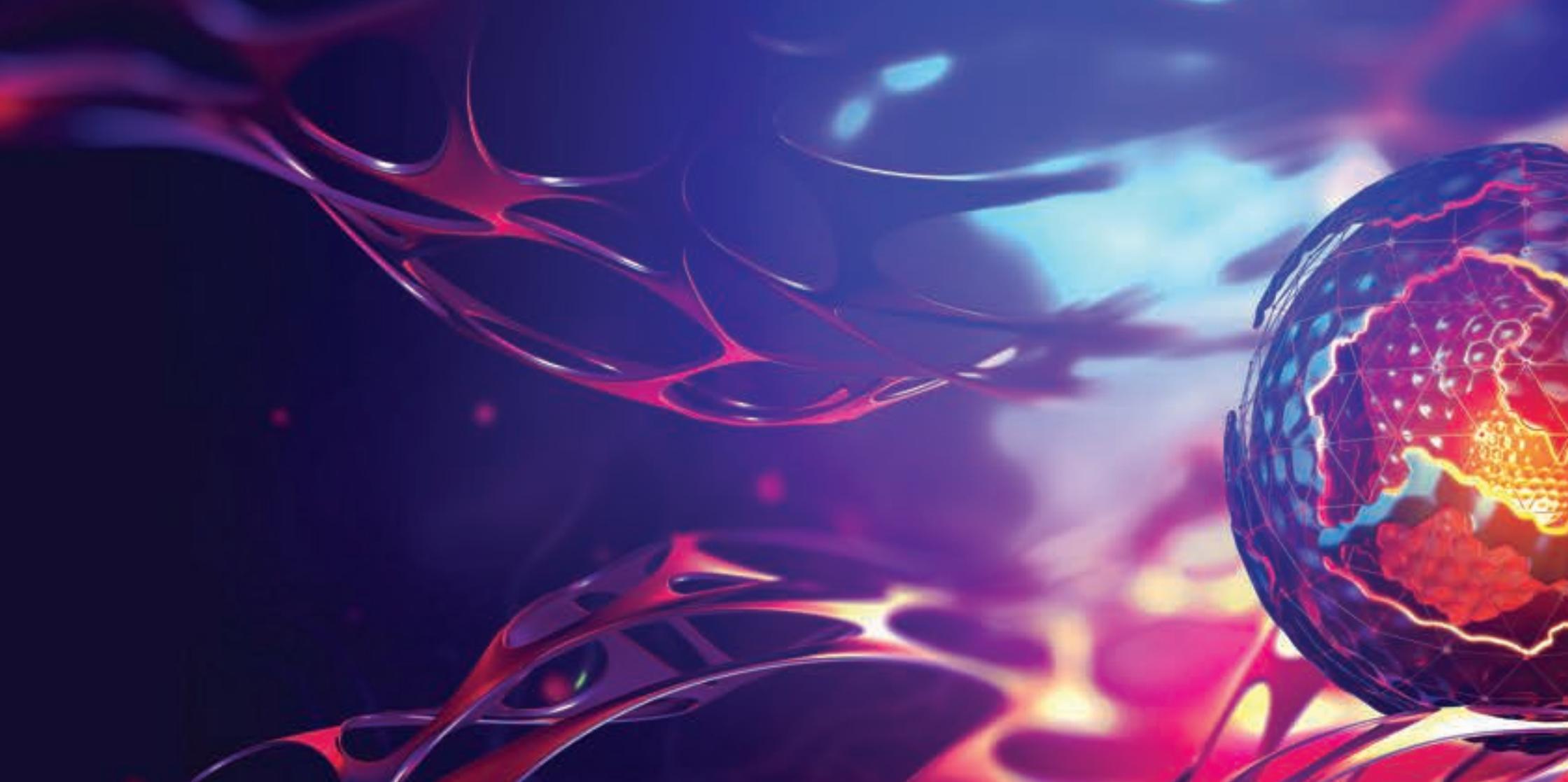
In 2022, NanoMalaysia celebrated significant accomplishments, notably receiving the prestigious Anugerah Gangsa at the Integrity, Governance, and Anti-Corruption Award (AIGA2022). This accolade, recognising our commitment to integrity and exemplary workplace practices, underscores NanoMalaysia Berhad's (NMB) dedication to fostering a culture of integrity within the public and private sectors.

Furthermore, our inauguration of NanoMalaysia Berhad's Hydrogen-Electric Vehicle-Battery (HEBATT) at Technology Park Malaysia marked a pivotal moment. HEBATT stands as a local pilot plant specialising in the production of Pouch Cell Graphene-based composite batteries designed specifically for electric vehicle (EV) applications. This collaborative effort between NanoMalaysia Berhad, HyperTech Industries Sdn Bhd, and International Battery Center (IBC) Sdn Bhd showcases our commitment to advancing battery technology. HEBATT will serve as a nucleus for the development of local expertise in battery manufacturing, focusing on innovative battery chemistries and their application across hydrogen-based factors, forms, and storage.

NanoMalaysia remains steadfast in our commitment to providing comprehensive assistance across critical areas—ranging from global marketing, human capital development, infrastructure, product development, technology, knowledge, to financial support. Our holistic suite of resources aims to ensure the success of our esteemed partners as we continue to drive innovation and progress in the realm of nanotechnology.

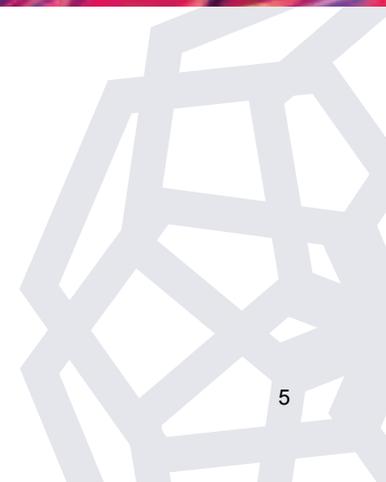
Rezal Khairi Ahmad,
Chief Executive Officer





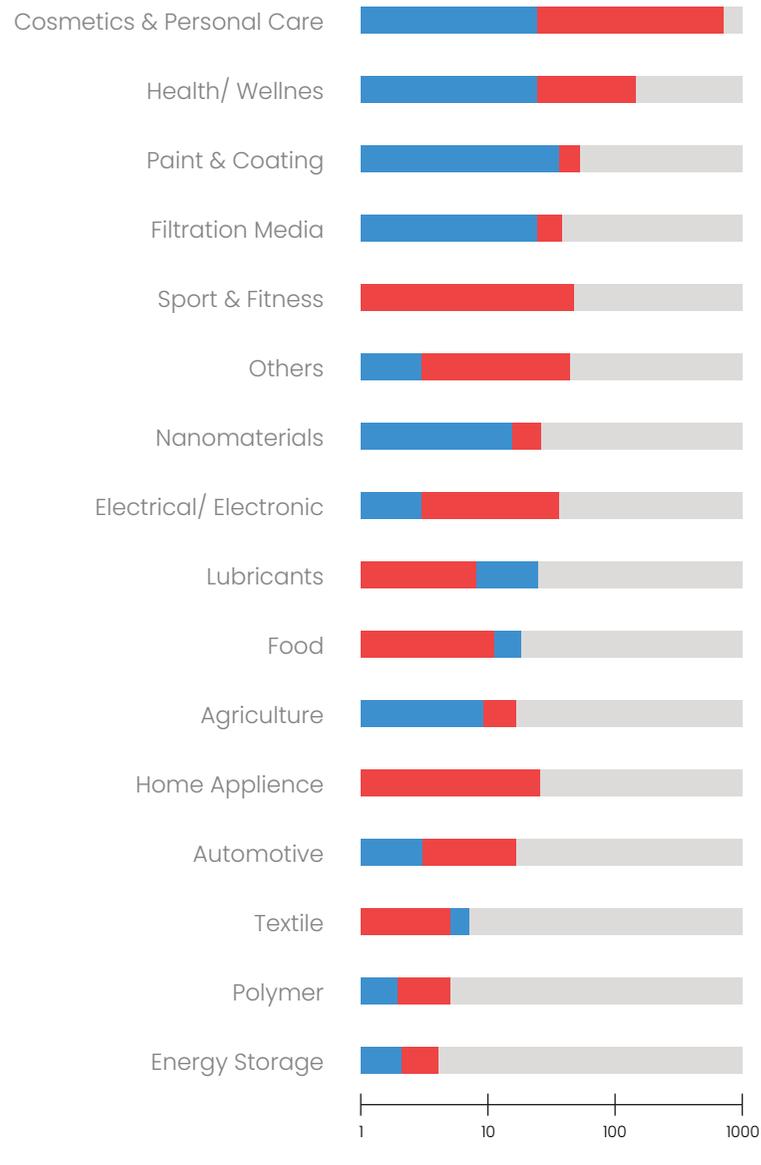
CHAPTER 1

THE NANOTECH INDUSTRY



Malaysian Nanotechnology Landscape

Malaysian Nanoproducts, By Category In 2022 (NANOVerified vs Potential)



The field of nanotechnology has been gaining traction in Malaysia, with an increasing number of nanotechnology products hitting the market. The analysed data reveals an exciting trend in Malaysia's nanotechnology market, with a significant presence of nanotechnology verified products across multiple industries. Among the various product categories, cosmetics and personal care, health and wellness, paint and coating, and filtration media stand out as the key sectors where nanotechnology is making its mark.

The paints and coatings industry is witnessing a nanotechnology revolution, with 35 verified products compared to 50 non-verified ones. This highlights the increasing adoption of nanoscale materials for advanced coatings and paints with enhanced performance properties. In the cosmetics and personal care category, while there are 688 non-verified products, 26 products have been verified with nanotechnology, showcasing a growing interest in utilizing nanoscale materials for enhancing beauty and personal care products. Similarly, in the health and wellness category, out of 166 products, 24 are nanotechnology verified, indicating a rising demand for nano-enabled wellness solutions.

Other sectors, such as nanomaterial/nano-intermediaries, lubricants, food, and agriculture, are also embracing nanotechnology, with a significant number of verified products in these categories. This signifies the widespread adoption of nanoscale materials in various industries, reflecting the blooming market of nanotechnology products in Malaysia.

In order to capitalise on the increasing demand for nanotechnology-based devices and equipment and secure a larger market share, industry players worldwide are anticipated to make substantial investments in research and development (R&D) activities. The challenges posed by the high costs of nano-based devices may hinder the growth of Small and Medium Enterprises (SMEs) due to inadequate funding or a shortage of specialised skills in the field. In conclusion, further efforts are required to enhance the human resource capacities within the sector.

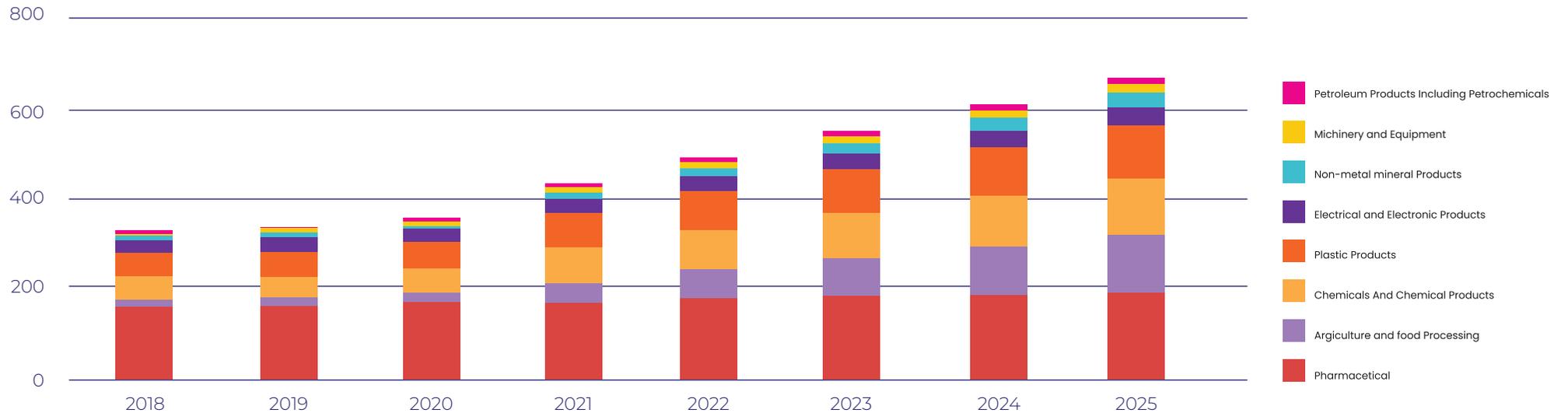


Malaysian Verified Nanotechnology Product Market Revenue (2018-2025, RM mil) (1)

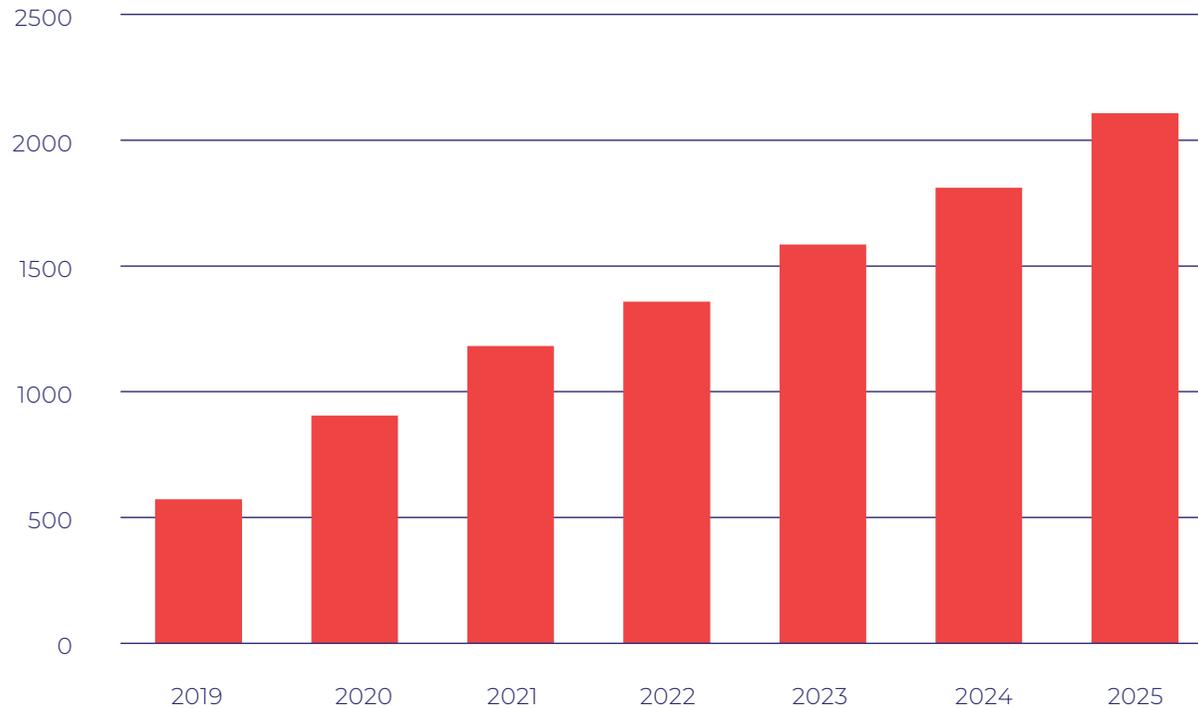
Malaysian nanotechnology products market revenue was valued at RM503.60 million in 2022 despite the challenges posed by COVID-19 pandemic and projected to reach RM682.96 million by 2025. We expect the local nanotechnology scene to register a healthy CAGR of 10.9% for the forecast period of 2024-2025 where pharmaceutical and agriculture and food processing sector are expected to dominate the Malaysian nanotechnology market with each of them are expected to register RM 193.56 million and RM 127.65 million by 2025, respectively.

Substantial growth in specific sectors such as pharmaceuticals, chemicals and chemical products, plastic products and agriculture and food processing indicates that nanotechnology is gaining traction in these sectors, which could be due to its increasing relevance in addressing challenges posed by the COVID-19 pandemic and addressing the food security challenges in Malaysia by enhancing and optimising agricultural productivity.

The growth of nanotechnology from chemical and plastic products shows a consistent growth, with both sectors expected to reach RM126.05 mil and RM117.05 million in 2025, respectively. With the growing number of verified products and companies exceeding the short-term target (2021-2022) of National Nanotechnology Policy and Strategy (NNPS) 2021-2030 accounting for 199 products and 122 verified companies within the span of 2015 to 2022 via NANOVerify programme, we expect that the revenue and participation from more sectors will be increasing.



Growth of Potential Nanotechnology Products in Malaysia



The growth trajectory for nanotechnology products in Malaysia implies on the increasing numbers of nano-products being developed and introduced into the market over the years. This suggests that there is a growing interest and investment in nanotechnology research and development in Malaysia, which may have potential economic and technological impacts in various industries and sectors in the coming years.

Due to the importance of certification in the Malaysian market, NVSB aims to increase the number of certifications for 2023. Currently, 199 out of 1,159 products (17.2%) have been certified under the NANOVerify Programme. Nanotechnology certification in Malaysia significantly enhanced the market competitiveness of certified products. As the market becomes increasingly competitive, having a certification can provide a competitive edge to products, making them more attractive to consumers and businesses.

Foresight: Emerging Nanotechnology Applications



Next-generation power semiconductors

Accelerated development has increased in wide-gap semiconductors substrates and devices using silicon carbide (SiC) or gallium nitride (GaN) aimed at early implementation.



Next-generation electricity storage devices

Heightened anticipation for next generation high performance batteries, such as all solid state, multivalent cation, metal-air and lithium-Sulphur (Li-S) batteries.



Bio-Fabrication

The emergence of 3D bio-printing for freely arranging biomaterials and cells paves the way for application in constructing tissues and organs, discovery of new drugs and regenerative medicine.



Neuroimaging

Remarkable advances in technologies to measure brain activity electrically or optically has led to the development of elucidating mechanisms for deciphering brain functions and data processing.



IoT enabled Artificial Intelligence (AI) devices

Hugely anticipated arrival of an IoT smart society based on AI and Deep Learning Technologies.



Quantum Computing

Super-fast computations through quantum mechanics and quantum



Porous Framework (PCP, MOF and COF)

These compounds have controllable nano spaces that could be used for highly selective absorption/ desorption



Topological Insulators

A candidate for next-generation electronic device, exhibiting a unique metallic state at its boundaries (surface in surface in 3D and edge in 2D systems) but not its interior (insulators) and supplies non-dissipative current.



Phonon Engineering

More focused research on the creation of new materials and devices that treats heat at the nanoscale as phonons and controls heat at origin.



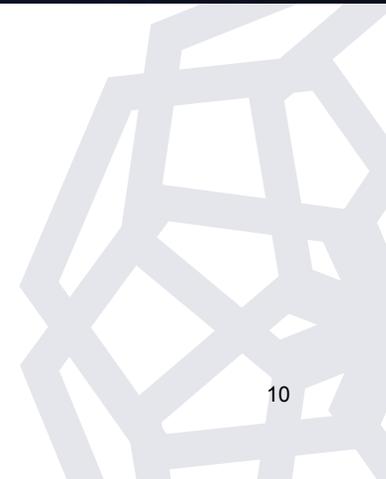
Operando Measurements

There is much interest in the development of operando measurements ranging from materials to organisms.



CHAPTER 2

REVOLUTIoNT: Our Commitment to Innovation



REVOLUTIoNT

A Revolution 4.0 the Internet of Nano-Things



NanoMalaysia Berhad's REVOLUTIoNT initiative aims to bring about revolutionary changes in various industry sectors through the application of nanotechnology. This cutting-edge technology has the potential to transform sectors such as information technology, homeland security, medicine, transportation, energy, food safety, and environmental science, among others. One notable example is the Internet of Nano -Things (IoNT), which consists of interconnected nanosensors and nanodevices linked to the internet.

NanoMalaysia Berhad firmly believes that the IoNT will serve as a key catalyst for the Industrial Revolution 4.0, driving transformative advancements across industries, businesses, and society as a whole. To this end, NanoMalaysia is dedicated to fostering industry revitalisation and promoting innovation through the successful development and commercialisation of nanotechnology in Malaysia.

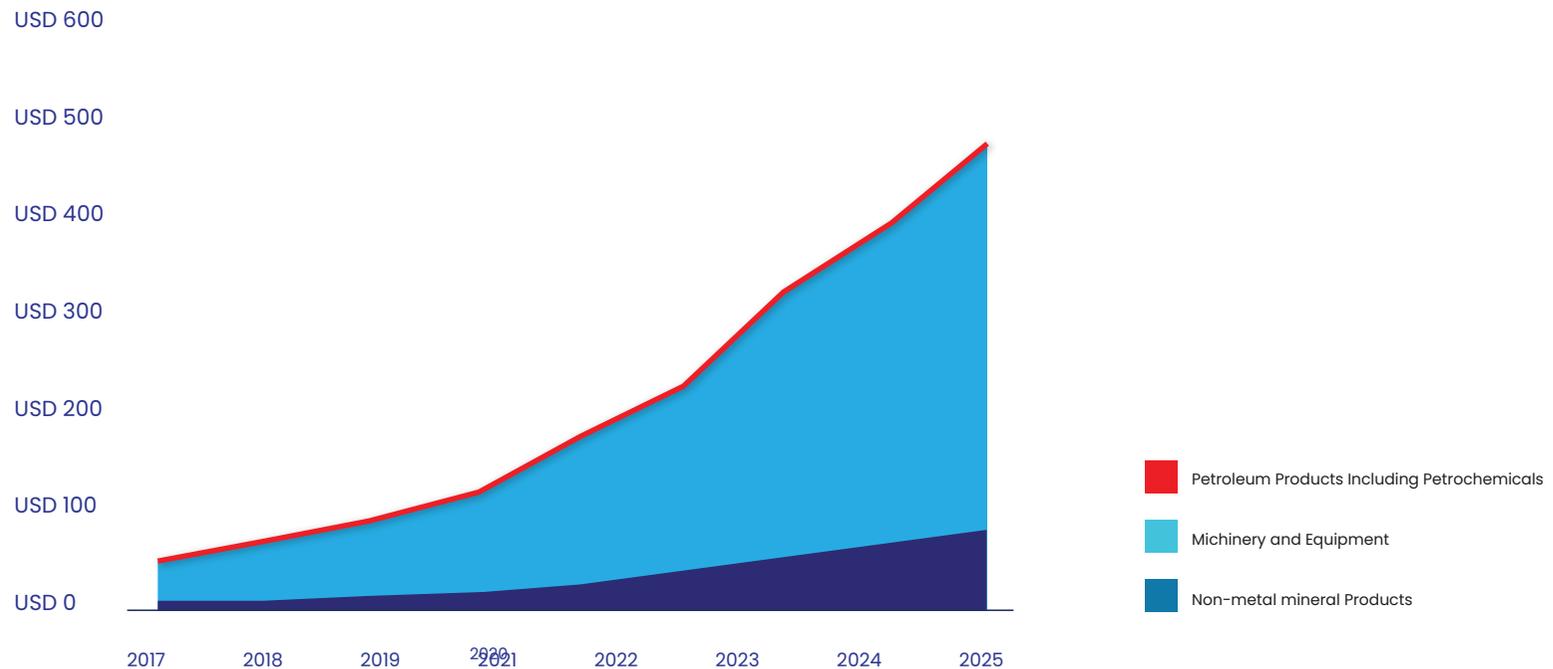
Global Market Review

The market size of Global IR4.0 is projected to experience substantial growth from 2021 to 2025. With a market revenue estimated at USD 87 billion in 2019, it is anticipated to exhibit a compound annual growth rate (CAGR) of 32.1% during the period of 2020 to 2025.

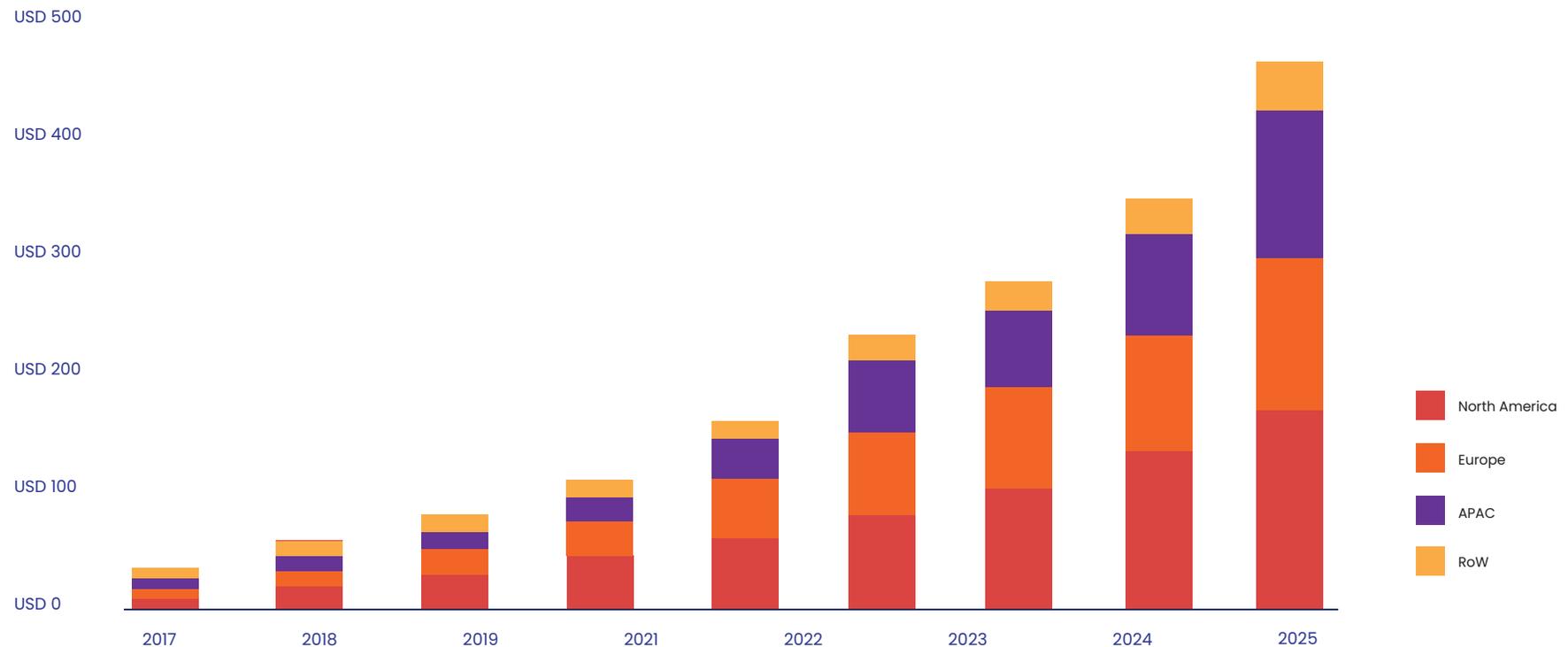
The Connected Industry Building Blocks (CIBB), which is a subset of the IR4.0 market, is poised to capture a considerable share and exhibit substantial growth throughout the forecast period. In 2019, the revenue generated by CIBB reached USD 67.5 billion, and it is projected to reach USD 404.0 billion by 2025, demonstrating a robust compound annual growth rate (CAGR) of 34.1%. The CIBB is comprised of six distinct building blocks, namely cloud platform & analytics, hardware, connectivity, applications, cybersecurity, and system integration

The IR4.0 Supporting Technologies, which form the technological subset of the IR4.0 market, encompass key elements such as Additive Manufacturing, Augmented & Virtual Reality, Collaborative Robotics, Connected Machine Vision, Drones/UAVs, and Self-Driving Vehicles. Despite occupying a relatively smaller market share, these supporting technologies play a vital role in facilitating the widespread adoption of IR4.0. In 2019, the market revenue for the Supporting Technologies amounted to USD 19.5 billion, and it is projected to expand significantly to reach a market size of USD 74.2 billion by 2025. This growth is expected to be driven by a robust compound annual growth rate (CAGR) of 23.7% over the forecast period.

Source: (1) IOT Analytics



Global 4IR Market Size 2017–2025, By Region⁽¹⁾



In 2019, the APAC region emerged as the dominant market in the global IR4.0 landscape, holding the largest market share valued at approximately USD 30.6 billion. This trend is expected to continue, as the region is projected to witness significant growth, reaching USD 184.7 billion by 2025. This remarkable expansion is forecasted to advance at a robust compound annual growth rate (CAGR) of 33%. Consequently, the influence of IR4.0 in the APAC region is set to extend beyond the forecast period, continuing to shape the global market.

The North American market, encompassing the United States and Canada, holds the position as the second-largest market in the IR4.0 landscape. In 2019, the total market revenue for this region amounted to USD 26.35 billion. It is projected to experience substantial growth, with an estimated market size of USD 151.1 billion by 2025. This growth is anticipated to progress at a rate of 32.6%.

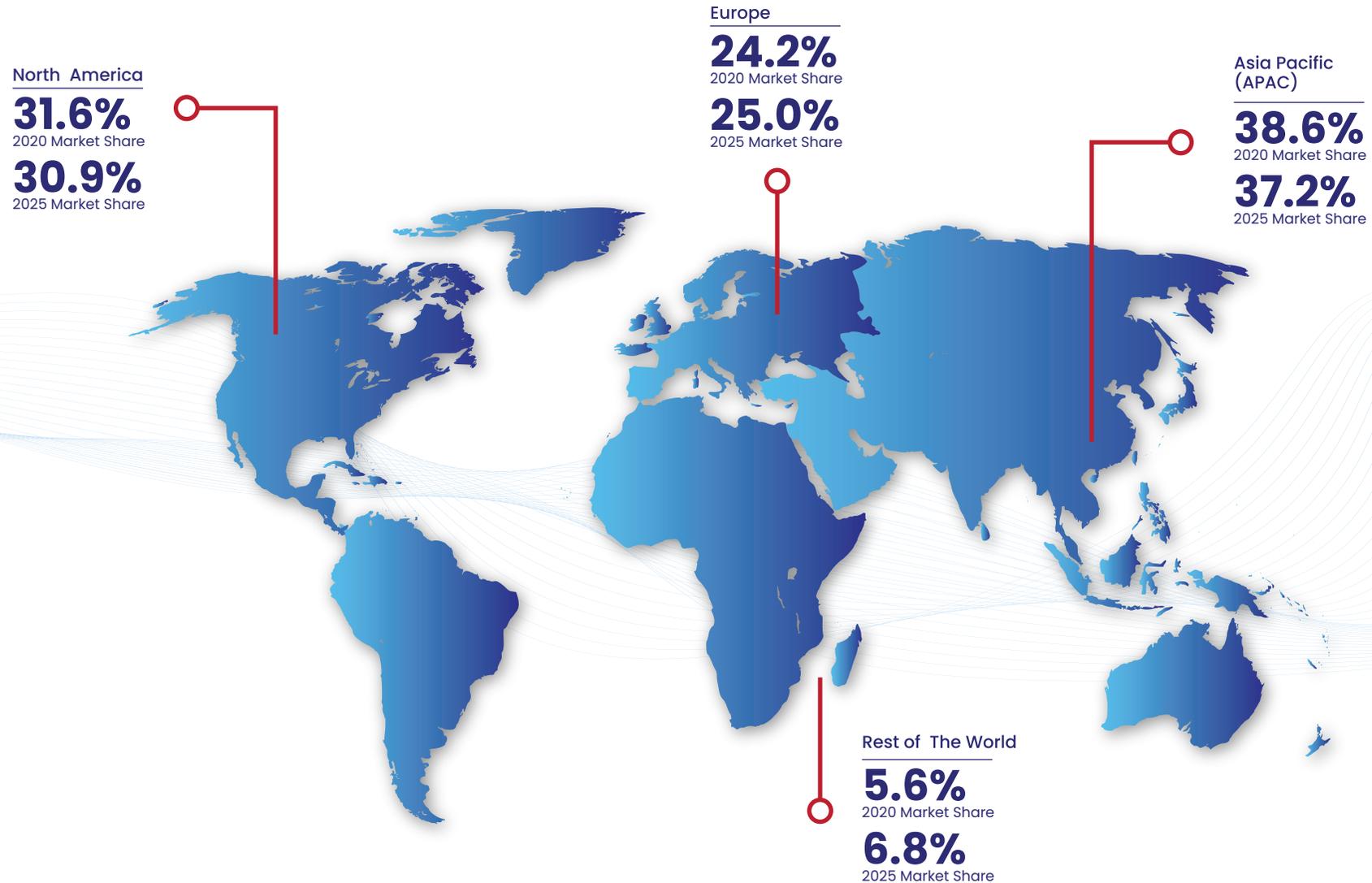
The European market, which includes European Russia, reached a valuation of USD 23.7 billion in 2019. It is expected to witness notable growth at a rate of 31.2% during the forecast period. By the end of the forecast period, the market is projected to reach USD 115.7 billion.

Source: (1) IOT Analytics

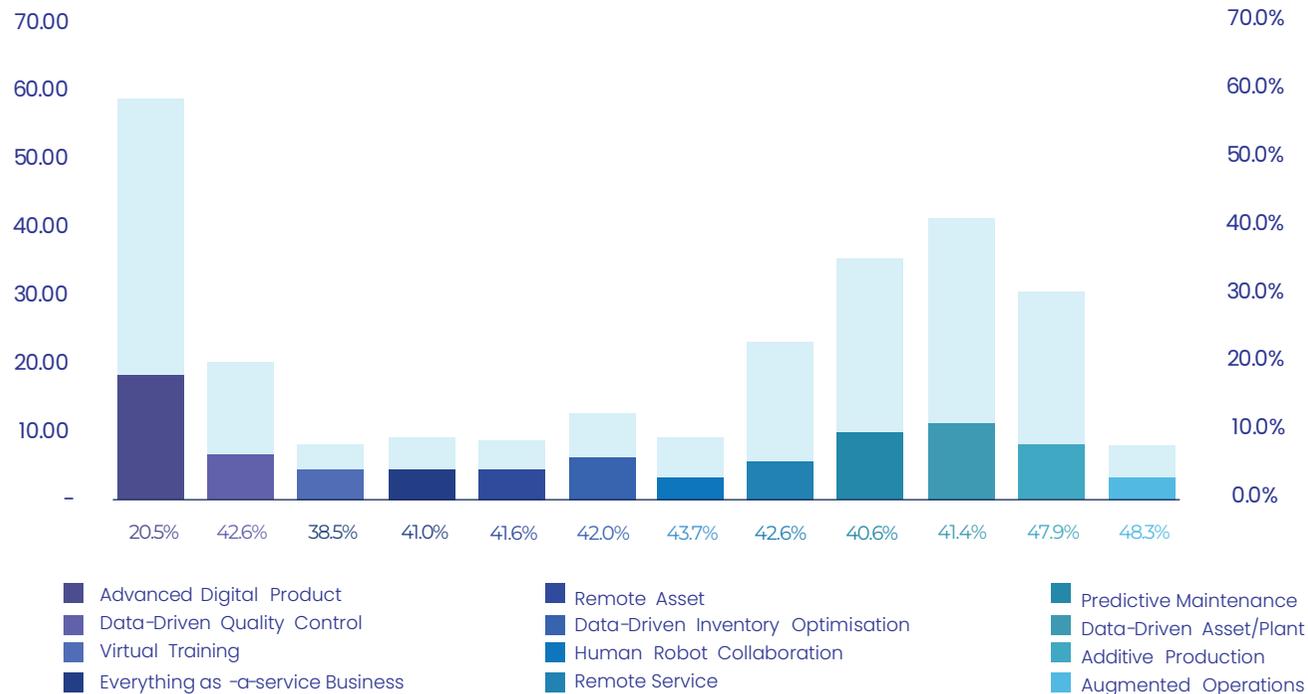
2020 Vs 2025 Landscape: A Glimpse on the IR4.0 Future ⁽¹⁾

The APAC region and North American region are anticipated to exhibit impressive growth rates of 33% and 32% respectively, strengthening their global position by 2025. In contrast, Europe and the rest of the world are expected to hold a smaller portion of the market share by the conclusion of the forecast period.

Source: (1) IOT Analytics



4IR Use Cases (2020 vs 2025)⁽¹⁾



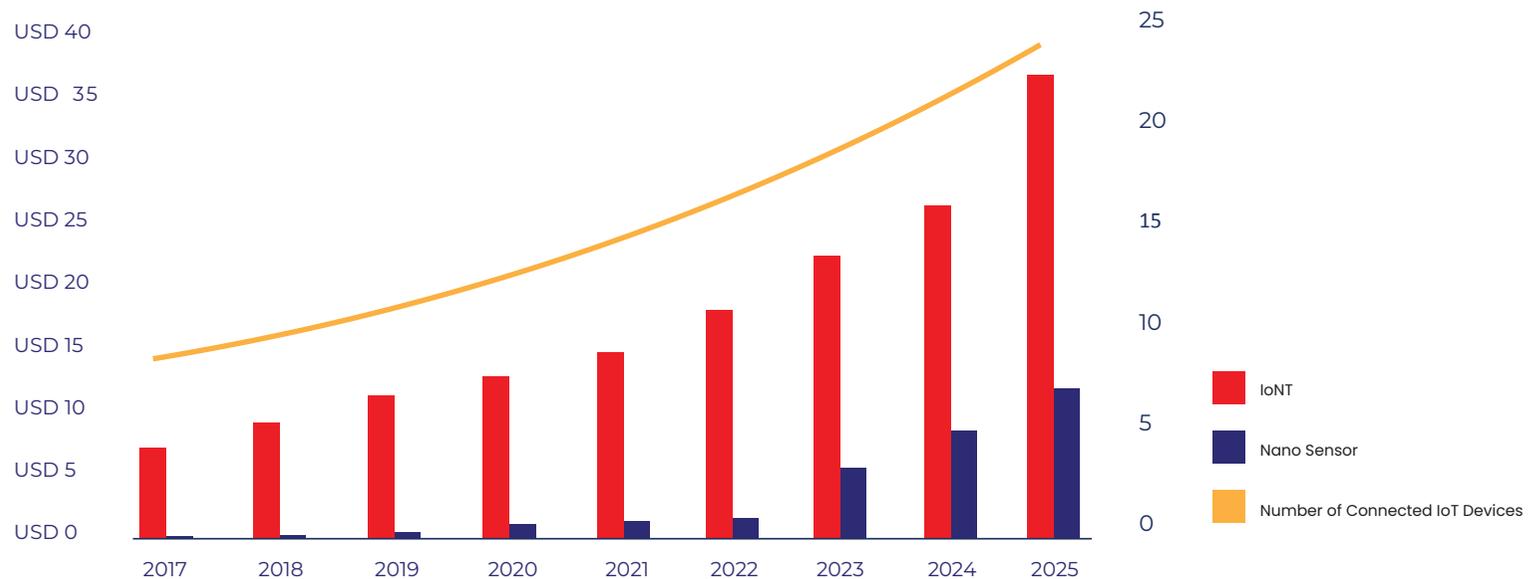
The bar chart illustrates the 12 use-cases of IR4.0 and showcases significant variations in growth and market share over the next five years (2020-2025). Among these use-cases, Advanced Digital Product Development stands out as the top revenue generator during this period. It is projected to generate USD 16.4 billion in 2020 and is expected to reach USD 41.7 billion by 2025. However, it exhibits a comparatively lower growth rate compared to the other use-cases. If the current trend persists, Advanced Digital Product Development is poised to maintain its position as the leader in market share for the next 10-15 years.

The second use case, Data-driven Asset/Plant Performance Optimisation, had a market value of USD 6.1 billion in 2020 and is projected to experience a remarkable compound annual growth rate (CAGR) of 41.4%. On the other hand, Predictive Maintenance holds the position as the third-largest revenue generator, with a total market revenue of USD 5.5 billion in 2020. It is estimated to reach USD 30.3 billion in 2025, demonstrating a substantial CAGR of 40.6%.

The Additive Production and Augmented Operations use cases are projected to experience substantial growth over the next five years, with compound annual growth rates (CAGR) of 47.9% and 48.3% respectively. However, it is worth noting that their market share remains relatively low in 2020. As a result, it is uncertain how these use cases will evolve and impact the market in the future. Further observation and analysis are necessary to determine their future trajectory

Source: (1) IOT Analytics.

Global Internet of-Nano-Things (IoNT) Market (2017-2025)⁽¹⁾⁽²⁾



The chart provides insights into the impact of the Internet of Nano-Things (IoNT) on the global market over the next five years. The continuous innovation in the nanosensors industry will drive exponential advancements in IoNT. Consequently, there is an anticipated rapid growth in the number of connected IoT devices, increasing from 9.9 billion devices to 21.5 billion devices by 2025. This significant growth highlights the transformative potential of IoNT and its role in shaping the future of the global market.

In 2020, the nanosensors market was valued at USD 1.2 billion, exhibiting a remarkable compound annual growth rate (CAGR) of 53.58%. The market is forecasted to experience further growth, reaching USD 10.26 billion by 2025 ^[2]. The increasing number of nanosensors in the market is expected to drive the demand in application industries, thereby stimulating the growth of the Internet of Nano-Things (IoNT) market. The IoNT market, valued at USD 12.78 billion in 2020, is projected to reach USD 36.17 billion by 2025, with a CAGR of 24.12%. This demonstrates the substantial growth potential and expanding market for IoNT driven by the demand for nanosensors.

Nano Positioning Systems, another technological subset, is poised to capitalise on this growth. With a market value of USD 119 million in 2020, it is projected to reach USD 277.3 million by 2025, exhibiting a compound annual growth rate (CAGR) of 18.39%. This indicates a significant expansion in the Nano Positioning Systems market and highlights the increasing demand and adoption of these systems in various industries.

Continuous trends over the forecast period will be significantly influenced by the introduction of new technologies and the increased adoption of the Internet of Nano-Things (IoNT) among both B2B and B2C sectors. These developments are expected to have a profound impact on various industries, shaping the way businesses operate and how consumers interact with technology. As a result, the ongoing advancements in IoNT and its integration into everyday life will drive and shape the continuous trends observed in the market during the forecast period.

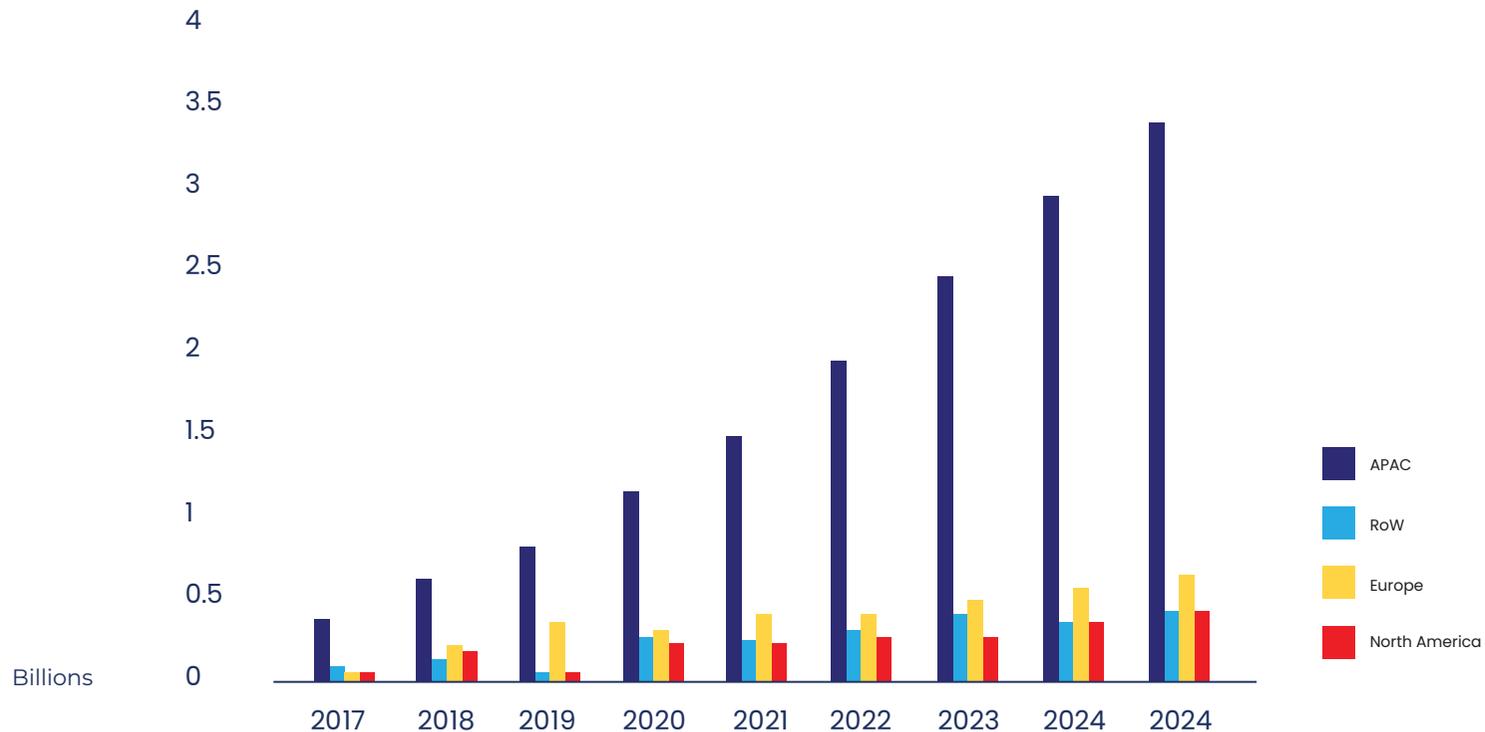
Number of Cellular IoT Connections, by Region (2020-2025)⁽¹⁾

The chart illustrates the projected shaping of the global market through the increasing adoption of the Internet of Nano-Things (IoNT). According to research conducted by Ericsson in 2018, there is a direct correlation between IoT connections and market growth. The Asia-Pacific (APAC) region currently holds the largest market share in 2020 and is expected to remain the most promising region in the future. This can be attributed to the region's large population and the presence of numerous economic powerhouses. In 2019, APAC recorded 857.14 million Cellular IoT Connections, and this number is projected to reach 3.39 billion in 2025, representing a growth rate of 23.8% during the forecast period of 2020-2025.

Europe holds the second-largest number of IoT connections, with 260.3 million connections in 2020. It is expected to reach 678 million connections in 2025, exhibiting a compound annual growth rate (CAGR) of 16.9%. Although the growth rate in Europe is similar to that of North America, the region has a lower overall number of connections. In 2019, North America had 127 million connections, which is anticipated to increase to 331.2 million by 2025.

These trends highlight the significant growth potential and increasing adoption of IoT connections, with APAC leading the way in terms of market size and growth, followed by Europe and North America.

Source: (1)Ericsson Mobility Report



Global Internet of Nano-Things (IONT) Market(2020-2025) by Sub-Sector

In 2019, the Smart City sub-sector was valued at USD 2.32 billion, and it is projected to reach USD 8.81 billion by 2025, demonstrating a compound annual growth rate (CAGR) of 24.7%. This sub-sector shows significant growth potential as cities increasingly embrace smart technologies to enhance efficiency, sustainability, and quality of life.

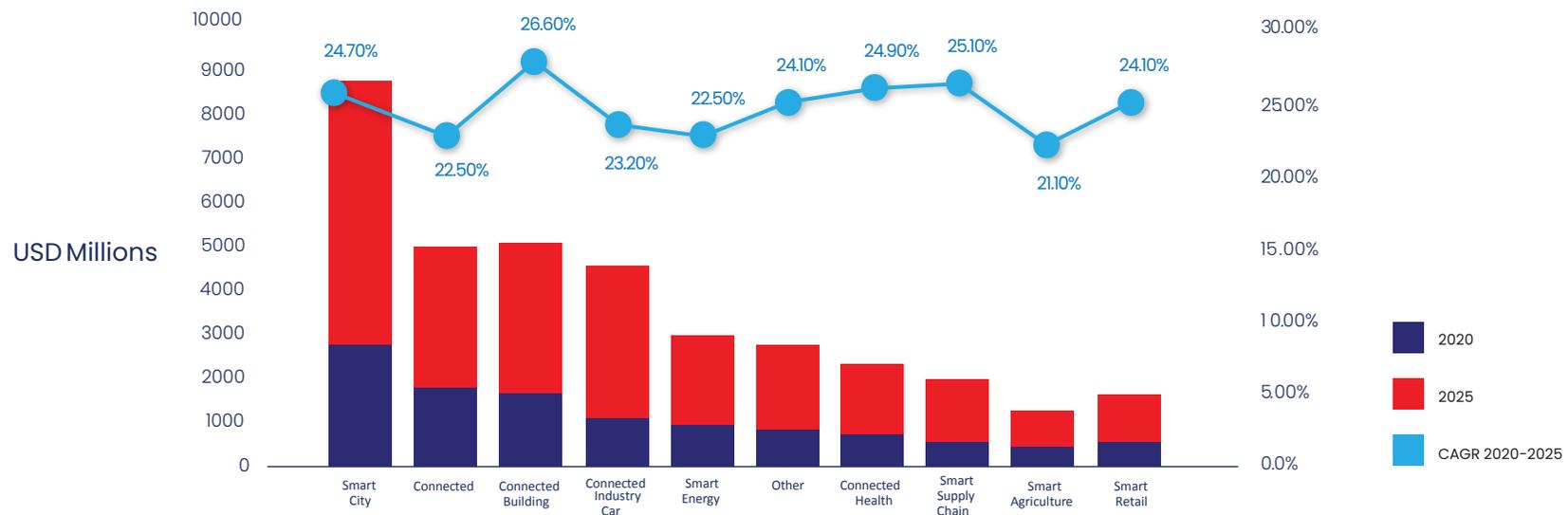
The Connected Industry sub-sector holds the second-largest market share, generating USD 1.61 billion in 2019. It is expected to reach USD 5.3 billion by 2025, with a CAGR of 22.5%. This sub-sector encompasses industries that leverage connectivity and IoT technologies to optimize their operations, improve productivity, and drive innovation.

These trends indicate the growing importance of smart city initiatives and connected industries, with substantial market growth anticipated in both sub-sectors. As technology continues to advance and cities and industries embrace digital transformation, the demand for smart solutions and connectivity is expected to fuel the market's expansion.

However, in 2025, the Connected Building sub-sector is anticipated to surpass both the Smart City and Connected Industry sub-sectors in terms of market size. With a remarkable growth rate of 26.6%, the Connected Building sub-sector is poised to experience significant expansion and become a key player in the market.

Connected Building refers to the integration of smart technologies and IoT solutions in buildings to enhance energy efficiency, security, comfort, and overall operational performance. This sub-sector's rapid growth can be attributed to the increasing adoption of smart building solutions, driven by the need for sustainable and energy-efficient infrastructure.

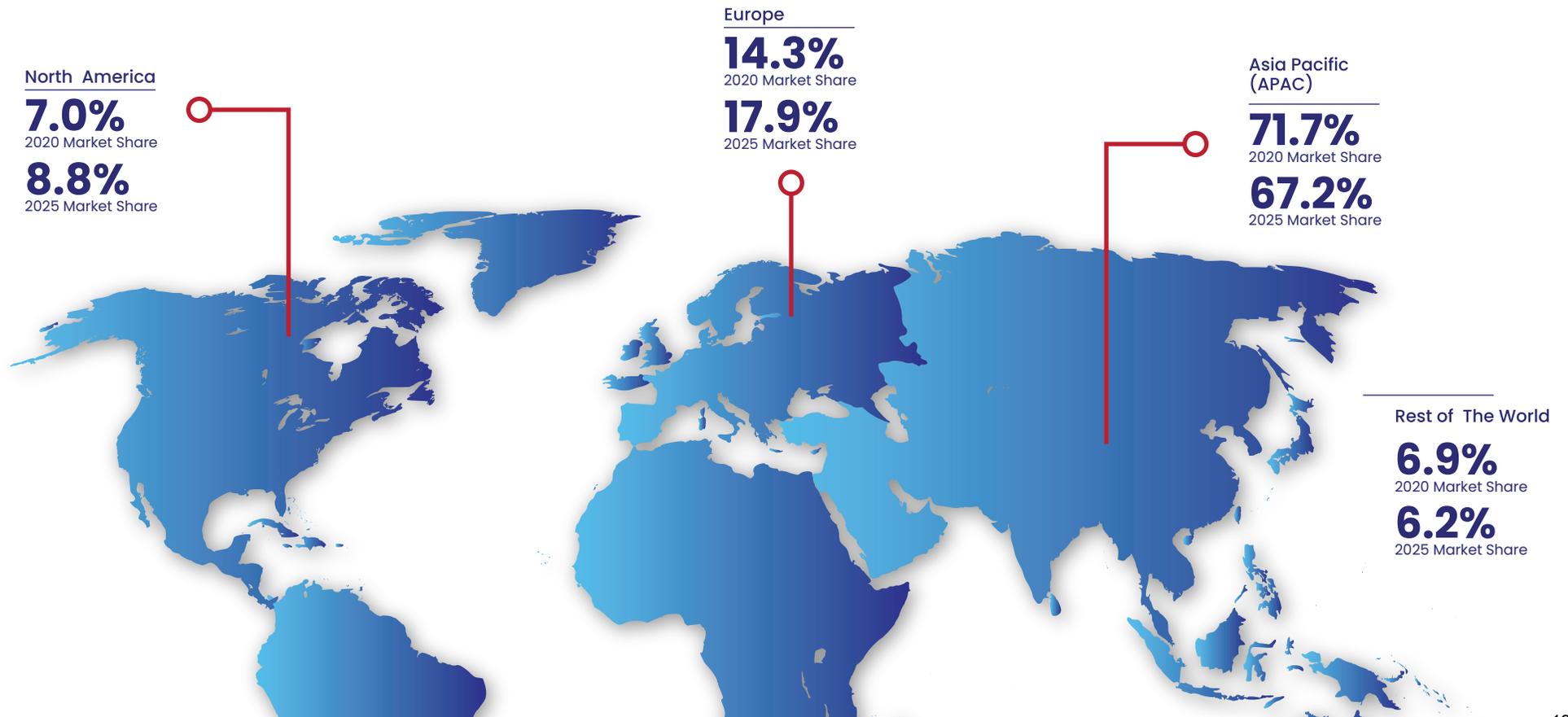
The projected growth of the Connected Building sub-sector highlights the rising demand for intelligent building systems and the transformation of traditional structures into digitally enabled environments. As advancements in technology continue to shape the real estate and construction industries, the Connected Building sub-sector is expected to play a crucial role in the future of smart infrastructure.



2020 Vs 2025 Landscape: A Glimpse on the IR4.0 Future ⁽¹⁾

The global market for IoNT is characterised by a strong concentration of major players who currently hold a significant share of the market. North American companies have established dominance, followed closely by European players. However, there is a noticeable shift occurring as more participants from the APAC region enter the global race to assert their presence and capture a larger market share in the IoNT industry. This trend is driven by the substantial increase in market revenue within APAC, attracting more players to compete on a global scale.

Over the forecast period, APAC and other regions across the globe are expected to experience a significant surge in market revenue, driven by their impressive growth rates. In contrast, the market share of North America and Europe is projected to decline. This shift can be attributed to the higher revenue generated in APAC and other regions, signaling their growing importance and influence in the market.



Malaysian 4IR Market Insight (2020-2025)

In 2019, the Malaysian manufacturing sector achieved a total sales value of RM 1.376 trillion. However, due to the impact of the COVID-19 pandemic, we anticipated a decrease in total sales to RM 1.212 trillion in 2021. Nevertheless, we are optimistic that the market will recover in the post-COVID-19 period, starting from 2022 and continuing until 2025. During this time, we project the market revenue to reach RM 1.864 trillion. The COVID-19 pandemic has compelled the Malaysian manufacturing sector to undergo a transformation, shifting its focus towards high-technology, innovative, and high-value-added industries. This includes sectors such as Electrical & Electronics, Machine &

By 2025, the market opportunities for IR4.0 in Malaysia are projected to experience substantial growth, reaching RM 205.5 billion. This growth can be attributed to the transformation and scale-up of small and medium enterprises (SMEs) as they strive to remain competitive in the market. These SMEs are recognising the importance of embracing disruptive technologies and innovation to harness their benefits. This proactive approach enables them to adapt to the changing business landscape and seize the opportunities presented by IR4.0.

Source: [1] IOT Analytics. [2] Industry4WRD National Policy [3] Jabatan Statistik Negara



Malaysian IoNT Market Opportunities (2020 Vs 2025) (In Millions, RM)

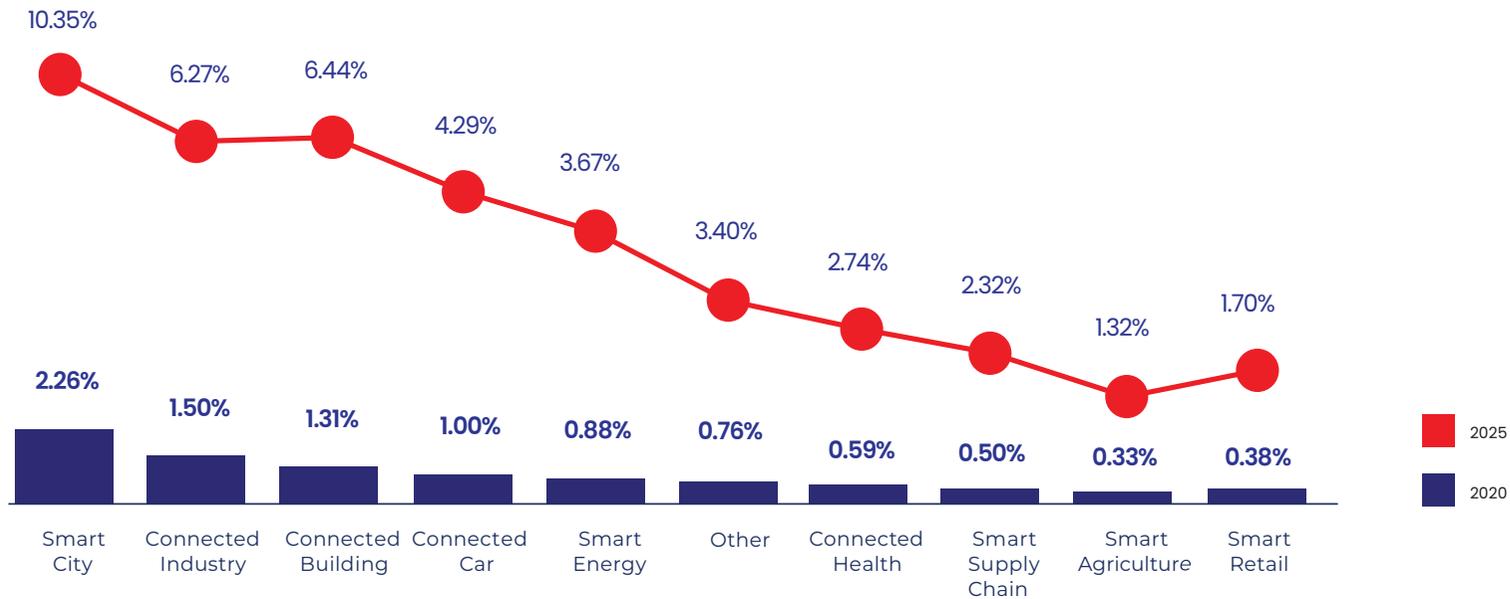
The market opportunities in the field of Internet of Nano-Things (IoNT) are projected to witness significant growth in Malaysia. By 2025, these opportunities are forecasted to reach RM 42.5 billion, a substantial increase from the estimated value of RM 9.5 billion in 2020. This growth can be attributed to the advancements in nanosensors technology and the development of robust ICT infrastructures in the country.

Among the various sectors within IoNT, smart cities are expected to hold the largest market share, accounting for 24.3% of the total IoNT market. This is primarily due to the rapid increase in high-tier urban areas, leading to a greater demand for smart city solutions. Additionally, the rising number of connected buildings and connected cars also contribute to the growth of the IoNT market in Malaysia. These segments collectively make up RM 17.05 billion of the total IoNT market revenue in the country.

The introduction of Internet of Nano-Things (IoNT) technology is set to revolutionise the medical industry, bringing in additional revenue of RM 2.74 billion. This advancement will pave the way for the development of smart supply chain and smart retail solutions, creating a new ecosystem that is projected to generate a market worth RM 4.02 billion by 2025.

In order to address the challenge of increasing self-sufficiency levels (SSL) for Malaysia's growing population, particularly with limited agricultural lands, the adoption of smart agriculture becomes crucial. This approach aims to enhance crop yield in terms of both quantity and quality. By 2025, the smart agriculture market is estimated to reach a value of RM 1.32 billion.

Overall, the implementation of IoNT, along with the emergence of smart supply chain, smart retail, and smart agriculture, will bring about significant transformations in various industries, fostering innovation and driving economic growth.

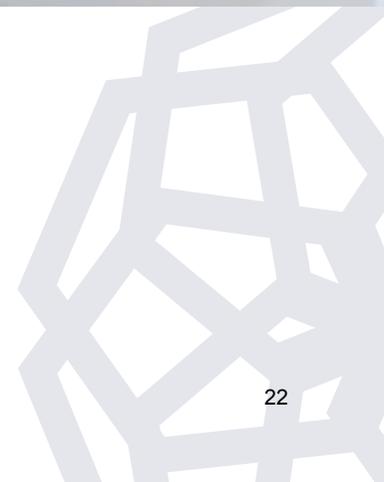


Source: [1] IOT Analytics. [2] Industry4WRD National Policy [3] Jabatan Statistik Negara



CHAPTER 3

ABOUT NANOMALAYSIA





NanoMalaysia Berhad is the primary agency in Malaysia tasked with driving the commercialisation of nanotechnology in the country. Established by the Government of Malaysia in 2011 as a dedicated entity, NanoMalaysia serves as a special purpose vehicle to spearhead the growth of the national nanotechnology sector. Recognising nanotechnology as a crucial catalyst for innovation across various technology-based sectors, it was identified under the New Economic Model (2011–2020) as a key enabler for driving economic growth.

NanoMalaysia's core responsibility is to provide support to commercial entities operating within the nanotechnology industry, facilitating their journey towards an innovation-driven economy. Our comprehensive support ecosystem encompasses global marketing activities, talent development initiatives, financial and infrastructure resources, technology and knowledge transfers, and the promotion of product innovations leveraging nanotechnology.

The ministry of Science, Technology, and Innovation (MOSTI), NanoMalaysia has been entrusted with the leading role in advancing the commercialisation of nanotechnology in Malaysia. Our key roles include:

- Driving the commercialisation of nanotechnology research and development
- Promoting the industrialisation of nanotechnology
- Facilitating investments in nanotechnology
- Fostering the development of human capital skills in the field of nanotechnology.

Our ultimate objective is to accelerate the growth of Malaysia's strategic industrial sectors through the application of nanotechnology. With a wide range of initiatives and programmes



Malaysia joined Asia Nano Forum



The National Nanotechnology Initiative was launched



The National Innovation Council identified Nanotech as an important growth engine for Malaysia's New Economic Policy



The National Nanotech Directorate (NND) was established and developed NanoMalaysia Programme 2011-2020

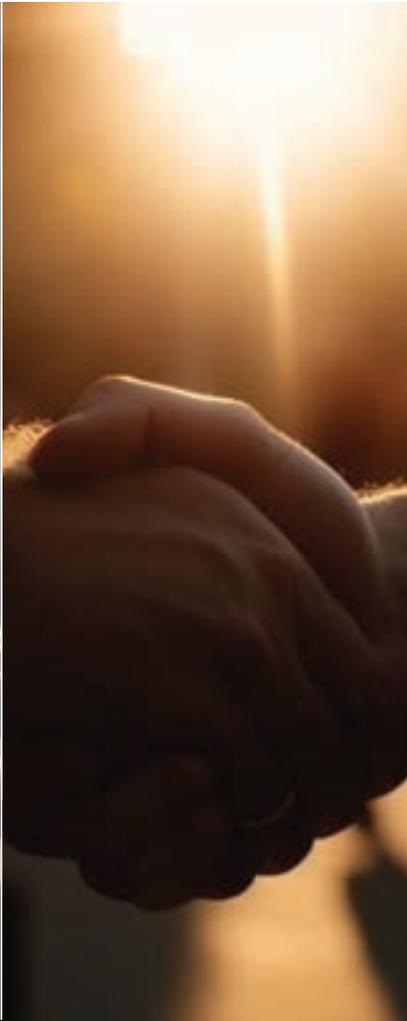


NanoMalaysia was introduced during the National Innovation Council (NIC) meeting and incorporated as a Company Limited by Guarantee (CLBG) in August 2011 under section 14(2)(c) of the Companies Act 1965

Core Business



To Provide Technology & Business Landscaping



To Identify and Facilitate Business Opportunities



To Facilitate Commercial Investment



To Strategise and Coordinate R&D Commercialisation



To Facilitate Human Capital Development

Our Ecosystem



Vision

To be a global leader in Nanotechnology Commercialisation.

Mission

- Energising Industries and Catalysing Economic Growth
- Deployment and Adoption of Nanotechnology in Industries
- Business Growth and Sustainable Development
- Cutting Edge Technological Leadership and Creating True Values



Board of Directors:

Chairman

Prof. Emeritus Dato' Ir. Dr Mohamad Zawawi Bin Ismail

Director

Dato' Ng Wan Peng

Director

Encik Zain Azmir Zain Azahari

Director

Professor Datuk Dr. A. Rahman Bin A. Jamal

Director

Dato' Ahmad Shukri Bin Hj. Tajuddin

Director

Dr. Mohd Nor Azman Bin Hassan

Director

Dr. Rezal Khairi bin Ahmad

Company Secretary:

Wong Youn Kim

HMC Corporate Services Sdn Bhd (83556-P)

Registered Office:

NanoMalaysia Berhad (955265-P) Suite C-5-4, Wisma Goshen Plaza Pantai, Jalan Pantai Bharu 59200 Kuala Lumpur.

Official Address:

Lot 21.02
Sunway Putra Tower
100, Jalan Putra
50350 Kuala Lumpur

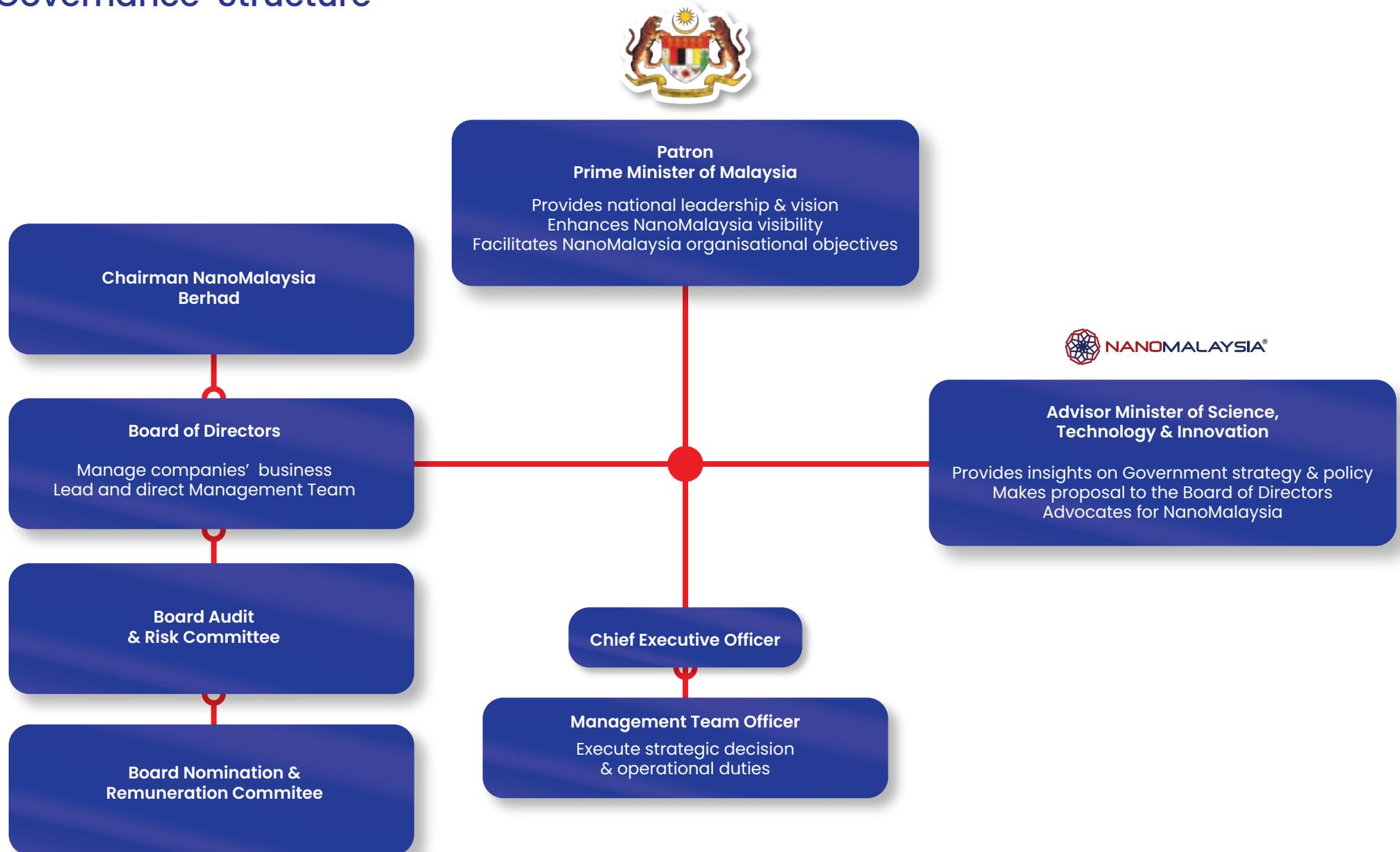
Website:

www.nanomalaysia.com.my

Auditor:

A. Razak & Co
Aftas Corporate Advisory Services Sdn Bhd

Governance Structure



Corporate Structure



NanoMalaysia Berhad
(Company No: 201101027130)

Holding company

- Facilitate investment in nanotech development
- Facilitate human capital development
- Strategise, recommend and coordinate R&D commercialisation IP ownership
- Promote public awareness on nanotech through events such as Graphene Malaysia and others

Intellectual Property



NanoVerify Sdn Bhd
(Company No.: 201501029698 (1155019-U))

Consultation and verification arm

- Provide technology and business landscaping, consultancy and due diligence
- Product and technology certification
- Consumer awareness on genuine nanotech products

Joint Ventures

Tangible Assets



Nano Commerce Sdn Bhd
(Company No.: 201401025384 (1101474-W))

Business and commercial arm

- Identify and facilitate business opportunities
- Holding company for investees and JVs
- Project management

Joint Ventures

Tangible Assets



Nanovation Ventures Sdn Bhd
(Company No.: 201401025385 (1101475-K))

Investment arm

- Facilitate investment in commercialisation

Venture Capital

Private Equity

Subsidiaries and New Ventures

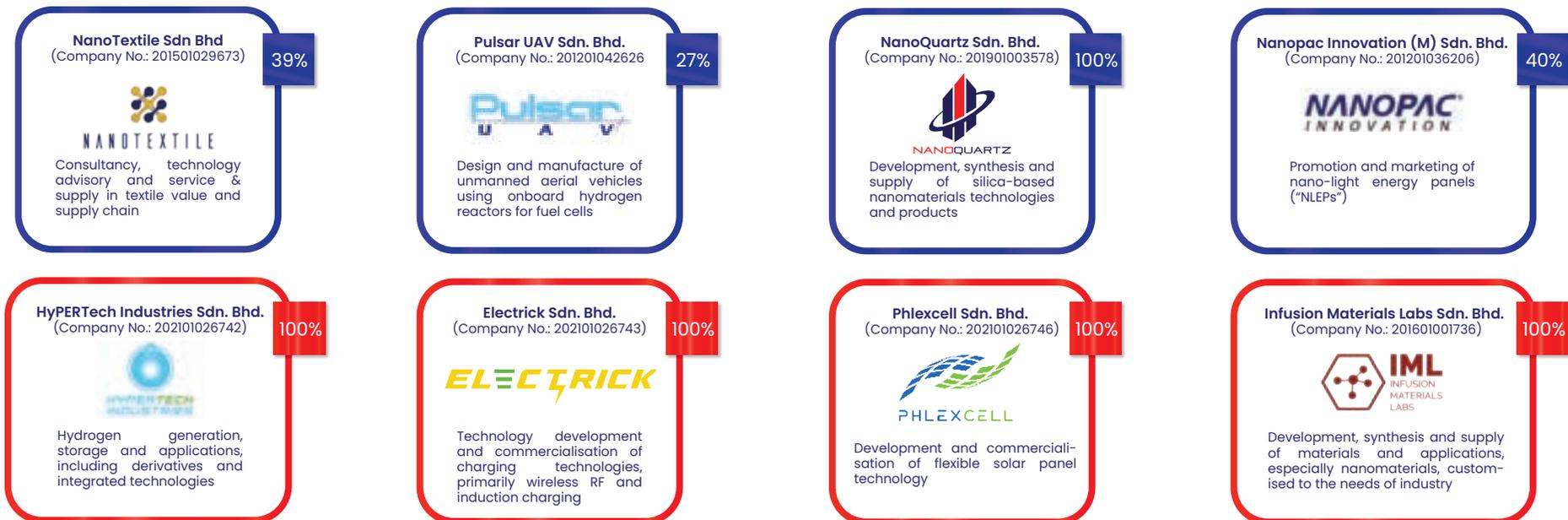


Nano Commerce Sdn. Bhd.
(Company No : 201401025384)

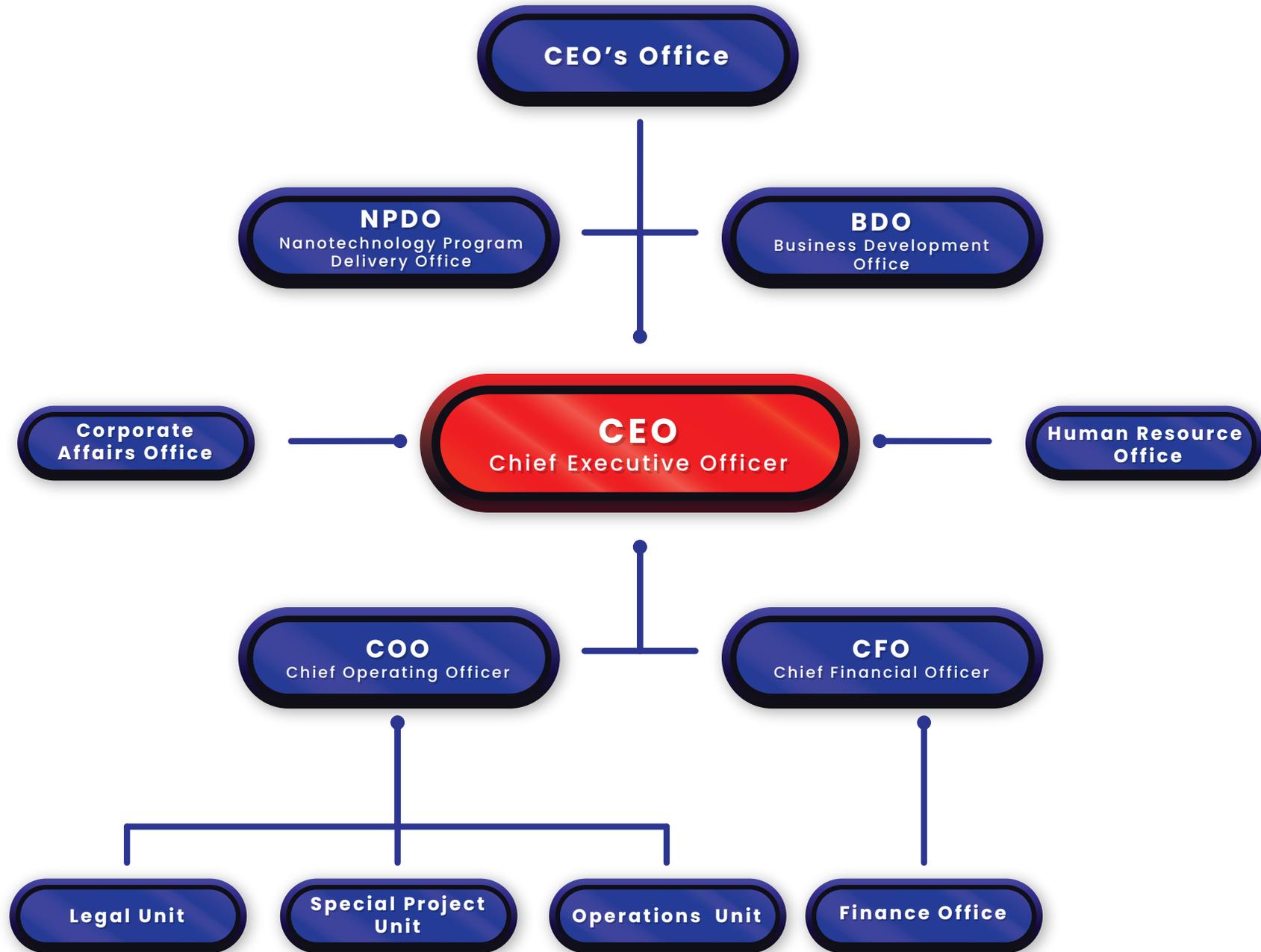
Product Development and Scale-Up Projects

Venture Building

Ecosystem Growth and Expansion



Organisational Chart



Board Members



From Left

Dato' Ahmad Shukri Bin Hj. Tajuddin
Member of Board Audit & Risk Committee

Dato' Ng Wan Peng
Director

Encik Zain Azmir Zain Azahari
Director

Professor Emeritus Dato' Ir.
Dr. Mohamad Zawawi Bin Ismail
Chairman

Dr. Reza I Khairi Ahmad
Chief Executive Officer

Dato' Ahmad Shukri Bin Hj. Tajuddin
Member of Board Audit & Risk Committee

Management Team



Mohamad Hafiz Bin Zolkipli
Chief Operating Officer



Dr. Daniel Bien Chia Sheng
Senior Vice President,
Nanotechnology Programme Delivery Office



Veronica Leong Mun Sum
Vice President
Operational Excellence, Group Operations



Raja Riznal Raja Abidin
Vice President, Corporate Affairs Office



Arzaman Ariffin
Vice President, Human Resources



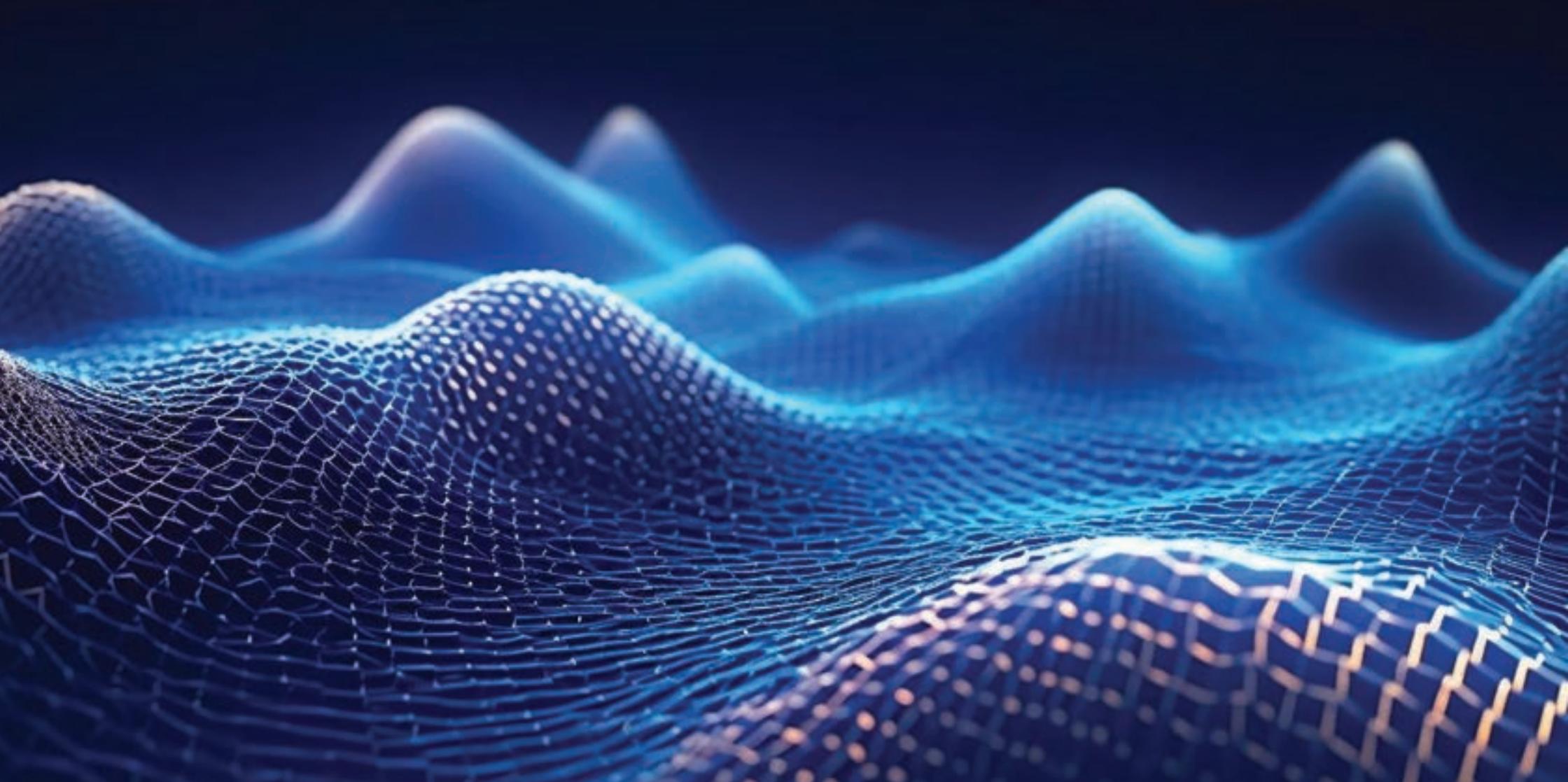
Ir. Tengku Kahar Muzaffar
Vice President, Strategy and Special Projects Office



Hairul Hafiz Hasbullah
Vice President, Legal Unit

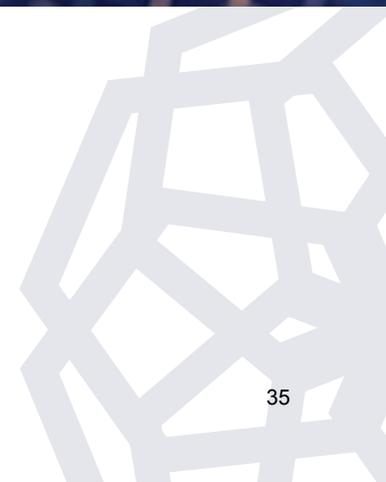


Sharizal Shaarani
Senior Vice President, Business Development



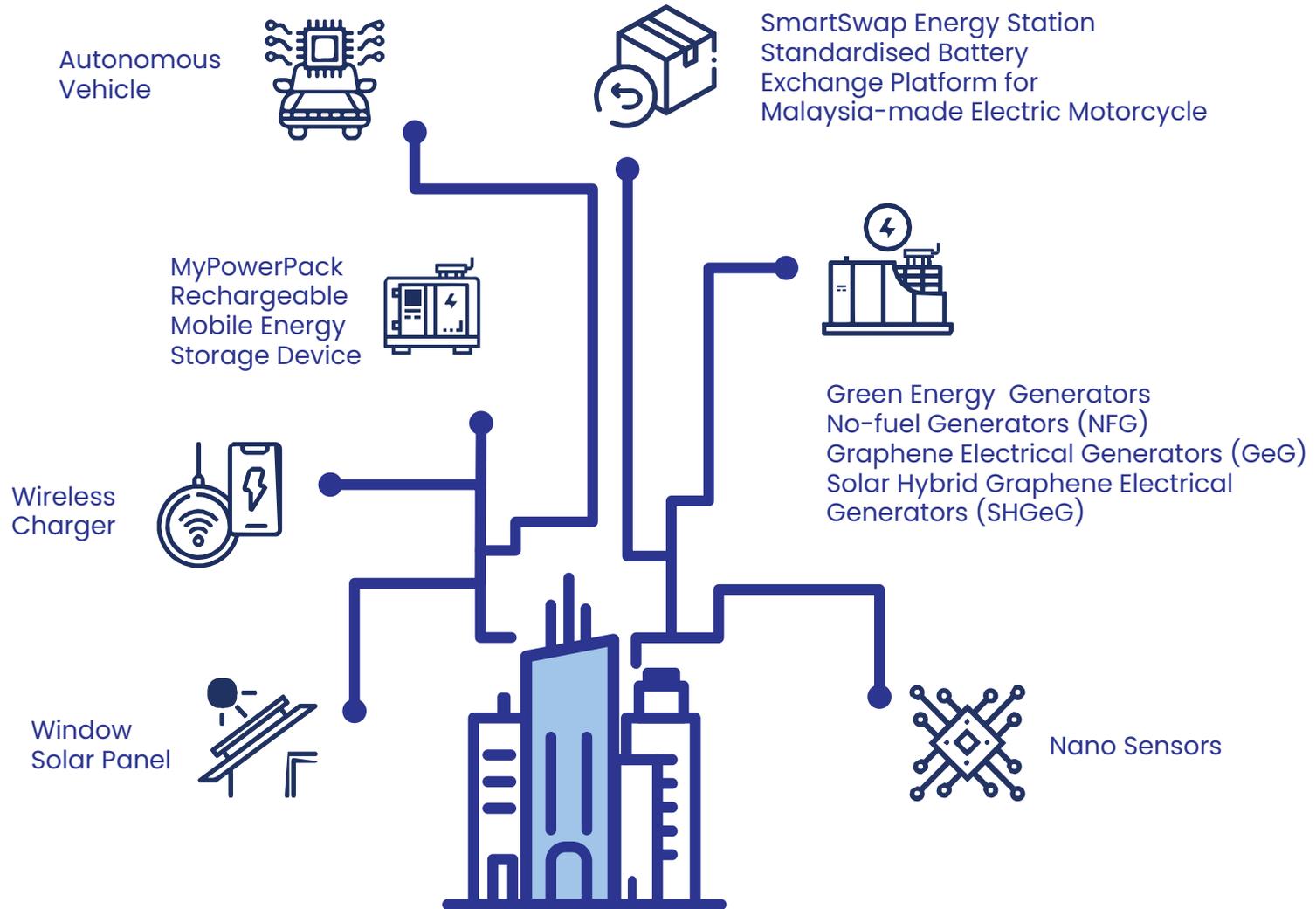
CHAPTER 4

NANOMALAYSIA PROGRAMMES



REVOLUTION 4IR Building-Block Projects

Supporting the 4th Industrial Revolution



2016–2022 : Achievements Snapshot

NanoMalaysia's Programmes



119 JV/Start-Up companies supported/created.



6,443 (direct) and 32,219 (indirect) high value job opportunities created over next 5 years identified by industry.



RM 3.97 billion (direct) and RM19.8 Million (indirect) potential GNI contribution generated over 5 years identified by industry.



119 products certified under NANOVerify.



Developed projects resulting in 187 Intellectual Properties



Filed a total of 57 patents, 44 copyrights, 18 trademarks, and 5 utility innovations with MyIPO.

12th Malaysia Programmes (2021-2025)

REVOLUTION *A Revolution 4.0 the Internet of Nano-Things*

GRAPHENOVATION

Product development and scale-up programme to produce graphene-based IPs and products



Product development, scale-up and ecosystem building programme focusing on wireless charging systems



Product development, scale-up and ecosystem building programme focusing on hydrogen production and storage technologies

iNanovation™

Product development and scale-up programme to produce broader nanotech-based IPs and products



Product development, scale-up and ecosystem building programme focusing on energy storage technologies

Project Highlights

Integrated Vertical Farming and Aquaculture with IoNT

Floraponics Farm Malaysia (FFM) is a scale up innovative aquaponics agriculture programme under a collaboration project between NanoMalaysia Berhad (NMB) and Flora Niaga Sdn. Bhd at Manong, Perak. The objective of this project was to create a combination of aquaculture and agriculture industry by incorporating nanotechnology component by inventing an alternative to the source of protein nutrient and vegetable through nano-coated solar panel as power generator. The FFM was built on 10,000 sqft site consist of various organic vegetables and tilapias which expected to be expanded their operation soon in future in Watermelon, Sugarcane, Pineapples.

The project is one of the innovative and sustainable solution by MOSTI to align with the national's food security policy prior to recent concern on raised inflation rate and induced the rise in food prices globally. Moreover, to implement IR4.0 component in the greenhouse and fish water tank ecosystem, FFM was also completed with water quality and environment sensors to monitor the surrounding parameters and nutrients supplied through the main water tank to the plants and fishes such as pH, temperature, and automatic pellets feeder.

On 18th June 2022, YBhg. Datuk Zainal Abidin bin Abu Hassan, Secretary General of Minister of Science, Technology and Innovation (MOSTI) paid a visit to the FFM. This project is led by NMB under the REVOLUTIoNT program which focuses on nanotechnology and product development as well as the use of the Internet of Nano-Things (IoNT) to improve solutions for various uses, including in the food and agriculture industries in line with the National Nanotechnology Policy and Strategy (DSNN) 2021 – 2030, National NanoTechnology Roadmap 2021 – 2025, and Food Security Policy Action Plan 2021-2025.

According to the Department of Statistics Malaysia (DOSM), the agricultural sector contributes 7.4 percent to Malaysia's Gross Domestic Product (GDP) in 2020. Malaysia ranks eighth among the 10 ASEAN countries for the contribution of the agricultural sector to GDP. In addition, the country's total food imports have increased from RM45.3 billion in 2015 to RM55.4 billion in 2020 (an average rate of 4.1 percent per year) making Malaysia highly dependent on imported food.



Secretary General of Minister of Science, Technology and Innovation (MOSTI), YBhg. Datuk Zainal Abidin bin Abu Hassan walked along the aisle of vertical farming section of FFM which consist of dwarf pak choy and salads.



Nano Light Energy Panel



Growing of lettuce



Tilapia fishes grown in aquaculture setup

Project Highlights

Graphene Pre-Cured Tread Liners (KH 25 & KH 27)

GIIB Rubber Compound Sdn Bhd, a Malaysian manufacturer of rubber compounds and a fully owned subsidiary of GIIB Holdings Berhad, with NanoMalaysia Berhad (NMB) have worked together to develop an improved and optimised rubber compound formulation using Graphene-M15 to improve the mechanical properties of pre-cured tread liners. Graphene M-15 is a type of graphene nanoplatelet incorporated into pre-cured tread liners rubber compound, more commonly known as tire flowers. This is the first Graphene infused pre-cured tread liner developed in Malaysia.

This new formulation has been demonstrated to have better mechanical properties compared to the standard tread liner compound WG-51 without incorporation of graphene at GIIB. It also has higher durability to tackle problems such as abrasion loss and high rolling resistance, inadequate abrasion resistance and reduced uses of high amounts of carbon black, which are not environmentally friendly.

The graphene pre-cured tread liners also have shown for improvement in energy efficiency, extend the life span of tires and be used in diverse climates or extreme road conditions. Enhancements to energy efficiency will lower carbon emissions, which is one of the main objectives of Malaysia's National Energy Policy 2022-2040. The new graphene pre-cured tread liners labelled as KH25 & KH 27 also have passed to be certified under MS1208:2020 which is the specification for 'Precured Tread for Retreading Tyres' by Standard and Industrial Research Institute of Malaysia (SIRIM).

The APAC industrial rubber market was valued at USD\$36.1 billion in 2017 and is expected to reach USD\$55.4 billion by 2025, at a CAGR of 5.5% during 2017-2025. Meanwhile, the Malaysian industrial rubber market, valued at RM1.18 billion in 2017, is expected to grow to RM1.7 billion in 2025. This suggests an increasing demand for industrial rubber products due to rising worldwide vehicles production and sales. Significant growth is expected in emerging economies such as Malaysia, India, Thailand, and Brazil, resulting in increased demand for rubber products.



Graphene M-15



Recycled Carbon Black



Natural & Synthetic Rubber



Accelerators



Pre-cured Tread Liners



Project Highlights

Retailer's Smart Shopping Cart

Founded in 2018 and started since January 2020, Retailer's has successfully developed ezyCart using IoT Solution for Retail Platform, including integrating beacon technology for cart navigation, items detection and promotional activities at the designated shopping sections. This solution, paired with wireless technology, enables efficient power management of the carts. Through this project, Retailer's created an enhanced retailing ecosystem through three components: ezyList, ezyRetail, and ezyCart. With an intuitive user interface that is supported by real-time data from sensors, cameras and Artificial Intelligence (AI), ezyCart enables grocery retailers to engage shoppers and deliver personalised and frictionless experiences inside their stores while gaining access to real-time insights into shopper preferences and behaviour and boosting brand value, footfall, sales and customer retention.

Retailer's has collaborated with NanoMalaysia Berhad to develop and commercialise the smart shopping cart with weight sensors, artificial intelligence (AI) software, wireless charging system and nano coating application. These smart cart have the comprehensive AI software in the tablet device installed at the handlebar section, which enable the system to recognise object in the cart and location of the customer by communicating with the beacons installed throughout the store. In the same time, the weight sensors fitted at the base of the cart basket will keep track if non-scanned items added into the cart and the Smartwheels will alert the retail owner if the cart being removed beyond the retail premises' perimeter. Taking into account of the pandemic, the ezyCart is also coated with nano-coating to keep it virus and bacteria free for up to 12 months.



Advantage To Customer

- Personal Dashboard – Shopping List, Store Catalogue,
- Promotions, Shopping History & Receipts
- Self-checkout – no more queues
- Antibacterial coating
- Personalised greetings, rewards, promotions and messages
- In-store navigation

Advantage To Retailer

- Automatic customer identification & segmentation
- Planned and instant promotion
- Heat map
- In-cart self-checkout
- Cashless – FPX/Credit/Debit Card & Wallets
- Advertising (wrap cart surfaces & screen)

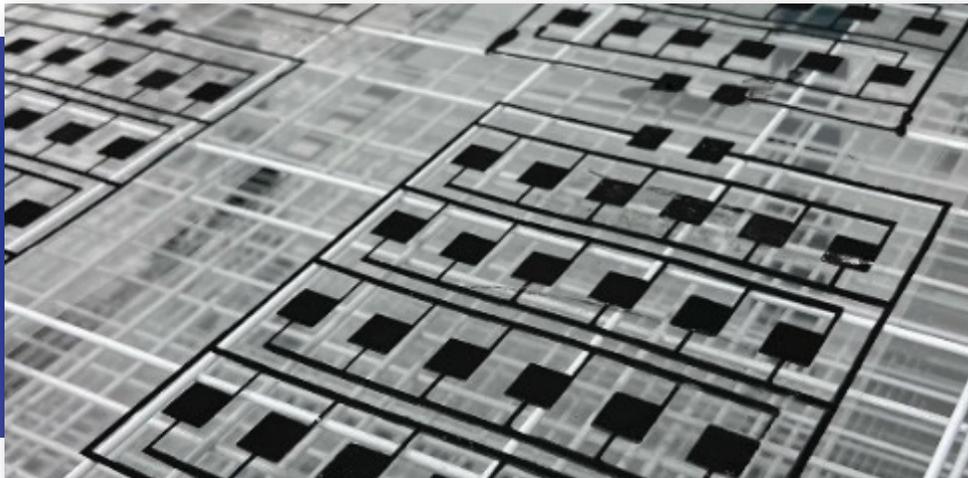
Project Highlights

CNT-based Organic Conductive Paste

Serdang Paste Tech (SPT) was founded in 2017 known as Putra Serdang Paste and based at Universiti Putra Malaysia. It was a startup business inside Innohub UPM responsible in managing and commercialise new product to the market. Based on their previous research and vast experience working with conductive paste in Malaysia, SPT decided to take the next step and commercialise the conductive paste. They aimed to be a pioneer in developing technology using conductive paste in Malaysia and regional countries.

SPT has collaborated with NanoMalaysia Berhad to scale up, reformulate and commercialise the organic conductive paste which they have formulated and patented by their research team under MyIPO. The main objective of the project was to reformulate and investigate the performance of organic conductive paste and facilitating SPT on scaling up the production process of organic conductive paste by establishing low volume production line. Organic conductive paste is a liquid-based material with used organic binder acting as vehicle mixed with carbon-based material. Its developed using green process, environmental friendly for electric and electronics applications and come with various ratio. The organic conductive paste can be operated at low and high temperature and easy to be applied on any substrate.

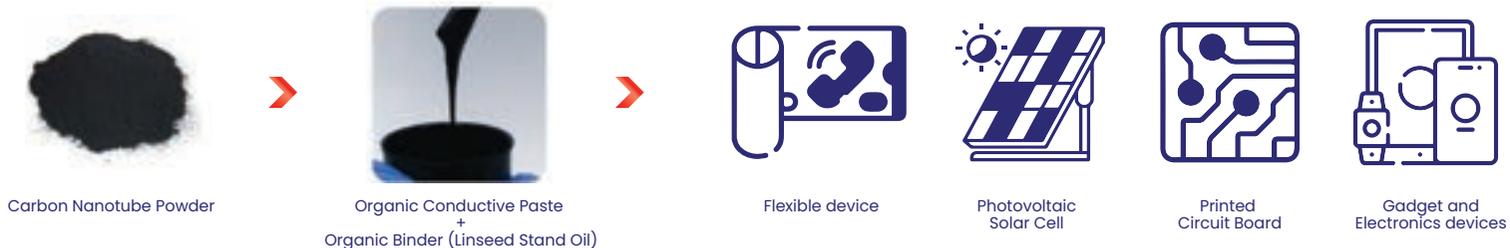
Moreover, SPT Sdn. Bhd. also capable to provide consultancy, printing services, product manufacturing based conductive paste and selling organic conductive paste . The developed OCP can be applied in various applications such as photovoltaics solar cells, flexible and wearable devices, printed circuit board, gadgets and electronic devices.



A sample of screen-printed conductive paste from SPT for touch panel application.



CEO of NanoMalaysia Berhad, Dr. Rezal Khairi Ahmad discuss about the moving forward potential of organic conductive paste with CEO of Serdang Paste Tech, Mr. Asnawi at the production area.



Project Highlights

Graphene-based Nanofluids for Cooling Systems

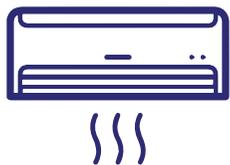
Blue Snow Consulting and Engineering (“BSCE”) Sdn Bhd was established in 2005 and is registered with the Board of Engineers, Malaysia. BSCE provides energy and building technology services to the building and infrastructure sector (e.g. hospitals, offices, industrial buildings) to enhance the energy performance. Other services provided by BSCE include utility and building audits, mechanical systems design, analysis, solution & implementation, commissioning & facility maintenance, and consulting in energy engineering (energy efficiency). On account of its numerous experiences and know how related to energy-efficient air-conditioning, BSCE plans to take a step ahead by producing its own solution towards heat transfer enhancement and energy saving for cooling systems.

Under NGAP 2020 programme (Jan-Nov 2019), BSCE has developed graphene-based (GNP) nanofluids for cooling systems during a Product Development Stage. The developed GNP nanofluid is capable to enhance the heat transfer in a cooling system by to reduce the energy consumption by 18-46% (average of 32%) compared to using traditional chilled water system.

The GNP nanofluid can be use in any cooling systems that uses chilled water for cooling and can be adopted in various applications such as building central chilled water plants (e.g. shopping malls, hospitals), concentrated solar power, food & beverage, chemicals, and HVAC (heating, ventilation, and air-conditioning).



- **Enhanced heat transfer and reduced energy consumption** when compared to all-air and air-water systems up to 32%



Potential Prospects



Active Chilled Beam chilled water circuit



District Cooling Plants, Industrial Process Cooling



Building Chilled Water Plants



Cooling System Manufacturers



Data Center Cooling



Cooling System Owners/Operators



Microprocessor Heat Sink



Vehicle Cooling

Nanotechnology Programme Delivery Office

The Nanotechnology Program Delivery Office offers assistance to enterprises and start-up companies involved in nanotechnology, supporting their business growth. This assistance includes various mechanisms that enable small and medium-sized enterprises (SMEs) to establish a market presence by introducing new processes or materials, and successfully transitioning from conventional methods to state-of-the-art nanotechnology-enabled operations.

The Nanotechnology Programme Delivery Office carries out two types of technology development:

- Graphenovation, which focuses on graphene-based technologies, and
- iNanovation, which encompasses non-graphene-based technologies.

Within each of these components, investment schemes are provided to help SMEs and start-ups expand their presence in the nanotechnology industry. These schemes involve offering venture funds, soft loans, business partnerships, and technological expertise and support. Additionally, the Nanotechnology Programme Delivery Office actively invests in businesses within the nanotechnology sector, acquiring equity stakeholding in order to provide targeted support.

The projects initiated by the Nanotechnology Programme Delivery Office and the profits generated from joint ventures are reinvested into the office itself. This creates a virtuous cycle of funds and expertise that can be utilised to further invest in new nanotechnology ventures.

Our strategic approach ensures the completion of ecosystems within key sectors, fostering innovation and technological advancements. By staying ahead of the curve in the Malaysian nanotechnology landscape, we are able to continually support the growth and success of the nanotechnology industry in the country.

Nanotechnology Project Delivery Office

Building Awareness

To foster sectoral expansion and growth, it is vital to raise awareness about the advantages of commercialising graphene and nanoproducts throughout the broader ecosystem. NanoMalaysia plays a critical role in this endeavor by consistently engaging with small and medium-sized enterprises (SMEs) to enhance their knowledge and comprehension of the potential applications of nanotechnology. We actively facilitate partnerships and collaborations among different stakeholders within the ecosystem, promoting synergies between industry and academia, as well as facilitating connections between upstream and downstream producers.

Executing Initiatives

NanoMalaysia's dedication to effectively implementing projects with significant growth potential has yielded measurable outcomes that support our advancements in this field. Our services primarily revolve around aiding companies in the later stages of research and development (R&D) and prototyping projects. We provide assistance to companies, partnerships, and joint ventures that explore potential applications enabled by graphene.

The Nanotechnology Programme Delivery Office consists of two central units, each focusing on distinct types of developments: Graphene-based and Non-Graphene based. Under the National Graphene Action Plan (NGAP) 2020, our emphasis has been on five key areas: Lithium-ion battery anodes/ultracapacitors, Conductive Inks, Rubber Additives, Plastics Additives, and Nanofluids, all related to graphene developments. NGAP 2020 has now transitioned into NGAP 2.0, which concentrates on Fourth Industrial Revolution sectors, namely Energy Storage, Energy Generation, Sensor Technologies, and Advanced Packaging.

Additionally, we prioritise the commercialisation of various types of nanomaterials in four significant jumpstart sectors: Electronic Devices & Systems, Food & Agriculture, Energy & Environment, and Wellness, Medical & Healthcare.

Product Development and Scale-Up Support

NanoMalaysia plays a crucial role in offering support for scaling up during the product commercialisation phase. We provide financial investment to companies that require assistance in establishing production-scale facilities. Additionally, NanoMalaysia facilitates collaborative partnerships between relevant government agencies and industry players, enabling business entities to access various resources, tax incentives, and Entry Point Projects that aid them in the scaling-up process.

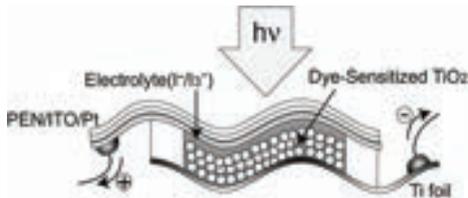
Monitoring and Assessing Progress

NanoMalaysia has the responsibility of closely monitoring and evaluating the advancement and growth within the five identified application areas. This rigorous process includes closely tracking the progress of projects, particularly when public funds are utilised for research and development as well as scaling-up purposes. Furthermore, we thoroughly examine the potential impacts of each project, especially in terms of its contribution to gross national income (GNI), investments, and job creation.

Nanotechnology Programme Delivery Office

Flexible Dye Sensitised Solar Cells for Light Electronic Charging

This product development project aims to enable self-powered device applications that offer portability, eliminates the need to have battery or wired power connector and the use of renewable energy - solar.



Advantage

- Portable & durable
- Low cost
- Work in low-light condition
- Able to generate more power using artificial light

Application



Portable devices



Smart textile



Low power Electronic devices



Wearable devices

Development of Peltier Cooling System in Smart Water Purifier

Most cold-water module technology in water purifiers are using tanks with very high energy consumption. This product developed a cold-water module featuring both cooling and heating system known as Peltier technology which is a thermoelectric semiconductor device.

New Technology

Cold water module based on Peltier Effect Mechanism using Carbon Nanotube thermal paste.

Advantages

- Flexible location
- Lightweight
- Economical
- Quiet
- Green Technology
- Less maintenance needed



Nanotechnology Programme Delivery Office

Scale Up Production of UV LED with Fused Nano Silica lenses for Disinfection Application

With the initiative of HVA Covid-19 programme, this cost-efficient UV LED Disinfectant System which integrated with the fused Nano Silica optics will be able to minimise the rate of spreading of any contagious diseases in human dwelling and animal farms (indoor breeding).

Advantage

- Eco-friendly
- Cost effective
- Proven "Germs killing"
- reusability
- Eliminate the need for constant spraying & wiping
- Zero germs environment

Application



UV Disinfection Unit For continuous Air Disinfection



UV Disinfection Unit for Ceiling Panel

Conversion of Internal Combustion Engine (ICE) to Electric Vehicle (EV) for 4-Wheeler with Hybrid Battery

The proposed system helps to prolong the battery shelf life and with graphene ultracapacitor it provides electricity for extended time, faster charging, improve acceleration due to fast discharge power & high energy density

Advantage

- Environmentally friendly
- Regenerative braking
- Long battery life
- Improved acceleration



Project Technology

The benefits of lithium-ion battery and graphene ultracapacitors are combined to form the hybrid energy storage system for the EV.

Nanotechnology Programme Delivery Office

Nanotechnology Programme Delivery Office Achievements As At End 2022 (Electronic Device & System)

Company	Nanotechnology Product	Application	Advantages
UTEM Holdings Sdn. Bhd.	<p>High Thermally Conductive Hybrid Graphene-based Die Attach Materials</p> <p>Hybrid graphene based non-sintered and sintered die attach paste with high thermal conductivity of >100 W/mK (non-sintered) and >300 W/mK (sintered)</p>	High thermal conductivity paste for electronics applications	<ul style="list-style-type: none"> ● Enhanced thermal conductivity ● Compatible dispensability performance ● Improved heat dissipation ● Reduced thermal resistance ● Long term stability
Retailtics Sdn Bhd	Smart shopping cart	Shopping mall, supermarket, grocery store,	<ul style="list-style-type: none"> ● Customer Personal Dashboard ● Customized Shopping List, Store Catalogue, Promotions, Shopping History & Receipts ● Self-checkout ● Antibacterial coating ● Personalized greetings, rewards, promotions and messages ● In-store navigation
NanoVerify Sdn Bhd	GrapheneVerify	A Product certification scheme to verify the presence of graphene material in a product	<ul style="list-style-type: none"> ● Expedite the application process with the identified companies ● Verify the presence and quality of graphene in a product. ● Nurture public trust amongst consumer and industry players towards verified graphene products

Nanotechnology Programme Delivery Office

Nanotechnology Programme Delivery Office Achievements As At End 2022 (Energy & Environment)

Company	Nanotechnology Product	Application	Advantages
Blue Snow Consulting & Engineering Sdn. Bhd.	Graphene-based cooling fluids	For maintaining good indoor air quality through adequate ventilation and provide thermal comfort through for Heating, Ventilation and Air Conditioning (HVAC) system	<ul style="list-style-type: none"> ● Enhanced heat transfer ● Reduced energy consumption ● Energy saving cooling system for multiple stories building such as hospitals, malls and living houses
My Synergy Factors (M) Sdn. Bhd.	Advanced formulation of locally produced Carboxymethyl Sago Starch (CMSS) with Graphene Oxide as oil drilling additives.	Optimizing drilling efficiency was developed by optimizing rheological, filtration loss and thermal conductivity properties of water-based mud and creating wellbore stability	<ul style="list-style-type: none"> ● Environmentally friendly ● Withstand HPHT (High Pressure and High Temperature) ● Conformance to testing/target output standards as per Benchmarking on PETRONAS Technical Standards (PTS)
Enhance Track Sdn Bhd	Wireless Power Distribution System	IoT Wireless Systems for Automatic Dispenser Wireless Charging System and Wireless Battery Water Level Sensor	<ul style="list-style-type: none"> ● Solving problems of energy constrained in wireless networks ● Seamless high-end wireless powered IoT solution ● Batteryless maintenance ● Less wiring and cables connection

Achievements As At End 2022 (Food, Health & Medical)

Company	Nanotechnology Product	Application	Advantages
VNI Scientific Manufacturing	Crystalline nano cellulose as a key ingredient in cosmetics product	Bio-cellulose mask Nano-emulsion serum	<ul style="list-style-type: none"> ● Anti-wrinkle agent ● Green-based source ● Safe for human body ● Superior physicochemical
Flora Niaga Sdn Bhd	Integrated vertical farming and aquaculture with IoT	Incorporating nanotechnology component by inventing an alternative to the source in agriculture and aquaculture through nano-coated solar panel as power generator and smart monitoring solutions.	<ul style="list-style-type: none"> ● Real time air and water quality monitoring ● Less manpower ● High yield and crop production ● Remote monitoring and data driven decision.
Farmasia Sdn. Bhd	Chitosan-CNC Composite Gel	Used in wound dressings and bandages due to its biocompatibility, antimicrobial properties, and ability to accelerate wound healing	<ul style="list-style-type: none"> ● Antimicrobial properties ● Accelerate wound healing ● Moisturizing properties ● Enhances delivery of active material to skin ● Can be employed in skincare and cosmetics products
Bonric Sdn. Bhd	Graphene infused latex (g-NR) Gloves	<ul style="list-style-type: none"> ● Electronics manufacturing ● Medical and surgery 	<ul style="list-style-type: none"> ● Antistatic properties ● Enhanced mechanical strength ● Improved flexibility and comfort ● Antimicrobial properties

Corporate Governance

NanoMalaysia's Organisational Anti-Corruption Plan (OACP) for 2021-2025

NanoMalaysia's Organisational Anti-Corruption Plan (OACP) serves as a crucial framework designed to eliminate corrupt practices within our organization. This comprehensive document outlines a series of integrated actions that are aimed at fostering professionalism, efficiency, and integrity among the members of NanoMalaysia Berhad.

The primary objective of the OACP is to cultivate a highly professional and efficient environment while upholding the values of integrity. In line with our commitment to combat corruption, NanoMalaysia Berhad has developed the Organisational Anti-Corruption Plan (OACP) for the years 2021-2025. This plan reflects our unwavering support for all initiatives that aim to prevent corruption within our administrative services.

Participation in Integrity, Governance, Anti Corruption Award (AIGA)



NanoMalaysia Berhad (NMB) received the Anugerah Gangsa at the Integrity, Governance, and Anti-Corruption Award (AIGA2022) under the work culture and practice of integrity in the workplace category.

AIGA is a Government initiative, through "Institut Integriti Malaysia" (IIM), to cultivate integrity, best governance and Anti-Corruption in the public and private. The award recognise and appreciate the public and private sectors who show commitment to the culture and practice of integrity and best governance. NMB received the "Anugerah Gangsa" category award for AIGA 2022 and is awaiting for AIGA 2023 result after being assessed by IIM's appointed panel on 24 May 2023.



We oversee the drafting and review of legal documents, skillfully negotiate with technology recipients, collaborators, and partners to safeguard NMB and its partner's rights and interests. Moreover, we diligently identify potential legal risks and develop robust strategies to mitigate them.

Company Secretarial: We expertly manage all matters pertaining to the Board, offering comprehensive company secretarial services. Our team remains up-to-date with regulatory and statutory changes and policies related to the technology ecosystem.

Intellectual Property: NanoMalaysia's intellectual properties (IP) is diligently managed under our purview. We handle the prosecution of patents, trademarks, and copyrights, ensuring robust protection and enforcement of NMB's IP rights against any infringement. Furthermore, we provide invaluable support for corporate development activities, including intellectual property due diligence and freedom-to-operate analyses.

Corporate Governance: Our commitment to corporate governance is unwavering. We work tirelessly to ensure NanoMalaysia's seamless operation within the legal framework, strictly adhering to all relevant laws and regulations. Through our advisory role and extensive awareness initiatives, we foster a culture of governance and integrity throughout the organisation.

Navigating Regulatory Changes & Ensuring Legal Compliance

Identifying and Mitigating Legal Risks

Our vigilance extends to identifying potential or actual legal issues across all areas of NanoMalaysia's business. Swiftly and meticulously, we devise comprehensive plans to circumvent any adverse outcomes, thereby safeguarding NanoMalaysia's reputation.

Knowledge Enhancement and Empowerment

In recognition of the significance of legal literacy within the organisation, we organise a range of in-house training sessions, sharing sessions, and briefings. These initiatives cover a wide array of topics, including understanding legal documents, promoting bribery and anti-corruption awareness, and fostering a comprehensive understanding of the intellectual property framework. Through these efforts, we empower all employees and our partners with the requisite knowledge to navigate legal complexities effectively.

As we remain steadfast in our commitment to providing robust legal assistance, ensuring compliance, protecting NanoMalaysia and our partners, and fostering a culture of integrity throughout the organization

Corporate Governance

The Legal 500 – GC Powerlist



**Hairul Hafiz
Hasbullah**

Vice president, group legal |
NanoMalaysia

Hairul Hafiz, Vice President of Group Legal of NanoMalaysia Berhad, has been named in the Legal 500 GC Powerlist: Southeast Asia 2022. The Legal 500 GC Powerlist is one of the most distinguished industry awards highlighting the best GCs and senior in-house counsel, following a comprehensive and detailed research process that includes recommendations from other legal professionals. Congratulations to Hairul for his well-deserved recognition and for leading Group Legal team for collective growth and transformation strategies, especially on IP.

Intellectual Properties



Intellectual property (IP) pertains to any original creation of the human intellect such as artistic, technical, literary, or scientific creation. Patent, copyright and trademark are types of intellectual property rights that provide the creator an exclusive right over the use of his/her creation of mind for a limited period of time.

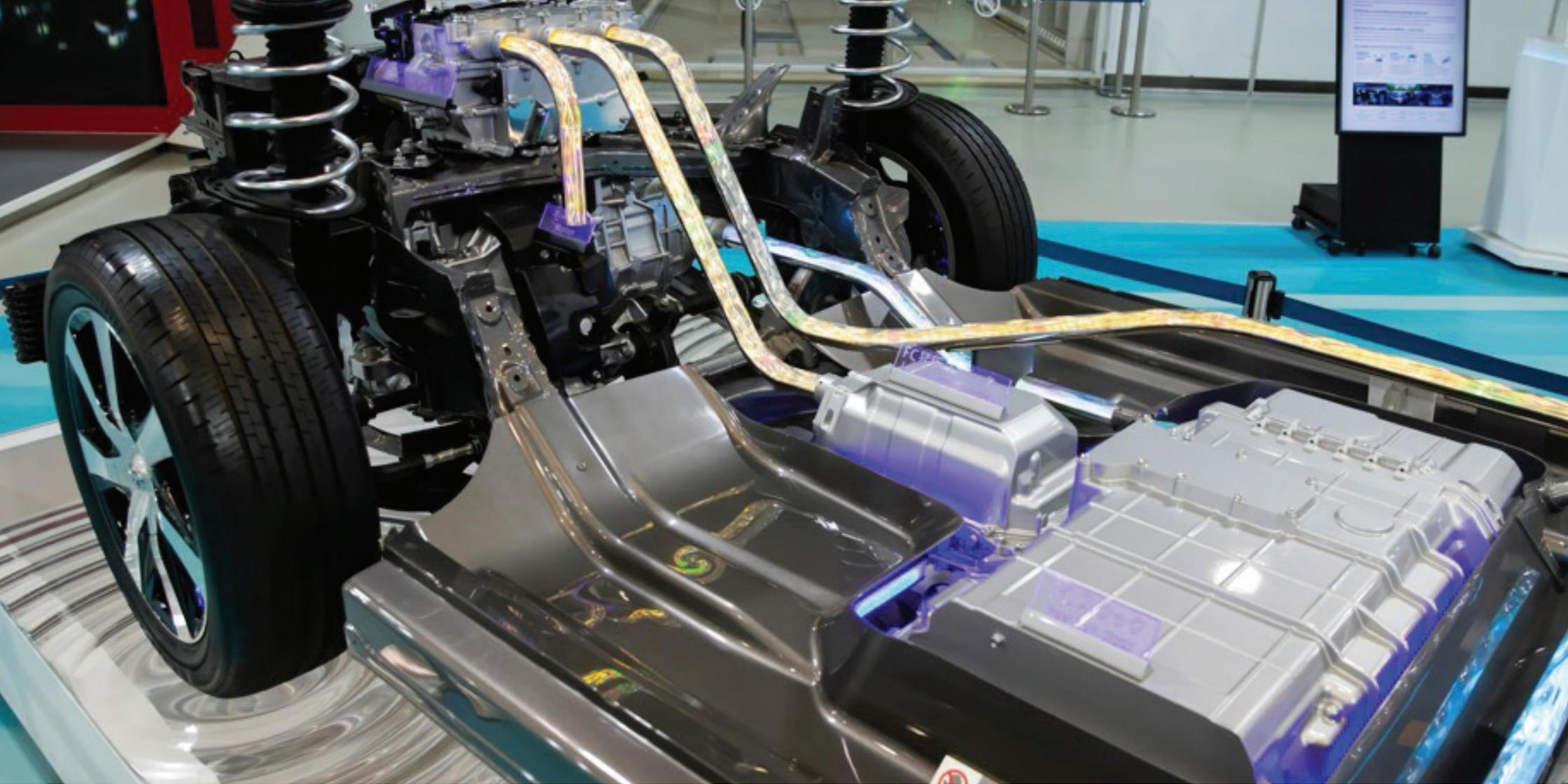
IP in nanotechnology

Nanotechnology has applications across a variety of industrial sectors, including energy, transportation, healthcare, manufacturing, materials and consumer products. Intellectual Property (IP) plays a central role in facilitating nanotechnology journey from science to the marketplace. IP represents the potential future economic values for nanotechnology start-ups through possibility to increase in market share, brand recognition, competitive presence on the market and ability to engage in collaborative agreements and innovativeness.

To this situation, patents can be used as technological indicators intended for commercial gain. Even when patents are not obtainable, other IP rights can still have a role to play. Trademarks, including certification marks offer guarantees to consumers regarding reputation for quality and reliability as well as enhancing the company's goodwill. Trade secret is another inexpensive way to protect IP for start-ups who may be at a stage of strategic mapping of the market.

Commercialisation of IP

While commercial exploitation of nanotechnology has become key focus in many jurisdictions, the successful commercialisation of nanotechnologies has proven to be rather a difficult task. As we have seen, there are few challenges surrounding the commercialisation of nanotechnology IP including weak link between research institutes and industry which contributed to slow translation of the discovery from lab to the market. Further, many sub-areas of nanotechnology are often in an early, immature phase of development as well as difficulties in recruiting human resources for activities related to R&D and production.



CHAPTER 5

NANOMALAYSIA'S EV AND ENERGY STORAGE PROGRAMME





NanoMalaysia's EV and Energy Storage Programme

Over the past five years, NanoMalaysia has invested significant resources and formed partnerships with industry players and universities to drive the development of critical energy components and technologies. This concerted effort includes the formulation of strategies to realise various programs centered around electric vehicles and energy storage technology. As a result, these technological advancements are now being applied in a wide range of commercial and industrial projects, encompassing areas such as mobility, stationary applications, and portable uses. The ultimate aim is to position Malaysia as a leading market in terms of capability and expertise in electric vehicles and energy storage technology.

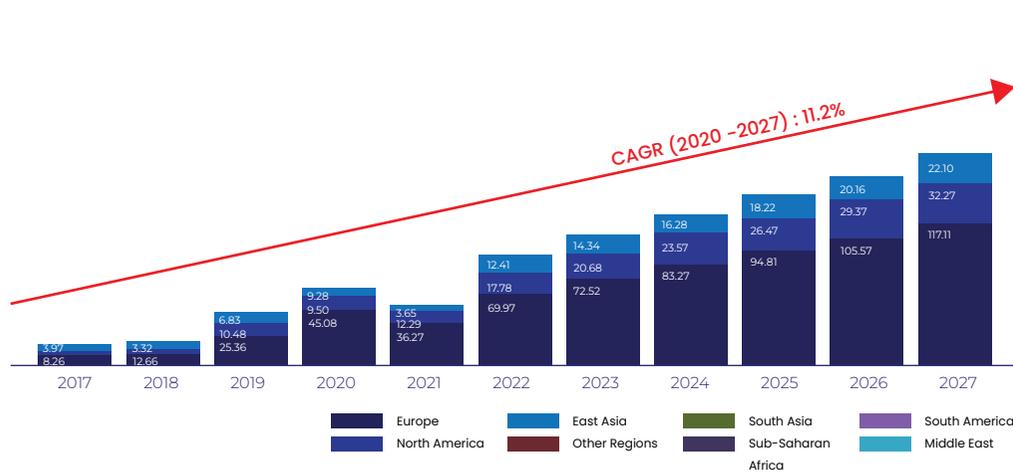
NanoMalaysia's primary objective is to transform Malaysia into a prominent hub for manufacturing cutting-edge electric vehicles and energy storage components and systems. These advanced technologies will be utilised both domestically and for export purposes. Nanotechnology plays a crucial role in enhancing the overall performance, reliability, and efficiency of these systems. Through the NanoMalaysia Energy Storage Technology Initiative (NESTI), NanoMalaysia actively collaborates with various partners in the development and implementation of energy storage technologies. This includes batteries, ultra-capacitors, solid-state hydrogen systems, energy management systems, and monitoring systems. Additionally, NanoMalaysia places special emphasis on creating a high-performance motor controller specifically designed for mobile applications.

With the active support of the Ministry of Science, Technology, and Innovation (MOSTI) and other key stakeholders, NanoMalaysia Berhad (NMB) will play a pivotal role in coordinating and uniting leading Electric and Micro E-Mobility players in Malaysia. These players will serve as vital ecosystem partners for research and development (R&D), pilot deployment, testing, certification, and eventual commercialisation. Additionally, NanoMalaysia will leverage existing projects and forge new partnerships to establish the secondary use of batteries for stationary applications, effectively extending their life cycle. By doing so, NanoMalaysia aims to facilitate the integration of Green Charging Stations, Battery Swapping, and Nano/Micro-Grid Systems into the Micro and Electric Mobility ecosystem.

As the global electric vehicle (EV) market continues to grow rapidly, witnessing a surge in EV sales worldwide, it is imperative to proactively foster the adoption of electric micro-mobility. This strategic initiative by NanoMalaysia plays a crucial role in expediting the widespread adoption of electric micro-mobility, which will eventually pave the way for full-scale electric mobility. Establishing a robust micro-mobility ecosystem in Malaysia is not only advantageous for the country but also has far-reaching implications for the future of transportation. It positions Malaysia as a frontrunner in low-carbon mobility, promotes safer road transportation, and enhances commuting convenience across various market sectors.

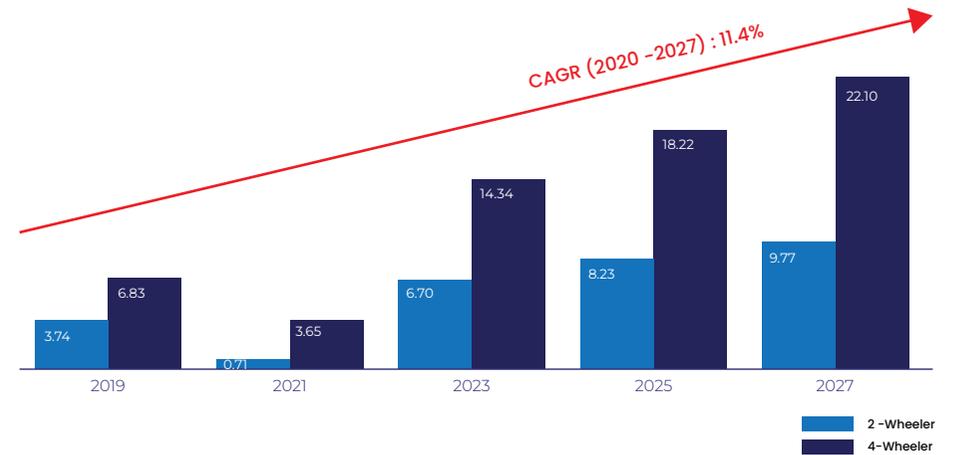
Global Ev Market value (2017 -2027) in USD Billion

Europe is currently leading the global drive towards adoption of Ev primarily due to the government intervention. Their initiative to ban internal combustion engines in major cities in the near future is bearing the fruit.



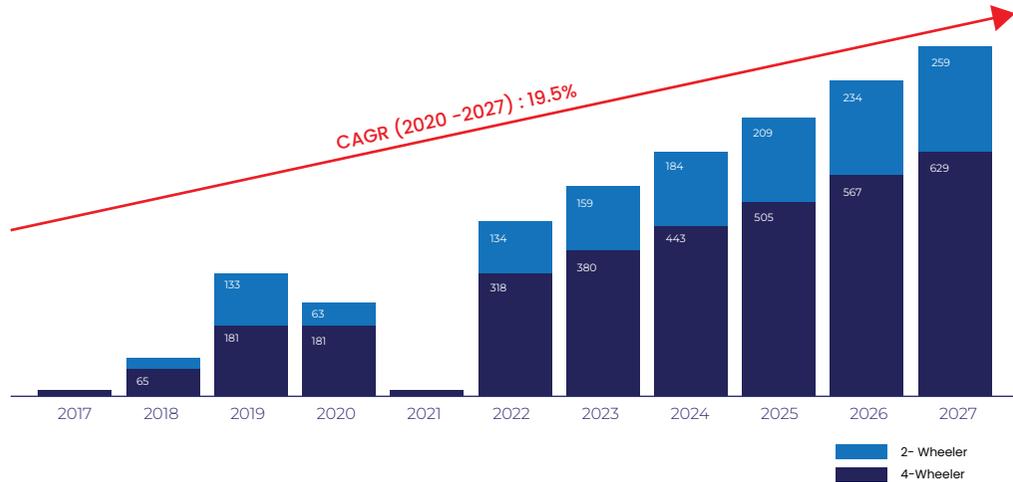
APAC Electric 2-Wheeler and 4 Wheeler Market Revenue (2017 -2027) in USD Billion

APAC region is lucrative market for electric vehicles due to its sheer number of population and supportive government policies and interventions.



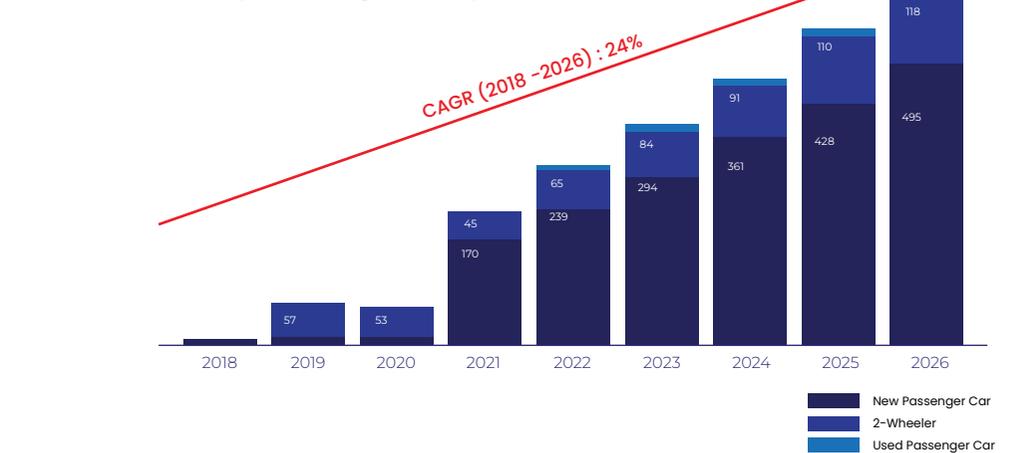
ASEAN Electric 2-Wheeler and 4 Wheeler Market Revenue (2017 -2027) in USD Billion

COVID-19 Has impacted ASEAN on the trade performance of electric 2-Wheeler and 4-Wheeler but it is expected to rebound in 2022.

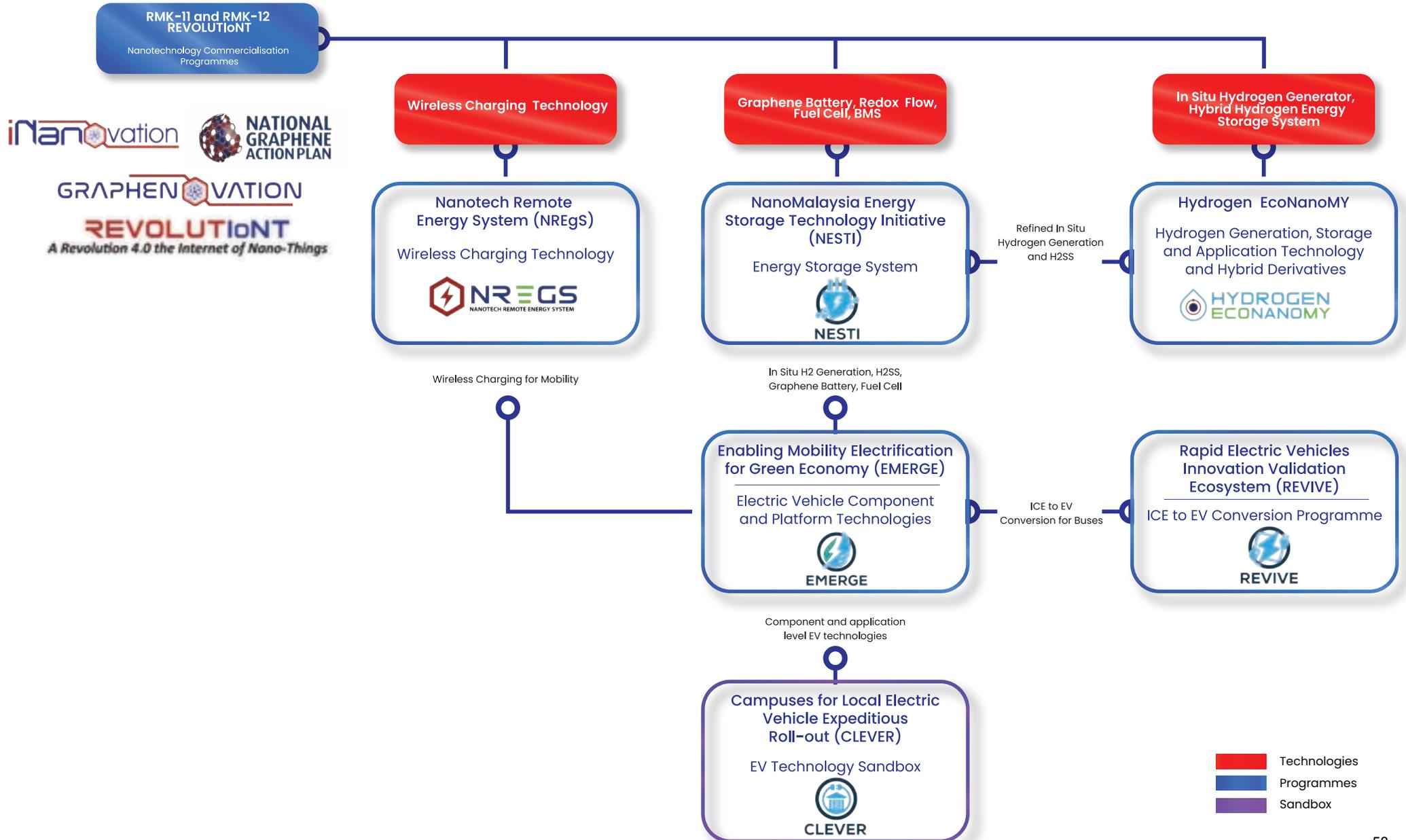


Import Value of New, Used and 2-Wheeler EVs 2018-2026

Despite setback from COVID-19 in 2020, Malaysia is expected to recover from the pandemic, and government subsidies and interventions, the EV market will be expected to rise over the years. More interestingly, imports of new EV's have jumped significantly in 2021. We expect that the trend will be steadily increasing over the years



NanoMalaysia's EV and Energy Storage Programme



NanoMalaysia's EV and Energy Storage Programme



What is Nanotech Remote Energy System (NREGS)

Under High Impacts Projects at NanoMalaysia, NREGS targets game-changing Malaysian innovation for Wireless Power Transfer under the Industry 4.0

Nanotech Remote Energy System (NREGS) is an initiative driven by NanoMalaysia's High Impact Projects, with the primary goal of revolutionising wireless power transfer in alignment with the principles of Industry 4.0. By focusing on the development, commercialisation, and implementation of both far-field and near-field wireless power transmission technology in Malaysia, NREGS aims to pave the way for a paradigm shift in how energy is transferred wirelessly.

One of the core focuses of the NREGS program is to target the component level of wireless technology systems. This approach allows for a more granular examination and optimisation of individual components, enabling the program to overcome the limitations typically associated with wired technologies. By doing so, NREGS aims to address the challenges related to restricted user experience and the limited accessibility of wired technologies, particularly in areas where wired connections are impractical or challenging to deploy. To achieve its objectives, NREGS places a strong emphasis on advancing wireless power transfer (WPT) projects that have already reached a proven Technology Readiness Level (TRL) of 3 or higher. This focus on projects with a significant level of development progress allows NREGS to expedite their commercialization, bringing cutting-edge wireless power transfer technologies to the market more efficiently.

One key motivation behind the NREGS program is to alleviate range anxiety, a common concern associated with traditional wired charging solutions. By encouraging the commercialization of wireless power transfer and wireless-powered device projects that have attained at least TRL 3, NanoMalaysia addresses the limitations of wired charging systems, such as the need for physical proximity to power sources. This shift toward wireless power transfer not only improves user convenience and experience but also opens up opportunities for innovative applications in various industries.

As part of its support ecosystem, NanoMalaysia offers funding opportunities to promising wireless power transfer and wireless-powered device projects. By providing financial support, NREGS encourages the development and commercialization of these projects, fostering a conducive environment for technological innovation.

Additionally, NanoMalaysia establishes partnership channels to facilitate collaboration between project developers and industry experts, ensuring a seamless transition from experimentation to successful commercialization. This collaborative approach helps bridge the gap between research and real-world implementation, maximizing the potential impact of wireless power transfer technologies developed under the NREGS program.

Current Projects under NREGS:

Development of Metamaterial Energy Harvester

One of the NanoMalaysia's Nanotech Remote Energy System (NREGS) project is focused on developing a metamaterial energy harvester for low-powered IoT sensors. The key objective of this product development project is to create an RF energy harvesting device that utilizes metamaterials to efficiently convert radio frequency (RF) signals into direct current (DC) power.

The program aims to develop both a single unit and a 9-unit array configuration to determine the optimal design for achieving a 5V output. The targeted RF to DC efficiency for the energy harvester is 50%, meaning that it aims to convert 50% of the received RF energy into usable DC power. The device is intended to operate at a measurement distance of 2 meters.

In terms of the RF parameters, the targeted transmit frequency for the energy harvesting system is 2.45 GHz. The program aims to accommodate a wide range of transmit power levels, ranging from 500mW to 5W.

This project has partnered with UTHM as a technology collaborator to leverage their expertise and resources in developing this metamaterial-based energy harvester.

One of the main advantages of utilizing metamaterials in this energy harvesting system is their high RF energy efficiency. Metamaterials are known for their unique electromagnetic properties, allowing them to efficiently capture and convert RF signals into usable energy. Additionally, the use of metamaterials enables a smaller form factor for the energy harvester compared to conventional RF energy harvesting systems. This size reduction is particularly beneficial when installing the device in locations with limited space, where a wireless charging system is required.

2021 NR PD IML Graphene PLA Filament

The NanoMalaysia Nanotech Remote Energy System (NREGS) program has introduced a new initiative involving the development of a graphene-based filament for 3D printing, specifically the 2021 NR PD IML Graphene PLA Filament. This filament serves as a crucial component for antenna development within the NREGS program, as it possesses conductive properties that enable the creation of 3D-printed antennas.

The primary objective of this initiative is to develop an end-to-end wireless charging solution for devices of all sizes, addressing the issue of limited charging range. By introducing the graphene filament through 3D printing, the program aims to leverage its conductive properties to enable efficient wireless charging.

NanoMalaysia's EV and Energy Storage Programme



Some advantages of the graphene filament and its incorporation into the NREgS program are as follows:

The 2021 NR PD IML Graphene PLA Filament is the first locally produced graphene filament that utilizes 3D printing technology. This highlights the program's focus on utilizing cutting-edge technology to develop innovative solutions.

The graphene filament exhibits excellent conductive properties, with a resistance volume of 0.6 Ohm-cm. This conductivity makes it particularly suitable for applications such as capacitive sensors, where reliable and efficient electrical conductivity is required.

In addition to its conductive properties, the graphene filament offers higher mechanical properties when compared to other commonly used filaments like PLA or ABS. This enhances the overall durability and strength of the 3D-printed components, ensuring their longevity and robustness.

The graphene filament possesses anti-rust properties, making it suitable for use in various environments, including those with higher moisture levels. This ensures the longevity and reliability of the 3D-printed antennas and other components developed within the NREgS program.

Overall, the initiative of incorporating the graphene-based filament into the NREgS program aims to leverage the unique properties of graphene to enable efficient wireless charging solutions. By utilizing 3D printing technology, the program seeks to develop robust and conductive components that can address the limitations of traditional charging methods and enhance the overall user experience.

NR PD Electric Autonomous Delivery Vehicle Wireless Charging

The NanoMalaysia Nanotech Remote Energy System (NREgS) program has initiated a project called NR PD Electric Autonomous Delivery Vehicle Wireless Charging. This project combines two key technologies, namely an autonomous last mile delivery system and a wireless charging solution, to create a fully autonomous system for efficient and convenient delivery operations.

The project's key specifications include a power level of 1kW and an electrical efficiency of 85%. The targeted charging rate is less than 2 hours to fully charge the vehicle's battery from 0 to 100%. The NREgS program has collaborated with UM and Helloworld as technology partners to bring this project to fruition. The advantages of this initiative are manifold. Firstly, the implementation of a wire-free charging system eliminates the need for physical connectors and cables, enhancing convenience and reducing maintenance requirements. The fully autonomous system integrates the wireless charging mechanism seamlessly, allowing the delivery vehicles to autonomously navigate their routes and automatically charge whenever necessary.

Additionally, the system is equipped with monitoring capabilities to track the conditions of the vehicle's battery and individual units. This enables efficient maintenance and ensures optimal performance. Furthermore, the system incorporates a user order system, allowing for streamlined delivery operations and improved customer satisfaction. Electric Static EV Wireless Charging

Electric Static EV Wireless Charging

This project aims to facilitate the development of a static charging system for electric vehicles (EVs). The project will involve the design and validation of a transmitter and a receiver pad for wireless power transfer. The key specifications of the wireless charging system include a power transmission capability of 22kW, aiming for an efficiency of 90%. The system is designed to accommodate an air gap of up to 20cm between the transmitter and receiver pads, allowing for flexible positioning and alignment during charging.

There are several advantages associated with the adoption and implementation of static charging as part of the NREgS program. Firstly, it aligns with the National Automotive Plan (NAP) and promotes the advancement of EV technology in the country. By facilitating static charging, the program contributes to the growth and acceptance of electric vehicles in Malaysia. One of the notable advantages of static charging is its high transmission efficiency, which remains consistent regardless of weather conditions. This ensures reliable and efficient charging performance, regardless of environmental factors.

Furthermore, static charging provides a universal charging solution, accommodating various EV models and manufacturers. This versatility simplifies the charging infrastructure and promotes interoperability across different electric vehicle platforms. Overall, the Electric Static EV Wireless Charging initiative within the NREgS program aims to develop an efficient and adaptable charging system for electric vehicles. By embracing static charging technology, the program supports the growth of EV adoption in Malaysia, promotes sustainability, and contributes to the realization of a cleaner and greener transportation ecosystem.

NanoMalaysia's EV and Energy Storage Programme



2021 NR SU Electrck E-Mobility Wireless Charger

The NanoMalaysia Nanotech Remote Energy System (NREgS) program is driving an initiative centered around the development of the 2021 NR SU Electrck E-Mobility Wireless Charger. This project focuses on scaling up a static charging system to facilitate efficient charging for electric vehicles (EVs) in motion.

As part of this initiative, a 100-meter track will be deployed, featuring an embedded transmitter. The objective is to test and validate the dynamic charging capabilities of the track using an electric buggy. The key specifications of the wireless charger include a power level of 10kW and an electrical efficiency of 80% at a speed of 15km/h. The track length of 100 meters allows for sustained charging during the vehicle's movement.

The NREgS program has partnered with UM (University of Malaya) and Helloworld Robotics as technology collaborators for this project, leveraging their expertise in wireless charging and mobility solutions.

The initiative offers several advantages for electric vehicle users and the overall e-mobility ecosystem. Firstly, it overcomes range anxiety by providing a continuous charging solution. The dynamic charging track allows vehicles to recharge on the go, eliminating the need to stop and charge at fixed charging stations. This convenience enhances the user experience and facilitates longer journeys without concerns about battery range limitations.

Additionally, the ability to charge vehicles while in motion reduces the reliance on large battery sizes. With continuous charging available, EVs can optimize their battery sizes for more storage or other functional requirements, improving the overall efficiency and design flexibility of electric vehicles.

Overall, the 2021 NR SU Electrck E-Mobility Wireless Charger project within the NREgS program aims to revolutionize electric vehicle charging by deploying dynamic charging tracks. By offering on-the-go charging capabilities, the initiative enhances the practicality, convenience, and range of electric vehicles, further driving the adoption of sustainable e-mobility solutions.

2022 NR PD Electrck NFC Electronic

This project focuses on the development of a wireless charging system designed to charge electronic devices like mobile phones and smartwatches.

The technology utilized in this project is magnetic resonance induction charging, which builds upon existing induction charging technology. Magnetic resonance induction charging allows for efficient wireless charging by utilizing the principles of magnetic resonance to transfer power between the transmitter and receiver units. The key specifications of the wireless charging system include a transmit power range of 10-17W and a minimum system efficiency of 60%. The transmitter unit has dimensions of 200mm x 200mm, while the receiver unit measures 120mm x 80mm (length x thickness).

To realize this project, NanoMalaysia has collaborated with UTAR (Universiti Tunku Abdul Rahman) as a technology collaborator. This partnership leverages UTAR's expertise and research capabilities in wireless charging technology. The initiative offers several advantages in wireless charging technology for electronic devices. By utilizing magnetic resonance induction charging, the project aims to provide efficient and convenient charging solutions. Users will be able to charge their devices without the need for physical connectors or cables, enhancing the user experience and reducing wear and tear on charging ports.

The 2022 NR PD Electrck NFC Electronic project within the NREgS program aligns with the growing demand for wireless charging solutions for electronic devices. By collaborating with technology partners like UTAR, NanoMalaysia strives to advance the development and commercialization of this wireless charging system. The project aims to provide users with a reliable and efficient method of charging their electronic devices, further enhancing the convenience and accessibility of wireless charging technology.

NanoMalaysia's EV and Energy Storage Programme



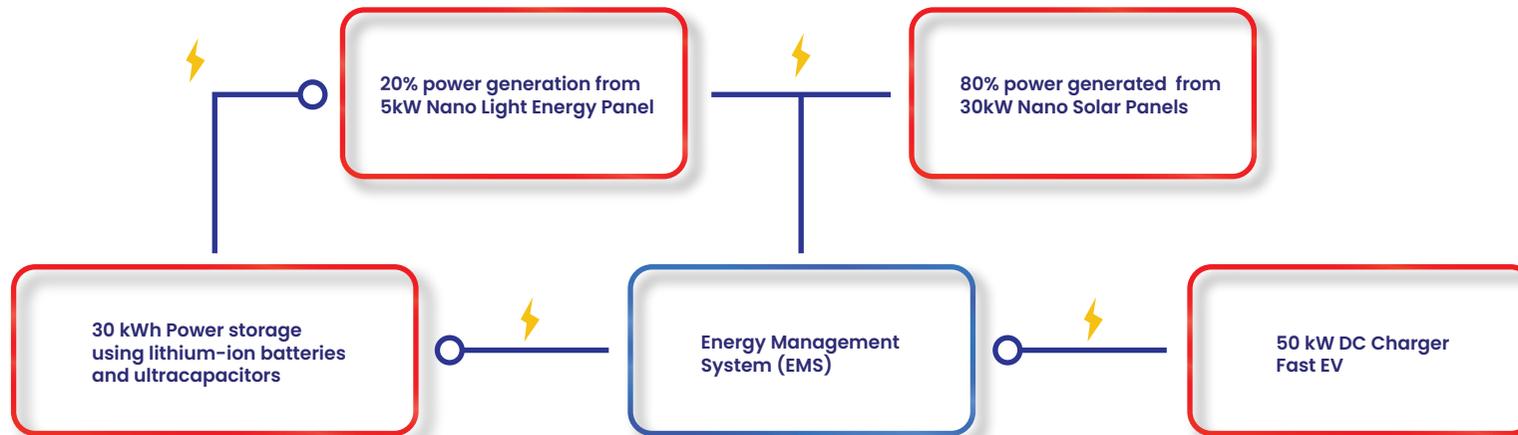
Development of E-textile with wireless charging and sensory Functionalities

This project aims to advance the existing proof-of-concept (PoC) of a wireless energy harvesting system and integrate it onto textile surfaces, enabling a larger surface area for energy harvesting. For this project, a combination of thermoplastic polyurethane (TPU) film imprint and graphene-infused flexible circuitry is utilized. This integration allows for the development of e-textiles that possess both wireless charging and sensory functionalities. The primary objective of this initiative is to harness wireless energy from sources such as WiFi and ambient radio frequency (RF) signals in order to power sensory devices. The harvested energy is then stored using a small battery system, ensuring a continuous power supply.

Key specifications of the wireless energy harvesting system include a microwave frequency of either 868MHz or 2.4GHz, an effective distance of up to 1 meter, and a power harvested of 10 μ W. One of the notable advantages of this project is its ability to harvest ambient RF energy to power devices with small energy requirements. This makes it particularly suitable for low-power sensory devices. Additionally, the receiver antenna is built into a washable e-textile fabric, allowing for easy maintenance and durability.

By developing E-textile with wireless charging and sensory functionalities, the NREgS program aims to advance the integration of energy harvesting technologies into textiles. This opens up possibilities for various applications, including wearable devices, smart textiles, and Internet of Things (IoT) systems. The project aligns with the growing demand for portable and self-sustaining energy solutions, providing convenience, flexibility, and innovation in the field of e-textiles.

NanoMalaysia's EV and Energy Storage Programme



Onsite development of wired and wireless EV charging system using renewable energy NANOGRID

This initiative focuses on addressing the challenges associated with recharging electric vehicle (EV) battery cells, particularly in Malaysia where the quantity of charging facilities remains low.

To tackle this issue, the program proposes the development of a 50-kW Charging and Recharging Station. This station will serve as a pilot project and will be strategically located to support the increasing demand for electricity to charge EVs. It will be equipped with various technologies including nano-photovoltaic (PV) panels, Nano Light Energy Panels (NLEP), ultracapacitors, and batteries. The integration of these technologies brings several advantages. Firstly, the pilot project will showcase the integration of small-scale PV, nano light energy panels, lithium-ion batteries, and grid-connected ultracapacitors, demonstrating a comprehensive and sustainable energy solution. This integration not only optimizes energy management costs but also promotes the utilization of Nanogrid sustainable energy.

One of the key benefits of this initiative is the improved availability and quality of grid electricity supply to EV users. The Charging and Recharging Station will feature inductive charging capabilities, offering convenient and efficient charging experiences. This advancement in charging technology contributes to the growth and adoption of EVs in Malaysia, fostering sustainable transportation and reducing carbon emissions. Overall, the NREGS program's initiative to address the challenges of recharging EV battery cells through the development of a pilot Charging and Recharging Station demonstrates NanoMalaysia's commitment to driving advancements in the Energy and Environment, as well as Electronic Devices and Systems sectors. By integrating various technologies and optimizing energy management, the program aims to provide reliable and accessible charging solutions, supporting the country's transition towards a greener and more sustainable future.

NanoMalaysia's EV and Energy Storage Programme



What is NanoMalaysia Energy Storage Technology Initiative (NESTI)?

The NanoMalaysia Energy Storage Technology Initiative (NESTI) is a comprehensive program that focuses on the technological development and commercialisation of key components of energy storage devices. The initiative recognises the importance of energy storage in capturing and utilising energy produced or supplied for later use, contributing to the efficient and sustainable utilisation of energy resources.

NESTI places emphasis on the development of core components of energy storage devices, including electrodes, electrolytes, and overall structure designs. By advancing these key elements, NESTI aims to enhance the performance, efficiency, and reliability of energy storage systems. Through research and development efforts, the initiative seeks to optimize the design and composition of these components to improve energy storage capabilities and overall system performance. In addition to the development of conventional energy storage technologies, NESTI also explores new battery chemistries that utilize alternative raw materials and nanomaterials. This approach promotes resource diversification and reduces reliance on scarce or environmentally challenging materials. By exploring alternative chemistries, NESTI aims to develop energy storage solutions that are sustainable, cost-effective, and environmentally friendly.

NESTI also recognizes the importance of recycling and sustainability in the energy storage sector. The initiative investigates innovative recycling techniques and urban- or phytomining technologies to extract valuable materials from used batteries. By implementing efficient recycling processes, NESTI aims to minimize waste and promote the circular economy in the energy storage industry. To facilitate the commercialization and technology transfer of energy storage solutions, the government has approved the establishment of a one-stop center under NESTI.

This center will serve as a hub for commercialization activities, providing support and resources for technology transfer from research institutions to the market. The establishment of this center demonstrates the commitment of NESTI to bridge the gap between research and commercial deployment, ensuring that innovative energy storage technologies reach the market and contribute to Malaysia's sustainable energy goals.

In conclusion, the NanoMalaysia Energy Storage Technology Initiative (NESTI) is a comprehensive program that focuses on the development, commercialization, and sustainability of energy storage technologies. Through advancements in core components, exploration of new battery chemistries, and the implementation of recycling and urban mining techniques, NESTI aims to revolutionize the energy storage industry and contribute to a more sustainable and efficient energy future.

Who involve in NESTI program?

NESTI will adopt the Quintuple Helix model for broad participation from government agencies (NanoMalaysia, National Nanotechnology Center, MGTC, MARii), funding authorities (NanoMalaysia, Cradle, MTC, KMP, MAVCAP, MDV, MIDA), research community (MIMOS, UKM, UM, UTHM, UMP), industry (start-ups and SMEs) and end-users (Malaysian EV Owners Club – MyEVOC) to rapidly develop, validate and commercialise relevant energy storage technologies.



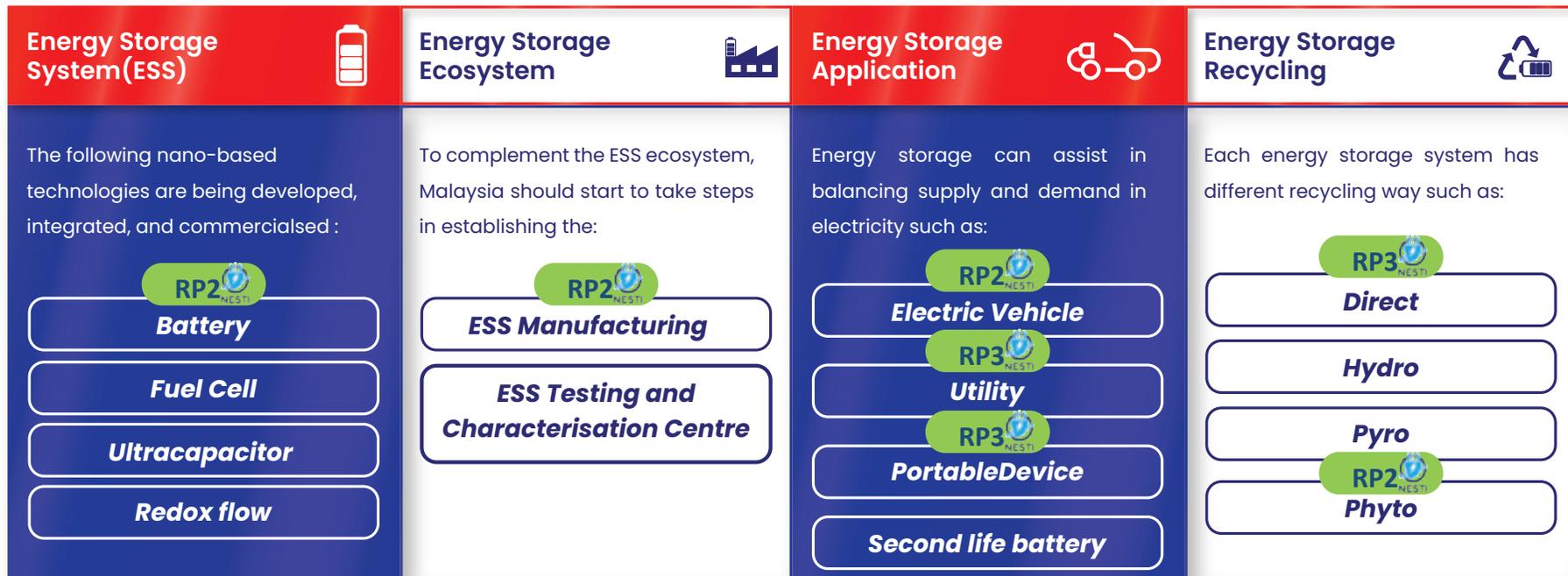
NanoMalaysia's EV and Energy Storage Programme

NESTI: Key Focus Technologies

A great need for a sustainable energy supply storage system because it is considered as a critical technology in transition to sustainable renewable energy system.

Key drivers for energy supply storage technologies include:

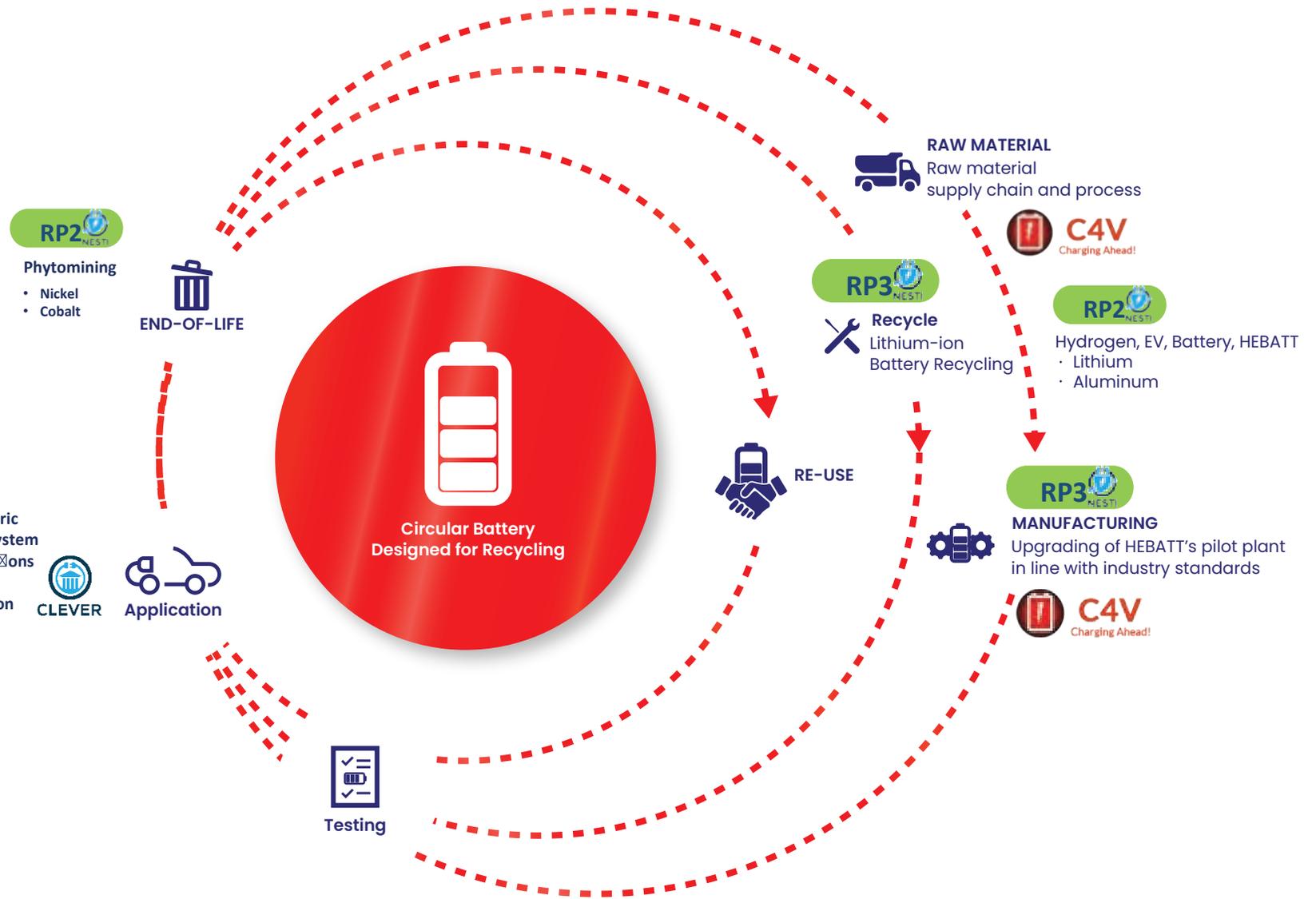
- The growing demand for uninterrupted power supplies in the residential, and commercial and industrial sectors, and;
- The development of the local market to be created through the Low Carbon Mobility Blueprint, regional ASEAN (Indonesia and Thailand) and global electric vehicles (EV).



BMS: Battery Management System

Energy Storage System Life Cycle

NESTI: Circular Battery for Sustainable Energy



NanoMalaysia's EV and Energy Storage Programme

The HEBATT Center of Excellence (CoE) is an important initiative under NanoMalaysia's NESTI program that focuses on the development and advancement of graphene-based composite batteries. This center is dedicated to research, development, and commercialization activities related to lithium-ion batteries with ultra-large capacity and quick charge-discharge capabilities.

One of the key objectives of the HEBATT CoE is to produce pouch cell batteries as an alternative to cylindrical batteries. Pouch cell batteries offer several advantages, including being lighter in weight and having the ability to store high power and energy density. By focusing on the production of pouch cell batteries, the HEBATT CoE aims to enhance battery performance and address the growing demand for energy storage solutions in various applications. The establishment of local research and development battery fabrication facilities for electric vehicles (EV) and stationary power generation applications is a significant advantage of the HEBATT CoE. By establishing these facilities, the center enables the local production of batteries, reducing the reliance on imported batteries and promoting self-sufficiency in the energy storage sector. This contributes to the National Green Economy agenda by creating a local ecosystem for battery production and fostering expertise in the field.

The HEBATT CoE holds immense commercial potential by leveraging the advantages of graphene-based composite batteries and establishing local battery fabrication facilities. The production of high-capacity and fast-charging batteries not only addresses the demand for EVs but also opens up opportunities in stationary power generation applications. By developing a local ecosystem for battery production, the HEBATT CoE contributes to the growth of the battery industry, job creation, and the overall advancement of the National Green Economy agenda.



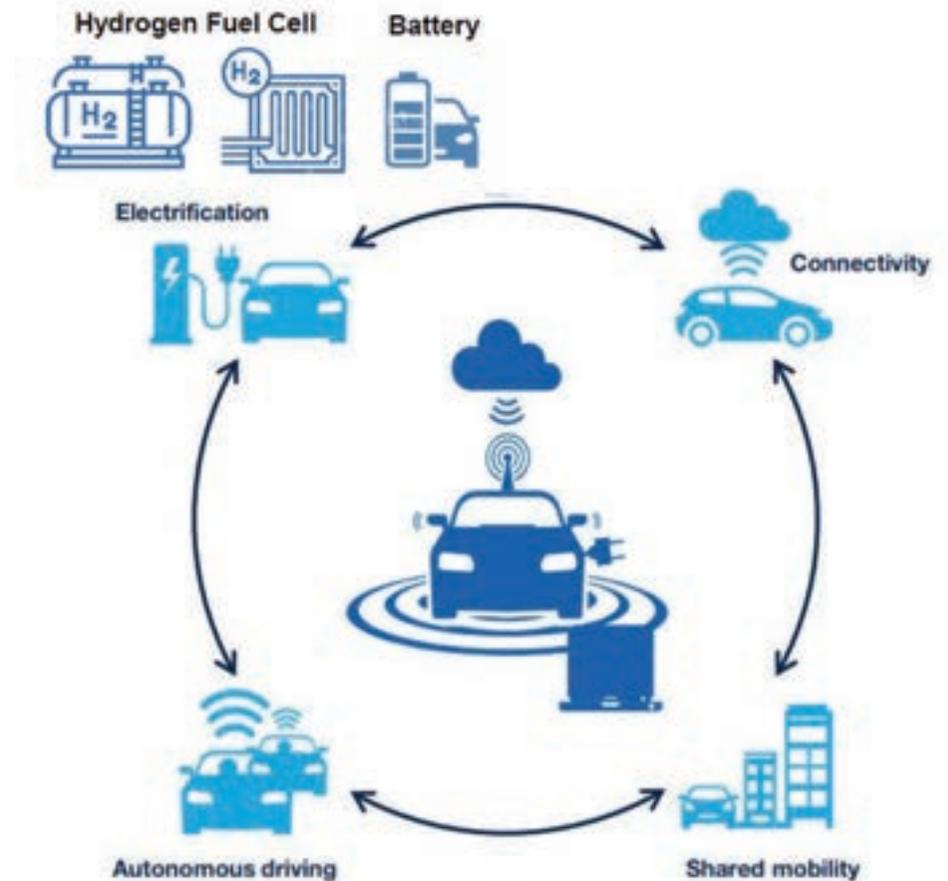
NanoMalaysia's EV and Energy Storage Programme



What is Enabling Mobility Electrification For Green Economy (EMERGE)?

The program focuses on electrification of mobility and smart mobility for various electric vehicles (EV) using energy storage and generation system technology to disrupt and introduce EVs locally and generate an ecosystem surrounding low carbon mobility efforts. Enabling Mobility Electrification for Green Economy, or EMERGE, is a MOSTI Strategic Research Fund program focusing on developing and commercialising EV-related technologies on both component and application levels.

Conversion of ICE Buses to Battery and Fuel Cell Electric Vehicles	Graphene based Super Batteries or Mid Drive EV Bikes
Renewable Energy Charging and Refueling Station	Smart Mobility Autonomous Transportation Network
Nanotech-Enhanced Membranes and Electrodes into Fuel Cells	Nano-based Liquid Cooling for Thermal Management System
DC-DC Converters for e-Mobility and Nanogrid Applications	Graphene-based Electric Motorcycles



NanoMalaysia's EV and Energy Storage Programme



Development Of Internal Combustion Engine to Electric Bus Conversion

One of the projects under this program is the Conversion of Internal Combustion Engine to Electric Bus. The global EV segment has seen the rise of electric buses, which have become the frontrunners in the industry since 2019. It is projected that electric buses will continue to grow and capture 80% of the market share by 2040. In line with this trend, ASEAN countries, including Indonesia, Singapore, Vietnam, and Thailand, are actively preparing for the widespread adoption of EVs in road transportation. Vietnam, in particular, is focusing on producing EV passenger cars.

The primary motive of the project is to revitalize Malaysia's EV mobility sector. The project overview includes the conversion of the powertrain from diesel to electric, involving modifications to the junction box for electronic parts, preparation of wire harness and component packs, ECU remapping, circuit board modifications, and onboard charger modifications. The project also involves the development of an EV Conversion Kit with different battery capacities to cater to varying needs. Additionally, the project includes the fabrication and assembly of a Hydrogen Module, as well as the integration of an Energy Management System for pairing hydrogen fuel cells and batteries.

To support the project, NanoMalaysia has collaborated with industry partners such as DreamEdge, HyPERTech Industries, and Admatix Solutions. These collaborations bring together expertise in EV technology, manufacturing, and solutions to facilitate the successful conversion of internal combustion engine buses to electric-powered buses.

Through the Conversion of Internal Combustion Engine to Electric Bus project, the EMERGE program aims to drive the adoption of EVs in Malaysia, contributing to the country's efforts in building a sustainable and environmentally friendly transportation system. By collaborating with industry partners and developing innovative conversion technologies, the program strives to accelerate the growth of EV mobility and promote the use of cleaner and more efficient transportation options.

Pilot Production of Graphene-based Batteries

The project specifically focuses on enhancing battery performance through the inclusion of graphene in the graphite-carbon cathode and formulation of the electrolytes, particularly for Aluminum-ion (Al-ion) batteries. These improvements aim to increase the cycle-life of the battery and enhance its charging rate.

The project overview includes scaling up the electrode and electrolyte formulation for Al-ion batteries from single cell to battery pack level and evaluating their performance. The objective is to fabricate a minimum of five units of graphene-infused pouch cell battery packs, with each unit having a minimum voltage of 36V and a capacity of 60Ah. Furthermore, the battery packs will be developed to comply with industrial standards such as UN 38.3 and MS IEC 62133, ensuring their safety and reliability.

By conducting the Pilot Production of Graphene-based Batteries, the EMERGE program aims to advance the development and commercialization of graphene-enhanced batteries for electric vehicles. These batteries have the potential to offer improved energy storage capacity, faster charging times, and enhanced performance, contributing to the growth of the EV industry and promoting sustainable and eco-friendly transportation solutions.

NanoMalaysia's EV and Energy Storage Programme



Deployment of Renewable Energy Charging Station for Electric Vehicles

NanoMalaysia aims to accelerate the adoption of electric vehicles (EVs) and promote sustainable transportation solutions by the Deployment of Renewable Energy Charging Station for Electric Vehicles.

The project focuses on establishing a comprehensive and convenient charging and swapping center for electric vehicles, catering to both two-wheelers (e-scooters and e-motorbikes) as well as four-wheelers (electric and hydrogen automobiles). The charging and refueling station will utilize renewable energy generated and stored on-site, ensuring a clean and sustainable power source. The project overview includes the deployment of renewable energy charging and refueling stations at two strategic locations. These stations will incorporate solar photovoltaic (PV) systems, energy storage systems, and nanogrid applications to efficiently manage and distribute energy. An adapted Energy Management System (EMS) will be developed specifically to meet the demands of such a station, optimizing the utilization of renewable energy resources and ensuring a reliable charging infrastructure.

The targeted industry and market for this initiative include the energy sector, with a focus on renewable energy technologies such as solar PV and energy storage systems. Additionally, the project aligns with the green transportation sector by providing charging and refueling facilities for electric and hydrogen vehicles, contributing to the growth of eco-friendly transportation options. To bring this initiative to fruition, NanoMalaysia collaborates with various technology partners, including EVC, Nanopac Innovation, the University of Malaya (UM), Educity, and MNA Energy. These collaborations bring together expertise in EV charging infrastructure, renewable energy solutions, nanotechnology, and academic research, ensuring a comprehensive and robust deployment of the renewable energy charging station.

Through the Deployment of Renewable Energy Charging Station for Electric Vehicles, the EMERGE program aims to establish a reliable and sustainable charging infrastructure that supports the increasing demand for electric and hydrogen vehicles. By promoting the use of renewable energy and advancing green transportation technologies, this initiative contributes to the transition towards a greener and more environmentally friendly mobility ecosystem.

Development and Market Validation of Smart Mobility Autonomous Transportation Network

The project's primary objective is to develop a comprehensive smart mobility network that integrates autonomous vehicles, accessibility features, and smart wireless charging infrastructure. To achieve this, five units of electric buggies will be retrofitted with autonomous kits, enabling them to operate autonomously within a designated test site. Communication within the network will be established through Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) technologies, allowing vehicles to exchange information and interact with the surrounding infrastructure. This communication enables enhanced safety, coordination, and efficiency within the transportation network.

As part of the project, three bays of Smart Autonomous Wireless Charging Stations will be implemented to support the charging needs of the autonomous electric buggies. These charging stations will incorporate advanced wireless charging technologies, providing convenient and efficient charging capabilities for the vehicles. The project overview includes several key components and technologies. Data collection and mapping of the test site will be conducted to facilitate navigation and ensure the smooth operation of the autonomous vehicles. An onboard computing unit will be responsible for processing the collected data, while front and rear cameras, lidar-based systems, and side cameras will enable computer vision capabilities such as lane detection, obstacle detection, object recognition, and passenger onboarding/dispatching.

Additional sensor systems, including inertia measurement units, radar, ultrasonic sensors, and GPS, will be utilized for vehicle tracking, localization, obstacle detection, and V2I/V2V communication. Infrastructure retrofitting with sensors and visual markers will create a feedback loop for the autonomous network, further enhancing its capabilities. To bring together the required expertise, NanoMalaysia collaborates with technology partners, including UiTM, Helloworld Robotics, PEARL, and the University of Malaya (UM). These collaborations ensure a multidisciplinary approach, leveraging expertise in autonomous systems, robotics, data processing, and infrastructure development.

NanoMalaysia's EV and Energy Storage Programme

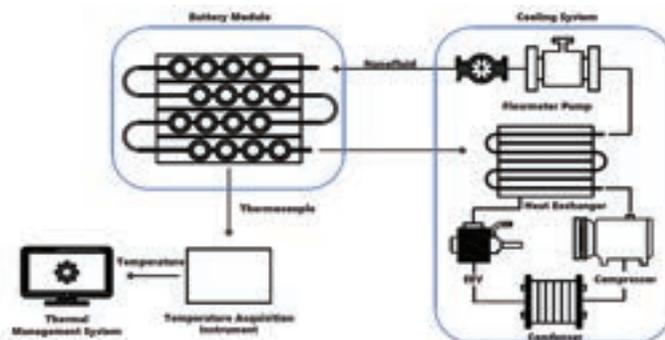


Development and Market Validation of Thermal Management System For Electric Vehicles

This initiative aims to improve the thermal dissipation of EV batteries, thereby increasing the vehicular range and reducing battery consumption. One key aspect of the project is the use of graphene-enhanced nanofluid in the thermal management system. This nanofluid, which incorporates graphene, serves as a heat transfer medium. It replaces traditional water-based cooling systems and offers enhanced heat transfer properties. The proprietary graphene nanofluid, in combination with an encapsulation heat exchanger, efficiently transfers heat from the battery to the heat transfer medium. The advantage of this approach lies in the improved heat transfer achieved through both the encapsulation material and the graphene nanofluid. This enhanced heat transfer capability allows for reduced compressor runtime or the use of a smaller compressor, leading to improved energy efficiency.

The project overview includes several key components and objectives. The team will focus on designing a nano-material-based liquid cooling system that is lightweight and exhibits high heat transfer properties. This system will be specifically tailored for EV applications. Additionally, the project aims to fabricate a thermal management black box kit suitable for both pouch cell and cylindrical-based batteries. This kit will provide a comprehensive solution for managing and controlling the thermal conditions of the batteries. The development also involves the creation of a Battery Thermal Management System (BTMS) and a Battery Cooling Monitoring System (BCMS). These systems will ensure efficient heat dissipation and maintain optimal temperature levels within the battery modules and packs. The battery modules and packs consist of batteries themselves, encapsulation materials, fluid cooling channels, and electrical connections for charging and discharging.

Through the Development and Market Validation of the Thermal Management System for Electric Vehicles, the EMERGE program aims to enhance the performance, range, and energy efficiency of EVs. By leveraging graphene-enhanced nanofluid and innovative heat transfer technologies, the project contributes to the greening of transportation and the acceleration of electric mobility adoption.



The Cooling System works on a vapour-compression cycle using a 2 phase refrigerant that will evaporate within the heat exchanger.

NanoMalaysia's EV and Energy Storage Programme



What is Campuses for Local Electric Vehicle Expeditious Roll-out (CLEVER) ?

Campuses for Local Electric Vehicle Expeditious Roll-out (CLEVER) is a technology and market validation programme to deploy EV-related technologies at selected university campus grounds as technology sandboxes for closed environment studies. A task force under CLEVER will be responsible for facilitating technology, setting up regulations, amendment of insurance, and user acceptance data before mass-scale investment and deployment to the Malaysia market.

Technology validation program and commercialization of EV technology on university campuses as a sandbox platform for research in a closed environment.

Proposed University to be part of CLEVER initiatives

The data collected and applications improved through this program will facilitate industrial facilitation (MITI-MIDA), set regulations (MOT-JPJ), insurance matters (PIAM), technology development and improvement (MOSTI-NMB) and user safety before being used on the road Malaysian public holiday.

Off-Grid EV Charging System is accompanied with NANO Solar Panel, EV Fast Charging Panel 50 kW (ABB), Li-on Battery & Ultracapacitor (EXICOM & Skeleton Technologies) & NANO Light Energy Panel Roof system (NLEP)



Rakan Industri



Initiatives under CLEVER	
ICE to EV Conversion (REVIVE) 	Converting a conventional vehicle into electric vehicle to be deploy in campuses such as two-wheelers (motorbikes) and four-wheelers (cars, buses)
Fast Charging Technology 	An effective and sustainable transition into e-mobility will require the deployment of fast-charging infrastructure to keep pace with the growth of BEVs on the road
Pilot Testing of NMC-LFP Batteries 	Pilot testing of locally made batteries under Malaysia's environment such as environmental and operational.
Battery Swapping Sandboxing 	An effective approach in supplying power to the EVs, while mitigating long waiting times in a battery charging station.
Off-Grid Charging 	Development of an off-grid electrical vehicle charging station hybridised with renewables sources such as solar panel.
Small Scale EV Deployment 	A small-scale deployment of EVs such as e-bicycle, e-scooter, moped can be economically manageable to universities' resident

Pilot Implementation and Scale-Up Projects



Technology validation program and commercialization of EV technology on university campuses as a sandbox platform for research in a closed environment.

Proposed University to be part of CLEVER initiatives

The data collected and applications improved through this program will facilitate industrial facilitation (MITI-MIDA), set regulations (MOT-JPJ), insurance matters (PIAM), technology development and improvement (MOSTI-NMB) and user safety before being used on the road Malaysian public holiday.

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Technology Development Program	Current Activity	Potential Collaboration University	Terms of Use
<ul style="list-style-type: none"> • Low Power Mopeds into Electric Motors • Conversion ICE-EV • Battery Management System • Battery Exchange System 	<ul style="list-style-type: none"> • 2-wheel electric vehicle Ecosystem Validation (Micro Mobility) – Hyundai/ThamLEV/EcoRide/Eclimo 	<ul style="list-style-type: none"> • Universiti Malaya (UM) • Universiti Islam Antarabangsa (UIA) • Universiti Teknikal Malaysia Melaka (UTeM) • EduCity 	<ul style="list-style-type: none"> • Battery standards • UNECE R136 – electric power train • safety requirement
<ul style="list-style-type: none"> • Conversion of ICE-EV bus • Fast charging platform 	<ul style="list-style-type: none"> • Endorsement of hydrogen hybrid storage system technology for electric buses (EMERGE) – HyPERTech Industries 	<ul style="list-style-type: none"> • Universiti Malaya (UM) • Universiti Islam Antarabangsa (UIA) • EduCity 	<ul style="list-style-type: none"> • 55 UNECE standards for new EV bus VTA • 12 UNECE standard retrofit/conversion to EV. (R10, R13, R18, R28, R39, etc.)
<ul style="list-style-type: none"> • Infra Electric Motor • “Off Grid” Charging Station • Conversion ICE-EV go-kart • Consumer commercial vehicle conversion – Perodua 	<ul style="list-style-type: none"> • Conversion of 2 units of Mitsubishi Pajero to EV (REVIVE) – Malaysia Public Works Department • ICE to EV vehicle (REVIVE) – Inventira 	<ul style="list-style-type: none"> • Universiti Tenaga Nasional (UNITEN) • Universiti Malaya (UM) • Universiti Teknologi Malaysia (UTM) • EduCity 	<ul style="list-style-type: none"> • UNECE standards as a reference but some countries introduce their own standards, including: • USNCAP – battery chemical spill inclination test • JNCAP – IPXX protection rating for EV components

NanoMalaysia's EV and Energy Storage Programme



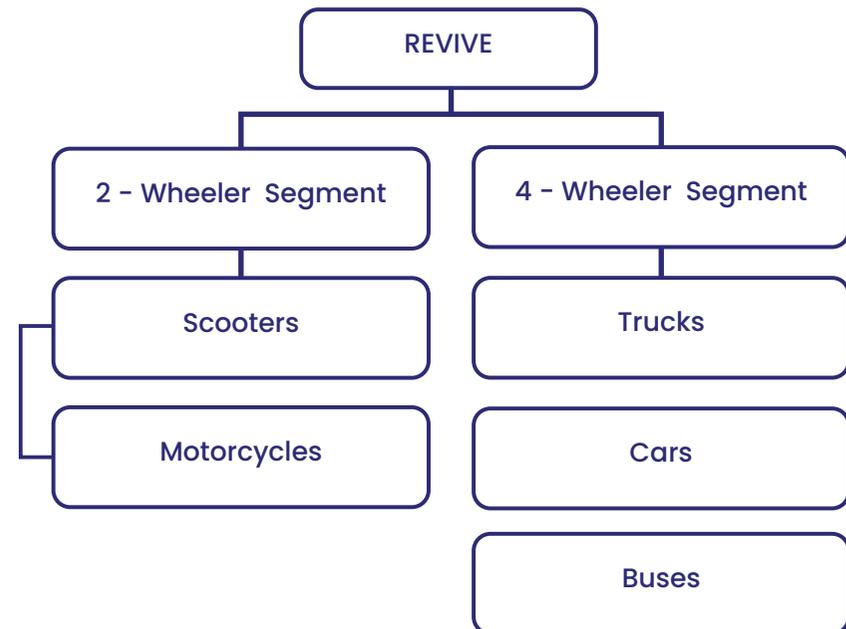
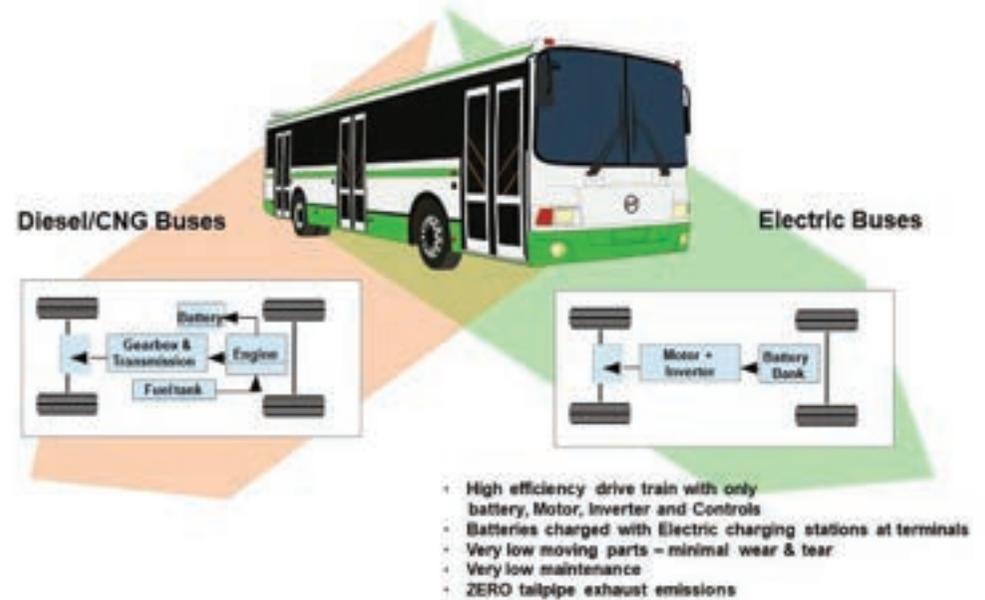
What is Rapid Electric Vehicles Innovation Validation Ecosystem (REVIVE)?

REVIVE, focusing on ICE to EV conversion, aims to establish processes and procedures for conversion of ICE vehicles to road-worthy and safe EVs, to ensure that all aspects of road-worthy cars are met with regard to the converted cars, e.g., safety, performance, maintenance, insurance, etc. This program is a spin-off initiative of EMERGE that will focus on ICE to EV conversion.

The objective of REVIVE is establish:

1. Processes and procedures for conversion of ICE vehicles to road-worthy and safe EVs
2. Ensure that all aspects of road-worthy cars are met with regards to the converted cars, e.g. safety, performance, maintenance, insurance, etc.

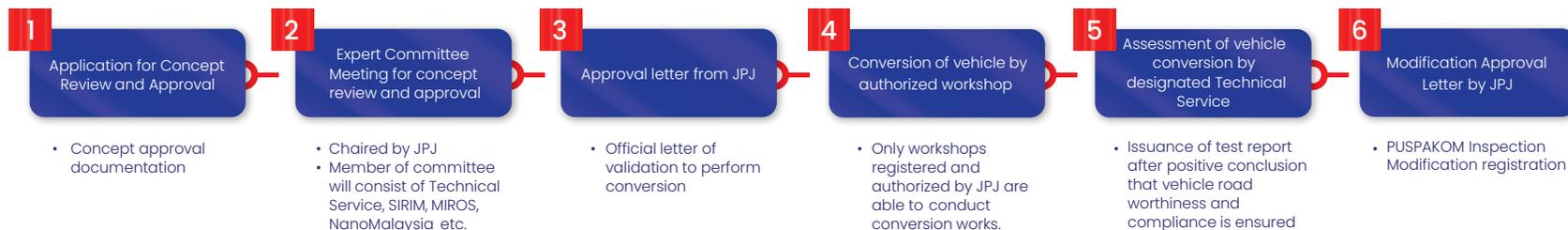
NanoMalaysia Berhad will collaborate with JPJ, APAD, MOHE universities, PIAM, local start-ups, and SME partners to validate and deploy converted vehicles on the road. This initiative will provide reskilling and upskilling of the Malaysian technical workforce, thus creating new jobs.



NanoMalaysia's EV and Energy Storage Programme

WHY IMPLEMENT AN EV KIT APPROACH ?

- Implementing an EV kit approach for the conversion of internal combustion engine (ICE) vehicles to electric vehicles (EVs) offers several advantages and benefits. Here's an expansion of the provided information:
- Standardized kits based on ICE specification: By utilizing standardized conversion kits, the hazardous components typically found in ICE vehicles can be filtered out. This ensures the safety and compliance of the converted EVs, reducing potential risks and hazards associated with the conversion process.
- Quick pick of conversion specifications: The availability of pre-designed conversion kits allows for easy selection of specifications required for the conversion. These kits are readily available on the shelf, streamlining the conversion process and saving time in sourcing individual components.
- Cost reduction through economies of scale: The use of standardized EV conversion kits enables economies of scale in production. With a larger volume of kits being produced, the overall cost of each kit decreases. This cost reduction can make EV conversions more affordable and accessible to a wider range of vehicle owners.
- EMC testing efficiency: Electromagnetic compatibility (EMC) testing is an essential step to ensure that the converted EVs comply with electromagnetic radiation and interference standards. By using standardized kits, EMC testing needs to be conducted only once for each kit rather than for each individual converted vehicle. This streamlines the testing process and reduces costs associated with multiple testing procedures.
- Development of a local economic niche: The EV conversion initiative can create a new niche within the local economy. By promoting the conversion of ICE vehicles to EVs, there is an opportunity to develop a thriving industry around EV conversion kits, components, and related services. This can lead to job creation and the growth of local businesses within the EV sector.
- Local technology and innovation: The focus on EV components and conversion opens doors for local technology development and innovation. As the demand for EV conversions increases, there will be opportunities for local companies and entrepreneurs to develop advanced EV components and technologies, contributing to the growth of the domestic EV ecosystem.
- Development of local talent and expertise: The EV conversion initiative provides a platform for developing local talent and expertise in the field of electric mobility. It encourages the training and upskilling of technicians, engineers, and other professionals involved in the conversion process. This helps to build a skilled workforce that can support the ongoing development and maintenance of EVs in the country.
- In line with these advantages and the growing interest in EV conversions, the Jabatan Pengangkutan Jalan (JPJ) aims to introduce a conversion guideline in 2023. This guideline will establish the regulations and standards for EV conversions, ensuring the safe and proper conversion of vehicles in accordance with local requirements and regulations.

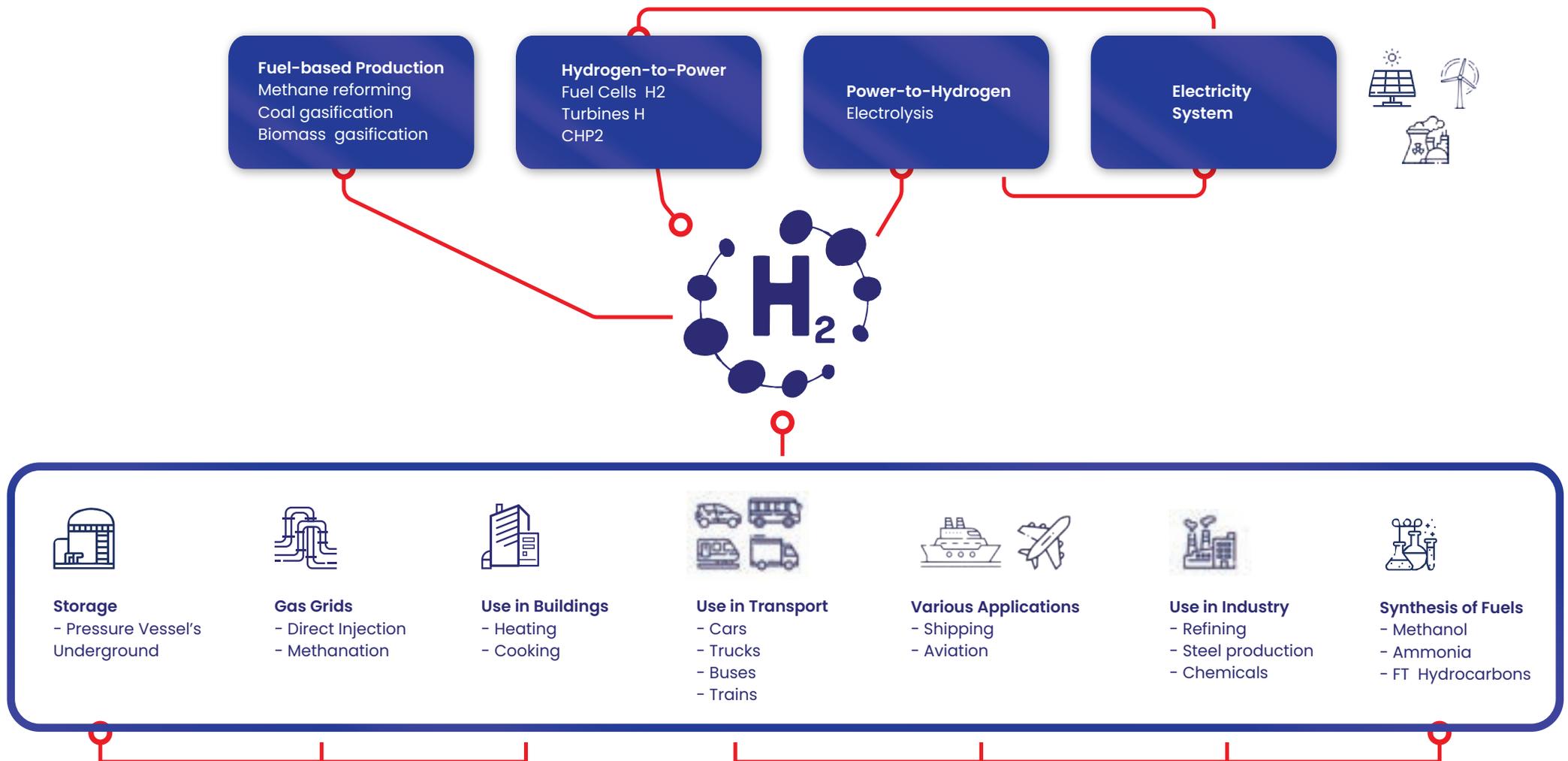


NanoMalaysia's EV and Energy Storage Programme



What is Hydrogen EcoNanoMY Programme

The Hydrogen EcoNanoMY programme under the facilitation of NanoMalaysia Berhad aims to develop and produce local game-changer technology enabling cost-efficient hydrogen on-demand and on-site production while also looking into the ecosystem surrounding the value chain and addressing market interest in hydrogen economy, including technology locally and internationally.



NanoMalaysia's EV and Energy Storage Programme



Hydrogen EcoNanoMy

The local hydrogen energy ecosystem platform initiated by NanoMalaysia is aimed at establishing a comprehensive framework for large-scale hydrogen generation in Malaysia. The program focuses on leveraging nanotechnology to develop and apply local hydrogen technology, enabling secure and efficient hydrogen production.

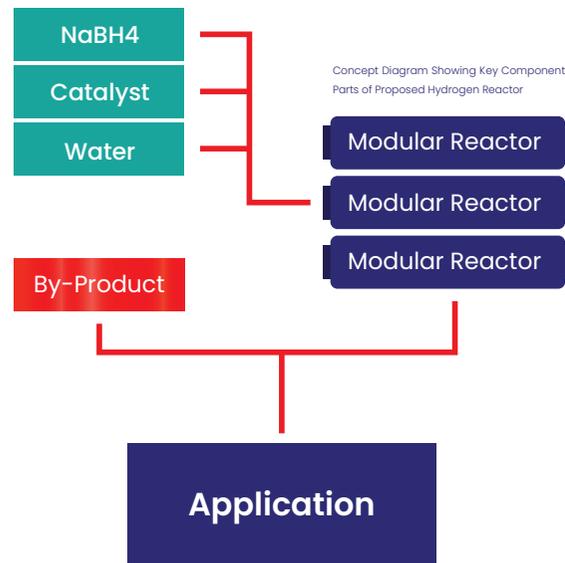
One of the key objectives of the program is to develop a system capable of generating hydrogen on-demand and on-site. This decentralized approach eliminates the need for long-distance transportation and storage of hydrogen, making the process more secure and efficient. By utilizing nanotechnology, the program aims to enhance the performance and reliability of hydrogen generation systems, ensuring a consistent and sustainable supply of hydrogen. The program also emphasizes the development and integration of devices and systems that utilize hydrogen as fuel and input in various industrial processes. This includes applications such as fuel cells, hydrogen-powered vehicles, and other hydrogen-based technologies. By promoting the use of hydrogen across the hydrogen economic value chain, the program aims to facilitate the adoption of hydrogen as a clean and sustainable energy source in different sectors.

Product Development of Modular and Scalable 1kW-Rated Solid State Hydrogen Reactor

Hydrolysis based hydrogen production has been proven in a previous Product Development for applications towards the Hydrogen Hybrid Energy Storage System (H2SS) Design and develop a modular and scalable cartridge based solid-state hydrogen reactor system together with feeding mechanism (the "cartridge") to provide for:

- (a) safe and proper storage of NaBH₄;
- (b) easy and efficient operations when reloading (refueling) NaBH₄ alongside a consumer-suitable Solid-State Hydrogen Reactor

The cartridge is to be a quick coupling cartridge that is specially designed for quick and efficient reloading of NaBH₄ into the Reactor – replacing the cartridge which has been depleted through earlier usage.



Application in NanoMalaysia projects:

- Development of Hydrogen based Converted Lightweight EV Two and Four-Wheelers
- Deployment of Hydrogen Hybrid Energy Storage System for Converted EV Trucks

Technology Initiatives

HyPER
Hydrogen Paired Electric Race Car

On-board Hydrogen Generation Reactor + Energy Management System (EMS)
H₂SS for E-Mobility Applications IP
Hydrogen Paired E-Bikes

Fuel cell H₂ Generation System Just add water
On-Board H₂ Generation System for UAV and Precision Agriculture

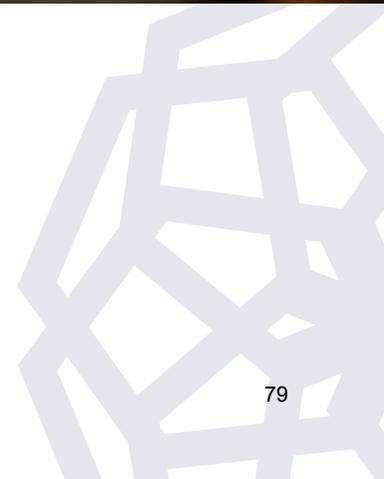
<p>Development & Optimisation of Nano-Catalyst for Rapid Hydrogen Production</p>	<p>Recycling of by-product of Solid State Hydrogen Chemicals</p>	<p>Chemical Hydride Refuelling System for Onboard Hydrogen Reactors</p>	<p>Hydrogen Hybrid Energy Storage System on commercial electric bus</p>	<p>Hydrogen Hybrid Energy Storage System on ships & Marine Applications</p>	<p>Nano-enhanced Efficiency Membranes & Electrodes for Electrolyser</p>
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← End to end Ecosystems develop for Nanomaterials to application →



CHAPTER 6

MONETISING TECHNOLOGY



Business Objectives

Spearheading The Nanotechnology Revolution by Re-energising Industries

**Driving Economic Growth
and Commercialisation**

At NanoMalaysia, our primary focus lies in cultivating long-term sustainable growth within four key strategic sectors that hold immense potential for value creation and profitability. These sectors, known as our Jumpstart sectors, have been identified based on their significant opportunities for driving innovation and generating favorable financial returns.

**Strengthening The Ecosystem
and Enhancing Competitiveness**

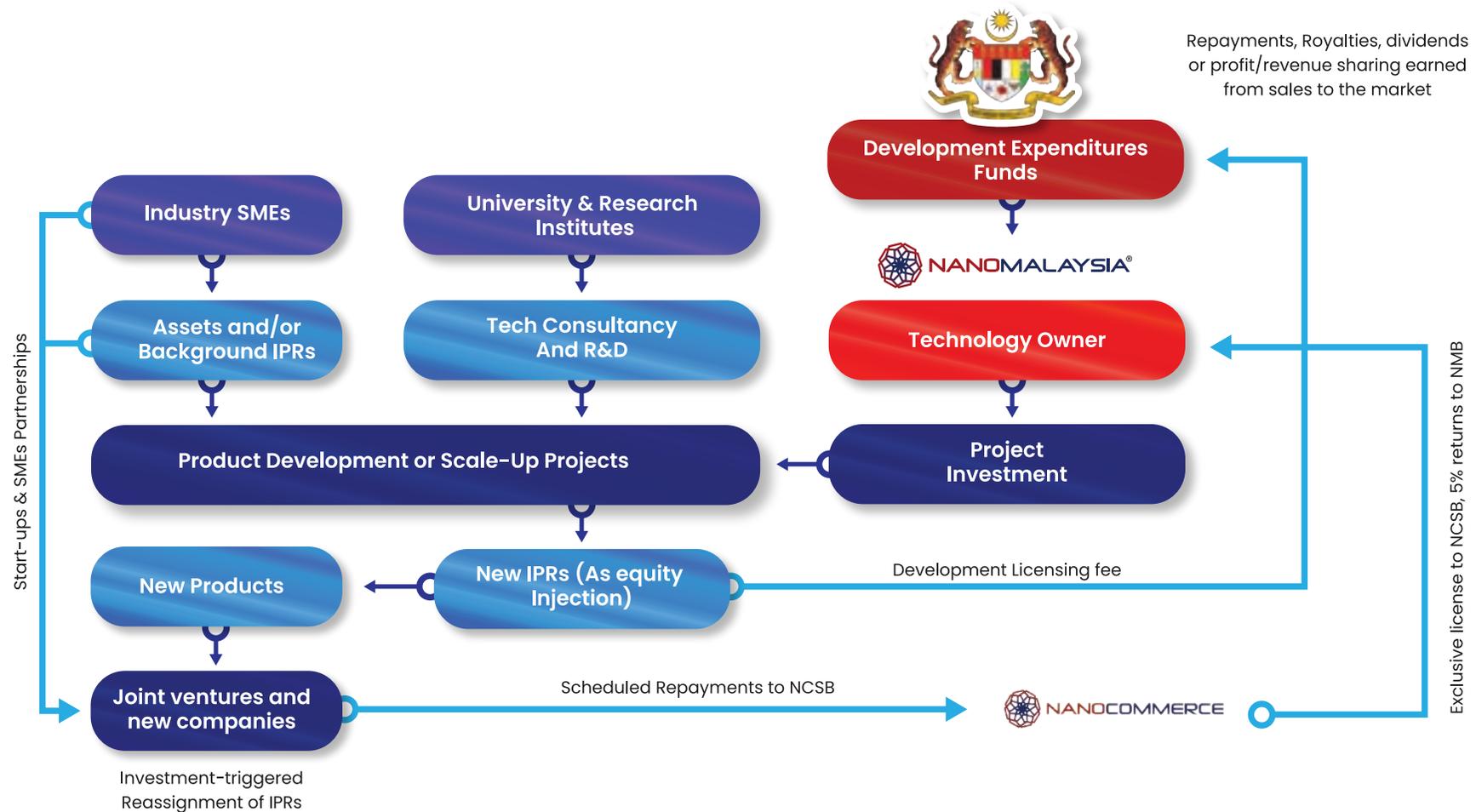
We actively manifest our strategic intent through a wide range of business activities conducted by NanoMalaysia throughout the year. In order to maximise value creation and ensure that our endeavors align with our objectives, we have implemented a comprehensive and structured project management workflow process. This systematic approach enables us to effectively plan, execute, and monitor our projects, thereby optimizing their outcomes and driving successful results.

Increasing Public Awareness

Our unwavering commitment to executing our strategy is evident through our comprehensive business model. By adhering to a disciplined approach and staying focused on our objectives, we have established robust business fundamentals and fostered the long-term resilience of our organisation. This commitment ensures that we stay on track, navigate challenges, and capitalise on opportunities that arise, positioning us for sustained growth and success in the ever-evolving business landscape.



NanoMalaysia's Venture Builder: From Idea to Market



Transforming Nanotech Concepts into Commercial Reality

NanoMalaysia's venture builder model is a unique approach to supporting startups in the nanotechnology industry. Unlike traditional venture capitalists who invest in existing companies, NanoMalaysia acts as a venture builder by working with startups from the early stages of idea development to building a prototype and eventually scaling up to the market. NanoMalaysia's venture builder model aims to maximise the potential of each venture and provide sustainable business development in the nanotech industry. It offers startups not only financial support but also access to resources, expertise, and government recognition and assistance in the commercialisation process.

NanoMalaysia's Venture Builder: From Idea to Market

NanoMalaysia operates on a business model that revolves around strategic investments in diverse projects and initiatives, fostering collaboration with business owners, universities, research institutes, and other research industries. This collaborative approach is designed to enhance the resources available during crucial phases of development and scale-up.

NanoMalaysia provides comprehensive assistance to its esteemed partners, spanning across six critical areas:

- Global marketing
- Human capital
- Infrastructure
- Products
- Technology and knowledge
- Financial support

In addition, acting as a trusted intermediary between government entities and industries, NanoMalaysia facilitates significant government recognition and assistance for companies engaged in collaborative ventures. This recognition and support extend well beyond monetary investments, offering substantial value that surpasses mere financial contributions. NanoMalaysia's commitment lies in ensuring their partners' success by providing a comprehensive suite of resources and expertise.



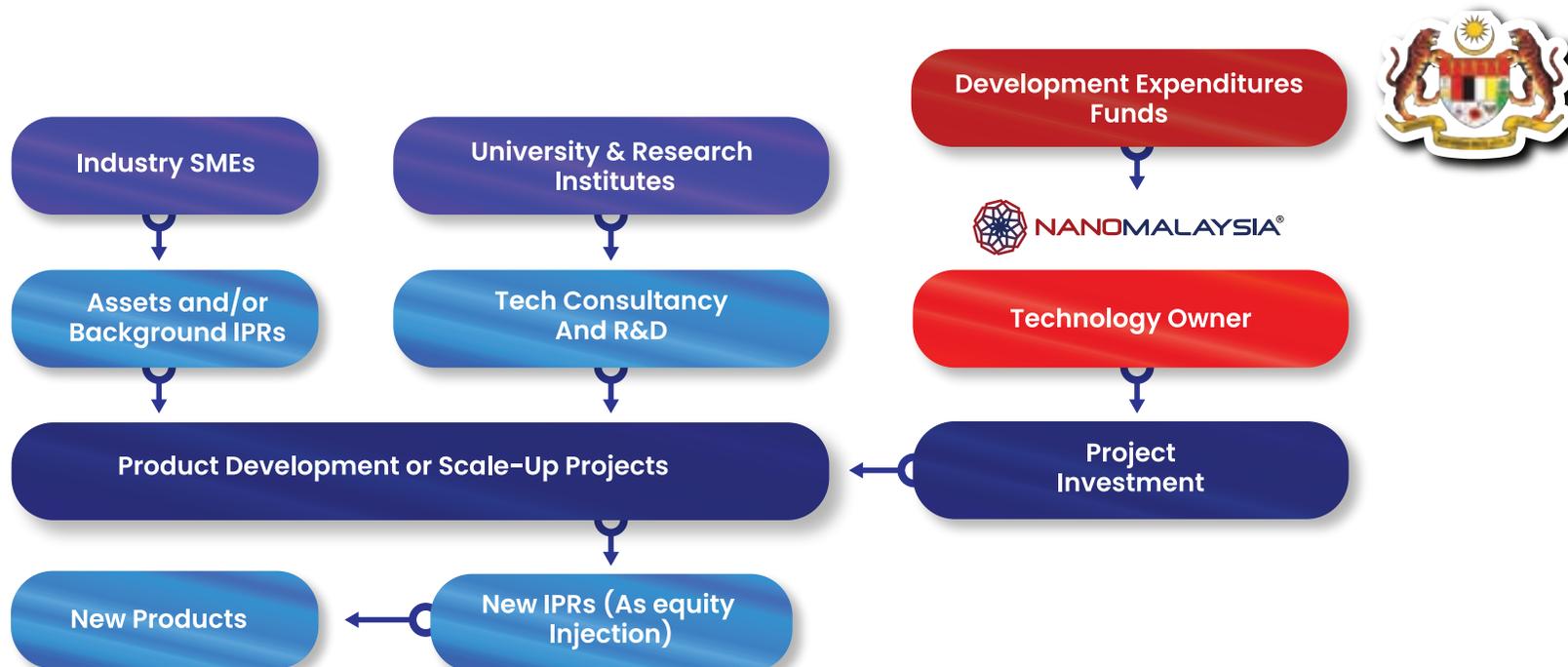
There are 2 brackets in NanoMalaysia's venture business model which is:

1. The Development Stage:

NanoMalaysia's Venture Builder Model begins with the Development Stage, catering to entrepreneurs with nano-based product ideas but lacking a prototype. During this phase, NanoMalaysia collaborates closely with the entrepreneurs to evaluate necessary materials and resources for prototype development. Investments are channeled through NanoCommerce Sdn Bhd, NanoMalaysia's subsidiary company. To safeguard the partners' legal and commercial rights, NanoMalaysia creates Intellectual Property (IP) for the project, thereby protecting the technology from potential theft. This IP can be repurposed or used for pilot production. In case of quality issues, NanoMalaysia provides assistance in prototype improvement, ensuring a robust and market-ready product.

2. The Scale-Up Stage:

For entrepreneurs who already possess a prototype but require support to bring the product to market, NanoMalaysia's Scale-Up Stage comes into play. Leveraging their expertise in nanotechnology, NanoMalaysia assists with technology licensing and manufacturing materials for the project, encompassing sub-components, components, or complete systems. Market validation is conducted if necessary to ensure product-market fit. NanoMalaysia further facilitates the introduction of the finished product to the target audience, including consumers, prosumers, and industry professionals, thus providing exposure and market access.



NanoMalaysia's Venture Builder: From Idea to Market

The Venture Builder Model takes three (3) standard commercialization approaches jointly with the Business Partners.

- a. **Sale of Equipment Model :** The Sale of Equipment Model is an offer to the Business Partners to own the equipment. In this step, NanoMalaysia will assist the Business Partners in seeking further funding from external sources or investors to start the manufacturing facility lines, including setting up the marketing and distribution channels to sell the nanotechnology products.
- b. **Licensing Model:** NanoMalaysia will also offer Licensing Model, in parallel to the Sale of the Equipment Model. The Licensing Model (exclusive or non-exclusive) with the right to sub-license is aimed to generate larger income based on the fair market value of the Intellectual Property, as mutually agreed by the Business Partners.
- c. **Equity Model:** In this option, NanoMalaysia will subscribe equity in the Business Partners company or jointly establish a new joint venture company to commercialize the Nanotechnology Intellectual Property. NanoMalaysia will assign the Equipment and license the Nanotechnology Intellectual Property to the Business Partners company or the joint venture company

The Venture Builder Model aims to mitigate the risk and challenges of the Nanotechnology Intellectual Property, along the journey of Valley of Death reaching the market. The multiple business models are progressive and provide constructive steps towards "Commercialisation", ie: Venture Builder Model

Funding

Licensing

Joint Venture

IP Sale

Post-Deployment Support:

After successful product deployment, NanoMalaysia continues to provide invaluable support to entrepreneurs, enhancing their prospects for success in 4 ways:

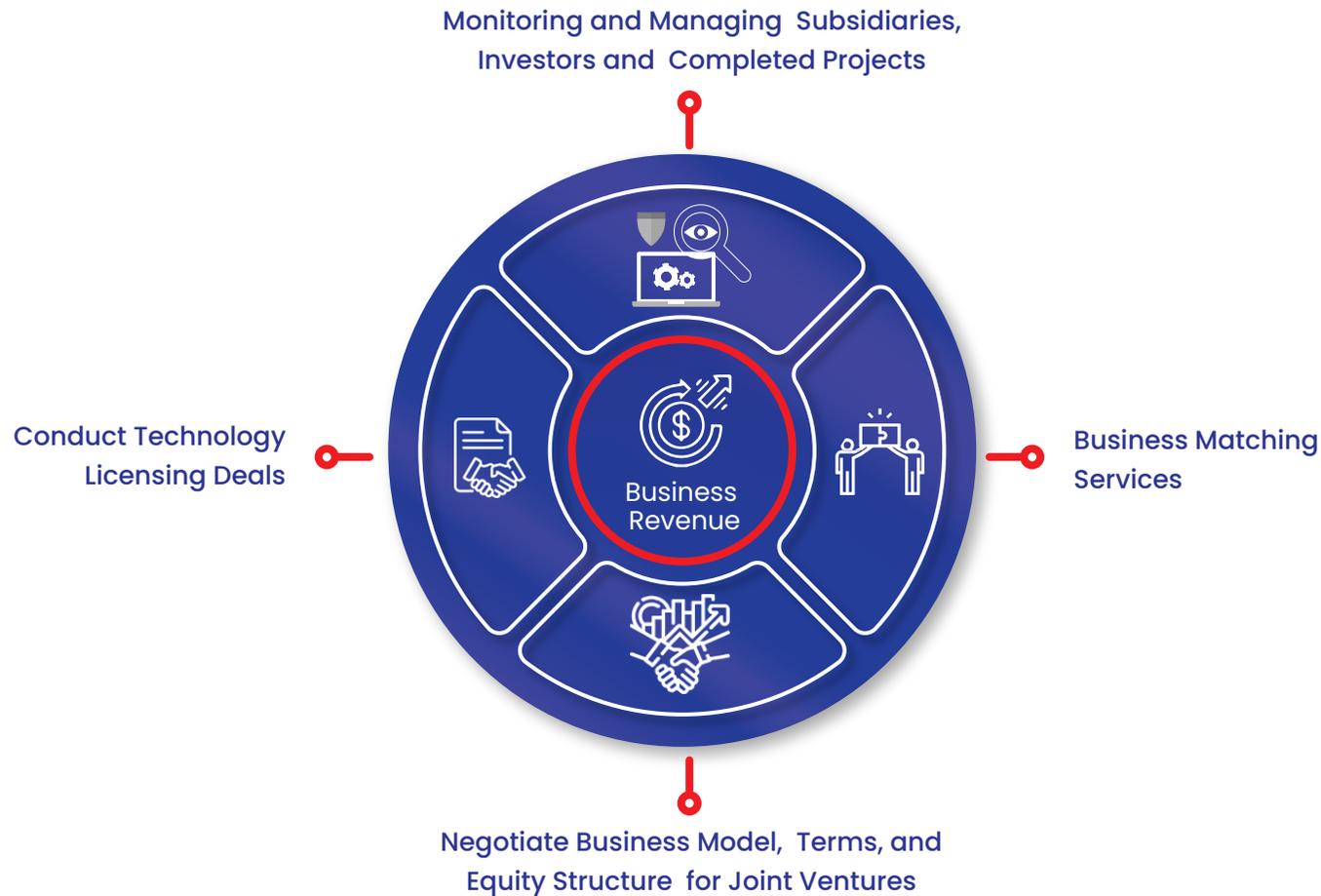
1. **Funding:** NanoMalaysia facilitates connections with local funding agencies, enabling entrepreneurs to secure additional funding for production equipment, thereby fueling further growth.
2. **Licensing:** In cases where other entities express interest in utilizing the technology developed through the project, NanoMalaysia assists in sublicensing, opening up new revenue streams and partnerships.
3. **Joint Venture:** NanoMalaysia can help forge strategic partnerships by involving additional stakeholders or investors. This collaborative approach allows for shared investments, leveraging the strengths of multiple parties to achieve mutual success.
4. **IP Sale:** Upon project completion, entrepreneurs have the option to sell the Intellectual Property or collaborate with NanoMalaysia to explore new applications, markets, or technology enhancements. This cooperative effort ensures that entrepreneurs maximize the potential of their technology and products.

These four factors serve as catalysts to propel the success of each project, exemplifying NanoMalaysia's commitment to maximizing the potential of each venture in collaboration with NanoMalaysia's esteemed partners.

Enabling Growth Through Strategic Partnership

Spearheading The Nanotechnology Revolution by Re-energising Industries

NanoMalaysia has achieved significant milestones in driving commercialization activities through fruitful collaborations and joint ventures. These endeavors have not only contributed to our business revenue but also played a pivotal role in fostering the sustainable growth of the local nanotechnology sector.





CHAPTER 7

4TH INDUSTRIAL REVOLUTION STRATEGY



Our Strategy Beyond the 12th Malaysia Plan

NanoMalaysia was founded as Malaysia's leading agency for the commercialisation of nanotechnology. Our core objective is to provide the industry with essential technology and business leadership, ensuring the sustainable and long-term development of the nanotechnology sector.

To achieve our strategic growth ambitions, we have formulated a comprehensive strategy that capitalises on the opportunities presented by the Fourth Industrial Revolution's (4IR) Internet of Nano Things (IoNT). IoNT refers to the integration of nanosensors and nanodevices with the Internet, leading to the emergence of new standards based on the Internet of Things (IoT). We firmly believe that IoNT will serve as the primary catalyst for 4IR, driving transformative and revolutionary changes across industries, businesses, and society as a whole.

Our primary focus is to capture revenue streams associated with nanotechnology and IoNT-enabled products and applications. This is achieved through targeted investments of financial and human resources in feasible business ventures and projects that offer realistic and high-value returns in the medium to long-term. Additionally, we place significant emphasis on national agendas related to job creation and the promotion of an environmentally sustainable future.

In the short to medium-term, our primary focus lies in the implementation of our RevolutIoNT strategic campaign. This campaign serves as the driving force to mobilize the local industry and aligns with our overarching vision of spearheading the Nanotechnology Revolution in Malaysia. The RevolutIoNT strategic blueprint encompasses the diverse benefits of nanotechnology, emphasising enhanced and efficient solutions within key sectors such as food and agriculture, wellness, medical and healthcare, electronic devices and systems, as well as energy and the environment.

To generate returns for our stakeholders, we have developed several programmes to catalyse the growth and development of the fledging nanotechnology sector in Malaysia. We extend our support to both esteemed local and multinational companies based in Malaysia, as well as local small and medium enterprises (SMEs).

These impactful programs were devised in accordance with the 12th Malaysian Plan (12MP), which identifies the commercialisation of nanotechnology as a key driver for high-growth potential, capable of propelling national economic development. In line with this strategic vision, we are actively spearheading initiatives to facilitate the commercialisation of nanotechnology through dedicated projects focused on product development and scaling. By leveraging these initiatives, we aim to fuel the progress and maturation of the nanotechnology industry in Malaysia, fostering a vibrant ecosystem while delivering substantial economic benefits.



Our Strategy



National Graphene Action Plan

Product development and commercialisation programme

Produces intellectual Property and Products Focuses on 5 Key Application:

- Lithium-ion battery
- Conductive Inks
- Rubber Additives
- Plastic Additives
- Nanofluids

Experimental and Rapid R&D



iNanovation

Product development and commercialisation programme based on broader nanotech innovation

Produces intellectual Property and products Focuses on 4 Jumpstart Sectors:

- Electronics Devices and System
- Food and Agriculture
- Energy and Environment
- Wellness, Medical and Healthcare

Experimental and Rapid R&D



NANOVerify Certification Programme

Strengthen product reputation and credibility in local and international markets by creating positive brand association

Increase consumer awareness



4th Industrial Revolution [Internet of Nano Things (IoNT)]

RevolutionNT Strategic Blueprint

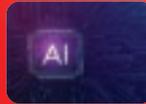


Capturing opportunities with NanoMalaysia programmes via product development/scale up projects and commercialisation activities

Transitioning from the 11th Malaysia Plan to the 12th Malaysia Plan

Transitioning from the 11th Malaysia Plan to the 12th Malaysia Plan

11th Malaysia Plan Nanotechnology Commercialisation Programme

 Sensors	 Fuel Cells	 Artificial Intelligence	 Radio Frequency Identification
 Solar Panels and light Energy Panels	 Smart City	 Internet of Nano Things (IoNT)	 Electric Vehicles
 Energy Storage	 Autonomous Vehicles	 Robotics	 3D Printing



12th Malaysia Plan Nanotechnology Commercialisation Programme - REVOLUTION NT



NMB's on-site generated H₂ technology to create a National Hydrogen Industrial Ecosystem for the energy sector

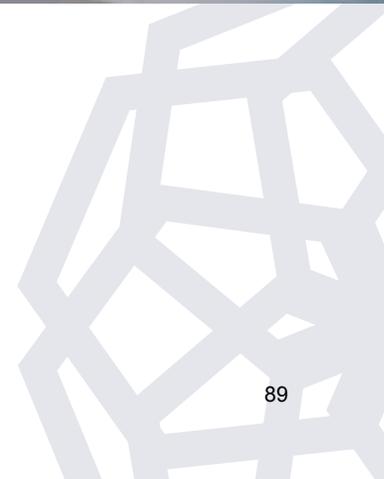


NMB's long-range wireless charging technology to create new energy transfer applications for the electronics and automotive sectors



CHAPTER 8

NANOMALAYSIA GROWTH PHASES



NanoMalaysia Growth Phases

Phase 01

2012–2015
Positioning and Branding

Since its inception, NanoMalaysia has been through 2 distinct phases of growth. During our first phase between 2011 and 2014, we focused on building the brand and refining our market positioning to build strong foundations and ensure the long-term resilience of our business.

Phase 02

2016–2019
Creating Economic

In the first half of the 11th Malaysia plan, our second phase of growth covered the period between 2015 and 2018, in which we focused on creating economic value to ensure long-term growth and profitability through various strategic programmes and collaborative partnerships with leading international nano technology agencies and companies.

Phase 03

2020 & Beyond

During the final year of the 11th Malaysia plan, in preparation for the 12th Malaysia Plan, we focused on spearheading the Nanotechnology Revolution in Malaysia through our fourth Industrial Revolution (4IR) internet of Nano things (IONT) driven REVOLUTION strategy. Our goal is to achieve financial independence and ensure the long-term sustainability of our business.

Phase 01: Positioning and Branding

2011

Incorporated on 1 August 2011

2012

- Conducted Nanotechnology Enabler Lab to design programmes and identify commercialisation projects.
- Signed MOU with Advanced Energy Research and Technology Centre (AERTE) New York and Malaysian Industry – Government group for High Technology (MIGHT).

2013

- MOU with IBM and start of IBM star polymer joint research programme.
- MOU with Human Life Advancement Foundation formed the iNanovation platform.
- Conducted Nanotechnology Enabler Lab 2.0
- Creation of National Key Economic Area (NKEA) Electrical and Electronics (E&E) Entry point project (EPP20) for nanotech
- General nanotechnology commercialisation partnership with Russian based RUSNANO capital.

2014

- Led National Graphene Strategy study conducted by Mckinsey & co./Agensi Inovasi Malaysia (AIM)
- Launched The National Graphene Action plan 2020 (NGAP2020) programme.
- First NKEA E&E project conducted.
- Partnership with Lux Research Inc. to provide nanotech market study.
- Collaboration programme with BAE systems.

2015

- Incorporated NANOverify Sdn Bhd
- Launched the NANOverify certification programme.
- MOSTI Techno Fund project – CNT LED Mounting Substrates with UTP, SIRIM and NANS, LED.
- Nano Malaysia CEO appointed as treasure of Asia Nano Forum.

2016

- 21 product development and 7 scale up projects executed.
- 27 products developed and 6 products commercialised.
- 28 IPs developed.
- Launched annual Graphene Malaysia international event.
- MOU with Taiwan based TANIDA on cross country nanotech product certification.

Phase 02 : Creating Economic Value

11th Malaysia Plan Nanotechnology Commercialisation Programme

Phase 03 : 2020 & Beyond

REVOLUTION
A Revolution 4.0 the Internet of Nano-Things

2017

- 16 product development and 4 scale up projects executed.
- 16 products developed and 6 products commercialised.
- 1 patent and 2 copyrights filed by MyIPO.
- 23 IPs developed MOU with Nanopolis Suzhou.
- NanoMalaysia CEO appointed International Advisor to the

2018

- 14 product development and 8 scale up projects executed.
- 7 products in development.
- 2 IPs developed.
- 8 patents, 1 utility innovation and 1 copyright filed with MyIPO

2019

- 5 product development and 14 scale up projects executed.
- 5 patents.
- 3 utility innovations
- 5 trademarks
- 5 patents and 4 copyrights filed with MyIPO
- 8 products to be commercialised

2020

- 3 product development and 7 scale up projects executed.
- 5 trademarks
- 4 trade secrets
- 5 utility innovations
- 10 patents and 9 copyrights
- 12 products to be commercialised

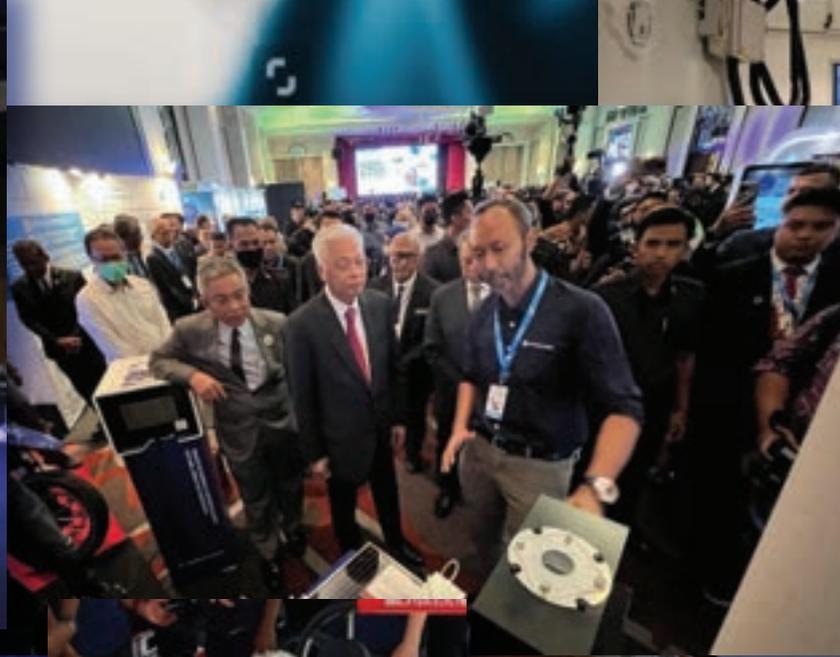
2021

- 11 product development and 6 scale-up projects executed.
- 13 patents.
- 3 utility innovations
- 4 trademarks
- 14 copyrights filed with MyIPO
- 34 trade secret
- 10 products to be commercialised

2022

- 119 JV/Start-Up companies supported/created.
- 6,443 (direct) and 32,219 (indirect) high value job opportunities created over next 5 years identified by industry.
- RM 3.97 billion (direct) and RM19.8 Million (indirect) potential GNI contribution generated over 5 years identified by industry.
- 119 products certified under NANOVerify.
- Developed projects resulting in 187 Intellectual Properties Filed a total of 57 patents, 44 copyrights, 18 trademarks, and 5 utility innovations with MyIPO





CHAPTER 9

2022 HIGHLIGHTS



Smart Urban Farming Systems (SURF)

The Smart Urban Farming Systems (SURF) pilot project has been collaboratively developed by the Malaysian Red Crescent Society and NanoMalaysia Berhad. NanoMalaysia is contributing to the project by providing Internet of Nano-Things (IoNT) solutions and monitoring for the aquaponics system. The system is powered by Nano Light Energy Panels (NLEP). The project is situated at SK Kg Tunku in Petaling Jaya and aims to establish a self-sufficient food supply for the B40s population, address food security concerns, and serve as an educational initiative for Standard 6 students.



Blue Snow Energy

A technical visit took place, with Deputy Minister YB Datuk Haji Ahmad Amzad from the Ministry of Science, Technology and Innovation (MOSTI) and Dr. Ruslinda, Director of the National Nanotechnology Centre, visiting Blue Snow Consulting & Engineering Sdn. Bhd. The purpose of the visit was to discuss NanoMalaysia and Blue Snow Energy's graphene-based coolant for industrial applications. Blue Snow Energy has previously accomplished a project in the Product Development stage, successfully meeting all milestones.

NanoMalaysia Berhad Flood Rescue Volunteer

Volunteers from NanoMalaysia and selected NGOs today helped with the cleaning up of areas affected by the floods in Kampung Padang Jawa, Petaling, Shah Alam.



Karnival Belia dan Sukan at Ipoh, Perak

YB Dato' Seri Ahmad Faizal Bin Azumu saw the Hydrogen-Paired Electric Racecar or better known as Hydrogen-Paired Electric Racecar (HyPER) at the Youth and Sports Carnival today in Ipoh, Perak

Happy International Women's Day

In line with 2022 campaign theme, some of our NanoMalaysia team members are showing their solidarity by striking the #BreakTheBias pose.





Lab Tours and MoU Signing Between NanoMalaysia Berhad and UTHM

Lab tours & MoU signing between NanoMalaysia Berhad and Universiti Tun Hussein Onn Malaysia (UTHM) on 24th March 2022 at UTHM, Batu Pahat, Johor. The MOU is signed by NanoMalaysia Berhad's CEO, Dr Rezal Khairi bin Ahmad and the Vice Chancellor of UTHM, Professor Datuk Ts. Dr. Wahid Razzaly. The MOU will focus on efforts to intensify technology deployment activities between universities, local research institutions and industry players.

Nanotech Talk Webinar Series Volume 1

NanoMalaysia and its partners conducted a NANOTECH TALK 2022 Webinar sharing session aimed at highlighting the opportunities and facilitation services provided by NanoMalaysia to industries and SMEs interested in exploring the field of Nanotechnology, particularly within the Malaysia market. The webinar covered various topics, including business opportunities within the nanotechnology market, becoming NanoMalaysia's business partners, intellectual property protection for nanotechnology inventions, building public trust in Nano-based products, and insights shared by project partners who have collaborated with NanoMalaysia.





WattMec 2022 Conference at Heriot Watt University

Dr. Rezal Khairi Ahmad, CEO of NanoMalaysia Berhad presented his keynote speech “Malaysia’s Low Carbon Technology Development Initiative” at the Watt Malaysia Exhibition and Conference (WattMEC) 2022, Heriot-Watt University Malaysia. The theme of the WattMEC 2022 conference is “Sustainable Innovation toward NetZero – WattaDECADE”, which is aligned with the global Heriot-Watt university goal towards decarbonisation while celebrate its 10th Malaysia Campus anniversary. NanoMalaysia is also strongly anchoring decarbonisation activities in Malaysia and neighbouring countries.



National Graphene Action Plan Presentation

NanoMalaysia Berhad has presented the National Graphene Action Plan and EV Programs. The presentation also attended by YB Dato’ Sri Dr. Adham Baba, Minister of Science , Technology and Innovation (MOSTI).





National EV Conversion Initiative: Rapid Electric Vehicles Innovation Validation Ecosystem (REVIVE) Workshop

REVIVE Initiative:

CE (internal combustion engine) vehicle conversion program to multi-platform EV such as buses, trucks, motorcycles, and cars. This initiative aims to enable EV adaptation with an alternative way than buying a new EV and is generally more expensive in rate 20-50%. In addition, new job opportunities will be created and at the same time increase workshop skills and local workers. This national level program will involve collaboration with various strategic partners such as Ministry of Higher Education (JPT), Road Transport Department Malaysia (JPJ), Land Public Transport Agency (APAD) and many more. Sim Chuo Eink - NMB



Introduction to NanoMalaysia Berhad

Introduction to NanoMalaysia Berhad and how our venture builder business model is used to industrialise and commercialise Malaysian nanotechnology innovation was presented to the representatives from the Center for Progress and Development of Iran by Mr Hafiz, Chief Operating Officer of NanoMalaysia Berhad.



Bengkel Technology Innovation Support Center (TISC): Asas Harta Intelek & Paten

The event featured a distinguished guest speaker, Mr. Azri Roslan, Assistant Director of the Business Development Division at the Intellectual Property Corporation of Malaysia (MyIPO). With his extensive expertise in intellectual property matters, Mr. Roslan shared valuable insights and practical knowledge about protecting and leveraging intellectual property assets, particularly focusing on patents. The session at Bengkel TISC provided attendees with a deeper understanding of the importance of intellectual property and the processes involved in securing patents, fostering an environment conducive to innovation and growth.



Sarawak Energy Berhad Visit

Working visit of the National Nanotechnology Center (NNC) & NanoMalaysia Berhad (NMB) to Sarawak Energy Berhad led by YBhg. Datuk Ts. Dr. Mohd Nor Azman bin Hassan, Deputy Secretary General (Technology Development), Associate Prof Dr Ruslinda A. Rahim, Director of NNC, Dr. Rezal Khairi bin Ahmad, Chief Executive Officer of NMB and officials from NNC and NMB.



Flora Niaga Sdn Bhd Visit

NanoMalaysia Team visited one of the aquaponic project with Flora Niaga Sdn Bhd at Manong, Perak that was funded by NanoMalaysia Berhad under the REVOLUTiONT program.



Certified Technology Transfer Professional Graduation Ceremony

YBhg. Academician Emeritus Prof. Tan Sri Dato' Dr. Syed Jalaludin Syed Salim (Chancellor, Putra Business School, Universiti Putra Malaysia) together with Y.Bhg Professor Emeritus Dato' Ir Dr Mohamad Zawawi Ismail (Chairman, NanoMalaysia Berhad) and YBrs. Professor Dr. Zulkornain Yusop (President and Chief Executive Officer Putra Business School, Universiti Putra Malaysia) present the certificate to 12 participants from NanoMalaysia Berhad who have completed the CTPP course. This CTPP course consists of 8 modules certified by Putra Business School, moderated by Global Intellectual Property Ventures. The course started on 8th July 2021, completed on 28 February 2022 with assessment and presentation. Mini graduation of the Certified Technology Transfer Professional is held on 21.06.2022 at Putra Business School NanoMalaysia participated the CTPP program for the purpose of acquiring knowledge and skills in term of understanding the transfer of creative innovations into industrial exploitation, commercialisation and generating new revenue/profits to the organisation.





Hydrogen- Electric Vehicle – Battery (HEBATT)

NanoMalaysia Berhad's Hydrogen-Electric Vehicle-Battery (HEBATT) project had a successful soft launch at Incubator 3, Technology Park Malaysia. The event was graced by Prof. Emeritus Dato' Ir. Dr. Mohamad Zawawi bin Ismail, the chairman of NanoMalaysia Berhad. HEBATT represents a local pilot plant that specialises in the production of Pouch Cell Graphene-based composite batteries specifically designed for electric vehicle (EV) applications. These pouch cell batteries offer a lightweight alternative to cylindrical batteries while delivering high power and energy density. The project is a collaborative effort between NanoMalaysia Berhad, HyperTech Industries Sdn Bhd, and International Battery Center (IBC) Sdn Bhd.



Battery Swapping Station Workshop

NanoMalaysia Berhad hosted a Battery Swapping Station Workshop on 14th July 2022 to discuss standardisation for battery swapping systems for 2-wheelers in Malaysia. Battery Swapping Station or BSS is a system which allows users to exchange depleted batteries with a fully charged one. The use of BSS can save a lot of time as compared to the commercialized charging alternative in addition to relieving stress to the grid when users charge at the same time. The objective of this BSS Workshop is to discuss and establish a uniform standard for BSS technology nationwide and accelerate the adoptions of BSS technology in Malaysia's EV ecosystem. Moreover, this workshop also aims to help EV users move around smoother throughout our country. This is an initiative led by NanoMalaysia to empower the development of EV technology in Malaysia.



19th Asia Nano Forum Summit 2022

Ministry of Science, Technology and Innovation (MOSTI) through the National Nanotechnology Centre (NNC) and NanoMalaysia Berhad, in collaboration with Asia Nano Forum (ANF) organised the 5th EU-Asia Dialogue on NanoSafety 2022 and the 19th Asia Nano Forum Summit 2022 on the 18th and 19th July 2022. Ybhg. Datuk Zainal Abidin Abu Hassan, Secretary General of MOSTI presented his welcoming remarks for the event. The 5th EU-Asia Dialogue on NanoSafety 2022 was held in hybrid mode on 18th July 2022 with participants from 15 countries who attended the dialogue including Malaysia. The goal of this international platform is to enhance exchange and understanding between policymakers, researchers, and non-governmental organisations from Europe and Asia on nanosafety. Over the past six years, this dialogue has built on synergies between Asian and European countries for setting standards test guidelines that can be utilised as a reference document among Asian and European countries. This is important in ensuring the safe development and safety of nanomaterials in the market as well as supporting the growth of nanotechnology industry in the two continents.



5th EU-ASIA Dialogue on NANOSAFETY ,19th Asia Nano Forum Summit 2022 Gala Dinner

Ministry of Science, Technology and Innovation, YB Dato' Sri Dr. Adham Baba said as with other new advancements in science and technology, the ability to manipulate and engineer materials at nanoscale levels, will bring a different set of concerns to the public mind. The safety of nanomaterials and possible impacts on human health and the environment are the challenges that we must address together through science. "Society must continue to innovate to secure the wealth of current and future generations. Legislation must keep pace with these developments so that governments can attain the public's trust in innovation," said YB Dato' Sri Dr. Adham Baba in his speech during the Gala Dinner. He added, "Legislation must also not impede the growth of new technology and industries, hence one cannot effectively legislate without information. For nanotechnology, international efforts on testing and safety standards, such as the EU-Asia Dialogue on Nanosafety is a good example of how international scientists' collaboration can provide the much-needed information for legislators and policymakers." During the Gala Dinner, YB Dato' Sri Dr. Adham Baba also witnessed the Memorandum of Understanding (MoU) exchange ceremony, which was earlier signed between NanoVerify Sdn. Bhd., a subsidiary of NanoMalaysia Berhad, with P.T Nanotech Indonesia Global T.B.K on nanotechnology certification programmes. The MoU also intended for both parties to benefit from cooperation with international certification bodies and direct certification of new nano products in Indonesia through NanoVerify Sdn. Bhd.'s NANOVerify programme.

ANF Commercialisation Workshop and the Annual General Meeting of the ANF Executive Committee

19th July 2022 saw the ANF Commercialisation Workshop and the Annual General Meeting of the ANF Executive Committee members held in Kuala Lumpur. The Asia Nano Forum is a network of nanotechnology associations comprising 23 organisations from 17 countries in the Asia Pacific region. Malaysia is one of the founding members of ANF and the Chief Executive Officer of NanoMalaysia Berhad, Dr. Rezal Khairi Ahmad is currently the Vice President of ANF.



Thomas J. Watson Research Center Visit

Delegation from Malaysia led by Datuk Zainal Abidin Abu Hassan, Secretary General of Ministry of Science, Technology and Innovation and Prof. Emeritus Dato' Ir. Dr. Mohamad Zawawi bin Ismail, Chairman of NanoMalaysia, together with NanoMalaysia and MRANTI team, had a visit to the Thomas J. Watson Research Center. The center includes facilities in Yorktown Heights and Albany, New York, as well as Cambridge, Massachusetts. It serves as the headquarters of IBM Research – one of the largest industrial research organizations in the world – with 12 labs on six continents. Scientists at T.J. Watson, and at IBM labs around the globe, are pioneering scientific breakthroughs across today's most promising and disruptive technologies including the future of artificial intelligence, blockchain, and quantum computing. The visit aims to learn more about IBM's Quantum Computing initiatives, with IBM being one of the leading innovators in this field. NMB is looking to spearhead quantum technology in Malaysia, while at the same time rekindling old relationships with IBM to unlock the star polymer technology initiated in 2012.



Persidangan Inovasi Malaysia 2022

Prime Minister Dato' Sri Ismail Sabri, together with YB Dato' Sri Mustapa Mohamed, Minister of Economic Planning Unit, and YB Dato' Sri Dr. Adham Baba, Minister of Science, Technology and Innovation visited our booth at Persidangan Inovasi Malaysia 2022 today at MITEC, Kuala Lumpur.

New York State Energy Research & Development Authority (NYSERDA) Visit

NanoMalaysia Berhad (NMB) delegates led by Prof. Emeritus Dato' Ir. Dr. Mohamad Zawawi bin Ismail, Chairman of NanoMalaysia, visited New York State Energy Research & Development Authority (NYSERDA) on 29th July 2022. The interaction with NYSEDA was part of an extended due diligence effort on a New York-based energy storage business and commercialization facilitation in the clean energy industry. Our discussion found similarities and excellent synergies between two organisations, NanoMalaysia and NYSEDA, particularly in their approaches, structures, and areas of interest. The High Tech Clean Energy platform made possible by our two businesses will benefit partners under the NanoMalaysia Energy Storage Technology Initiative (NESTI) and Renewable Energy Adoption Leadership with Innovative Technologies (REALITIES). This is part of NanoMalaysia's larger focus on Climate Resilience.





Forum of “Convergence of Technology And Society: The Journey Towards A High Tech Nation”

Dr Rezal Khairi Ahmad, led the “Forum of Convergence of Technology And Society: The Journey Towards A High Tech Nation” as moderator yesterday, at Pelancaran Pelan Hala Tuju Teknology by the Ministry of Science Technology and Innovation(MOSTI) at Aloft KL Sentral.



Rapid Electric Vehicles Innovation Validation Ecosystem (REVIVE)

Rapid Electric Vehicles Innovation Validation Ecosystem (REVIVE) Focus Group Discussion (FGD) 1 – Technology & Components was conducted by Special Project Offices of NanoMalaysia Berhad at Intercontinental Hotel Kuala Lumpur. REVIVE is a program focuses on the conversion of internal combustion engine (ICE) vehicles into electric vehicles (EV) and how to make it viable through the 4 clusters:

- i. Cluster 1: Technology & Components
- ii. Cluster 2: Process & Procedures
- iii. Cluster 3: Business Case & Model
- iv. Cluster 4: Policy & Governance

Conversion is an alternative to buying a new EV in which the target is to have the conversion be cheaper than buying a new EV. It is also an alternative to accelerate EV adoption in Malaysia. For commercialisation status of the product, countries such as Australia, Indonesia, the United Kingdom, Ireland, USA have managed to establish regulations to have converted EVs to be deemed legally roadworthy. Hence, REVIVE works with multiple ministries, agencies, and industry players to establish the stated regulations. The initiative also includes insuring the converted vehicles through our engagements with Persatuan Insurance Am Malaysia (PIAM).



NanoMalaysia Berhad's Plenary at ISES 2022

Dr Rezal Khairi Ahmad, CEO of NanoMalaysia Berhad's Plenary session at International Sustainability Energy Summit (ISES 2022) with the topic of Green Circular Economy Empowers Innovation & Prosperity.



International Sustainable Energy Summit (ISES 2022)

Ir. Tengku Kahar Muzaffar Tengku Mohd Yusof Anuar, Vice President of Strategy and Special Projects of NanoMalaysia Berhad (NMB) presenting at the main motherbooth, International Sustainable Energy Summit (ISES 2022) about NMB & national electric vehicles and hydrogen initiatives.

Malaysian Banking Conference 2022

Panelist gave views on carbon pricing and its significant costs for companies globally; decarbonisation strategies and tools post-carbon pricing from the regulator's perspective; climate action on an enterprise level with a focus on culture, accountability and the price of inaction; galvanising corporates to embed sustainable financing as part of their climate change agenda; developing the competencies and culture for low carbon organisations; the enormous economic benefits that could be generated by a just transition, as well as the Taskforce on Nature-related Financial Disclosures (TNFD) framework.

Regardless of what a good transition looks like, achieving the goal of climate neutrality is a collective responsibility. The way forward for the financial sector is to understand the broader environment and how it interlinks with climate. The panelist for yesterday's plenary session was — moderator Datin Seri Sunita Rajakumar, Chairman of Climate Governance Malaysia; Dr Rezal Khairi Ahmad, Chief Executive Officer, NanoMalaysia Berhad; Madelena Mohamed, Director, Sustainability Unit of Bank Negara Malaysia; Faroze Nadar, Adj Professor, Executive Director of United Nations Global Compact Network, Malaysia & Brunei; Lavanya Rama Iyer, Head of Policy and Climate Change at WWF-Malaysia and Alizakri Alias, Chairman of Malaysia Venture Capital Management Berhad.



National Energy Policy 2022-2040

Dr. Rezal Khairi Ahmad, Chief Executive Officer of NanoMalaysia Berhad explained the products displayed at the NanoMalaysia Berhad exhibition booth to YAB Dato' Sri Ismail Sabri bin Yaakob, Prime Minister of Malaysia together with YB Dato' Sri Mustapa bin Mohamed, Minister of the Prime Minister's Department (Economy) and YB Dato' Sri Dr. Adham Bin Baba, Minister of Science, Technology and Innovation, at the Launching Ceremony of the National Energy Policy 2022-2040 (DTN), Marriot Hotel, Putrajaya. The government formulated the DTN after taking into account internal and external developments and challenges to ensure that the energy sector can continue to develop sustainably. DTN is the Government's commitment to provide new job opportunities and make the energy sector the main catalyst of socioeconomic sustainability for the well-being of Malaysian Families. The government will also continue to play an important role in realizing DTN's vision so that great economic benefits will be obtained through the development of new growth areas.

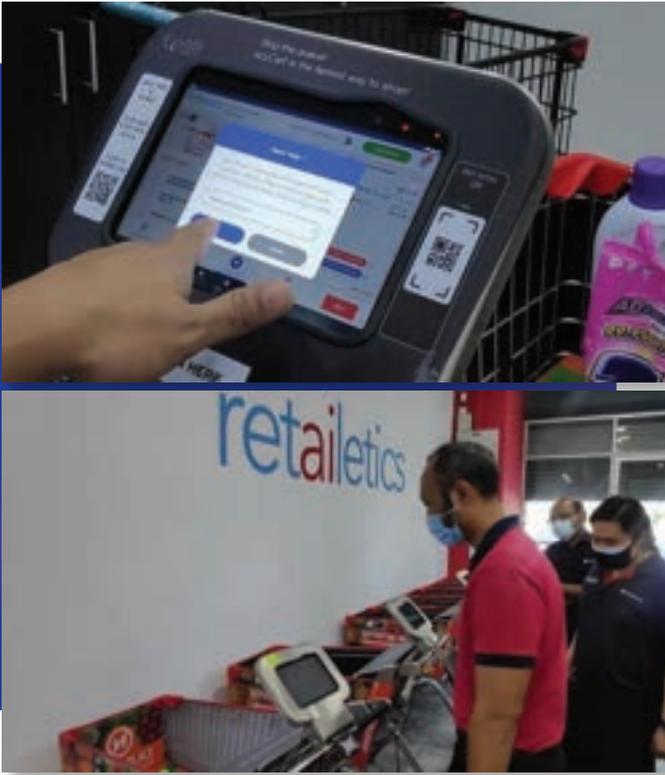


Hydrogen - Electric Vehicle - Battery (HEBATT) Inauguration

Minister of Science, Technology and Innovation, YB Dato' Sri Dr. Adham bin Baba inaugurated the Hydrogen-Electric Vehicle-Battery Centre or HEBATT which is a local battery innovation center that will produce nanotechnology pocket cell batteries for Electric Vehicle (EV) applications at Incubator 3, Technology Park Malaysia.

HEBATT is a collaboration between the investment recipient of the NanoMalaysia Group, HyPERTech Industries Sdn. Bhd. (HTSB) and International Battery Center (IBC) Sdn. Bhd. which is a one-stop consultation center for local and international innovative collaboration between industry, universities and government agencies. This center will be a focus in the construction and development of local expertise in battery manufacturing and its application for related industrial sectors. It will focus on the development of new battery chemistries and the production of advanced batteries in various hydrogen-based factors, forms and storage.





Nano-Tech based Smart Trolley project visit

Project closure visit looking into Retail Platform using IoT solutions at Retailytics. This product gives refined Shopping experiences for both retailers and Shoppers. AI and machine Learning convergence to give optimum output to ease shoppers to get good deal of purchasing ability.

For retailers it enables ease to Control in Shop Operations to prevent hiccups for fast moving retail activities especially in urban Settings. The ability of wireless charging for the carts operation gives retailers minimized Operating cost and nanocoated carts gives more comfort for hygiene of carts being used.

Retailytics is an applied technology company building new and innovative retail concepts and experiences. Retailytics know that retailers want to offer consumers a great experience every time they step into the store, but experience costs money, lots of it. "Win-Win" - that's the only way they do business. Retailytics share the costs and risks by offering all their products on a subscription model.

Graphene Reinforced Nanocomposites Project Closure Visit

Project closure visit of toughened graphene reinforced nanocomposites by Compounding and Coloring Sdn Bhd (CCSB). Toughened Graphene Reinforced Polymer Nanocomposites is collaboration project between Compounding and Coloring Sdn Bhd (CCSB) and NanoMalaysia Berhad. In this project polymer composites were enhanced by using graphene with the aim to produce graphene enhanced polymer nanocomposites that had been proven to increase the properties of the polymer composites that having a huge potential in automotive components with the hopes to drive the automotive future into a lightweight with stronger parts that can further guarantee consumer safety at the same time reducing oil consumption.



Phytomining Project at Kampung Manggis Greenhouse

Pn. Rimi Repin, Deputy Director of Sabah Park, Dr. Gerald Jetony, Secretary of Sabah Biodiversity Centre (SaBC), YB Dato' Sri Dr. Adham Baba, Minister of Ministry Science, Technology and Innovation (MOSTI), Dr. Zakuan, a researcher from Universiti Islam Antarabangsa Malaysia (UIAM), Dato Zainudin, Secretary of Ministry of Science, Technology and Innovation Sabah (KSTI), Dr. Ruslinda, Director National Nanotechnology Centre (NNC) and Dr. Rezal Khairi Ahmad Chief Executive Officer of NanoMalaysia Berhad (NMB) planting trees as symbolic of cooperation between MOSTI through NMB and UIAM with Sabah Park, KSTI and SaBC at Nickel Garden, Monggis Sub-Station, Sabah yesterday.

MOSTI through NMB and UIAM will conduct a research collaboration to implement a phytomining project at the Kampung Monggis greenhouse here.

Phytomining is the extraction of active metal substances from high biomass plants, and the project is being carried out as part of the NanoMalaysia Energy Storage Technology Initiative Programme (NESTI). Phytomining uses local native plants, namely *Phyllanthus Rufuschaneyi* and *Rinorea Bengalensis*, that will produce nickel and cobalt which are the active ingredients of lithium-ion type batteries.

The findings of this phytomining research can conserve the limited supply of active materials in lithium batteries; it can also reduce the conventional mining activities of active materials to produce new lithium-ion batteries. This project involves battery sustainability, leading the development of sustainable battery technology in line with Malaysia's aspirations to become a high-tech country by 2030.



IGEM 2022 Conference

YBrs. Dr. Rezal Khairi Ahmad, Chief Executive Officer are on of the panelist at the International Greentech & Eco Products Exhibition & Conference Malaysia (IGEM) 2022 with the topic of advancing sustainability development through science, technology and innovation policies.





Legal 500 GC Powerlist: Southeast Asia 2022

En Hairul Hafiz, Vice President of Group Legal of NanoMalaysia Berhad, has been named in the Legal 500 GC Powerlist: Southeast Asia 2022. The Legal 500 GC Powerlist is one of the most distinguished industry awards highlighting the best GCs and senior in-house counsel, following a comprehensive and detailed research process that includes recommendations from other legal professionals. Congratulations to Hairul for his well-deserved recognition and for leading Group Legal team for collective growth and transformation strategies, especially on IP.



Project Closure Visit Between NanoMalaysia Berhad, NanoVerify Sdn Bhd and Farmasia Berhad

Project closure visit and meeting between NanoMalaysia Berhad, NanoVerify Sdn Bhd and Farmasia Sdn Bhd for Chitosan-CNC composite bioheal gel project. Chitosan Biopolymer is a natural biopolymer derived from chitin (non-animal origin fungi). (Improved by adding Crystalline Nano Cellulose (CNC)).

As a chemo-attractant (Cationic polysaccharide), it enhances and localises macrophages, cytokines, and other crucial micro-molecules that are required for the healing process.

By creating a moist environment, the necessary biomolecules may quickly and easily migrate to the site of injury, which allows the healing process to begin right away. Some other advantages are good antimicrobial properties, encourages natural blood clotting (hemostasis) and minimises scarring and prevent keloid formation.



“Kesedaran Anti Rasuah” Talk

The NanoMalaysia Training Area office hosted a session titled "Promoting Anti-Corruption Awareness: A Talk with SPRM". Participants had the opportunity to engage in an enlightening discussion on the topic of "Kesedaran Anti Rasuah" (Anti-Corruption Awareness) led by the distinguished speaker, Samsul Bin SALIP, Head of Government & Agency Branch, Public Education Division of the Malaysian Anti-Corruption Commission (SPRM). The session aimed to raise awareness and encourage the development of a culture centered around integrity and transparency.



National EV Initiative

National EV Conversion Initiative: Rapid Electric Vehicle Innovation Validation Ecosystem (REVIVE) Focus Group Discussion: Cluster 4 - Policy & Governance Rapid Electric Vehicles Innovation Validation Ecosystem (REVIVE) was held at HIVE 5, MRANTI.

REVIVE Initiative: ICE (internal combustion engine) vehicle conversion program to multi-platform EV such as buses, trucks, motorcycles, and cars. This initiative aims to enable EV adaptation in an alternative way to buying a new EV which is generally more expensive in rate 20-50%. In addition, new job opportunities will be created and at the same time increase workshop skills and local workers. This national-level program will involve collaboration with various strategic partners such as the Ministry of Higher Education (JPT), Road Transport Department Malaysia (JPJ), Land Public Transport Agency (APAD), Bank Negara Malaysia and many more.



Campuses for Local Electric Vehicle Expeditious Roll-out (CLEVER)

Yang Berhormat Dato' Sri Dr Adham bin Baba, Minister of Science, Technology, and Innovation (MOSTI), officiated the launch of Campuses for Local Electric Vehicle Expeditious Roll-out (CLEVER) at EDUCity Iskandar Johor. It is a technology and market validation programme developed and led by NanoMalaysia Berhad (NMB), Malaysia's leading agency in nanotechnology and advanced solutions commercialisation, to deploy electric vehicle (EV) technologies on university campus grounds. Participating campuses include EduCity Iskandar (a subsidiary of Khazanah Nasional Berhad), Universiti Tun Hussein Onn Malaysia, Universiti Teknologi Malaysia, and Universiti Tenaga Nasional. CLEVER will serve as a regulatory and innovation sandbox, allowing start-ups and other innovators to conduct live experiments in a controlled environment. There will be two-wheeled electric rides, battery swapping stations, and the development of internal combustion engine-to-EV conversions.



NanoMalaysia Board Retreat and Board Meeting No. 52

NanoMalaysia Berhad (NMB) Board Retreat and Board Meeting No.52 (8/2022) was held on 29th until 30th November 2022 at Royal Chulan Hotel Kuala Lumpur.

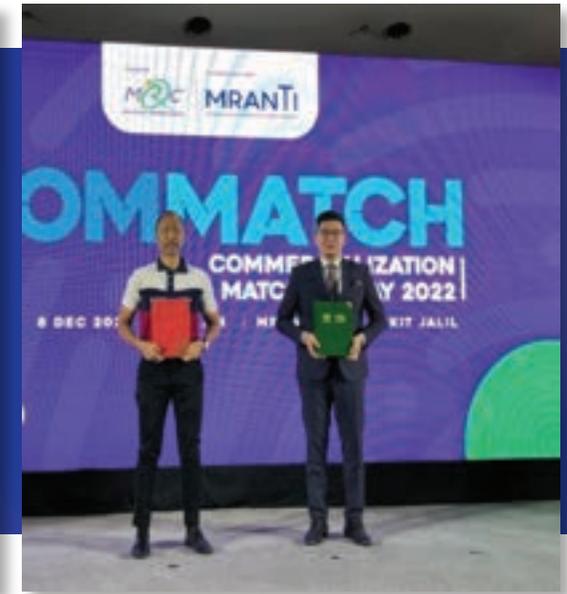
The meeting was held to discuss and strategise Corporate Planning and Key Performance Indicators, Business models, and other matters related to NMB Group of Companies for 2023. The Board retreat was attended by fellow Board of Directors (Dato Dr. Mohamad Zawawi bin Ismail, Dr. Rezal Khairi Ahmad, Dato' Ng Wan Peng, Professor Datuk Dr. A. Rahman Bin A. Jamal, Dato' Ahmad Shukri Hj. Tajuddin, Zain Azmir bin Zain Azahari, Datuk Ts. Dr. Mohd Nor Azman Hassan), the Management Team, and two members of the Company Secretary as well as 50 people from the NMB's project partners who attend the networking lunch that was held on 30th November.

The aim of the networking lunch is to introduce new and current BOD members of NMB, exchange experiences, advice, and support, and establish connections with the project partners of NMB. This initiative also aims to keep stakeholders and clients informed of our progress as well as strengthen ties.



NanoMalaysia Berhad and Malaysian Rubber Council (MRC) MoU Signing.

NanoMalaysia Berhad (NMB) signed a Memorandum of Understanding (MoU) with the Malaysian Rubber Council (MRC) to promote the successful uptake and commercialisation of local Intellectual Properties (IPs) and products developed by local companies related to the rubber industry under the previous National Graphene Action Plan 2020 and fulfil growing demands for the commodity. NanoMalaysia and its advanced solutions commercialisation provider under the Ministry of Science, Technology and Innovation (MOSTI) entered the agreement to align rubber and other commodities with the National Agricommodity Policy (DAKN) 2021-2030 and the National Nanotechnology Policy & Strategy (DSNN) 2021-2030.



EVM Asia 2022

NanoMalaysia Berhad participated in the EVM Asia 2022 which was held at Malaysia International Trade and Exhibition Centre (MITEC), Kuala Lumpur on 27 - 29 September 2022. Many dignitaries and VIPs attended NanoMalaysia's booth at MITEC on the 27th of September 2022, including the Minister in the Prime Minister's Department (Economy), YB Dato' Sri Mustapa Mohamed, and the Deputy Minister of Science, Technology & Innovation, YB Datuk Hj Amzad Hashim.



Battery Swapping System Standardisation Group Discussion

Battery Swapping System Standardisation for 2- Wheelers Focus Group Discussion session at Sunway Putra Hotel, Kuala Lumpur. Battery Swapping System or BSS is a system which allows users to exchange depleted batteries with a fully charged one.

The use of BSS can save a lot of time as compared to the commercialized charging alternative in addition to relieving stress to the grid when users charge at the same time. The objective of this BSS Workshop is to discuss and establish a uniform standard for BSS technology nationwide and accelerate the adaptations of BSS technology in Malaysia's EV ecosystem. Moreover, this workshop also aims to help EV users move around smoother throughout our country.



College of Engineering, UNITEN Visit

NanoMalaysia Berhad visited College Of Engineering, UNITEN for project closure of the development of renewable energy nanogrid and its power management system.

The renewable energy industry faces challenges in the quest for a carbon-free society, primarily due to varying sun isolation levels and difficulties managing the charge-discharge cycles of battery storage systems. As a result, a power flow management system that is optimised is required. To improve existing conditions for its students, the UNITEN Smart UniverCity programme and NanoMalaysia Berhad have developed smart and green technologies for the campus.

This project was successful in developing and deploying a 20kW nanogrid outfitted with nano-coated solar panels, NLEPs, lithium-ion batteries, and graphene-based ultracapacitors. Nanogrid also creates a high-level coordinated control system based on energy generation, consumption, and storage analysis.



Ministry of MOSTI Delegation Visit

A delegation by the Ministry of Science, Technology & Innovation (MOSTI) led by Minister YB Chang Lih Kang, visited NanoMalaysia Berhad on an official work visit. NanoMalaysia's Board members, Dato Ng Wan Peng, Professor Datuk Dr. A. Rahman Bin A. Jamal and NanoMalaysia's CEO, Dr Rezal Khairi Ahmad presented and shared NanoMalaysia's efforts and activities in the industrialisation and commercialisation of nanotechnology in Malaysia.

During the visit, YB Chang Lih Kang was shown some of the products that have been commercialised as well as on-going projects by NanoMalaysia's partners. The delegation also included Deputy Secretary General (Technology Development) Datuk Ts. Dr. Mohd Nor Azman Bin Hassan and Deputy Secretary General (Planning & Science Enculturation) Dr. Nagulendran A/L Kangayatkarasu.



Nanoscience and Nanotechnology Institute UPM Visit

NanoMalaysia Berhad visited (Institut Nanosains dan Nanoteknologi, Universiti Putra Malaysia) for project closure of the development of graphene-based multispectral camouflage materials for the defense industry.

Graphene is a material that has unique properties, including high strength and conductivity, making it a potentially useful material in the defense industry. One potential application of graphene is in the development of multispectral camouflage materials, which are designed to help military vehicles and equipment to become less detectable by RADAR. The use of radar blanket absorbing materials (RBAMs) in the defense industry is an important area of research and development. These materials are designed to reduce the reflection of electromagnetic signals, which can help military vehicles and equipment avoid detection by RADAR.



In this project work developed by Way Forward Resources Sdn Bhd and NanoMalaysia Berhad, an *RBAM embedded with graphene properties was developed*. This material was intended to have a high level of absorption, operating across a broad range of frequencies, and to be as thin and lightweight as possible. The goal of the project was to improve the performance of the RBAM by effectively reducing the reflection of electromagnetic signals. The specific design and coating-layer structure of the RBAM will likely play a key role in its effectiveness at reducing the reflection of electromagnetic signals.

Overall, the development of effective RBAMs is an important area of research in the defense industry, and this project work represents a potentially significant advance in the field. Further research and development will be needed to fully realize the potential of this technology.



CHAPTER 10

BUILDING TRUST: NANOVERIFY PROGRAMME



**NANOVERIFIED MARK ONLY FOR GENUINE
NANOTECHNOLOGY PRODUCTS**



Manufacturers of consumer goods have recognized the significant benefits that even small quantities of nanomaterials can bring to their existing products. These enhancements can result in improved properties or the emergence of entirely new ones, providing a distinct competitive advantage in the marketplace. Applications of nanotechnology span various sectors, including clothing and food packaging. While consumers stand to benefit from these advancements, ensuring the credibility and reliability of nanotech products remains a top priority. Given the relatively new nature of nanotechnology, it is crucial to protect consumers from misleading claims made by irresponsible manufacturers regarding the incorporation of nanotechnology-enabled benefits in their products. To address this concern, NanoMalaysia has initiated the NANOVerify Programme.

NANOVerify Programme



The NANOVerify programme is a voluntary nanotechnology certification programme. There are three (3) schemes under this programme:

NANOVerify Programme - jointly operated by SIRIM QAS International
NANOTrust and
GRAPHENEVerify

Launched on 22 May 2015, NANOVerify is the first voluntary nanotechnology certification programme in Malaysia, and only the sixth of its kind in the world. NANOVerify provides Malaysian nanotechnology products and applications with independent and credible quality assurance.

The NANOVerify Programme serves as a certification platform for processes and products that incorporate nano elements within the range of 1 to 100 nanometers. This certification encompasses not only size and type validation but also evaluates the functionality enhancements achieved through the integration of nano elements, encompassing mechanical, surface, and electrical properties. In 2020, the GRAPHENEVerify and NANOTrust Schemes were introduced to empower local SMEs in effectively marketing their nanotechnology-enabled products in both local and international markets. These programmes, categorized as Type 2 Certification schemes, focus on final product testing instead of production line audits. Since their launch, a diverse range of nanotechnology products has been verified through the programme, including everyday items like cosmetics, fertilizers, and clothing, as well as specialized technology applications such as technology wafers with carbon nanotubes. Upon successful certification, these products are awarded with the NANOVerified, NANOTrusted, or GRAPHENEVerified Marks.

NANOVerified Mark

NANOVerified Mark applied on products or smallest packaging unit to signify it has been verified and characterised to indicate presence of nano-sized element(s) has been verified.



Creating Industry Awareness

The NANOVerify Programme has been further segmented into distinct certification schemes such as NANOTrust and GRAPHENEVerify, tailored to suit the diverse needs of companies and their respective products or processes. Our proactive communication plan aims to promote NANOVerify through various channels, encompassing traditional media outlets as well as social and digital platforms. This includes regular appearances and interviews on television shows and news programs, along with coverage in print media and business publications. Collaborative efforts with other government agencies enable us to conduct cross-marketing activities, amplifying our reach within the industry. Additionally, we organize workshops and conferences on an ongoing basis, serving as platforms to disseminate valuable information about NANOVerify to industry stakeholders, fostering widespread industry exposure.

NANOVerify Achievements As At End 2021

Participation of 105 companies

156 NANOVerified products (spanning over three (3) certifications schemes)

1

Assures sales of genuine nanotechnology products

2

Boosts consumers' confidence and trust

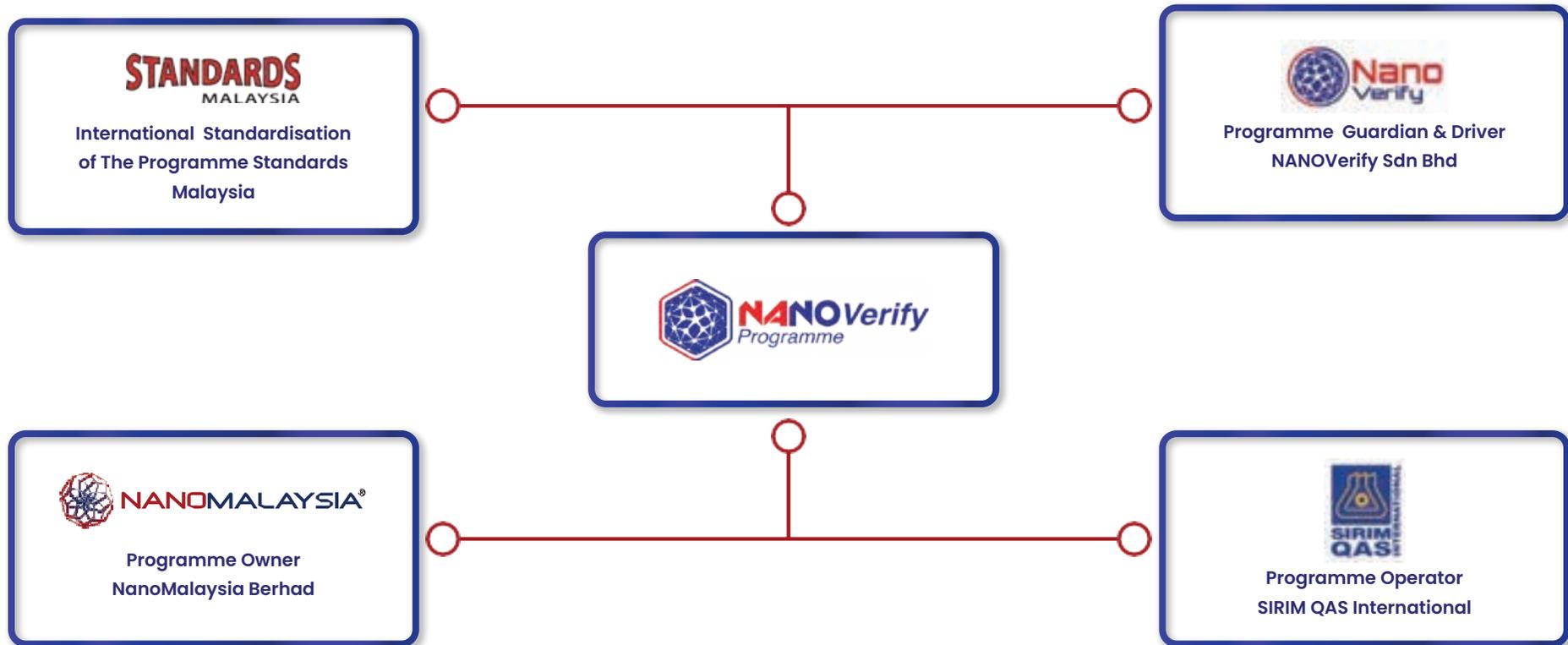
3

Creates greater market acceptance in other countries

4

Increase value of products

NANOVerify



To ensure the highest standards of international governance and compliance in the certification of nanotechnology-enabled products and applications, NanoMalaysia has established strategic partnerships with various Government Ministries and agencies. This collaborative approach guarantees a robust certification platform that adheres to globally recognized standards. As a result, applicant companies can confidently rely on our internationally recognized certification to support their business growth and expansion, providing them with a valuable proposition for success.

NANOVerified serves as the prestigious endorsement mark awarded to processes and products that have successfully undergone the NANOVerify programme. Looking ahead, NVSB (NanoMalaysia Verification Services Berhad) has developed the NANOVerify Enhancement Programme, a comprehensive five-year plan. This initiative aims to further enhance the functionality of the NANOVerify programme, specifically focusing on advancements within mechanical, electrical, and surface properties. This strategic approach ensures that the NANOVerify programme remains at the forefront of industry standards and continues to provide valuable certifications to deserving entities.

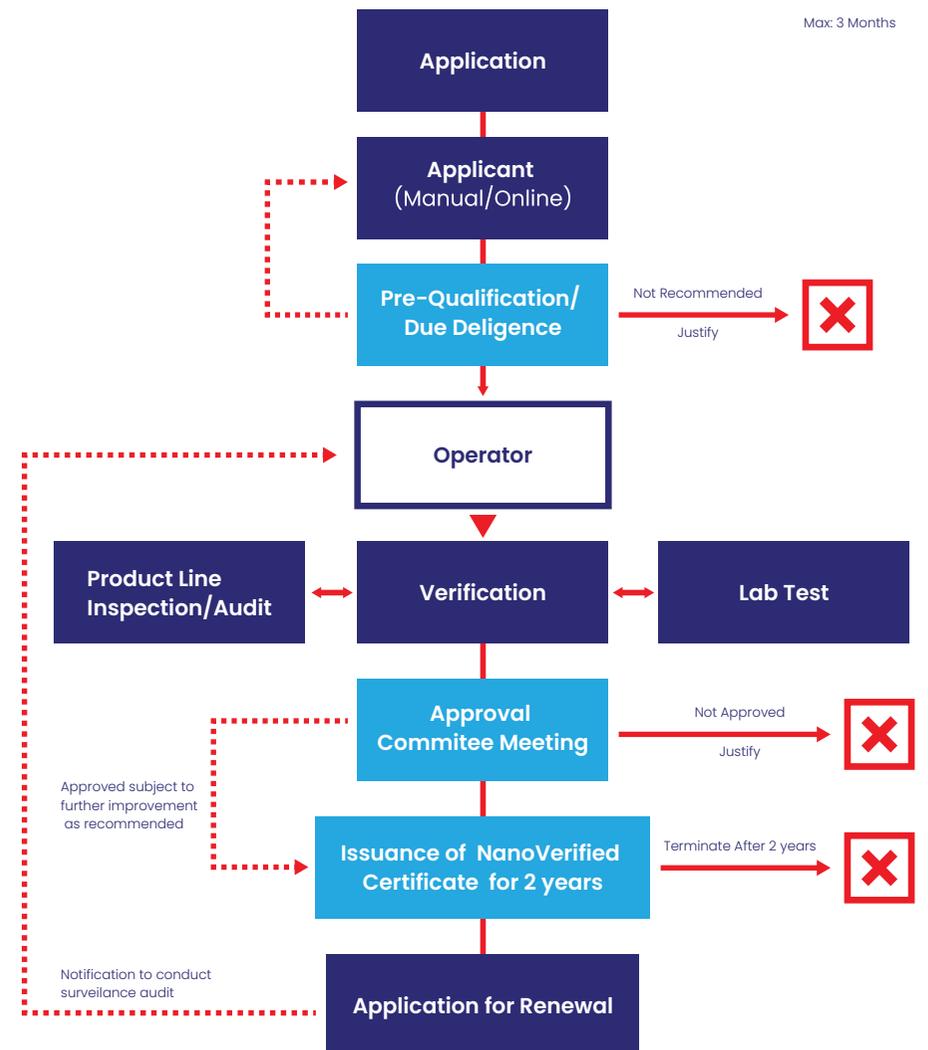
NanoVerify Programme Certification Process

The application process for the NANOVerify Programme is designed to be simple and streamlined. Companies are required to submit their application forms and payment receipts to the programme manager. Subsequently, NVSB carries out a pre-qualification and due diligence assessment to verify the eligibility of the product for certification. Once the due diligence process is satisfactorily completed, the company receives a memo, and the application is then forwarded to the programme operator, SIRIM, to initiate the product certification process. This structured approach ensures that the application and verification procedures are efficient and transparent for participating companies.

Following the application process, SIRIM proceeds to conduct an audit at the applicant's factory to observe the incorporation of nanomaterials in the product. Samples of the product are collected by SIRIM and sent to an MS ISO/IEC 17065 accredited laboratory for comprehensive characterization and functionality testing of the nanomaterials. Once the laboratory report is received and any non-compliance issues are addressed, the application moves forward for review and approval by the Approval Committee. Upon approval, applicants are granted their certificate and are authorized to utilize the NANOVerified mark as a symbol of endorsement. This rigorous process ensures the credibility and reliability of the certification, providing companies with the confidence to promote their NANOVerified status.

The application process for the NANOTrust and GRAPHENEVerify Schemes follows a similar framework as the NANOVerify Type 5. Interested parties are required to submit their application forms, relevant documents, and payment to NVSB. In contrast to the NANOVerify process, the NANOTrust and GRAPHENEVerify Schemes do not include production line audits. Instead, a rigorous testing procedure is conducted on the final product. This comprehensive testing involves several techniques such as Transmission Electron Microscope (TEM) for size and characterization analysis of the nanomaterial, along with Raman Spectroscopy, Gas-chromatography-mass Spectrometry (GCMS), and Dynamic Light Scattering (DLS) methods to accurately identify the composition of the nanomaterials. These testing methods ensure a strict and thorough assessment of the end product's nanomaterials, guaranteeing the credibility and reliability of the NANOTrust and GRAPHENEVerify certifications.

Upon approval, applicants will be issued their certificate and granted permission to utilize the NANOTrust and GRAPHENEVerified marks. The certifications of NANOVerified, NANOTrust, and GRAPHENEVerified are valid for a period of 2 years from the date of receiving the mark. During this period, certified entities can proudly display the respective marks, signifying their adherence to stringent quality standards in the field of nanotechnology.



5 Years of The Nanoverify Programme



11 AUG 2015

Birth of The NANOVerify Programme

The birth of Malaysia's first and only nano-product certification scheme.

12 APR 2016

MoU Mutual Mark Recognition

Taiwan Nanotechnology Industry Development Association (TANIDA) and NanoVerify Sdn Bhd signed an MoU to mutually recognise the nanocertificationmark between the two organisations.

2 APR 2018

Mutual Nano-Verification Verification Mark Programme

Taiwan Nanotechnology Industry Development Association (TANIDA) and NanoVerify Sdn Bhd finalised the mutual nano-verificationmark recognition programme between NanoMark and NANOVerified Mark

12 JUN 2018

Introduction of Functionality Testings

Functionality tests have been introduced to verify enhancements resulting from incorporation of nano-materials in a product.

11 MARCH 2018

Introduction of Functionality Testings

Functionality tests have been introduced to verify enhancements resulting from incorporation of nano-materials in a product.

NanoVerified Products Highlights



KM+ REVO NANO Advanced Engine Treatment and Friction Reducer
BioSurge ASIA Sdn. Bhd.

Advanced Engine Treatment and Friction Reducer is a highly concentrated Advanced Engine Treatment and Friction Reducer additive that works with most synthetic, semi-synthetic and mineral engine oils.



Premium Floor Coating
Bonding Technology Resources Sdn Bhd

Durable, anti-dust, anti-stains, & high gloss.
Good for high traffic industrial floors Easy to apply and fast dry.



Velocity Nano Plus API SN/CF SAE Lubrex
Prowheels Distributor (M) Sdn Bhd

Outstanding thermal and oxidation
Quick cold weather starting and fast protection helps extend engine life



Smart Coat
Titanium World Technology Sdn Bhd

Long lasting antimicrobial Nano coating



R8-Infinity Engine Oil Additive
Hexalab Sdn. Bhd.

Graphene Technology that acts like nano sized "ball-bearings", rolling resistance allowing significant friction reduction, restoring the power and performance loss.



Antimicrobial Coating
STOIKA Sdn Bhd

Kills 99.999% germs & effective against Covid-19 virus,
Non-toxic, non-alcoholic & no heavy metal
Applicable to any types of surfaces

Outcomes of The NANOVerify Certification Programme

Product Certification Facilities

RM2.6 million 2015-2021 Certifications

Local Market Penetration

13% 156 Certified Products (out of 1152)

Increase of Revenue

RM149.2 million 2015-2021 NanoVerified Companies

NanoVerified Products (2015-2021)

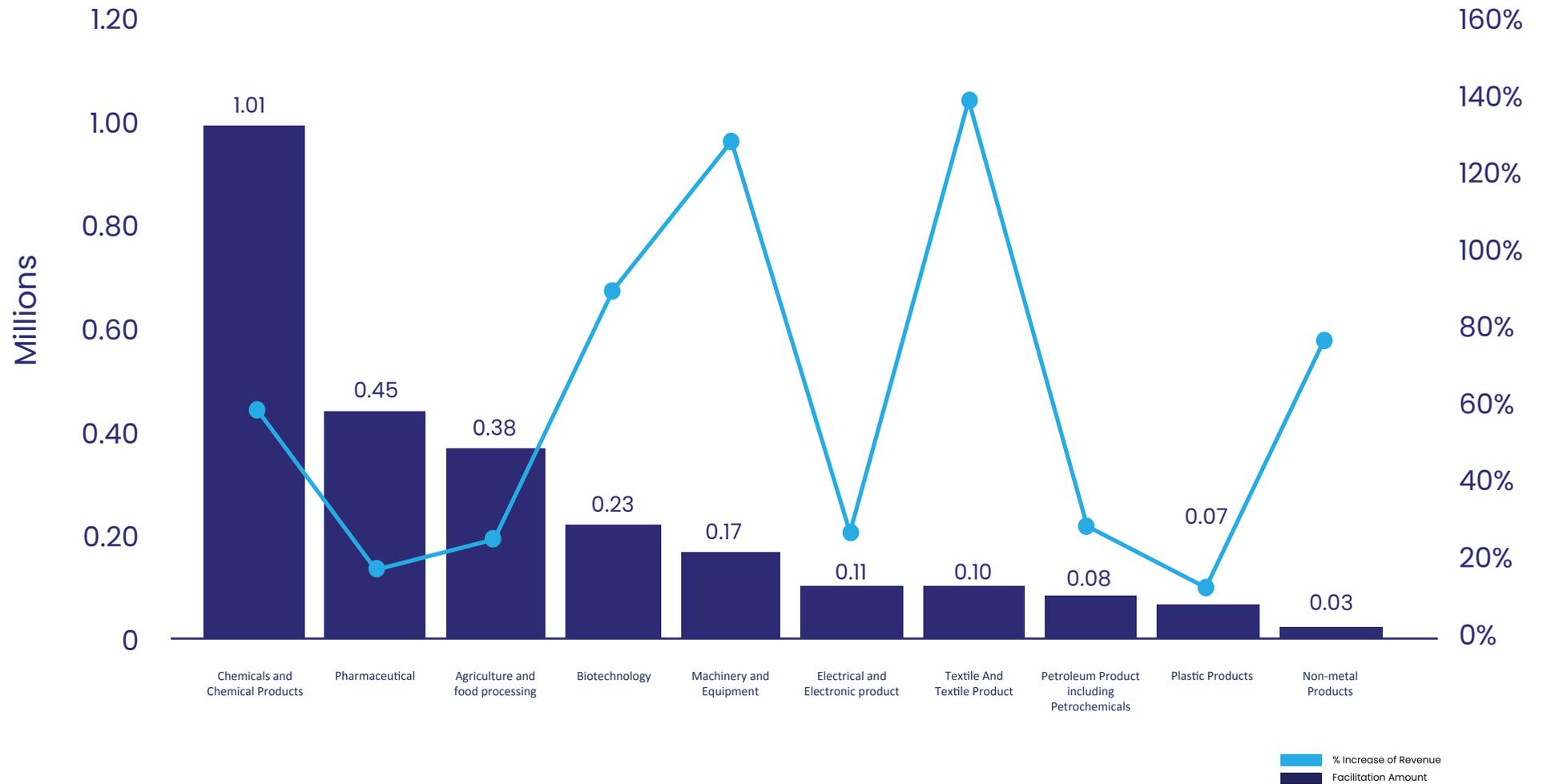
156 From 68 Companies

Overall Impact on Revenue

+50% 2015-2021 NanoVerified Companies



Revenue Increase (2015-2021) and Facilitation Amount (2015-2021), By Industry



Impact on Revenue, by Industry 2015–2021 NANOVerified Companies



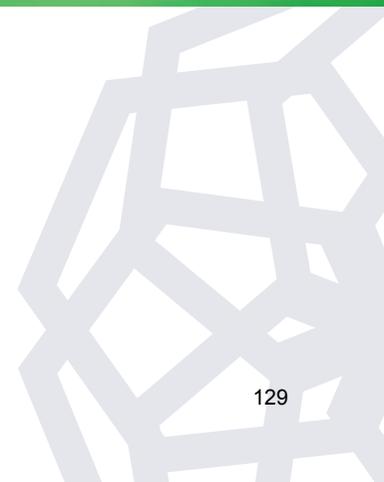
NANOVerified Companies





CHAPTER 11

CREATING A SUSTAINABLE FUTURE:
ECONOMIC, ENVIRONMENTAL, AND SOCIAL



Overview

NanoMalaysia is deeply committed to making positive contributions to the ongoing socioeconomic development of communities and the nation, recognising the importance of striking a balance between economic goals and social and environmental imperatives. Our corporate social responsibility agenda is guided by our aspirations within the realms of Economic, Environmental, and Social (EES) spheres.

We firmly believe that the long-term sustainability of our business is intricately linked to our ability to integrate the principles of the triple bottom line into our operations. Our projects and initiatives are designed to foster a greener planet, while also promoting economic growth and supporting underprivileged communities. In this pursuit, we are mindful of aligning our EES objectives with the 17 principles outlined by the United Nations Sustainable Development Goals, thus reinforcing our commitment to ESG (Environmental, Social, and Governance) practices and principles.



NanoMalaysia Berhad's Organisational Anti-Corruption Plan (OACP) 2021-2025

In November 2020, NanoMalaysia launched the first initiative under the National Anti-Corruption Plan (NACP), specifically in "Strengthening the effectiveness of Public Service Delivery." The Organisational Anti-Corruption Plan (OACP) is NanoMalaysia's primary document that outlines the comprehensive and integrated actions in eradicating corrupt practices within the organisation.

The main objective is to produce a highly professional and efficient with integrity among the member of the Group of NanoMalaysia Berhad.

NanoMalaysia Berhad's Organisational Anti-Corruption Plan (OACP) 2021-2025 is the anti-corruption policy that reflects the support for all efforts to avoid any corruption in administrative services in NanoMalaysia Berhad in general. This framework and strategies are generated through four (4) workshop sessions with the Malaysian Institute of Integrity (IIM) attended by all management officers and employees of NanoMalaysia Berhad, which is always committed to ensuring the development of OACP can implement and adopt within the organisation.

This OACP plan has covered the internal issues of the organisation related to weaknesses in governance, integrity, and anti-corruption that must be addressed at each level of work. To ensure the success of this OACP Plan, departments and the division in charge has identified an execution time period. The plan will also be a primary reference in addition to acting as a guide to all departments and divisions in implementing respective strategies.

Organisational OACP Plan

In accordance with the strategies used in the plan, there are five (5) strategies used in the OACP Plan 2021-2025 as follows:

5

Organisational OACP Strategic Plan

1

Strengthening More Efficient Administrative Management at NanoMalaysia Berhad

2

Strengthening Human Resource Management in Providing the Best Services in NanoMalaysia Berhad

3

Strengthening the Financial System and Accounts at NanoMalaysia Berhad to be More Systematic and Effective

4

Sustaining Business Continuity Extensively Through Increased Transparency in Commercialisation and Business Development

5

Institutionalising Management Best Practices and Implementation of Nanotechnology Programs and Special Projects

NanoMalaysia Berhad Anti – Corruption Plan Framework



Corruption and corruption practices are spreading at every level and community level, especially in public or private sectors. The pillars and values of the state are challenged when corrupt practitioners cannot distinguish right and wrong regardless of the trust and responsibilities to perform. NanoMalaysia Berhad wants to curb unethical practices jointly. We are determined to defend this institution from practices that will poison our developing intentions institutions with transparency and efficiency to achieve the goals of the organisation entrusted.

This plan can be translated by NanoMalaysia Berhad staff with an attitude of integrity, transparency, accountability, and good governance that will be fundamental in carrying out the tasks entrusted to every employee of NanoMalaysia.

These efforts towards implementing and monitoring all initiatives will be made neatly; this move will ensure NanoMalaysia Berhad will be an Agency under the Ministry of Science, Technology, and Innovation (MOSTI) that is always free from all corruption.

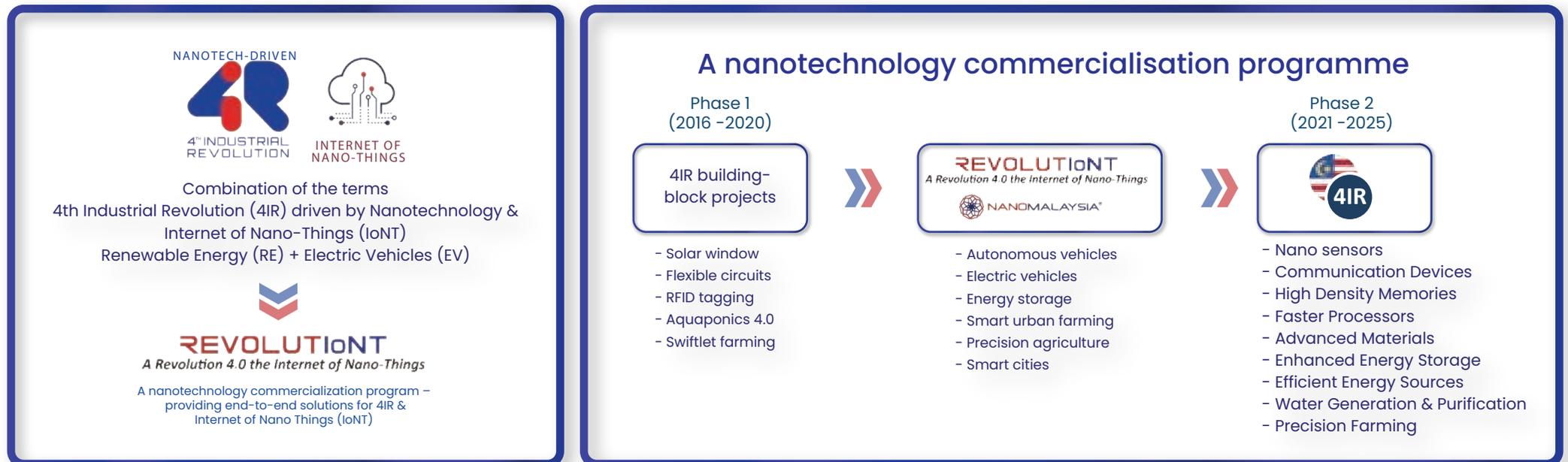
Creating Economic, Environmental and Social Value

Building a Waste to Wealth Supply Chain Ecosystem via the Biomass Innovation Circular Economy Programme (BICEP)

The "Waste to Wealth" programme from biomass waste is a valuable and high-impact green initiative (Circular Economy) program that is described as a game-changer that able to drive and increase Malaysia's per capita income which can give positive impacts to key sectors such as electronics, renewable energy, health, infrastructure, transportation, aero-space, chemistry and so on. The facilitated projects will utilise biomass waste from agricultural activities in Malaysia to produce high quality advanced materials and products that have various benefits such as advanced materials (graphene, nanocellulose, nanosilica) bio-composites, IoT devices, electric vehicle components as well as fuels for renewable energy such as hydrogen. Dumping of this biomass waste needs to be reduced to protect the environment from air and soil pollutions. Various companies and research institutions will collaborate in this program that involves sectors such as agriculture, manufacturing, medical and gas & oil. Through this collaboration, new intellectual property can be generated for licensing and used to produce new products and applications that can generate substantial revenue and profit returns.



Supply Chain Value Creation – from Waste to Wealth



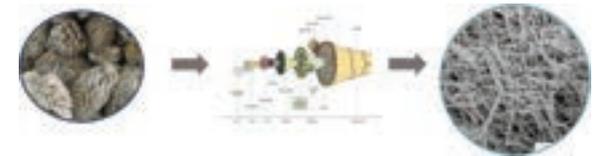
Creating Economic, Environmental and Social Value

Waste to Wealth – Oil Palm Waste to NanoCellulose, Graphene

1

Production of EFB Based Crystalline NanoCellulose (CNC)

Production of CNC from EFB with pilot plant capacity of 25 kg of CNC per month (or 300 kg per year)



2

Hydraulic Fracturing Fluid and Well Cleaning Fluids for Oil and Gas Applications

Development and scale up of CNC based hydraulic fracturing fluid (HFF) and CNC-based salt resistant agent for oil and gas sector applications.



HFF & Salt Resistant Agent

3

UV-Curable Coatings (UVCCs) for Paint and Coating Application

Modification and optimization process of CNC hydrophobic properties for paint and coatings



UVCCs Paint and Coating

4

Graphene & Green Hydrogen from Biomethane

Production of graphene using biomethane through "methane cracking process" generating green hydrogen as #by-product that can be utilized to support the hydrogen ecosystem.



5

Production of Reduced Graphene Oxide (rGO) from Oil Palm Trunk

Optimisation and production scale up of rGO from oil palm trunk as supply application development and product manufacturing.



Our Ecosystem

Waste-to-Wealth – From Rice Husk to Nano Silica

Rice Husk Ash (RHA) contains the highest amount of silica, a base commodity for Nano Silica, Zeolites and Aerogel compared to other agricultural products. RHA contains 75% to 95% Silica.

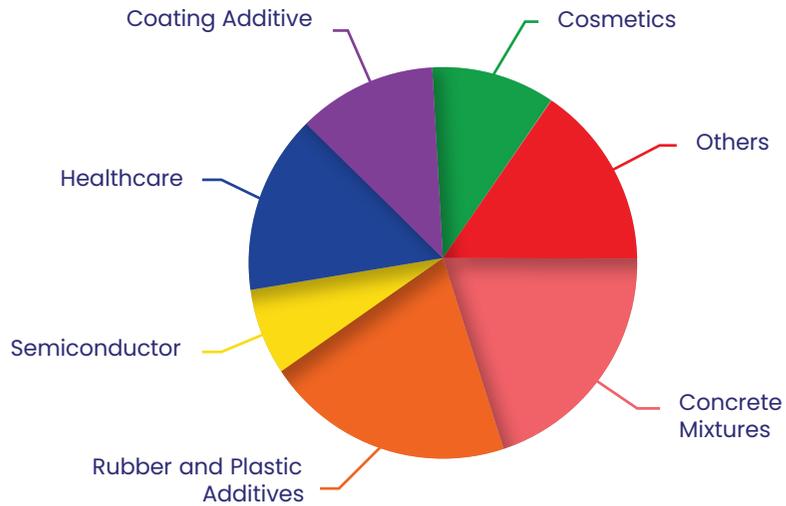
	Global	Malaysia
Total Paddy Production (2017)	769.7 MT	2.9 MT
% Rice Husk	169.3 MT	0.638 MT
Potential RHA (15%)	25.4 MT	95,700 Tonnes



Global Nano Silica market is expected to reach USD 5.14 billion by 2025, at a CAGR of 7.6%
 - Grand View Research

Global Rice Husk Ash market is worth USD 1.64 billion by 2025, at a CAGR of 5%
 - Transparency Market Research,

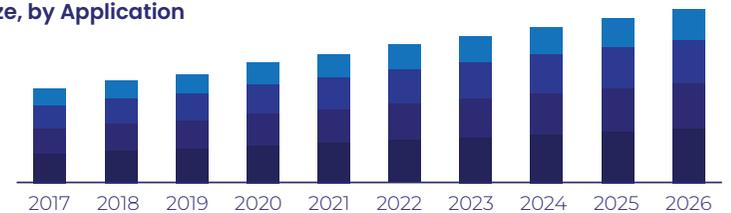
Raw material with high purity is available in Malaysia.. our own RICE HUSK!



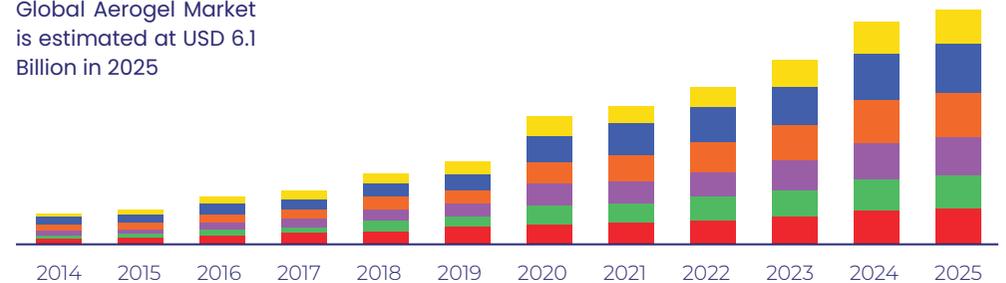
- Source :
1. HTF Market Intelligence
 2. Maximize Market Research
 3. Ameri Research

Global Zeolite Market Size, by Application

USD 38.5 Billion by 2026 at CAGR of 4.44 %



Global Aerogel Market is estimated at USD 6.1 Billion in 2025



Universities



Research Institutes



Funding and Incentives Authorities



Agencies



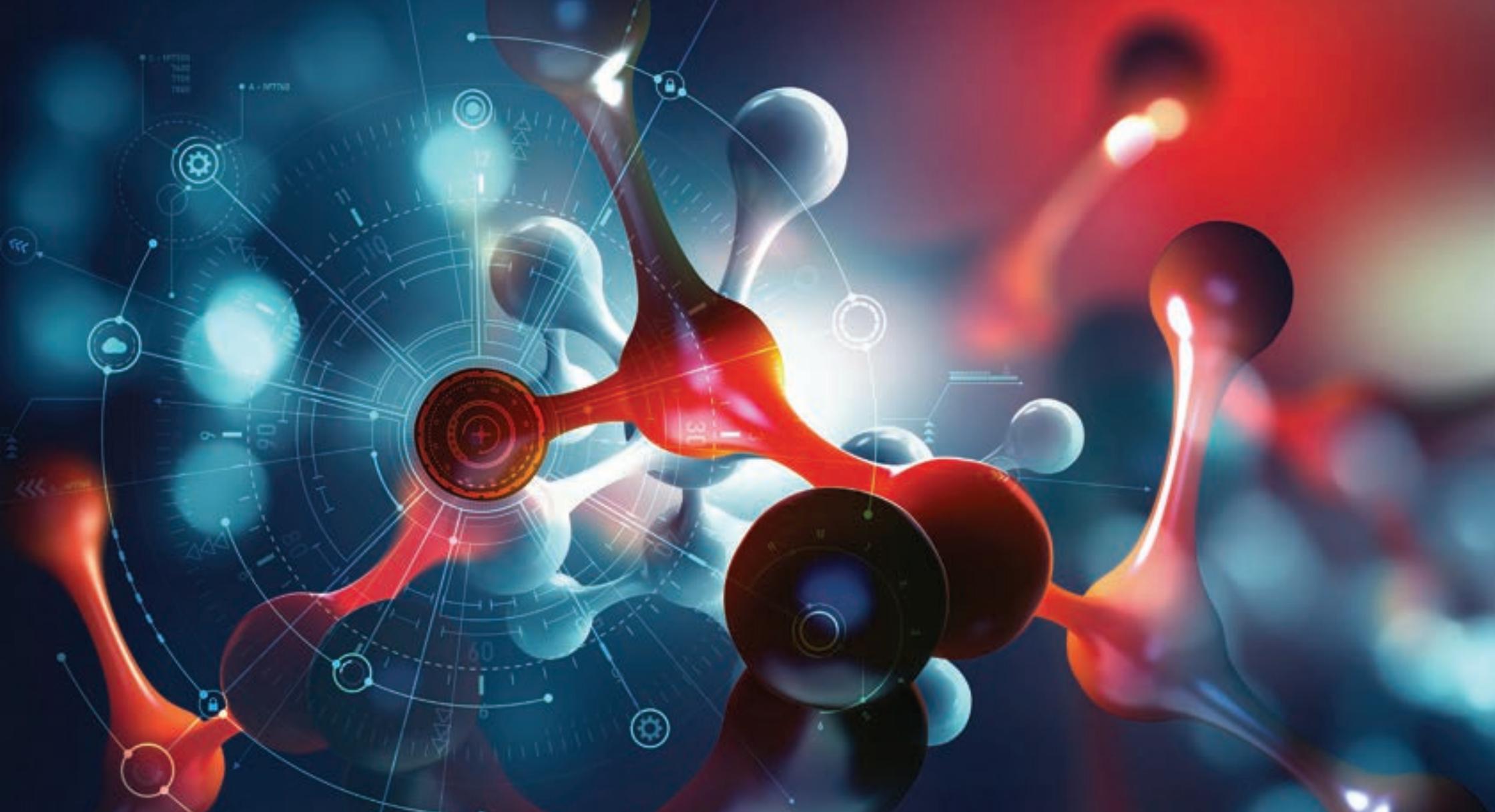
Our Ecosystem

International Patners



Programme Collabrators





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