



NANOMALAYSIA BERHAD

STRATEGIC REPORT 2021



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

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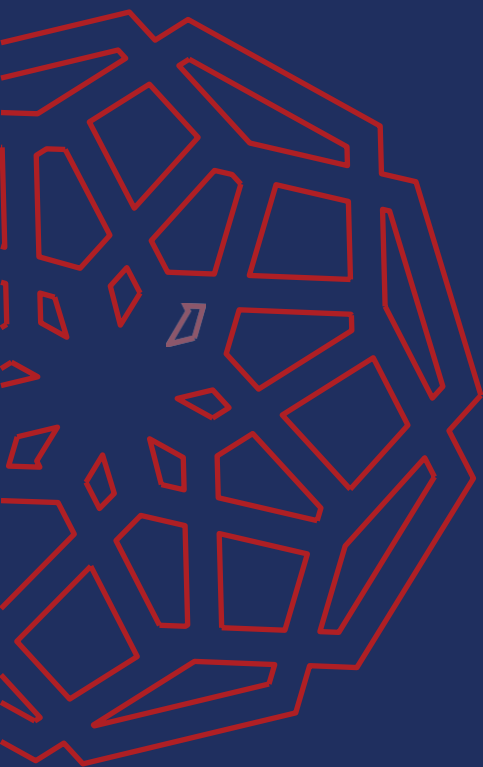
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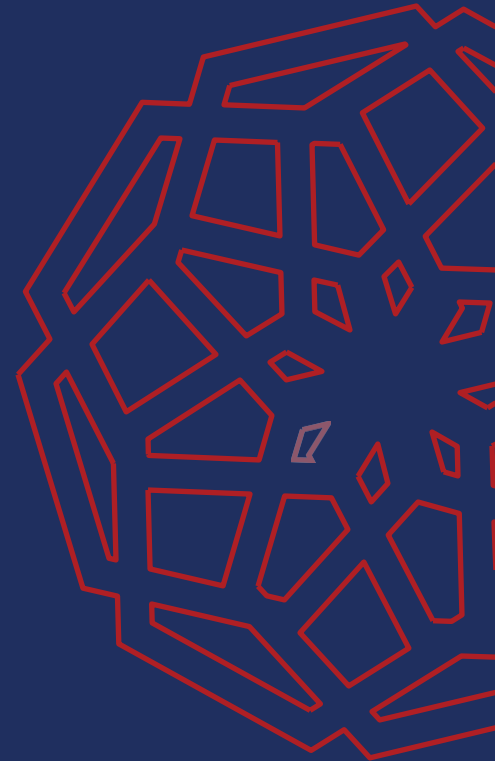
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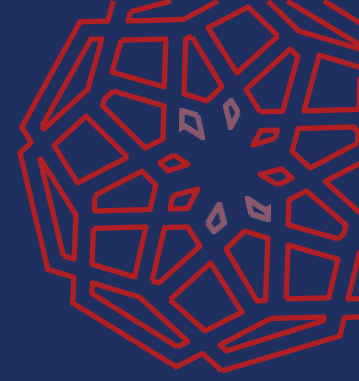
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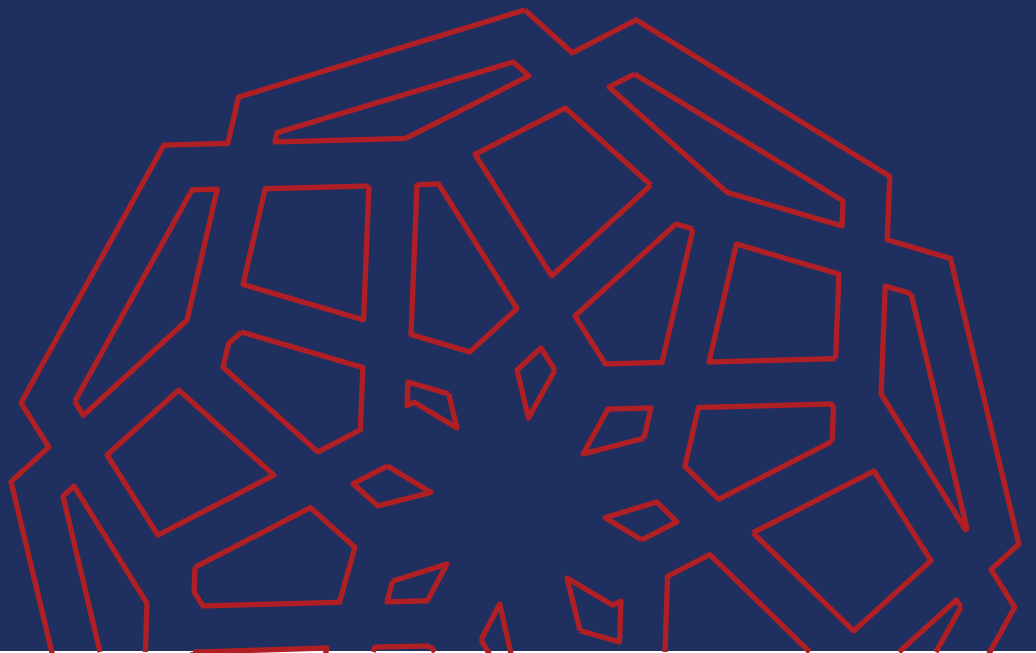
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Purpose of The Report

NANOMALAYSIA Strategic Report 2021 is prepared to provide our stakeholders with a comprehensive and consolidated overview of Malaysia's growing nanotechnology sector. Through this report, our key objective is to demonstrate to our stakeholders how we create values through various programs and initiatives as guided by our strategy.

Reporting Scope and Boundaries

This Strategic Report presents the performance of NanoMalaysia's value-creating activities accomplished as of 31st December 2021, unless otherwise stated. Data presented includes all NanoMalaysia business units and the primary activities of our nanotechnology core programmes. The reporting principles and methodology continue to remain in accordance with requirements of the which NanoMalaysia is ordained to conduct the following 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

In approving the content of this Strategic Report, the Board acknowledges its responsibility to ensure the integrity of this report. The Board recognises its obligation to oversee the preparation and presentation of the Strategic Report. The Board confirms that it has collectively reviewed the contents of the Integrated Report and is satisfied that it is a fair representation of NanoMalaysia's performance, in accordance with our commitment to maintaining the highest levels of governance and ethics.

Forward Looking Statements

This report contains forward-looking statements that are not guarantees of the future developments and results outlined therein. These depend on several factors; they involve various risks and uncertainties; and are based on assumptions that may not prove to be accurate. These statements can be identified using keywords such as "estimates," "believes," "intend," "will," "plans," "outlook," and other similar words in conjunction with discussions on future operating or financial performance. We are not obligated to update these forward-looking statements or the historical information presented in this Report. However, for years to come, we will be able to report with more extensive data on our focus area.

Feedback

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

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Sunway Putra Tower
100, Jalan Putra
50350 Kuala Lumpur

Phone: +603 2779 0200

Fax: +603 4050 3827

Web: www.nanomalaysia.com.my

Email: corporate.affairs@nanomalaysia.com.my



Chairman's Statement

Dear Stakeholders,

On behalf of the Board of Directors, I am honoured to present NanoMalaysia Berhad's Inaugural Strategic Report for the year 2021.

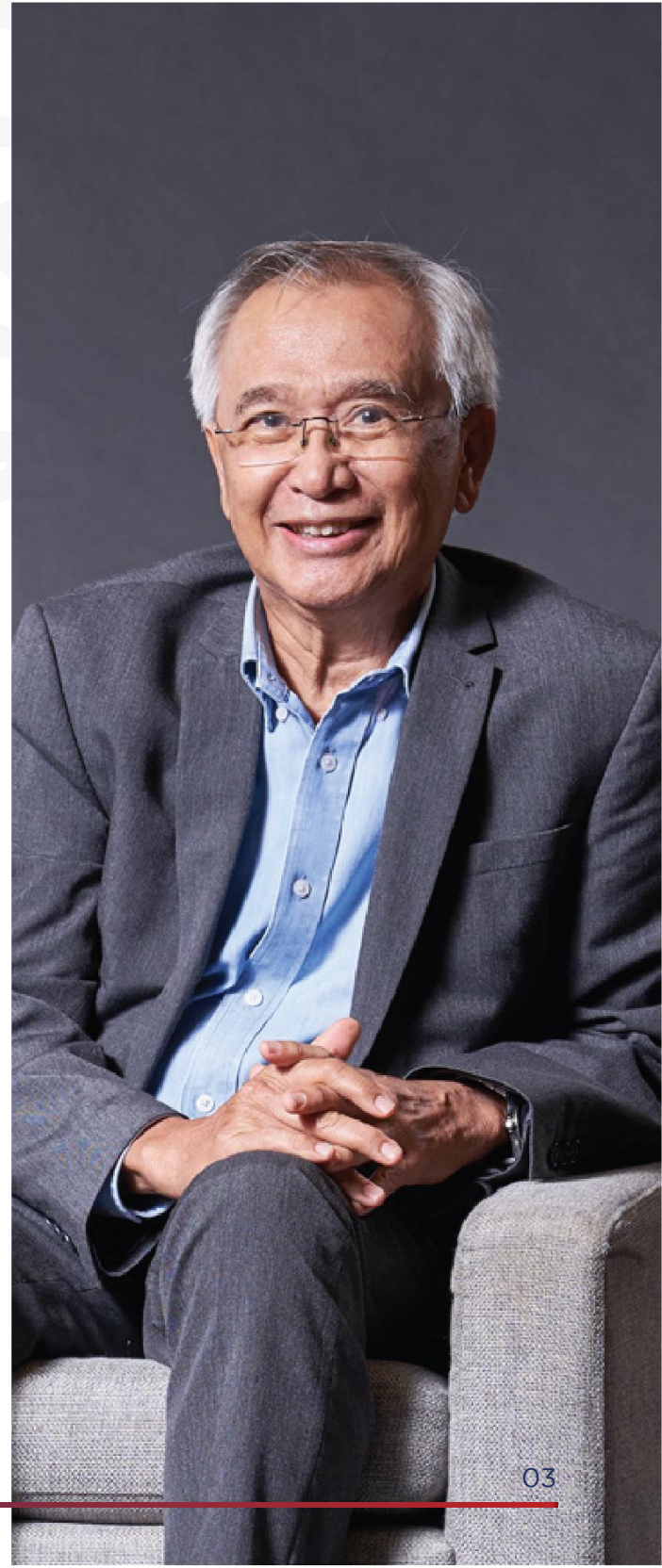
The last two years of the pandemic have been an uphill battle, but I am tremendously proud and inspired by the resilience and perseverance demonstrated by our management and staff in meeting challenges after challenges head-on. All these efforts and hard work translated into a strong operational performance in 2021.

At the end of 2021, NanoMalaysia developed 124 Intellectual Properties (IPs); 43 patents; 30 copyrights; 9 trademarks; 38 trade secrets; and 4 utility innovations, which have been filed with MyIPO.

2021 also saw us gaining recognition by the government with policies introduced to support our goal of driving the revolution towards the Internet of Nano Things (IoNT) and clean energy with our programmes. As we move into 2022, NanoMalaysia remains committed to being the leading agency in nanotechnology commercialisation—creating more job opportunities and helping the country achieve its goals of being a High-Tech Nation by 2030 and High-Income Nation by 2025.

I would like to take this opportunity as well, on behalf of the Board of Directors, to express my heartfelt appreciation to our management team and staff for their endless dedication in driving NanoMalaysia forwards. I also extend my gratitude to my colleagues on the Board; various stakeholders; project partners; academic partners; and industry partners for their unwavering support

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



CEO's Statement

When the pandemic hit in 2020, the business landscape changed and became more challenging than ever. Exciting projects that had hit the ground running and were making progress had to slow down—but that pushed us to find new ways to cope and adapt.

There was a need to transition towards system-based nanotechnology solutions, which we did and has proven to be successful—making it easier for uptake by local industries and equipping them with the necessary know-how on how to jump on the Fourth Industrial Revolution growth curve.

We achieved many milestones in 2021 and we are excited that the government has recognised the integral role NanoMalaysia plays in developing and commercialising nanotechnology in Malaysia—which in the long run will contribute immensely to the country's economy.

In the past year, we have made headway in a number of projects, including onboard generated hydrogen fuel cell; Hydrogen-Paired Electric Race Car (HyPER); e-motorbikes; remote wireless charger; graphene adoption in nanofluid applications, energy storage applications, rubber applications and Internet of Nano-Things (IoNT). We also have our REVOLUTioNT, Hydrogen EcoNanoMY, Nanotech Remote Energy System, and NanoMalaysia Energy Storage Technology Initiative programmes under the 12th Malaysia Plan.

Both Graphenovation and iNanovation continued to activate 17 new projects connecting the industry and research community, and 156 nanotechnology products were certified under the NanoVerify Programme with reported significant economic impacts on participating companies.

We were able to achieve this level of success even through such challenging times due to every single member of NanoMalaysia. I would like to thank our valued industry partners; research and consumer groups; or stakeholders, the Ministry of Science, Technology and Innovation (MOSTI), and Economic Planning Unit (EPU). I am looking forward to seeing what 2022 will bring us as we continue to build our vision of creating a conducive ecosystem for high technology commercialisation..

Rezal Khairi Ahmad,
Chief Executive Officer

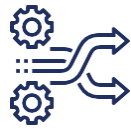




01

**Report
Highlights**

2016-2021 Achievements Snapshot



Project
Activation



73 Product
Development
Projects



Project
Execution



IPs
Developed



105 JV/Start-Up companies supported/created



3,798 (direct) and **18,990** (indirect) high value job opportunities created over next 5 years identified by industry



RM 3.74 billion (direct) and **RM 18.7 billion** (indirect) potential GNI contribution generated over 5 years identified by industry



156 products certified under NANOVerify



124

Projects
IPs developed




IPRs Filed

43 patents,
30 copyrights,
9 trademarks and
4 utility innovations
filed with MyIPO,
38 trade
secrets with
NMB



REVOLUTIONT

A Revolution 4.0 the Internet of Nano-Things



Nanotechnology helps revolutionise technologies and industry sectors: information technology, homeland security, medicine, transportation, energy, food safety, and environmental science, among many others. For example, the Internet of Nano Things (IoNT) is a network of nanosensors and nanodevices that are connected to the Internet.

NanoMalaysia Berhad believes that IoNT will be the core driver of the Industrial Revolution (4.0), catalysing the revolutionary changes in the industry, business, and society. Therefore, NanoMalaysia aims to pursue the vitalisation of industries and innovation through the successful development and commercialisation of nanotechnology in Malaysia..

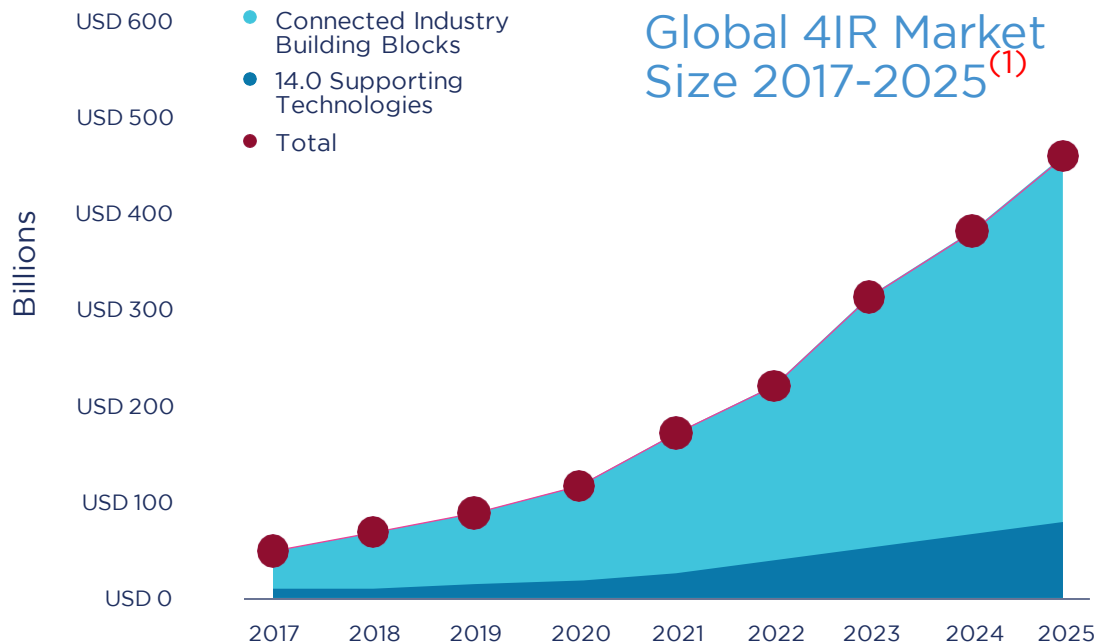
Global Market Review

The Global IR4.0 market size is expected to grow significantly from 2021 until 2025. The market revenue is estimated to be valued at USD 87 billion in 2019 and is expected to grow with a CAGR of 32.1% over 2020-2025.

The Connected Industry Building Blocks (CIBB) subset of the IR4.0 market will be taking a substantial portion of the share, and we will see the most significant growth over the forecast period. The revenue for CIBB was valued at USD 67.5 billion in 2019 and is anticipated to get to USD 404.0 billion in 2025 with a CAGR of 34.1%. The CIBB is further broken down into the six building blocks: cloud platform & analytics, hardware, connectivity, applications, cybersecurity, and system integration.

The technological subset of the IR4.0 market is the IR4.0 Supporting Technologies which comprises Additive Manufacturing, Augmented & Virtual Reality, Collaborative Robotics, Connected Machine Vision, Drones/UAVs, and Self Driving Vehicles. These supporting technologies, albeit smaller in market share, are pivotal to ensuring the full adoption of IR4.0. The market revenue for the Supporting Technologies was valued at USD 19.5 billion in 2019 and is forecast to reach a projected market size of USD 74.2 billion in 2025 with a CAGR of 23.7% over the forecast period.

Source: (1) IOT Analytics

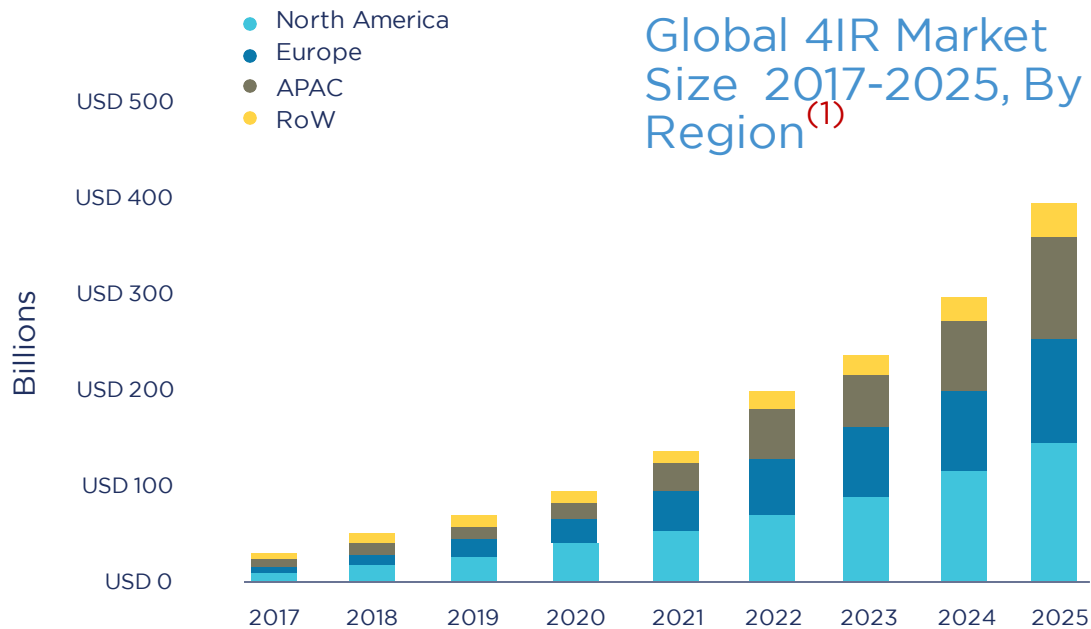


The APAC region is expected to hold the largest market share of the global IR4.0 market in 2019, with an estimated amount of USD 30.6 billion. Furthermore, this trend is ready to grow by USD 184.7 billion in 2025, progressing at a CAGR of 33%. Therefore, the IR 4.0 in APAC will continue to influence the global market beyond the forecast period.

The European market, including European Russia, was valued at USD 23.7 billion in 2019 and is projected to rise at a pace of 31.2% through the forecast period ending with an amount of USD 115.7 billion.

Source: (1) IOT Analytics

The North American market consisting of the United States and Canada, is the second-largest market, with total market revenue of USD 26.35 billion in 2019 and is expected to reach USD 151.1 billion in 2025 growing at a rate of 32.6%.



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

North America

31.6%

2020 Market Share

30.9%

2025 Market Share

Europe

24.2%

2020 Market Share

25.0%

2025 Market Share

Asia Pacific (APAC)

38.6%

2020 Market Share

37.2%

2025 Market Share

Rest of The World

5.6%

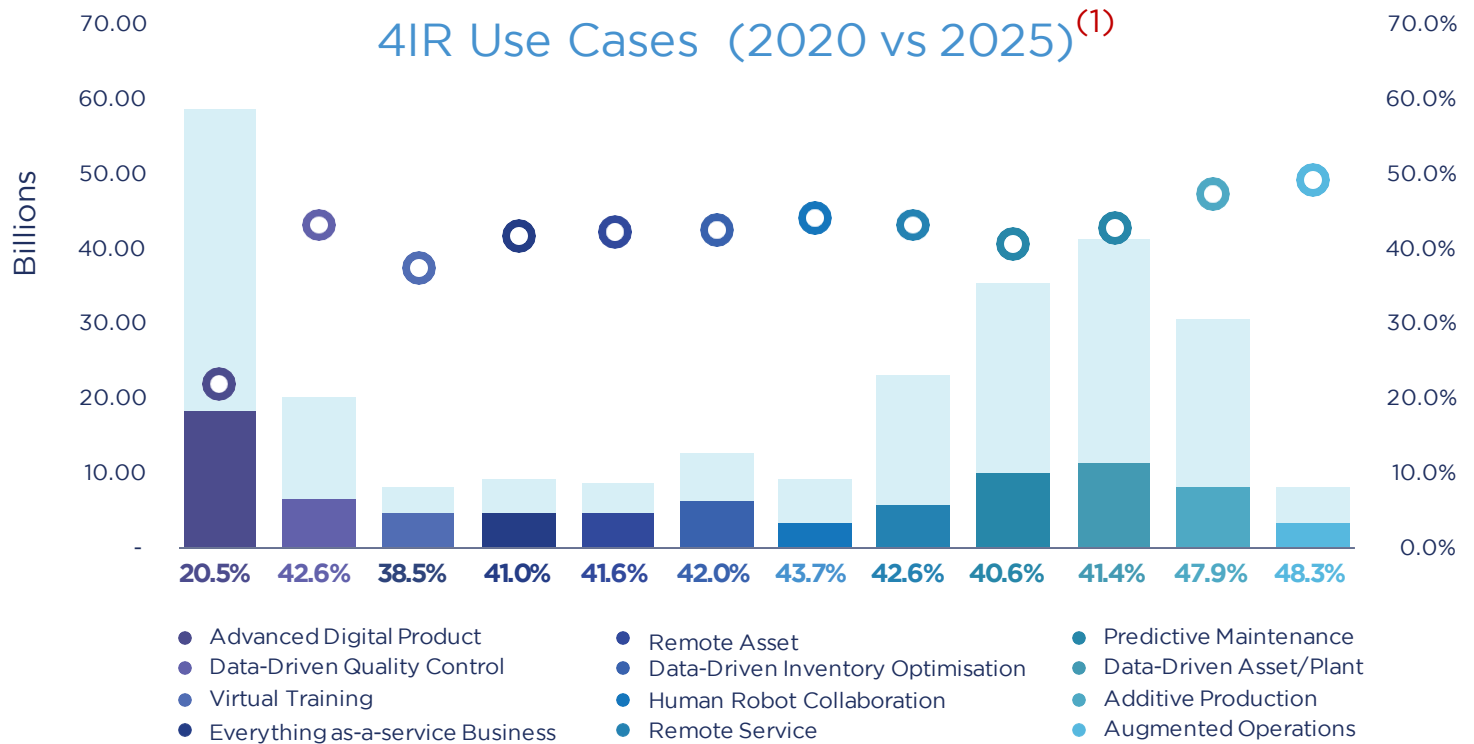
2020 Market Share

6.8%

2025 Market Share

APAC and the North American region are expected to grow at a CAGR of 33% and 32%, respectively. As a result, both regions will strengthen their position globally in 2025. On the other hand, Europe and the rest of the world will share a smaller slice of the pie by the end of the forecast period.

Source: (1) IOT Analytics



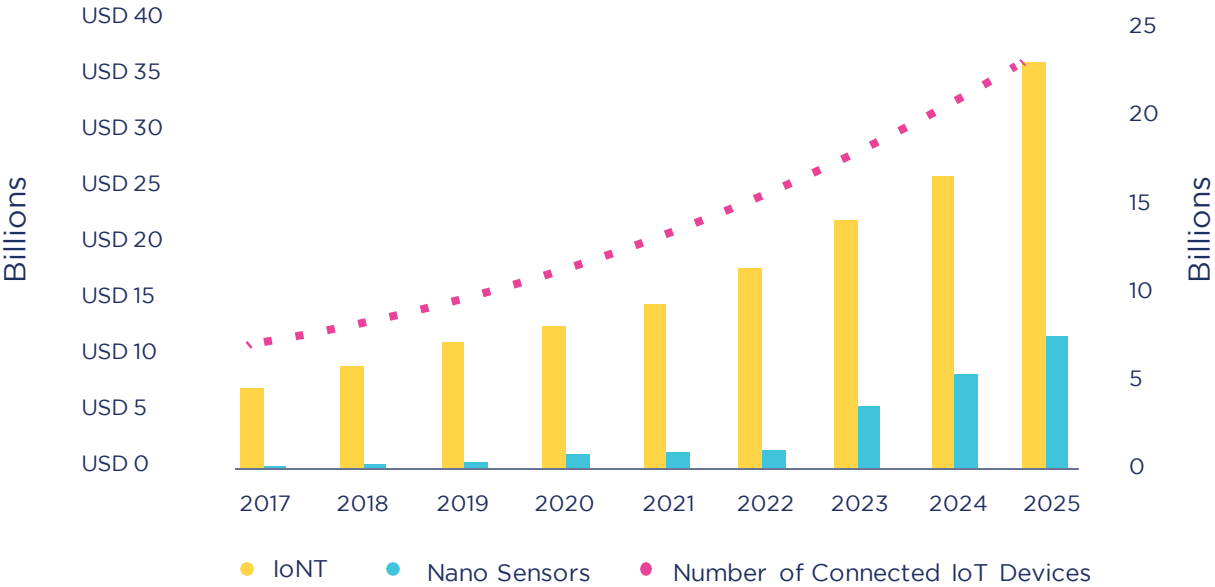
The bar chart shows the 12 use-cases of IR4.0, highlighting vast growth and market share differences over the next five years (2020- 2025). The Advanced Digital Product Development is the largest revenue maker for the next five years, where it will generate USD 16.4 billion in 2020 and is expected to reach USD 41.7 billion in 2025. However, the growth rate of the use-case is the least among the rest of the use-cases. If the current trend continues, it shall remain the largest market share over the next 10-15 years.

The second use case is Data-driven Asset/Plant Performance Optimisation, which was valued at USD 6.11 billion in 2020 and is anticipated to witness a CAGR of 41.4%. Finally, Predictive Maintenance is the third-largest revenue maker with total market revenue of USD 5.5 billion in 2020 and is estimated to be valued at USD 30.3 billion in 2025 with a CAGR of 40.6%.

The Additive Production and Augmented Operations are expected to propel significant growth over the next five years with a CAGR of 47.9% and 48.3%, respectively. However, the market share for these use cases is still amongst the lowest in 2020. Therefore, it is still unclear exactly how these use-cases will shape up in the future.

Source: (1) IOT Analytics

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



The chart shows how the Internet of Nano-Things would shape the global market in the next five years. The constant innovation in the nanosensors industry will increase the advancements of IoNT exponentially. As a result, the number of connected IoT devices is expected to grow rapidly in the coming years, from 9.9 billion devices to 21.5 billion devices in 2025.

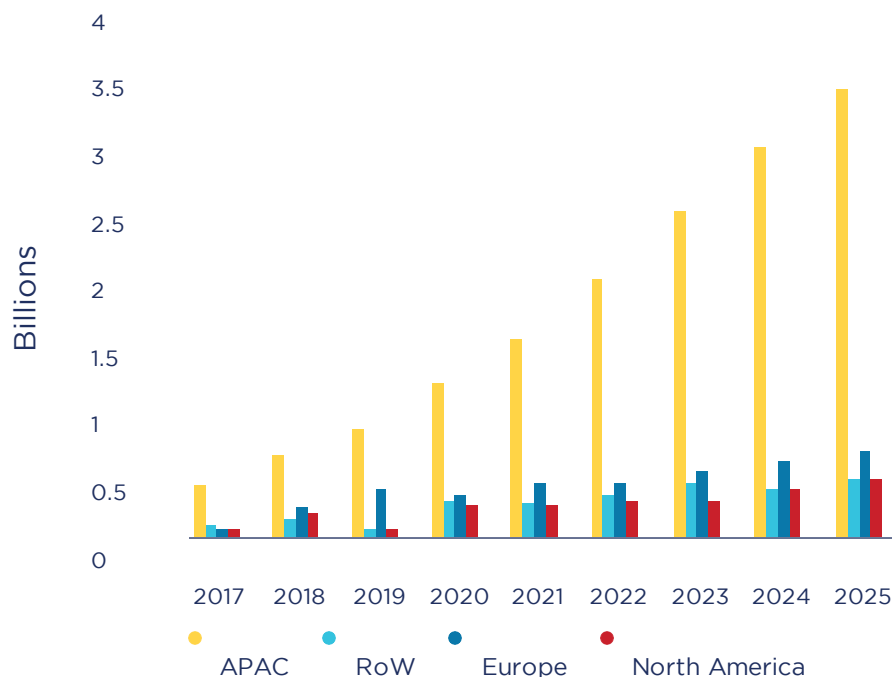
The nanosensors market was valued at USD 1.2 billion in 2020, trailing a CAGR of 53.58% with forecast growth of USD 10.26 billion in 2025 [2]. IoNT market would also be stimulated by growing demand in application industries driven by the increasing number of nanosensors in the market, jumping a value in 2020 of USD 12.78 billion to an amount of USD 36.17 billion in 2025 with a CAGR of 24.12%.

Another technological subset, Nano Positioning Systems, will be taking advantage of this growth from USD 119 million in 2020 to USD 277.3 million in 2025 with a CAGR of 18.39%.

The introduction of new technologies and further adoption of IoNT amongst B2B and B2C will significantly affect continuous trends over the forecast period.

Source: (1) IOT Analytics (2) BCC Research

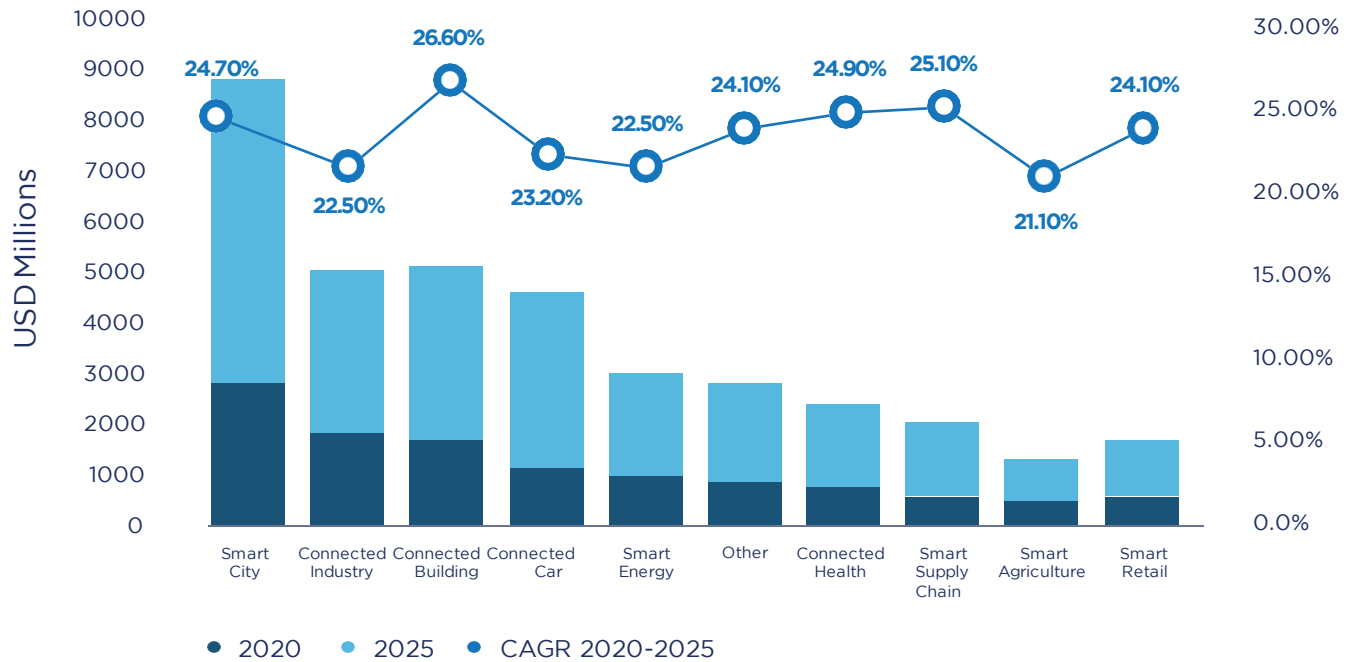
Number of Cellular IoT Connections, by Region (2020-2025)⁽¹⁾



The chart shows how the global market would be shaping up by the increasing adoption of IoT. Research by Ericsson in 2018 explained how IoT connections would be increased in correlation with the market. APAC holds the largest share in 2020 and will be the most promising region to look up to in the future and will remain so in the next five years. This is due to the vast population in the area and the number of economic powerhouses in that region. APAC registered 857.14 million Cellular IoT Connections in 2019. The numbers are expected to grow to 3.39 billion in 2025 with a growth rate of 23.8% during the forecast period of 2020-2025. Europe holds the second largest IoT connection, where the number of connections is 260.3 million in 2020 and is expected to reach 678 million in 2025 with a CAGR of 16.9%. The growth rate of Europe is similar to North America, but the region has a lower number of connections, with an amount of 127 million in 2019 and 331.2 million in 2025.

Source: (1)Ericsson Mobility Report

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



The Smart City sub-sector was valued at USD 2.32 billion in 2019 and is expected to reach USD 8.81 billion by 2025, expanding at a CAGR of 24.7%. The second-largest subsector is the Connected Industry, where it makes USD 1.61 billion in 2019 and is expected to reach USD 5.3 billion in 2025 with a CAGR of 22.5%.

Nevertheless, in 2025 will be expected to be surpassed by the Connected Building sub-sector, one of the sub-sectors with the highest growth rate of 26.6%.

The revenue of Connected Building in 2020 is slightly lower than Connected Industry but will overtake it in 2024. Subjected to the amount of investment by government and corporate entities, the trend amongst Smart City, Connected Industry, and Connected Building will be the largest as it is considered a Business Segment.

Source: (1)Ericsson Mobility Report

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

North America

7.0%

2020 Market Share

8.8%

2025 Market Share

Europe

14.3%

2020 Market Share

17.9%

2025 Market Share

Asia Pacific (APAC)

71.7%

2020 Market Share

67.2%

2025 Market Share

Rest of The World

6.9%

2020 Market Share

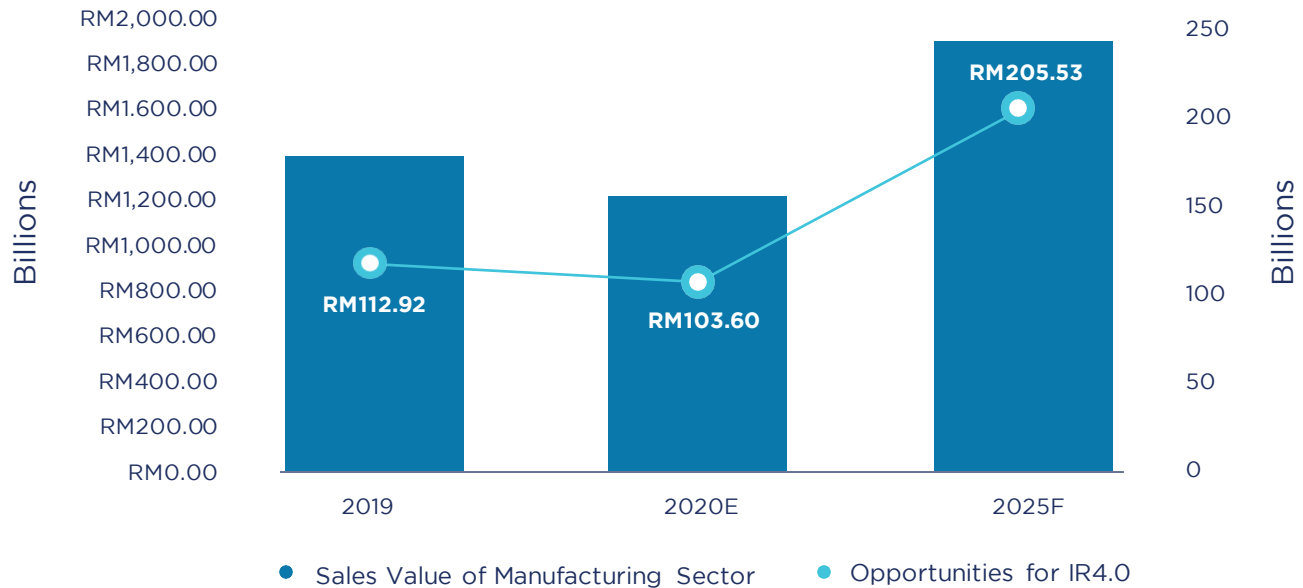
6.2%

2025 Market Share

The global market is highly focused, with major players dominating the overall market share. North America dominated the world, followed by European players. Nevertheless, more players from APAC will participate in the global race to dominate the IoNT market due to an increased market revenue in APAC.

APAC and the rest of the world will enjoy an increased market revenue contributed by a high growth rate. North American and European market share will be shrinking over the forecast period due to higher revenue in APAC and the rest of the world.

Malaysian 4IR Market Insight (2020-2025)⁽¹⁾⁽²⁾⁽³⁾

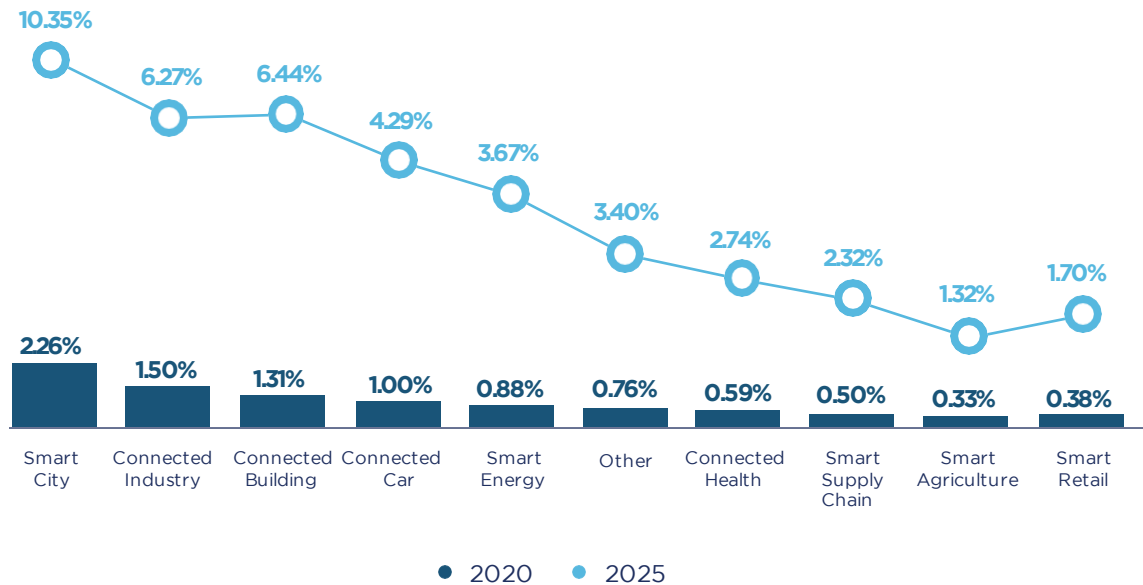


The Malaysian manufacturing sector recorded RM 1.376 trillion of total sales in 2019. In 2021, we estimated the total sales would go down to RM 1.212 trillion due to the COVID-19 pandemic. However, we expect the market to rebound post-COVID-19 in 2022 until 2025, when the market revenue reaches RM 1.864 trillion. The COVID-19 pandemic will shift the Malaysian manufacturing sector towards high-technology, innovative and high-value-added industries in years to come, namely Electrical & Electronics, Machine & Equipment, Chemicals, and Medical Devices in-line with Industry4WRD.

The market opportunities for IR4.0 will be expected to increase to RM 205.5 billion in 2025 due to the transformation and scale-up of SMEs to remain competitive by capturing the benefits of disruptive technologies and innovation.

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

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



The IoNT market opportunities are forecasted to reach RM42.5 billion in 2025, compared to the 2020 estimation of RM9.5 billion. The breakthrough of nanosensors technology and enhanced ICT infrastructures has paved the way for Malaysia to embrace the technology in the future. Smart cities will hold the most shares with 24.3% of the total IoNT market due to the increasing number of high-tier urban areas. This is further accompanied by the growing number of related industries, connected buildings, and connecting cars, making up RM17.05 billion of the total IoNT market in Malaysia.

Smart energy will be required to cater to the demands for better energy supply using nano-enhanced batteries and the power management system, making up RM3.67 billion market revenue for the IoNT market.

IoNT will open a new era in the medical industry with additional revenue of RM 2.74 billion. Smart supply chain and smart retail will be part of the new ecosystem, opening a market of RM4.02 billion in 2025.

To increase our self-sufficiency level (SSL) for an increasing Malaysian population in 2025 and further limited by the number of agricultural lands, the only option is to increase the crop yield in terms of quantity and quality through smart agriculture which will be valued at RM1.32 billion in 2025.

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

The background features a dynamic, abstract composition. On the left, a dense trail of red particles curves upwards. On the right, a blue particle trail curves downwards. These trails are set against a dark background with a grid of white dots. Two prominent wireframe structures, resembling molecular or crystalline models, are visible: one in the upper right and another in the lower right, both rendered in a light purple or blue hue.

02

**About
NanoMalaysia**

Who We Are



NanoMalaysia Berhad (NanoMalaysia) is Malaysia's lead agency responsible for the commercialisation of nanotechnology in the country. NanoMalaysia was incorporated by the Government of Malaysia in 2011 as a special purpose vehicle to spearhead the growth of the national nanotechnology sector. Nanotechnology was identified under the New Economic Model (2011 - 2020) as a crucial new growth engine and a key enabler to drive innovations across all technology-based sectors.

NanoMalaysia's role is to support commercial entities within the nanotechnology industry, to achieve targeted outcomes in moving towards an innovation-driven economy. Our support ecosystem includes global marketing activities, helping build sectoral talent, providing financial and infrastructure resources, assisting with technology and knowledge transfers, and catalysing product innovations leveraging nanotechnology.

Consequently, NanoMalaysia Berhad was incorporated as a company limited by guarantee (CLBG) under the Ministry of Science, Technology, and Innovation (MOSTI). NanoMalaysia has been entrusted with being the leading business entity in Malaysia, to advance nanotechnology commercialisation in the country.

Among the roles are:

- Commercialisation of nanotechnology research and development
- Industrialisation of nanotechnology
- Facilitating investments in nanotechnology
- Furthering human capital skills development in nanotechnology.

Our goal is to catalyse the growth of Malaysia's strategic industrial sectors with nanotechnology, through the various initiatives and programmes we have in place, towards creating a thriving innovation-driven national economy.



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**

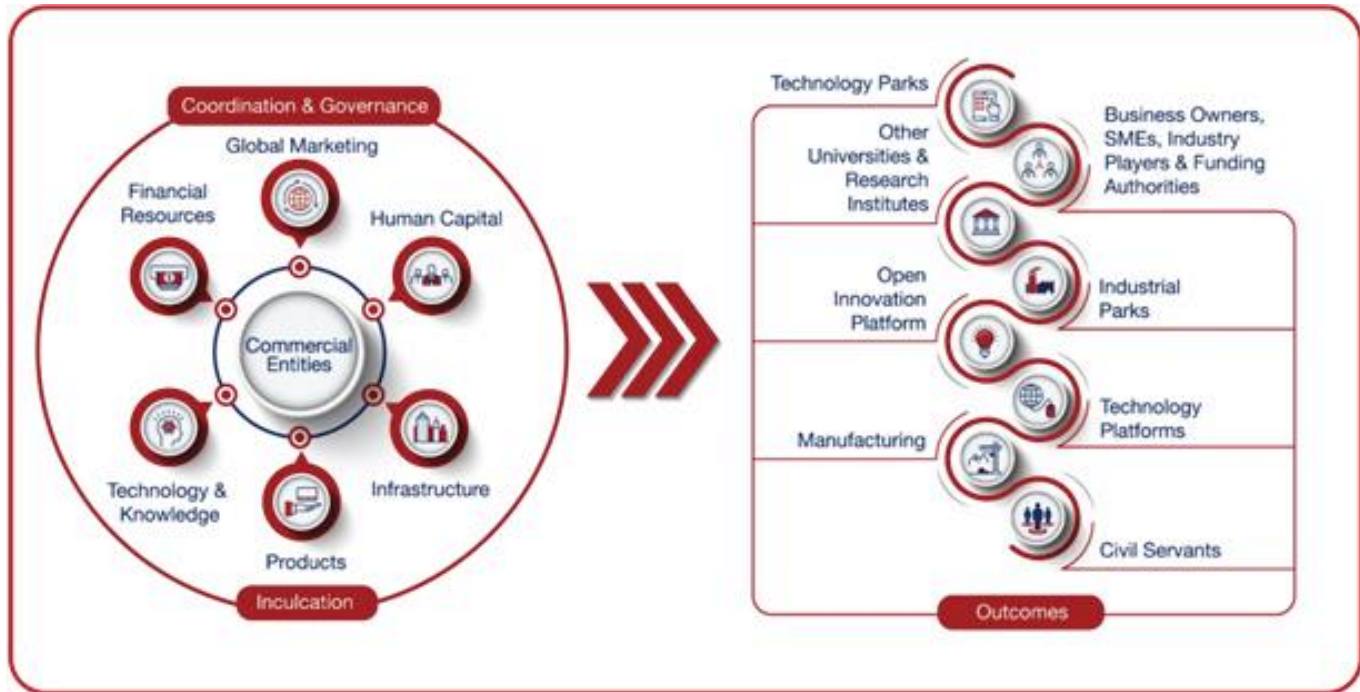


**To Strategise and
Coordinate R&D
Commercialisation**



**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



Company Information

Board of Directors:

- Chairman
Prof. Emeritus Dato' Ir. Dr Mohamad Zawawi Bin Ismail
- Director
Dato' Sri Ir. Dr. Judin Abdul Karim
- Director
Tan Sri Dato' Seri Dr. Salleh Bin Mohd Nor
- Director
Dato' Prof. Dr. Rujhan Bin Mustafa
- Director
Dato' Ahmad Shukri Bin Hj. Tajuddin
- Director
Mohd Yusof Bin Hussian
- 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

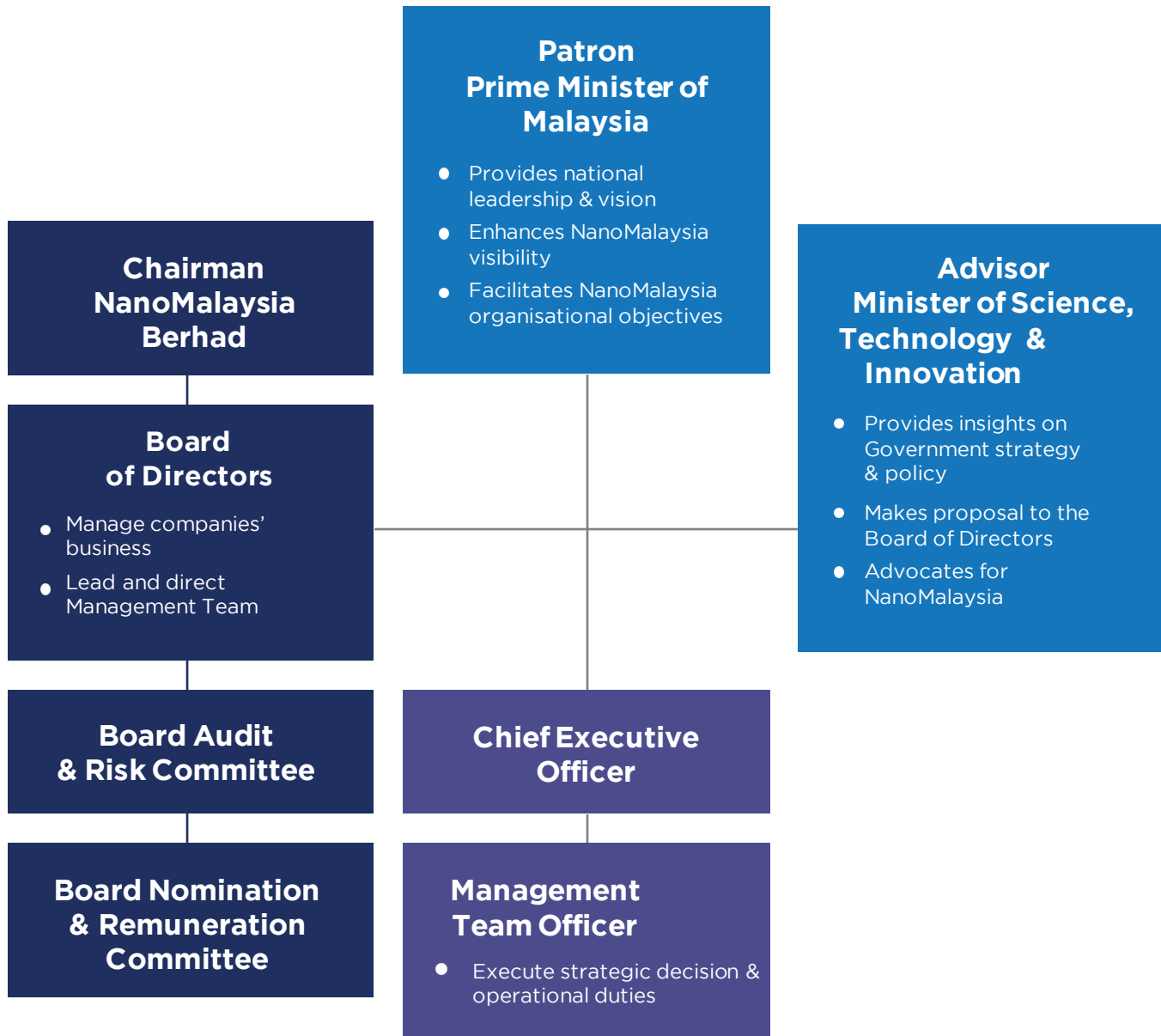
Website:

- www.nanomalaysia.com.my

Auditor:

- A. Razak & Co.
Aftas Corporate Advisory
Services Sdn Bhd

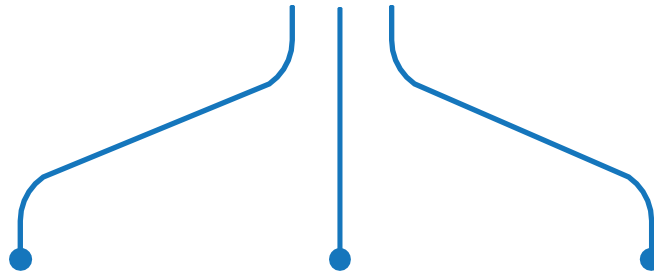
Governance Structure



Corporate Structure



NanoMalaysia Berhad
Holding Company



NanoVerify Sdn Bhd
Consultation and verification company



Nano Commerce Sdn Bhd
Business and commercial company

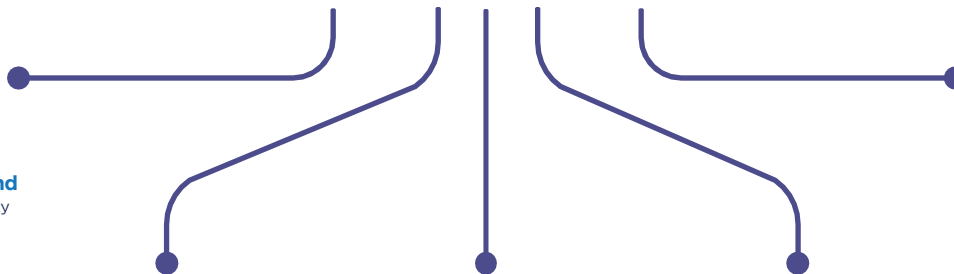


Nanovation Ventures Sdn Bhd
Investment facilitation company



NANOTEXTILE

NanoTextile Sdn Bhd
Shareholding: 30% equity



Pulsar UAV Sdn Bhd
Shareholding: 73% equity



NanoQuartz Sdn Bhd
Shareholding: 100% equity



Infusion Materials Labs Sdn Bhd

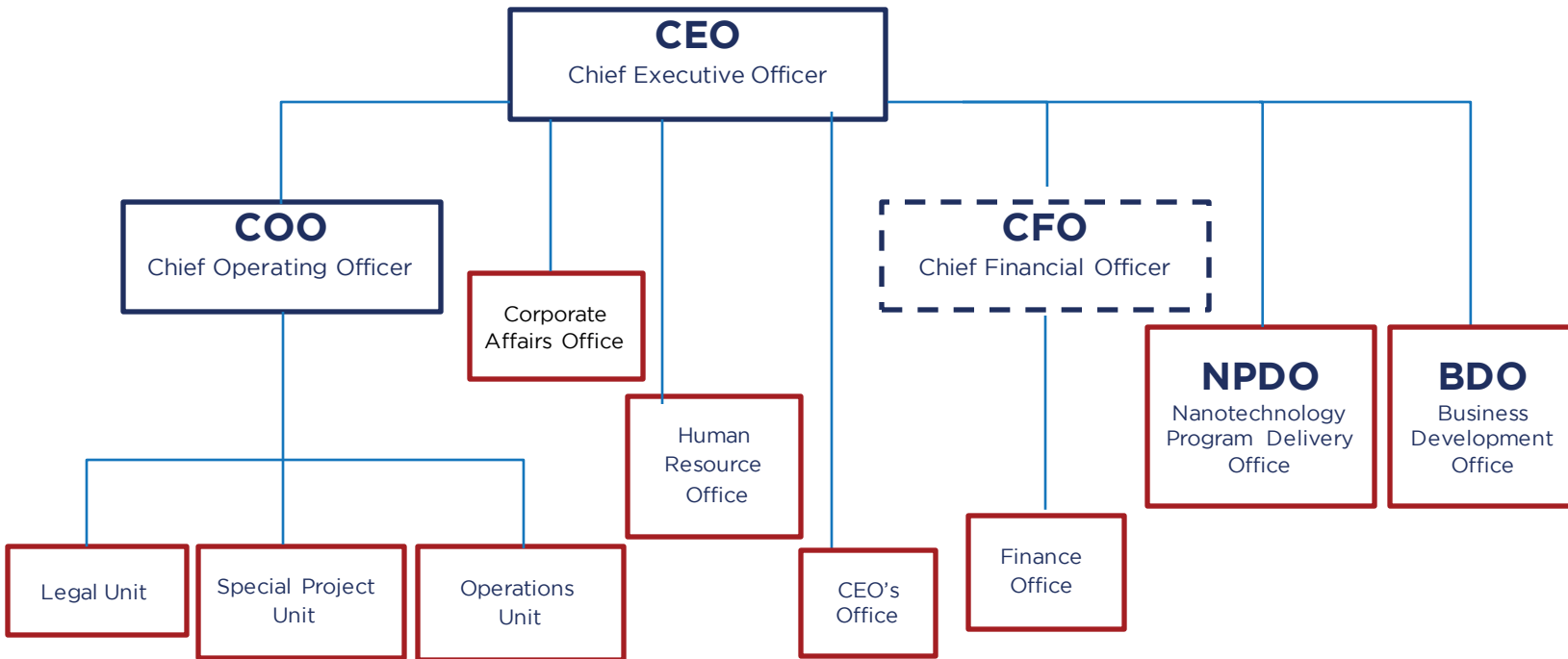
Shareholding: 100% equity

NANOPAC

Nanopac Innovation Sdn Bhd

Shareholding: 40% equity

Organisational Chart



Board Members



Board Members

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

Chairman



Dr. Zawawi joined NanoMalaysia in 25 Nov 2011. Prior to joining NanoMalaysia, he was the founding Vice-Chancellor of Universiti Malaysia Sarawak (UNIMAS), the Dean of Engineering and Deputy Vice-Chancellor of Universiti Kebangsaan Malaysia (UKM), the Founding Director of Commerce Leadership Institute of CIMB Group and one of the founders of Mimos Berhad. Dr. Zawawi had once served the Board of Malaysia Qualifications Agency MQA, Chairman of the Higher Education APEX Committee, Board Member of International Medical University, Board Member of National Defence University, Board Member of Razak School of Government, Chairman of Universiti Sains Malaysia (USM) and Chairman of Universiti Kebangsaan Malaysia. He had served several national bodies including National Information Technology Council, National Aerospace Council, National Scientific Research and Development Council, and National Higher Education Council. He was once advisor to both the National Science Centre and National Planetarium. Dr. Zawawi gained both his bachelor and doctorate degrees from the University of Leeds. He is a Foundation Fellow of the Academy of Sciences Malaysia, a Member of the Institute of Engineers Malaysia, and an Honorary Fellow of The Institute of Physics Malaysia for which he once served as its President (1976-79).



Dr. Rezal Khairi Ahmad

Dr. Rezal was appointed as the Chief Executive Officer of NanoMalaysia in January 2013 and is a Board Member since 16 July 2014. He is the architect of NanoMalaysia's Commercialisation Modul and Programme under the 11th Malaysia Plan including NGAP2020. He serves as Chairman of Advanced Materials Investment Advisory Panel Working Group under Malaysian Investment Development Authority (MIDA), Treasurer for Asia Nano Forum (ANF) and Chairman of Commercialisation Working Group under Asia Nano Forum. In September 2017, he was appointed as International Advisor to China Graphene Industry Alliance (CGIA) linking Malaysia's National Graphene Action Plan 2020 (NGAP2020) and mutual economic benefits. Dr. Rezal holds a Ph.D. in Nanotechnology, Electronic/Electrical Engineering from London Centre for Nanotechnology, University College London as the first Khazanah PhD Scholar from 2007 to 2010 with publications in high impact journals.



Dato' Sri Ir. Dr. Judin Abdul Karim

Member of Board Audit & Risk Committee

Dr. Judin joined NanoMalaysia in 25 November 2011. A former Director General of the Public Works Department, Dr Judin is a Fellow of IStructE United Kingdom, Fellow of the Institution of Engineers Malaysia (IEM) and Fellow of Academy of Sciences Malaysia. He is also the President of Board of Engineers Malaysia (BEM) and the Chairman of the World Road Association (PIARC) for Technological Exchanges and Development Commission. Dr. Judin is currently the Chairman of CIDB Holdings Sdn Bhd. He graduated from the University of Southern California, holding a Master of Science in Structural Engineering and Ph.D. in Civil Engineering.



Dato' Ahmad Shukri Bin Hj. Tajuddin

Member of Board Audit & Risk Committee

Dato' Ahmad Shukri joined NanoMalaysia in 25 November 2011 and a member of the Board Audit Committee. He has over 25 years of experience in various capacities in the private and government sector and has accumulated vast experience in property, construction, business and technology development. Dato' Ahmad Shukri is an Advisory Panel Member on Innovation to Malaysian National Productivity and was Technical Advisor and Head of Study Team, Government of Zambia for the setting up of Industrial Park in Zambia. He obtained his MBA from Greenwich University, Australia and is currently the Chief Executive Officer (CEO) and member of board of Senai Hi-Tech Park. Prior to that, he was the former CEO and member of board of Kulim Hi-Tech Park.



Tan Sri Dato' Seri Dr. Salleh Bin Mohd Nor

Member of Board Audit & Risk Committee

Member of Board Nomination & Remuneration Committee

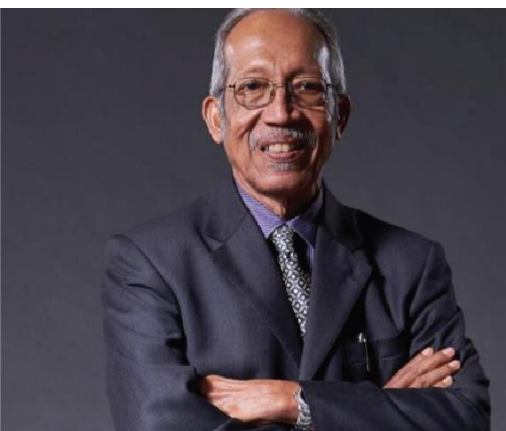
Respected conservationist and academician, Dr. Salleh has played a major role in the protection of the Malaysian environment and the conservation of nature and natural resources, particularly via his position as the First Director-General of the Forest Institute of Malaysia (FRIM) and the President of Malaysian Nature Society (MNS). A Merdeka Award recipient and one of the 50 "Tokoh Malaysia" award winners, Dr. Salleh received his Ph.D. and Master's Degree from Michigan State University. Dr. Salleh chairs the Antarctica Task Force and has visited Antarctica twice and is currently the Pro-Chancellor of Universiti Teknologi Malaysia.



Dato' Professor Dr. Rujhan Bin Mustafa

Chairman of Board Nomination & Remuneration Committee

Dr. Rujhan joined NanoMalaysia in 25 November 2011. He is also the Chairman of Board Nomination and Remuneration Committee. Dr. Rujhan received his Ph.D. and Master's Degree in International Economics from Ritsumeikan University, Japan. He is a Council Member of the Malaysian Qualifications Agency and The National Council for Science and Research. He is currently the Chief Executive Officer of Education Malaysia Global Services (EMGS) and the Chief Executive Officer, Education Performance and Delivery Unit.



Mr. Mohd Yusof Bin Hussain

Chairman of Board Audit & Risk Committee

Member of Board Nomination & Remuneration Committee

Mr. Mohd Yusof bin Hussain, CA (Malaysia), FCCA (UK), MCIPS (UK), CFP (USA), is currently the Non-Executive Chairman of Tune Insurance Malaysia Berhad, an associate Company of Air Asia Group i.e. (the largest public-listed subsidiary company under Tune Protect Group Berhad. He is also currently an independent non-executive director (INED) of Boilermach Holdings Berhad (a public-listed associate Company of QL Resources Berhad) where he is a member of the Audit and Nomination Committees. Yusof is also an independent non-executive director of Proton-Commerce, a joint venture Sdn Bhd between Proton and CIMB. In January 2019, Yusof latest appointment was as an INED, Chairman of BAC and member of NRC of NanoMalaysia Berhad a public company limited by Guarantee and fully owned by the Government.



Dr. Mohd Nor Azam Bin Hassan

MOSTI's Representative

Member of Board Audit & Risk Committee

Dr. Mohd Nor Azman Hassan is currently the Deputy Secretary General (Science) of the Ministry of Science, Technology and Innovation (MOSTI). He oversees the policies and development of science, technology and innovation ecosystem to support the socio-economic development of the country. His previous positions were in the areas of higher education, policy and technological development including industrial related technologies such as renewable energy, advanced materials and manufacturing, biotechnology and nanotechnology. He had extensive engagements with the industry especially the SMEs, to communicate government's policies relating to STI. Dr. Azman holds a doctoral degree from Carnegie Mellon University, Pittsburgh, USA in the field of renewable energy technology and is trained in conducting Life Cycle Analysis (LCA). He is also a registered Technologist with the Malaysian Board of Technologist.

Management Team



Dr. Rezal Khairi Ahmad

Chief Executive Officer

Dr. Rezal Khairi Ahmad was appointed as the Chief Executive Officer in January 2013 under a secondment from Khazanah Nasional. He is also a Board Member of NanoMalaysia and Nano Commerce Sdn Bhd, Founding Chairman of NanoVerify Sdn Bhd and Founding Director of Nanovation Ventures Sdn Bhd. Currently, he serves as Chairman of Advanced Materials Investment Advisory Panel Working Group under Malaysian Investment Development Authority, Treasurer for Asia Nano Forum, Chairman of Commercialisation Working Group under Asia Nano Forum and Member of the Board of Governors for Malaysia Laboratories for Academia -Business Collaborations (MyLAB). In September 2017, he was appointed the International Advisor to China Graphene Industry Alliance (CGIA), linking Malaysia's National Graphene Action Plan 2020 for mutual economic benefits. Formerly attached to the College of Engineering, Universiti Tenaga Nasional as an academician and Head of Semiconductor Group from 1998 to 2007, he was also an engineer at Tenaga Nasional ICT in 2003. In 2000, he co-founded Malaysia -Events Sdn Bhd, a start-up e-commerce platform. He was also appointed as Adjunct Professor at Universiti Teknologi Malaysia (UTM) in 2020. In 2021, he was appointed as a member of the Malaysian Petroleum Resources Corporation Industry Advisory Panel (IAP) to provide guidance on new energy opportunities in the oil and gas sector. He holds a PhD in Nanotechnology, Electronic/Electrical Engineering from the London Centre for Nanotechnology, University College London as the first Khazanah PhD Scholar from 2007 to 2010 with publications in high impact journals. In 2014, he was instrumental in crafting out Malaysia's National Graphene Action Plan 2020 and co-authored chapters pertaining to innovation under the 11th and 12th Malaysia Plan. He is also the architect of the nanotechnology commercialisation ecosystem in Malaysia. In 2017, he was listed as one of Malaysia's key business influencers by International Business Review and since 2019, he is Malaysia's Top 100 LinkedIn Icons. His current endeavors include renewable energy solutions including latest PV, hydrogen and battery technologies, projects on Internet of NanoThings and blockchain applications for high technology management towards the 4th Industrial Revolution.

Management Team



Mohamad Hafiz Bin Zolkipli

Chief Operating Officer

Mr. Hafiz was appointed as Chief Operating Officer in August 2018. He joined NanoMalaysia as the Senior Vice President, Operations in 2016. Prior to joining NanoMalaysia, he was with Petroliaam Nasional Berhad (PETRONAS) as the Head of Business Process Advisory and Solutions in the Malaysia Petroleum Management division and Head of Risk Planning and Governance in the Project Delivery and Technology division. He has also worked in various manufacturing and business processes functions across a wide range of industries; from manufacturing at Westem Digital and Flextronics as a process engineer, to banking at CIMB Group as Manager of Business Process Engineering. Mr. Hafiz is a certified Lean and Six Sigma practitioner and has completed a wide range of process improvement activities and reengineering projects within Malaysia and abroad. He obtained his Bachelor of Mechanical Engineering from University College London, United Kingdom.

Management Team



Dr. Daniel Bien Chia Sheng

Senior Vice President, Nanotechnology Programme Delivery Office

Dr. Daniel was appointed as Vice President, Innovation Office in March 2015. He was previously with MIMOS Berhad as the Head of Nanoelectronics Centre of Excellence, where he focused on driving the National Nanoelectronics Roadmap. Prior to that, Dr. Daniel was the R&D Specialist at Philips Lumileds Lighting Company Sdn Bhd, overseeing all developments of silicon-based LED products in Malaysia. He has chaired the National Mirror Committee for the International Electrotechnical Committee, IEC TC-113 on Nanotechnology Standardisation for Electrical and Electronic Product and Systems for Malaysia from 2010 to 2015 and has filed more than 50 international patents and technical publications respectively. Dr. Daniel has a Ph.D. in Electrical and Electronics Engineering from Queen's University, Belfast, United Kingdom.



Arzaman Ariffin

Vice President, Human Resources

Mr. Arzaman was appointed as Vice President, Group Human Resources of NanoMalaysia Berhad in March 2021. Prior to that, he was with University of Kuala Lumpur (UNIKL) as Head, Corporate HSE of the Group Human Resources Division. With more than 23 years experiences in Human Resources, Training & Development, Talent Management, Payroll, Industrial Relations, Compensation & Benefits and Occupational Safety & Health (OSHA), Mr. Arzaman brings diversified administrative experience to Group Human Resources of NanoMalaysia Berhad. He holds the Bachelor of Business Administration from the MARA University of Technology (ITM) and Master in Business Administration from University of Malaya (UM).



Veronica Leong Mun Sum

Vice President - Operational Excellence, Group Operations

Ms Veronica Leong was appointed as Vice President, Operational Excellence for NanoMalaysia Berhad in November 2019. She was previously with Bioeconomy Corporation as Senior Manager for Industry Development in Industrial & Healthcare Biotechnology. She has worked across start-ups and multi-national companies in the life science and medical industries as a Product Specialist at Vivantis Lifescience working on development and commercialisation of lifescience products and as a Regional Sales Manager at Kimberly Clark Malaysia working on establishing key accounts and distribution channels for medical devices. She holds a Bachelor of Science with Honours from Monash University Clayton, Australia.

Management Team



Raja Riznal Raja Abidin

Vice President, Corporate Affairs Office

Raja Riznal joined NanoMalaysia in March 2018 as Vice President, Corporate Affairs Office. Previously he started up Allworks Distribution Sdn Bhd and Futsalworks Sdn Bhd, where he managed all matters related to communications, branding and sales as well as the creative designs for the companies. He was also with DISITU Holdings where he assisted in setting up Odyssey Prestige Coaches and Compass Coaches. From 2000 to 2005, Raja Riznal was at PETROSAINS Sdn. Bhd, where he developed, coordinated and implemented marketing, branding and communication strategies and initiatives of PETROSAINS. He has also coordinated external and internal events, activities and programmes working with the Corporate Affairs Unit (CAU) and the Motorsports Division within PETRONAS to reach out the public through their F1 and CSR activities. He has a B.A. in Film & Video from the Arts Institute of Bournemouth, United Kingdom.



Hairul Hafiz Hasbullah

Vice President, Legal Unit

Mr. Hairul was appointed as Vice President, Group Legal of NanoMalaysia Berhad in August 2020. Prior to that, he was with HRD Corporation (Formerly known as “Human Resource Development Fund (HRDF)” as a Legal Advisor and Secretarial. It is agency that manage the levy under PSMB Act 2001 for training purposes under Ministry of Human Resources. He holds the Bachelor of Laws from the University Technology MARA. He also obtained advanced certificate from; University of London (International Law and Legal Studies) and University College London (UCL) (EU General Data Protection Regulation).



Dr. Roslan Bakri bin Zakaria

Senior Vice President, Business Development

Before joining NanoMalaysia, Dr. Roslan, an entrepreneur, had 6 startups since 1996, co-founded a prominent tech entrepreneur community, New Entrepreneur Forum where he was elected as their third President. Dr. Roslan was seconded to the Prime Minister’s Office in 2010 for two years to help strategize, develop, and build a sustainable youth development engagement framework for social innovation. In 2014, Dr. Roslan decided to pursue his Doctoral Degree at the Brunel University of London where he researched Organizational Innovation, Transformation, and Digital with a special focus on state-owned enterprises and proposed a chaos-based structured framework for transformation. He also holds a Degree in Economics from Indiana State University and a Diploma in Accountancy from Universiti Teknologi MARA (UiTM).

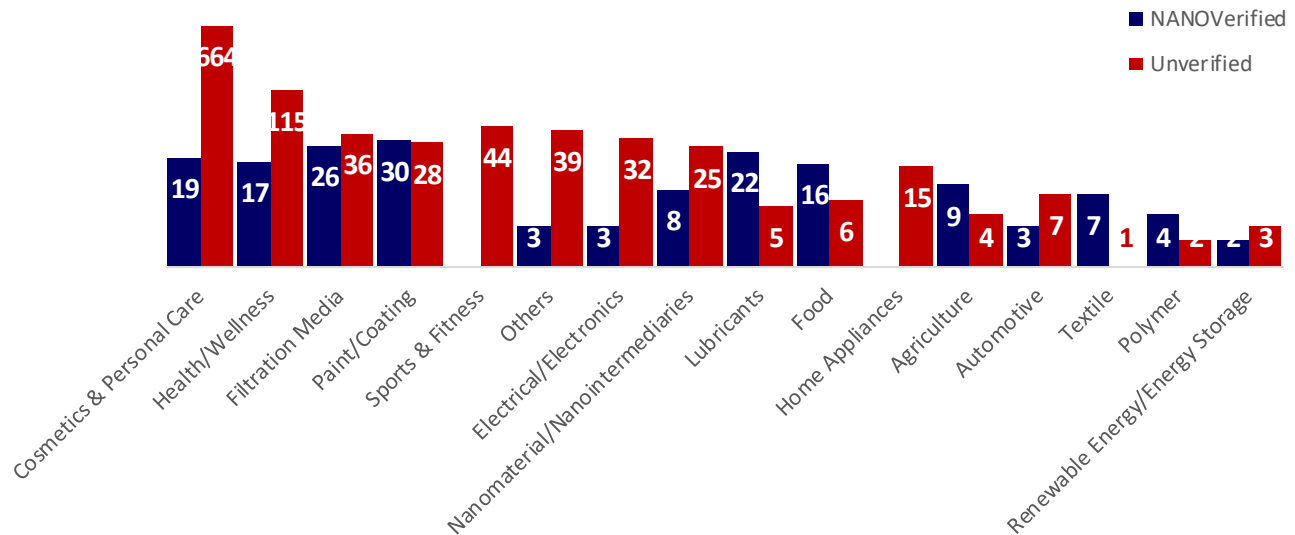


03

**The Nanotech
Industry**

Malaysian Nanotechnology Landscape

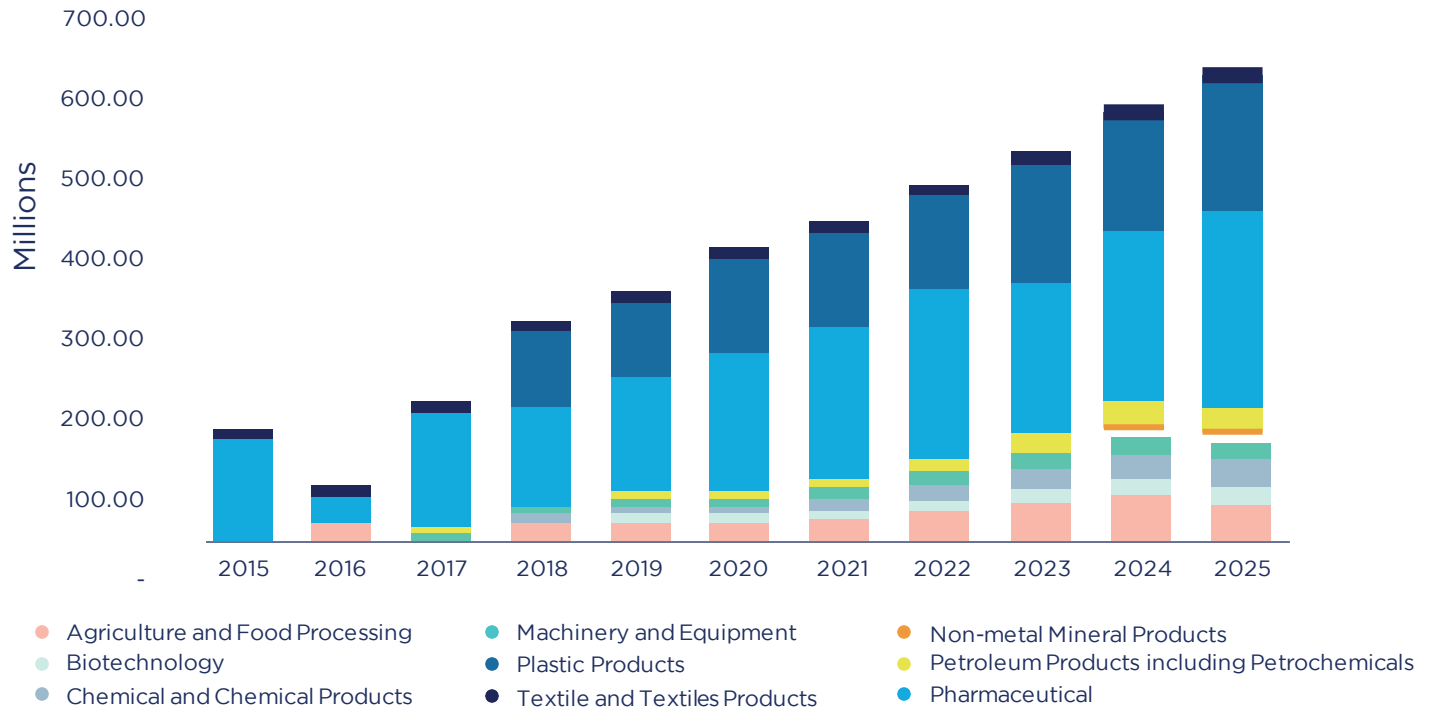
Malaysian Nanoproducts, By Category In 2021 (NanoVerified vs Potential)



Cosmetics, healthcare and sports sectors make up the primary shares of the Malaysian market, driven by the rapidly growing advancements in potential applications. Significant developments have been observed within the past few years in the healthcare, cosmetics, coatings and automotive.

Industry players globally are expected to invest significantly in research and development (R&D) activities to capture greater market share and to cater to the rising demand for nanotechnology-based devices and equipment. Challenges exist in the form of the high-cost nano-based devices. This could potentially slow down the growth of Small and Medium Enterprises (SMEs) due to the insufficient funding or the lack of specialised skills in the field. In conclusion, more efforts are needed to build sectoral human resource capacities.

Malaysian Verified Nanotechnology Product Market Revenue (2015-2025, RM mil) ⁽¹⁾



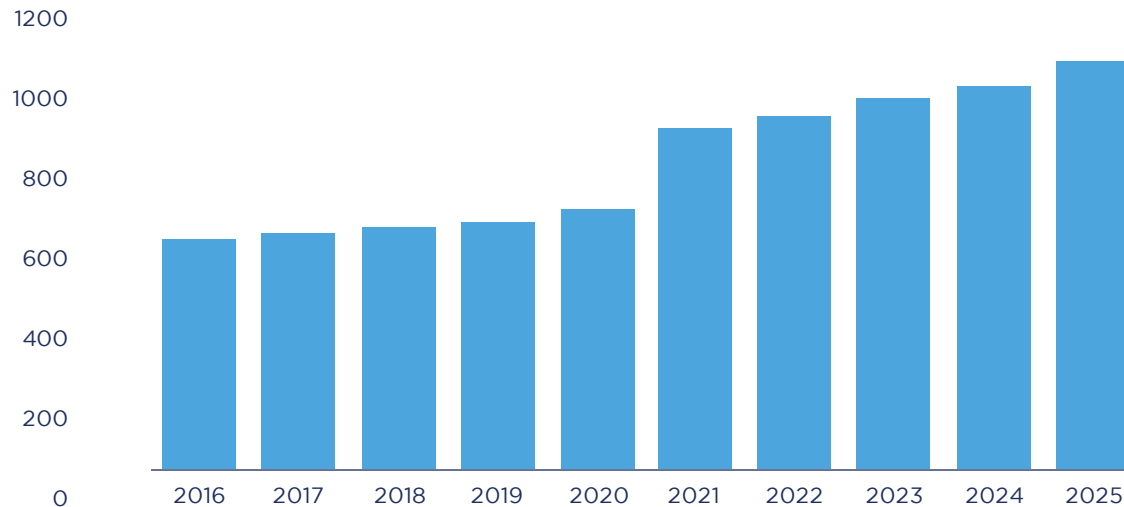
Malaysian nanotechnology products market revenue was valued at RM322.307 mil in 2019 and is expected to grow amid COVID-19 pandemic. This is because nanotechnology serves as a technology-enabler to combat COVID-19. Nanomaterials play a pivotal role as disinfectant and other preventive measures from SARS-CoV-2. For these reasons, we expect that the revenue from biotechnology, chemical, pharmaceutical, plastic and textile manufacturers to rise despite the challenges ahead.

We expect that the local nanotechnology scene to register healthy CAGR of 10.9% for the forecast period of 2020-2025 where pharmaceutical and plastic products will dominate the Malaysian market with each of them registering RM 249.46 million and RM 234.72 million respectively.

As the number of verified companies increase via NANOVerify Programme over the next 5 years, we expect that the revenue and participations from more sectors will be increasing.

Growing Numbers of Certified Malaysian Nanotechnology Products

Growth of Potential Nanotechnology Products in Malaysia ⁽¹⁾



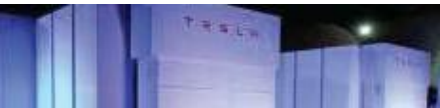
Due to the importance of certification in the Malaysian market, NVSB aims to increase the number of certifications for 2021. Currently, 139 out of 1,056 products (13.2%) have been certified under the NANOVerify Programme [1]

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 gate and quantum annealing systems are expected to have application in AI.



Porous Framework (PCP, MOF and COF)

These compounds have controllable nano spaces that could be used for highly selective adsorption/ desorption fields, electronic/ ionic conductivity and specific reactions.



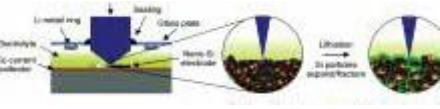
Topological Insulators

A candidate for next-generation electronic device, exhibiting a unique metallic state at its boundaries (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.



04

**NanoMalaysia
Programmes**

Focusing On 4 Keys Strategic Jumpstart Sectors



Food and Agricultural

- Nanofiber, Nanocellulose (Forestry Nanotechnology, Filtration system)
- Food processing and management (Smart packaging)
- Nanofertiliser (Bio-active ingredient detection and database)



Energy and Environment

- Drug delivery (Nanomedicine, biosensors)
- Packaging and systems (Nanonetworks for healthcare applications,RFID)
- Antimicrobial applications (Antimicrobial assays)



Wellness, Medical and Healthcare

- Li-ion battery anode/ultra-capacitors (Power system)
- Advanced materials (Nanogenerators, Nanochip)
- Green energy and power technology (Sensors for alternative power sources)



Electronic Devices and System

- Nanosensors (Scalar sensors & system)
- Nanoelectronics (Processors, NEMS)
- Nanodevices (Phones, cameras etc.)

NanoMalaysia Four Key Strategic Sectors

Sector: Food and Agriculture



Food and Agricultural

Two main types of agriculture dominate this sector in Malaysia – plantation and food production. Traditionally, plantation agriculture formed the main thrust of Malaysia's economic growth and remained one of the significant contributors to GNI.

In 2021, the agriculture sector contributed RM148.45 billion, or 9.61%, to Gross Domestic Product (GDP). Of this, oil palm was the most significant contributor at 4.8%, followed by other agriculture at 5.4%, livestock at 1.2%, fishing at 0.8%, rubber at 0.2%, and forestry and logging at 0.4%. While our plantation production capacities remain strong (especially in oil palm exports), our food production capacities are progressing slowly compared to our neighbors.

Considering the increasing prevalence of natural disasters such as earthquakes, tsunamis, storms, and droughts impacting the planet's ecosystem, food security has become a pressing issue in current times. Nanobiotechnology could potentially play a critical role in increasing agricultural productivity, boosting pest resistance, and improving food quality.

In addition, applying nanobiotechnology to agricultural food production can help avert global food crises.

Malaysian Nanotechnology Market Size

The Malaysian trade performance for the food and agricultural industry was valued at RM 148.45 billion in 2021, an increase of 9.13% compared to 2020. Currently, the national policy focuses on increasing our self-sufficiency level (SSL) to 90-100%, where we currently stand at 60-70%. To address this issue, our strategy now is to optimise yield from available lands instead of acquiring and developing new fields, which are costly and limited. New technologies are developed, particularly precision agriculture technology, to optimise crop yield in quantity and quality. Nanotechnology plays a pivotal role in precision farming, especially in the formulation of nano-fertilisers which delivers promising results. It is expected that if the nano-fertilisers could penetrate 28.63% of Malaysian paddy fields, our SSL could increase to 71.81%, with increased revenue of RM 1.73 billion. Based on our study, we expect the total nanotechnology market size in food and agriculture to reach RM 1.31 billion in 2025.

NanoMalaysia Four Key Strategic Sectors

Sector: Energy and Environment



Energy and Environment

Malaysia is blessed with abundant natural energy sources such as solar energy, biomass from plantation agricultural by-products, petroleum and natural gas reserves, and tidal wave and wind energy. In line with the need to combat the effects of climate change, the Ministry of Science, Technology, and Innovation have committed to a national target of achieving 20% renewable energy as the nation's electricity source by 2030.

To achieve this goal, we need to consider innovative new ways to transfer energy from its source to consumers in the most cost-effective, safe, and convenient ways. The focus is on generating a higher degree of portability, more extended usage periods, higher energy outputs, and more sustainable sources of energy supply. With conventional technology has reached the limits of its energy processing and storage capacity, we are now turning to nanotechnology to boost energy capacities and optimise processes.

Nanotechnology can be used to enhance energy efficiency across the board by embedding state-of-the-art technological solutions to optimise energy production. Using nanotechnology also presents a greener and more sustainable energy solution for the longer term

Malaysian Nanotechnology Market Size

The Malaysian trade performance for energy and environment was valued at RM 61.90 billion in 2021, an increase of 35% compared to 2020. Malaysia is on the right track to achieve our national goal of 31% by 2025 and 40% by 2035, looking at our current trajectory of 23% installed mix capacity. Based on a report by the Sustainable Energy Development Authority (SEDA), the total approved Net Energy Meeting (NEM) 3.0 Programme quota stands at 500MW, where a large portion of it comes from the industry (300MW). Nanotechnology plays an integral part in Energy and Environment due to its application in supercapacitors, fuel cells, solar cells, lithium-ion batteries, and under environmental applications through nano absorbents, nanocatalysts, and nanomembranes for water and wastewater treatment. The nanotechnology market size in energy and the environment is expected to reach RM 2.1 billion in 2025.

NanoMalaysia Four Key Strategic Sectors

Sector: Wellness, Medical and Healthcare



Wellness, Medical and Healthcare

Malaysia's wellness, medical, and healthcare sector continues to be one of the most dynamic, recording rapid growth and development, especially within the private healthcare sub-sector. The industry has significantly improved over the past decade due to extensive Government support in terms of investment in hospital medical infrastructure. Today, Malaysia's healthcare sector is on par with developed nations, consisting of highly trained medical staff complemented by excellent hospital facilities.

Malaysia's healthcare sector has received international recognition as being among the best in the world, thus creating global awareness of our healthcare system's strengths. In 2019, Malaysia was ranked first in the Best Healthcare in the World category of the 2019 International Living Annual Global Retirement Index. The previous year, in 2018, the International Medical Travel Journal recognised Malaysia as the Medical Tourism Destination of the Year, the third time it had done so.

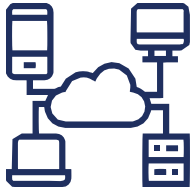
Healthcare delivery is transforming on the back of digital healthcare trends due to Industry 4.0 applications. The digital healthcare market is estimated to exceed USD379 billion by 2024. Recognising its tremendous growth potential, the Malaysian Government has identified healthcare equipment as one of the focus sectors of the National Policy on Industry 4.0. A straightforward way forward lies in leveraging breakthrough nanotechnology products and solutions, especially in drug delivery systems and anti-cancer treatment areas.

Malaysian Nanotechnology Market Size

The Malaysian health and wellness trade performance was valued at RM 14.28 billion in 2021 where imports and exports are balanced. In the other hand, medical instruments and devices with a total trade value of RM18.9 billion. The pharmaceutical sector has grown by an average annual rate of 8% over the last decade, reaching RM8.6 billion or 16.5% of total healthcare expenditure (RM52 billion). Imported medicines at RM5.4 billion still account for the largest part (63%) of the RM8.6 billion pharmaceutical market, while exports are only RM0.7 billion. Generic medicines now account for 55% of the controlled (prescription) medicines market by value. Pharmaceutical products manufacturer employs 23,344 employees in 2020, an increase of 9.5% from 2019 due to the demand during COVID-19 pandemic. Malaysia. Through nanotechnology, health and wellness products can be enhanced such as the use of nanosilver to provide anti-bacterial properties, the use of nanoparticles in drug delivery system, use of nanoparticles in medical imaging and the use of graphenes to enhance sensitivity of sensors especially in glucometers. The total addressable market for nanotechnology application in health and wellness is expected to reach RM 1.93 billion in 2025.

NanoMalaysia Four Key Strategic Sectors

Sector: Electronic Devices & System



Electronic Devices and System

The Electronics and Electrical (E&E) industry is one of the major sub-sectors of the manufacturing sector in Malaysia. E&E primarily consists of two leading industry components - computer, electronic and optical products, and electrical equipment. An essential contributor to the national economy, a vital contributor to the national economy, in 2021, E&E was Malaysia's largest export earner at RM368.1 billion, with 3.5% increase despite the COVID-19 pandemic[1].

The manufacturing sector grew strongly by 9.1% in the 4th quarter of 2021, led by electrical, electronic, and optical products (16.4%). The added value of the E&E sub-sector stood at RM75.9 billion in 2020, an 5.6% increase from the previous year. The increase in the sector's value is attributed to an industry shift from low-value-added activities to high-value operations to enhance the local sector's competitiveness within the international business landscape.

The increase in the sector's value is attributed to an industry shift from low-value-added activities to high-value operations to enhance the local sector's competitiveness within the international business landscape. Employment within the E&E sector has seen a decrease in the total manufacturing workforce by -1.2%, comprising of 556,223 workers as at end of 2020². However, the manufacturing industry is forecast to rebound by 7% in 2021³.

There is tremendous potential for the E&E sector to move up the manufacturing value chain and thus propel its growth by adopting nanotechnology within its manufacturing processes. Opportunities for growth and expansion are fueled by the advent of breakthrough discoveries in nanotechnology such as nanoelectronics and nanophotonic, as well as the rise of the Internet of Nano Things (IoNT).

Malaysian Nanotechnology Market Size

Electronic devices and systems in Malaysia were valued at RM 770.0 billion in 2021, where 40.9% (RM 455.73 billion) are exported goods. Electronic integrated circuits and micro assemblies made up a large chunk of the shares, with an export value of RM 368.1 billion. Malaysia's electrical and electronics (E&E) manufacturing industry will employ 556,223 paid employees in 2020. Nanotechnology complements the E&E industry through 2D materials such as graphene and carbon nanotubes, providing better performance than conventional counterparts. It is expected that the nanotechnology market for electronic devices and systems to be estimated at RM 1.78 billion in 2025.

Sources: (1) Department of Statistics Malaysia
(2) Economy Outlook 2021- Ministry of Finance

Innovation Highlights from 11th Malaysia Plan Programmes



Advanced hybrid graphene engine oil

- Lower wear and friction
- Higher heat transfer capacity
- Lower oil volatility
- Lower fuel consumption



Graphene nanofluid for cooling systems

- Lower specific heat capacity
- Lower energy consumption
- More efficient chilled water air system



Graphene-enhanced engine oil

- Lower frictional wear
- Lower volatility at high heat condition, therefore better engine protection



Graphene-based fluid loss control additive for drilling fluid

- Improve rheological, filtration loss properties, drilling efficiency, cost reduction, green technology

Graphene-based printed flexible circuit for electronic application

- Improved conductivity and flexibility
- 10-30% cost reduction

Nano Solar **Nano Sensors**
Nano Adsorbant **Nano Fertilizer**

Smart Urban Farming

Forklift Graphene Tires

- 1.5 times better than the virgin tires
- High abrasion rate
- 10% improvement in compression set and high tensile strength while being 30% cheaper than conventional tires

Graphene ESD LATEX GLOVE

- Comfort and less fatigue
- Higher tensile strength and elongation
- Sustainability and biodegradability

Development and Proof of Value (POV) IONT Solution for Linen Management

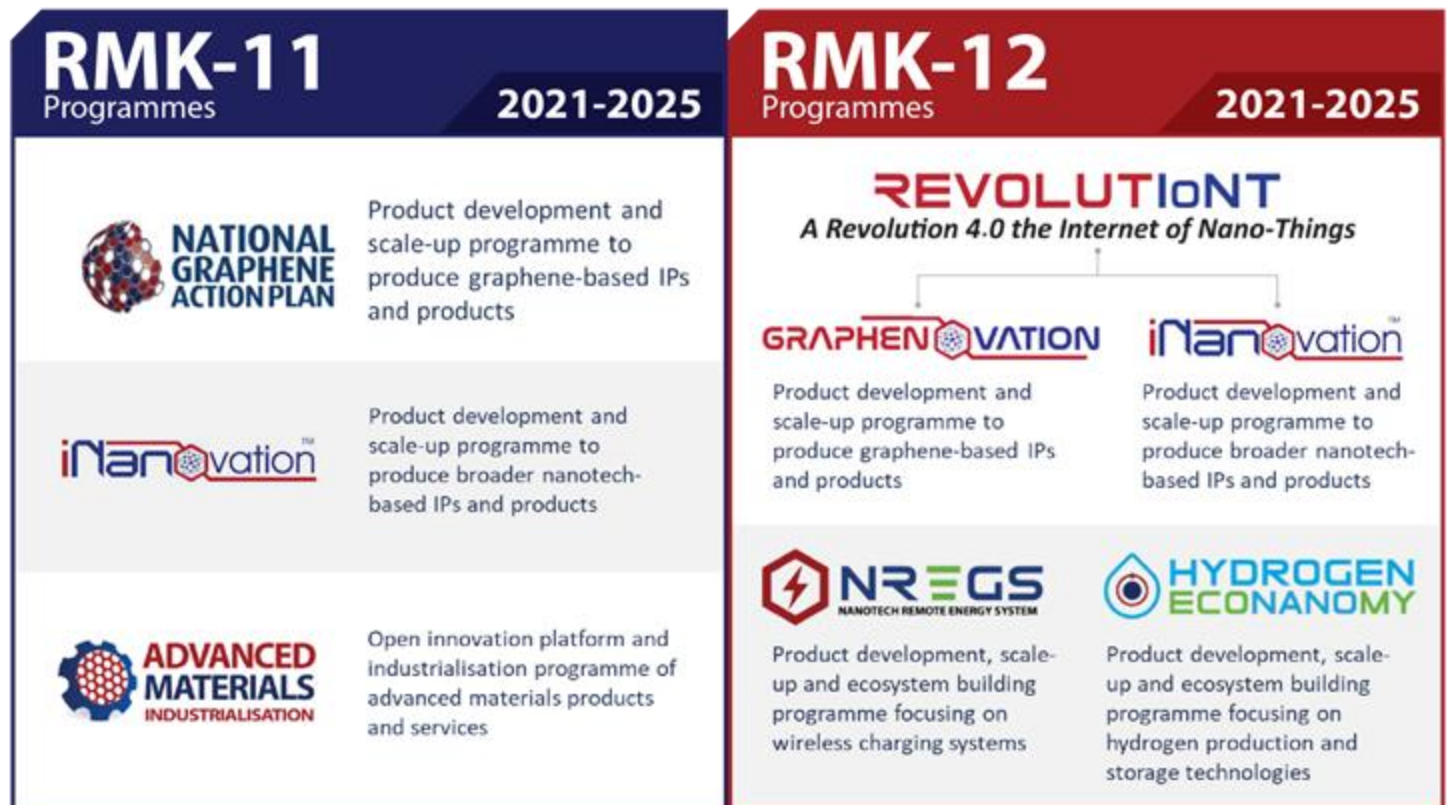
Production of Cu-CNT Substrates for LED Applications

Nanofibre and Nanocellulose from Oil Palm Empty Fruit Bunches

- Lightweight graphene-based materials for enhanced structural applications and improved fuel efficiency without compromising safety.
- Increased recyclability and reduced plastic contribution.

Production of nano-silica from rice husk

Project Investment Model under NanoMalaysia



Project Highlights

Onboard Generated Hydrogen Fuel Cell

Internet of Things (IoT)
Data Pairing with GPS module



Precision Plantation Services Mapping by drone
powered by fuel cell with onboard hydrogen
generation system

Project Highlights

Project HyPER-Hydrogen-Paired Electric Race Car



Fuel Cell Stack



Hybrid Energy Storage System



Electric Motor



Tyres



Benefits

To produce a locally developed electric vehicle powered by NanoMalaysia's "Hydrogen-paired Hybrid Energy Storage System" (H2SS)

Methodology

Deploy H2SS into a high-performance automotive platform



MoA Exchange Ceremony on 28th Oct 2019 witnessed by YB Yeo Bee Yin (MESTECC Minister)

Project Partners

- 1 NanoMalaysia Berhad**
 - Overall coordination, project management & Complimentary funding
 - Liaison between project partners and government or private investor
- 2 EV Connection & UM Power Energy Dedicated Advanced Centre (UMPEDAC)**
 - Hybrid Energy Storage System (HESS) composed of graphene-based Ultracapacitors & Li-Ion batteries
- 3 Pulsar UAV Sdn. Bhd.**
 - Onboard generated hydrogen with fuel cell stack
 - Power system integration with HESS to produce H255
- 4 Wheelspin Motorsports**
 - Vehicle platform Providers
 - Promotions within Motorsports industry

Project Highlights

E-Motorbikes

ES11 Electric Scooter



Fast Charging



Fully Electric



Eco-Friendly

Battery Monitoring System (BMS)

Sistem Pemantauan Bateri (BMS)

The Eclimo's electric scooters fitted with Battery Monitoring System (BMS) for commercial deployment.

Skuter elektrik Eclimo dilengkapi dengan Sistem Pemantauan Bateri (BMS) untuk penggunaan komersial.

The comprehensive application of the BMS is able to send out alerts if the battery voltage drops or increases to an alarming set level and has the tracking and playback capability. There are 14 series in the battery pack which has an upper limit of voltage set at 60V and a lower limit set at 46V. These limits are the alarm set levels which would be able to indicate to the driver. The lithium battery cell has improved the cycle life by almost three times compared to the previous normal battery cells. Remote monitoring feature via Mobile app is able to monitor Eclimo's electric scooters.

Aplikasi BMS yang menyeluruh dapat memberi amaran jika voltan bateri menurun atau meningkat kepada tahap yang membimbangkan dan memiliki keupayaan penjejakan dan ulang semula. Terdapat 14 siri dalam pek bateri yang mempunyai had atas voltan ditetapkan pada 60V dan had bawah ditetapkan pada 46V. Had ini merupakan had tetapan penggera yang boleh ditunjukkan kepada pemandu. Sel bateri litium memiliki hayat kitaran hampir tiga kali ganda lebih baik berbanding sel bateri biasa sebelumnya. Ciri pemantauan jarak jauh melalui aplikasi alat mudah alih dapat memantau skuter elektrik Eclimo.

Monitoring Through Internet of Nano Things (IoNT)

Pemantauan melalui Internet Pelbagai Benda Nano (IoNT)

Extended battery lifespan with integrated interconnectivity specifies the self regulating Internet of Nano Things (IoNT).

Jangka hayat bateri yang dilanjutkan dengan kesalinghubungan bersepadu menetapkan pengawalan sendiri Internet Pelbagai Benda Nano (IoNT).

Versatile Battery Monitoring Systems (BMS) with active cell balancing is able to monitor and manage different combinations of battery cells / hardware module / pack.

Sistem Pemantauan Bateri (BMS) serba boleh dengan pengimbangan sel aktif mampu memantau dan mengurus kombinasi sel bateri / modul perkakasan / pek yang berbeza.

Remote Monitoring Capabilities

Keupayaan Pemantauan Jarak Jauh

Battery performance of the scooters can be monitored via mobile application.

Prestasi bateri skuter boleh dipantau melalui aplikasi mudah alih.

Temperature, Voltage drop, Humidity and Input-Output power management of the scooters will also be monitored

Suhu, Penurunan Voltan, Kelembapan dan pengurusan kuasa Input-Output skuter juga akan dipantau

Revitalization of Electric Vehicle (EV) via IoNT

Penghidupan Semula Kenderaan Elektrik (EV) melalui IoNT

Defining technology architecture for EV.

Mendefinisikan seni bina teknologi untuk EV



Development Collaborator:



ECLIMO®

Project Highlights



NanoMalaysia Autonomous Vehicle (NAVi)

NanoMalaysia Autonomous Vehicle initiative (NAVi)

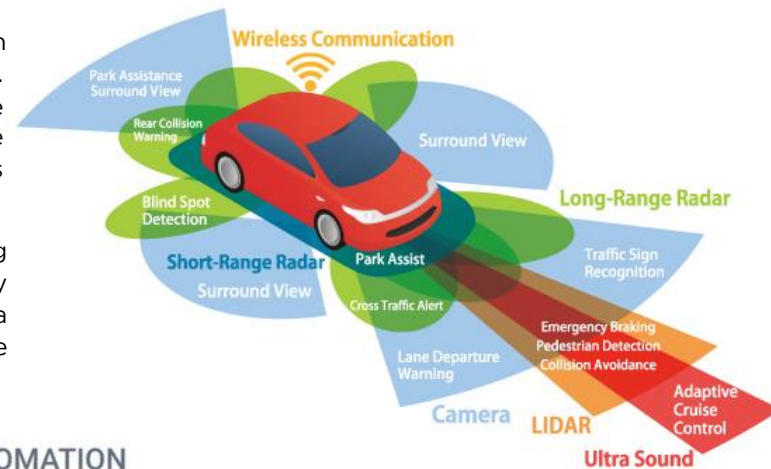
Developed Autonomous Driving technologies to achieve Visual based Autonomy able to navigate and operate within a closed environment (outside public roads). Currently, the car is sandboxing in Technology Park Malaysia.

NAVi achieving Level 3 Autonomy leverages a visual-based approach towards lane tracking and turning via image detection of predefined markers such as QR codes and signs.



Other autonomous vehicles adopt the 'open road' approach while NAVi focuses on a 'controlled environment' use case. With the 'controlled environment' approach, including the vehicle itself, certain environmental elements can be manipulated/controlled for the vehicle to perform its autonomous functions compared to the 'open road.'

NAVi utilises custom hardware modules for steering and braking via actuators at a component level. In addition, the technology developed is highly based on marker-based image detection via cameras, allowing the AI system to receive, decipher and execute instructions..



LEVELS OF DRIVING AUTOMATION

Level of Autonomy



Project Highlights

Graphene Adoption in Nanofluid Applications

\$23.5 Billion
CAGR 5.6%

Asia Pacific Engine Oil
Market Forecast (2024)

RM6.95 Million

Estimated Graphene based Engine
Oil in the Malaysian Market (2025)

\$59.2 Million

Estimated APAC Market for fluid
Loss Additive for Drilling
Fluids (2025)

Industry



Automotive



Oilfield
Applications



Drilling
Fluid



Oil & Gas

Graphene-enhanced engine oil

- Reduced friction and wear
- Reduced volatility at high heat condition, better engine protection

Graphene-based nanofluids for cooling systems

- Enhanced heat transfer
- Reduced energy consumption

Graphene-based emulsion solution for flow assurance in crude oil

- Reduced crystallisation tendency which leads to improved fluid flow
- Reduced drag between crude oil and pipeline internal surface

Graphene-based fluid loss control additive for drilling fluids

- Improved rheological and filtration loss properties
- Improved drilling efficiency and thermal conductivity properties

Project Highlights

Graphene Adoption in Energy Storage Applications

\$15.93 Billion
CAGR 5.6%

APAC Li-ion Energy Storage
Market Revenue Forecast 2025

RM821.6 Billion

Malaysia Li-ion Energy Storage
Market Revenue Forecast (2025)

Industry



Food Trucks
& Night Market



Outdoor
Activities



Telco
Tower Grid



Vehicle
Jumpstart

Graphene-based quantum cell (My Power Pack) for backup Storage application

- Lightweight
- Excellent lifecycle and discharge time

Graphene-based redox flow battery for energy storage

- Enhanced electrical & mechanical stability and energy efficiency
- High surface to volume ratio

High Energy Density Graphene-based lithium-ion battery

- Improved battery performance
- Reduced charge-discharge cycle
- Reduced charging time

Project Highlights

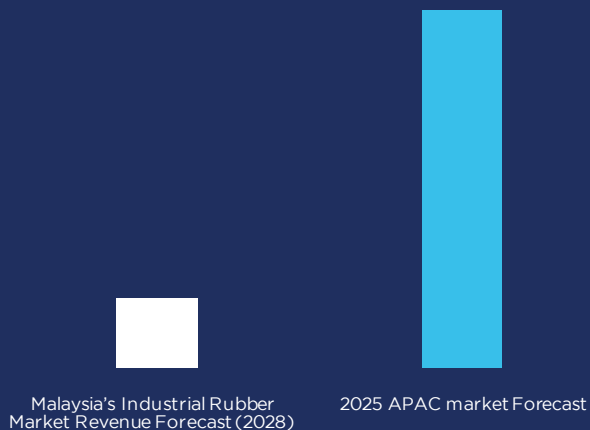
Graphene Adoption in Rubber Applications

\$55.4 Billion
CAGR 5.6%

2025 APAC market Forecast

RM1.7 Billion

Malaysia's Industrial Rubber
Market Revenue Forecast (2028)



Industry



Semiconductors
& Electronics



Forklift

Forklift Graphene Tires

- 1.5 times better than virgin tires
- High abrasion rate
- 10% improvement in compression set & high tensile strength
- 30% cheaper than conventional tires

Graphene ESD Latex Glove

- Comfort and less fatigue
- Higher tensile strength and elongation
- Sustainability and biodegradability

Project Highlights

Graphene Adoption in Internet of Nano-Things (IoNT)

RM410.4 Million

Total Malaysian Addressable Market
for Wireless Charger (2026)

\$1.76 Billion

RF Wireless Charger Market Share (2026)

\$21.12 Billion

Total Malaysian Addressable Market
for Wireless Charger (2026)

Industry



Electronics



Telecommunication



Water
Treatment

Graphene-based conductive inks for printed circuit

- Improved conductivity
- 20% cost reduction

Graphene-based wireless radio frequency (RF) mobile phone charger for building and public transport

- Long-range charging (ohm-m)
- Non-inductive mobile phone charging

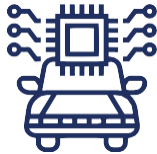
Graphene-based printed flexible circuit for electronic application

- Improved conductivity & Flexibility
- 10-30% cost reduction

Graphene-based E.coli sensor for water quality measurement

- Compact, in-situ detection
- Cost-effective
- Lightweight & user-friendly

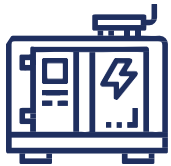
4IR Building-Block Projects From RMK-11 4th Industrial Revolution



Autonomous
Vehicle



SmartSwap Energy Station
Standardised Battery Exchange Platform
for Malaysia-made Electric Motorcycle



MyPowerPack
Rechargeable
Mobile Energy
Storage Device



Green Energy
Generators

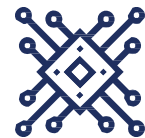
No-fuel Generators (NFG)
/ Graphene Electrical
Generators (GeG)
/ Solar Hybrid Graphene
Electrical Generators (SHGeG)



Wireless
Charger



Window
Solar Panel



Nano Sensors

Nanotech Smart City - Towards Connected
Nano Devices & System or Internet
of Nano-Things (IoNT)

12th Malaysia Plan Programmes

REVOLUTION^{IoT}
A Revolution 4.0 the Internet of Nano-Things

**HYDROGEN
ECONANOMY**

NR^{EGS}
NANOTECH REMOTE ENERGY SYSTEM


NESTI

REVOLUTION^{IoT}

- Pre-commercialisation and commercialisation projects focused on 4IR and IoT
- Programme timeline: 2021 – 2025

Hydrogen EcoNanoMY

- Pre-commercialisation and commercialisation of hydrogen-based energy technologies and the hydrogen economy eco-system
- Programme timeline: 2021 – 2023

Nanotech Remote Energy System

- Pre-commercialisation and commercialisation projects focused on wireless transfer of electrical energy for IoT devices and automotive applications.
- Programme timeline: 2021 – 2023

NanoMalaysia Energy Storage Technology Initiative

- Pre-commercialisation and commercialisation projects on nanotech-enabled energy storage systems collaboratively at the national level for mobility, stationary and portable applications, including second life and recycling.
- Programme timeline: 2022 – 2024

Nanotechnology Programme Delivery Office

The Nanotechnology Program Delivery Office provides enterprises and start-up companies in the nanotechnology space with the support they require to grow their business. These include mechanisms to ensure SMEs can establish market share by introducing new processes or materials and to effect a shift from current conventional processes successfully to cutting edge nanotechnology-enabled operations.

Nanotechnology Programme Delivery Office undertakes graphene-based technology development under Graphenovation and non-graphene-based technology development under iNanovation. The iNanovation and Graphenovation platform comprise three key verticals: iNanovation Push, iNanovation Pull and iNanovation Switch.

Each of these verticals provides investment schemes to assist SMEs and start-ups expand their business presence in the nanotechnology industry. These include the provision of other venture funds and soft loans, business partnerships, and technology expertise and support. Our focused support of businesses within the nanotechnology space is conducted via our investments and equity stakeholding.

Deliverables obtained from the projects we spearhead and the profits earned from our joint ventures are fed back into Nanotechnology Programme Delivery Office. This ensures that we have a virtuous cycle of funds and expertise which we can avail of to further invest in new nanotechnology ventures.

The innovation or technology cycle is crafted to complete respective ecosystems under our key strategic sectors. Our approach ensures that we can stay ahead of the curve in the Malaysian nanotechnology scene.



Nanotechnology Project Delivery Office

What We Do

1. Building Awareness

Creating awareness within the greater ecosystem on the benefits of the commercialisation of graphene & nanoproducts is crucial to drive sectoral expansion and growth. One of NanoMalaysia's key roles is to conduct continuous outreach efforts with SMEs to generate greater awareness and understanding of nanotechnology's potential applications. We have also facilitated partnerships and collaborations between various stakeholders in the ecosystem. These include promoting industry and academic synergies and upstream and downstream producers..

2. Project Execution

NanoMalaysia's focus on effectively executing projects with high growth potential has resulted in quantifiable outcomes supporting our progress in this space. Our services are related to assisting companies in the later stages of R&D and prototyping projects, to help companies, partnerships, and joint ventures that explore potential graphene-enabled applications.

Under Nanotechnology Programme Delivery Office comprises of two central units which focus on Graphene-based developments and Non-Graphene based developments. Focus on graphene developments via National Graphene Action Plan (NGAP) 2020, whereby we have been focusing on five focus areas: Lithium-ion battery anodes/ultracapacitors, Conductive Inks, Rubber Additives, Plastics Additives, and Nanofluids. NGAP 2020 is now being continued as NGAP 2.0, which focuses on areas revolving around Fourth Industrial Revolution, namely Energy Storage, Energy Generation, Sensor Technologies, and Advance Packaging. Another sort of nanomaterials commercialisation focuses on four main key jumpstart sectors: Electronic Devices & Systems; Food & Agriculture; Energy & Energy & Environment; Wellness, Medical & Healthcare.



3. Product Development and Scale-Up Support

NanoMalaysia's role in providing scale-up support comes into effect at the product commercialisation stage. We provide investment to companies identified with the help they require to build production-scale facilities. NanoMalaysia also facilitates synergistic partnerships between relevant Government agencies and industry players, whereby business entities can access available resources, tax incentives, and Entry Point Projects to support them in the scale-up..

4. Coordination & Monitoring

NanoMalaysia is responsible for tracking and monitoring the progress and development of each of the five application areas identified. This process is done by diligently tracking the project's progress, especially when public funds are utilised for R&D and scale-up purposes. In addition, we also look into the project's potential impacts, especially in terms of GNI contribution, investments, and job creation.

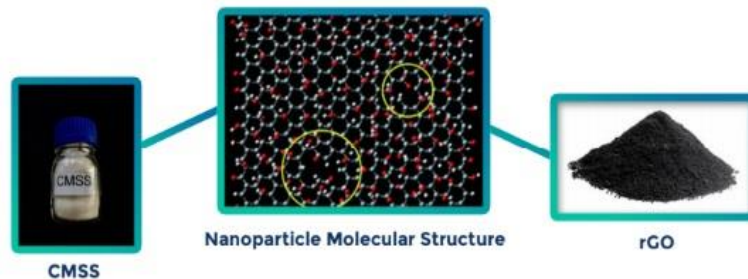
Graphene-Carboxymethyl Sago Starch (CMSS) based Fluid Loss Additives for Drilling Fluid Application

Technology Principle

- Product derived from esterification process of native sago starch to form CMSS and later infused with rGO (reduced Graphene Oxide)
- CMSS replaced imported modified starch as lubricant while rGO improved thermal conductivity that makes the product rheology properties improved until 250°C
- The product prolong drills bit shelf life by 75%, able to perform well under geothermal condition of 250–350 °C with new advanced formulation, enhancing rheological and filtration loss properties
- Hence, improving overall drilling efficiency and promoting cost reduction due to raw material locally produced – CMSS

Strengths:

- Driving & promoting Malaysia's plant resources (Sago Industry) by creating innovative value for high end market & export orientation, 40% cheaper than ready products for fluid loss control
- Health, Safety and Environment (HSE) aspect: categorised as green natural polymer which is biodegradable and environmentally friendly



UTeM Die Attach Materials

UTeM Holdings is a 100% Malaysian-owned company, founded in June 2006 to concentrate on developing sustainable business undertakings to become a sustainable contributor. The nature of business is to offer consultancy activities by providing adequate infrastructure, commercialise, and innovation culture by nurturing research and development (R&D). This project focuses on the product development of high thermal conductivity of graphene hybrid die attach paste, which was facilitated in 2019 by NanoMalaysia Berhad; ultimately, formulate two types of high thermal graphene hybrid conductive pastes.

Graphene-based products have become a preferred material due to their superior properties, especially in electrical conductivity. Because of that, the introduction of graphene conductive ink as interconnect material has attracted interest from many industrial players, especially for electronic packaging. But, unfortunately, there is still limited available formulation of graphene-based die attach materials related to its thermal performance. Die attach materials are the materials that are used to connect components and comprise two critical functions, including intemperance of heat produced in the die, and mechanical fixation of the die on the substrate. However, the current market for die attach materials mainly uses sinter silver die attach materials, which are relatively expensive and have a thermal conductivity of 200-300 W/mK. Thus, there is a need to develop a new kind of die attach materials with increased thermal conductivity and cost efficiency.



Semiconductor Industry



Consumer Electronics



Telecom & Computer Industry

DIE ATTACH MATERIALS

One of the most **crucial parts** for **microelectronics assembly**

Connecting:

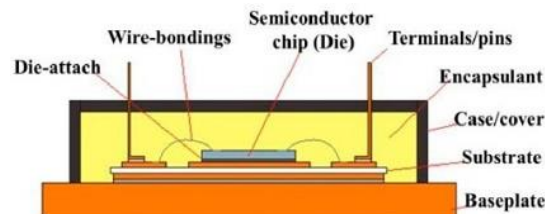
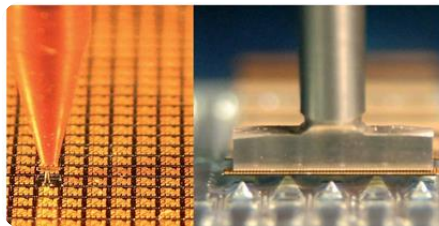
- Semiconductor chip to **lead frame substrate**
- Semiconductor device to **design circuit board**

Provide **thermal** and/or **electrical conductivity** between the die & package

Advantage:

- ✓ High thermal conductivity of sintered die attach paste >300 W/mK
- ✓ High thermal conductivity of non-sintered die attach paste >100 W/mK
- ✓ Shear strength >36 Mpa
- ✓ Good bending and twisting properties

Schematic diagram of die attach materials application



Scale Up Aquaponics with IoNT

Flora Niaga is a Plantation, Agriculture, and Commodity company formed in 2016. They focus on palm oil plantations and commodity/food crops production businesses. Currently, they are expanding their operations in Watermelon, Sugarcane, Pineapples, and Aquaculture production sectors.

Manong Aquaponics Agriculture is one of the NanoMalaysia projects with a combination of aquaculture-agriculture integrated with nanotechnology. This project aims to produce food sources using Nano Solar Energy Panel as the energy generation component to reduce operations costs. This project consists of fish aquaculture and vertical hydroponics components. Among the livestock and vegetables produced from this project in this initial period are small pak choy, lettuce, and tilapia fish.

The Manong facility run by Flora Niaga Sdn Bhd takes up 2.5 acres of land, with the vertical farming area at up to 3 tonnes per month and aquaculture area at 6000 fishes breeding per cycle. Under this project, the monitoring components such as indoor air humidity, light intensity, water temperature, pH, and environmental pressure can indicate the operating parameters and provide avenues for any needed troubleshooting for optimum output. The monitoring system implemented is based on mobile applications for remote monitoring via mobile phones or in operating offices in line with the aspirations of the Digital Economy and the country's 4th Industrial Revolution Policy.



Overall Aquaponics side view



Nano Light Energy Panel



Growing of lettuce



Tilapia fishes grown in aquaculture setup



Water quality sensor



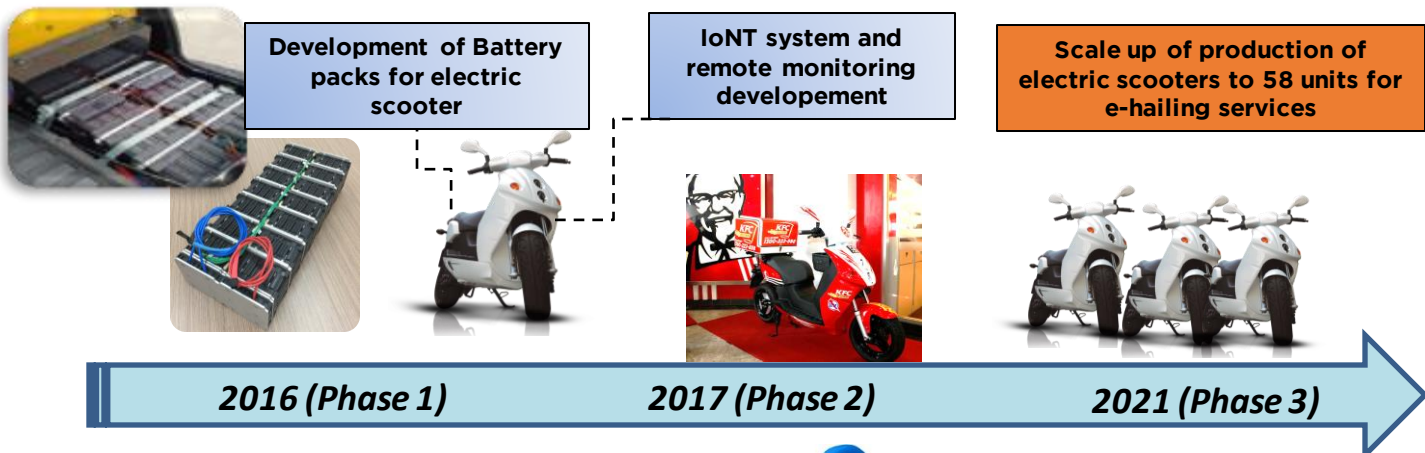
Indoor monitoring sensors

Eclimo Electric Scooters

Eclimo Sdn Bhd is a 100% Malaysian-owned EV company founded in June 2008 to champion our nation's contributions toward sustainable energy and unveil the wonder of the exciting global revolution of electric vehicles. Initially embarking on green technology research and development, Eclimo soon focused on productising sustainable energy, building its way towards manufacturing electric motorcycles (ES11) and Lithium-Ion battery packs and modules.

NanoMalaysia Berhad has collaborated with Eclimo to develop and commercialised the electric scooters with Battery Monitoring System (BMS). These electric scooters have the comprehensive application of the BMS, can send out alerts if the battery voltage drops or increases to an alarming set level, and has the tracking and playback capability. There are 14 series in the battery pack, with an upper voltage limit set at 60V and a lower limit set at 46V. These limits are the alarm set levels that would be able to indicate to the driver. The lithium battery cell cathode with graphene-enhanced material has improved the cycle life by almost three times compared to the previously tested battery cells. Remote monitoring via Mobile app can monitor all the bikes remotely.

Commercialisation Timeline

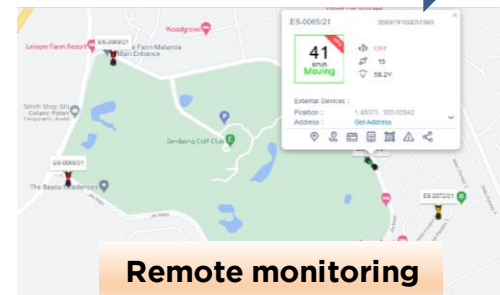


Advantage

- ✓ Environmental friendly- reduces air and noise pollution
- ✓ Less service and maintenance
- ✓ Cost effective

Application

Electric scooters can be used for e-hailing services, security patrolling and also for personal use.



Mobile app be able to monitor remotely for all the bikes. The voltage sensor send the data via wifi with SIM card. Other parameters will not be monitored

Graphene-based ESD Latex Gloves for Cleanroom Application

Rubber Additives

The Malaysian market demand for ESD gloves is set to grow with the following recent announcement of the 12th Malaysia Plan, which will focus on developing high-growth industries – advanced electrical and electronics. In addition, under the NGAP2020 initiative, NanoMalaysia Berhad is supporting Bonric Sdn Bhd in developing graphene-infused latex gloves by making them thinner, tear-proof, biodegradable, and less susceptible to Type IV chemical allergy.

This allows extensive application in numerous industries such as electronic disk drives, semiconductors; avionics; space technology; and even healthcare. In addition, integrating nanotechnology in rubber gloves will open new lateral commercial opportunities in other and adjacent markets that require improved and different glove performances. These opportunities are poised to generate new high-value jobs and high technology supply chains in Malaysia.

The global value of both market segments is estimated at RM 640 million, with nitrile dominating 85.0% of the market share, followed by a small volume of natural rubber (NR) gloves. G-NR cleanroom gloves are expected to attain a 15.0-20.0% market share in the next two years. The g-NR cleanroom gloves are comparable to nitrile gloves - in terms of ESD properties. However, it has superior advantages in terms of comfort, fatigue, tensile, elongation, sustainability, and biodegradability.



Benefits:

- ✓ Improved Comfort
- ✓ Less Fatigue
- ✓ Maximise Tensile Strength
- ✓ Good Elongation
- ✓ Biodegradability and Sustainability

Target Market:

- ✓ Europe
- ✓ APAC
- ✓ North East Asia
- *A total of 20 countries worldwide

End-user:

- ✓ Electronic
- ✓ Disk drive
- ✓ Semiconductor
- ✓ Aerospace

Nanotechnology Programme Delivery Office Achievements As At End 2021 (E&E And Food, Agriculture Sector)

Company	Nanotechnology Products	Application	Advantages
Nanoverify Sdn Bhd	Products related to National Pharmaceutical Regulatory Association (NPRA) and HALAL databases	For products in the HALALand NPRA database to be verified and prevent false Nanotechnology elements claim	Verification of nano-elements existence in commercial products - Prevents false claim in nanotechnology-based products.
Flora Niaga Sdn Bhd	Scale Up Aquaponics	For individual farming or nursery farming areas within community or commercial settings.	NLEP enables electrical energy production via natural or non-natural light for a sustainable system -IoNT Sensor Platform Sensors provides real time monitoring of diverse parameters (e.g. water Temperature, pH, indoor humidity & pressure)
Pulsar UAV Sdn Bhd	A high endurance drone powered by a fuel cell with onboard hydrogen generation system	Precision farming services via UAV landscaping for fertiliser dispersion with organic plant nano-enhancer	Long hours of flight mapping purposes Lighter in mass On-board hydrogen generator can solve the hydrogen infrastructure issues

Nanotechnology Programme Delivery Office Achievements As At End 2021 (E&E And Food, Agriculture Sector)

Company	Nanotechnology Products	Application	Advantages
SS Walit Berhad	Edible Bird's Nest (EBN) produced by swiftlet birds	Birdhouse operators, Owners and Department of Veterinary Services	<p>Allows continuous monitoring of both environmental condition and surveillance for birdhouses located off power grid</p> <p>The system enable continuous monitoring without the need for site visit such as conventional method which requires operator to physically enter the birdhouse</p>
MySnergy	Graphene-Carboxymethyl Sago Starch (CMSS) based Fluid Loss Additives for Drilling Fluid Application	As drilling fluid for oil & gas sector or other related sectors which uses drilling functionality	<ul style="list-style-type: none"> • Sago based derivative which is 40% cheaper than ready products for fluid loss control • Categorised as green natural polymer which is biodegradable and environmentally friendly
Retailetics Sdn Bhd	Smart Shopping carts with wireless charging capability	In retail stores	- Usage of AI for shopping carts operation and navigation within retail stores for products identification and related promotions. It also involves wireless charging capability for powerbank and tablets.

Nanotechnology Programme Delivery Office Achievements As At End 2021 (Energy & Environment Sector)

Company	Nanotechnology Products	Application	Advantages
Nano Commerce Sdn Bhd	Fuel Cell Kit with Nanotechnology-based Proton Exchange Membrane (PEM)	Battery Energy Storage Electrical & Electronic Circuit Board	Accelerate the flow of electrical charges through nanocellulose based PEM which is robust and green
Eclimo Sdn Bhd	Battery monitoring system	Transportation	Eco friendly (Less air and noise pollution) Fast charging Fully electric
NanoVerify Sdn Bhd	Products related to National Pharmaceutical Regulatory Association (NPRA) and HALAL databases	For products in the HALAL and NPRA database to be verified and prevent false nanotechnology elements claim	Verification of nano-elements existence in commercial products Prevents false claim in nanotechnology-based products.

Nanotechnology Programme Delivery Office Achievements As At End 2021 (Wellness, Medical & Healthcare Sector)

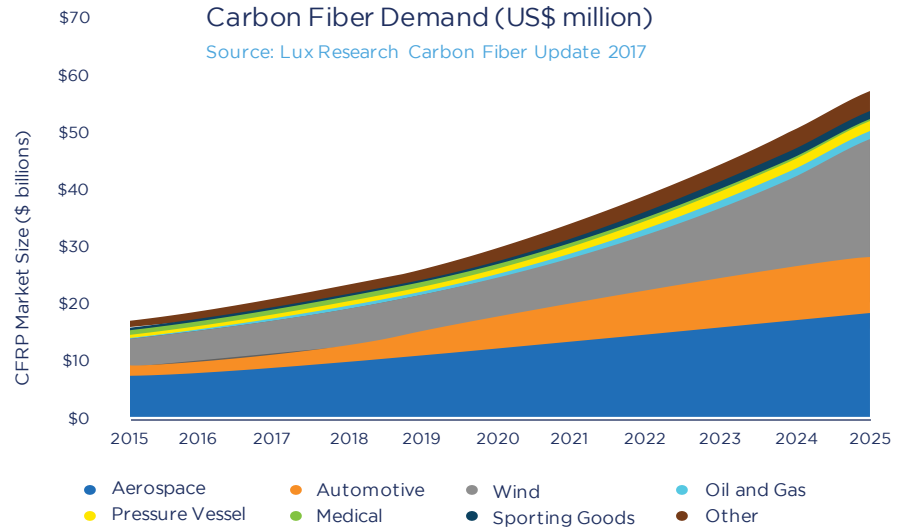
Company	Nanotechnology Products	Application	Advantages
Farmasia Sdn Bhd	Chitosan-CNC Composite Gel	Wound healing and care	Effective wound care product that shortens wound healing duration.
Puspamara Sdn Bhd	Nanotechnology functionalised apparel	Textile Industry in sectors below: Hygienic clothing Military clothing Sports attire	Reduce the medical and hygiene issue related to bacteria and fungi growth. Antibacterial and odor resistance
NanoVerify Sdn Bhd	Products related to National Pharmaceutical Regulatory Association (NPRA) and HALAL databases	For products in the HALAL and NPRA database to be verified and prevent false nanotechnology elements claim	Verification of nano-elements existence in commercial products Prevents false claim in nanotechnology-based products.

Plastic Additives

Malaysia has the right to develop a graphene-enhance composites center of excellence.

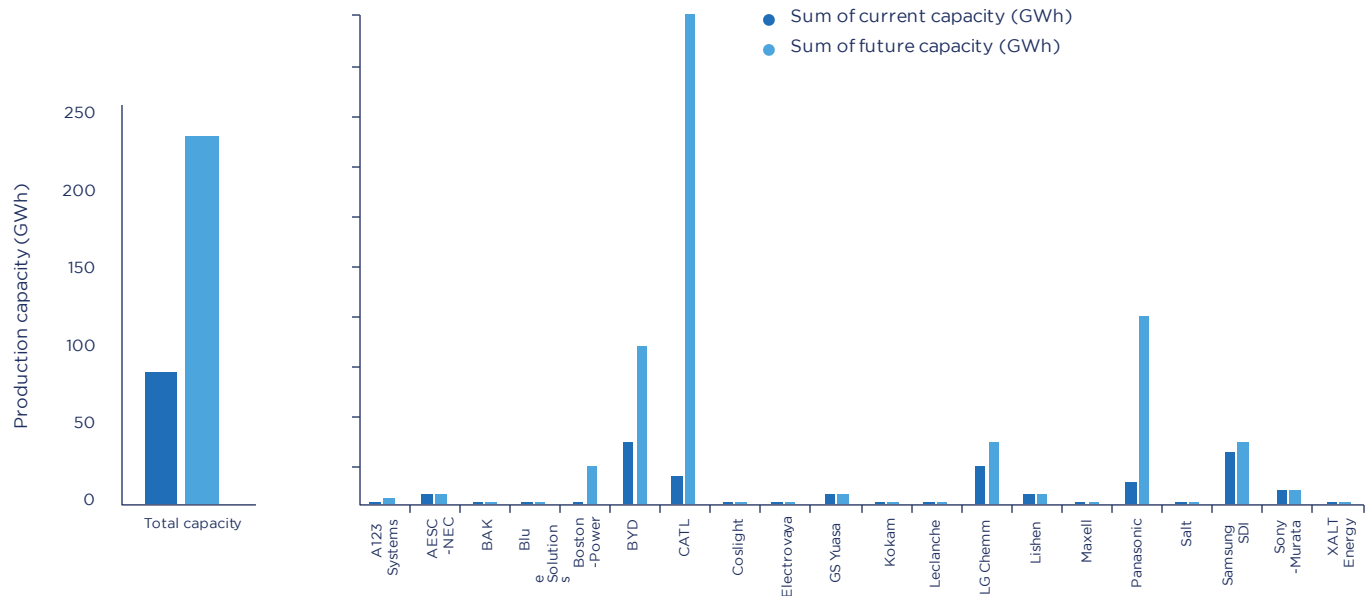
Hexce, Boeing expand Aerospace Composites Malaysia facility
Composites World, November 2013

Spirit AeroSystems to expand Malaysia Facility, Hire Additional Workers
Aviation Week, June 2017



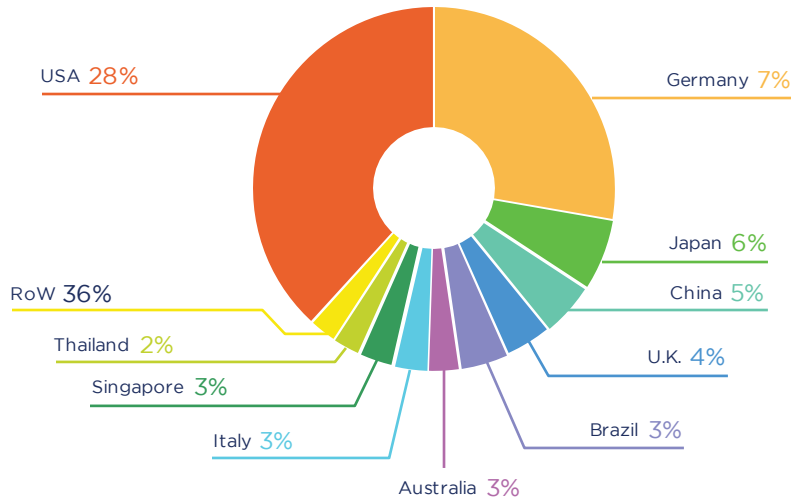
Energy Storage

Within a rapidly growing battery market, Malaysia can drive graphene development by incentivising the local market.



Rubber Additives

Battery production capacity: current & announced for 2020

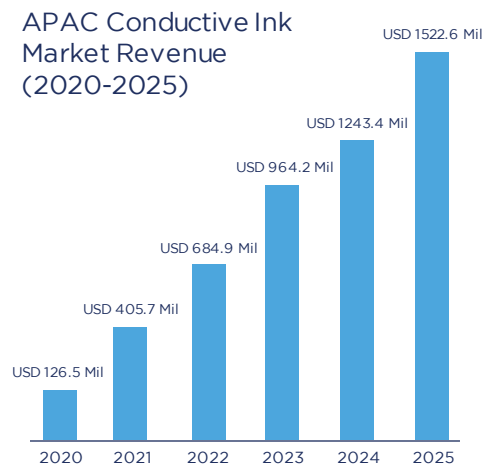


Malaysia's focus on higher-value rubber products is very well aligned with the performance benefits of graphene.

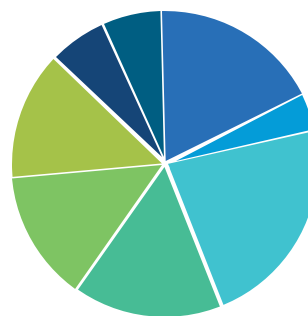
Source: International Rubber Study Group

Conductive Inks

Higher value conductive ink applications open the door for Malaysia to capitalise on IoT market growth.



APAC Conductive Ink Market Share, by Application



With a CAGR of 64%, the APAC region is the most competitive market for conductive inks.

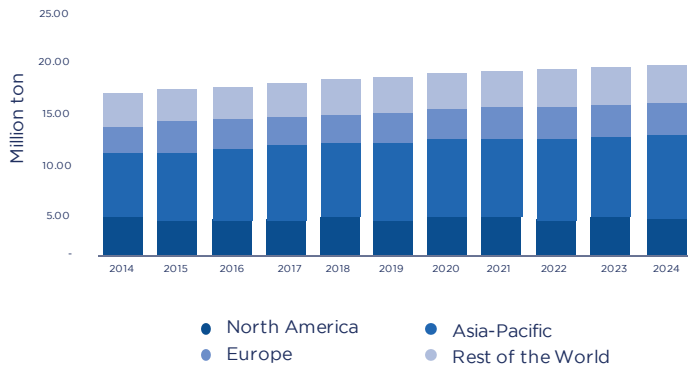
PCBs, Membrane switches and photovoltaics shows the most promising application for conductive inks.

- Photovoltaic
- Displays
- Smart Packaging
- Printed Circuit Boards
- Membrane Switches
- Automotive
- Biosensors
- Other Applications

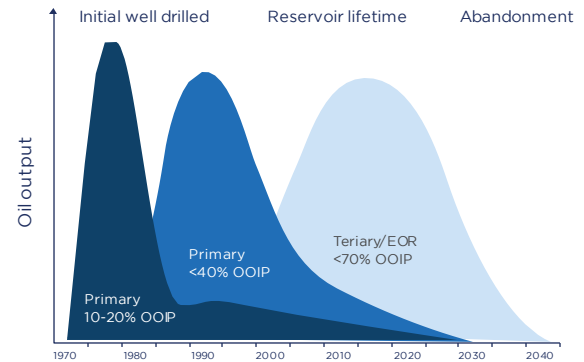
Lubricants

Graphene-enhanced lubricants can offer Malaysia's O&G sector a differentiated advantage in a competitive market.

Automotive lubricant base oil demand (CAGR 1.3%)



Enhanced Oil Recovery (EOR) is crucial for Oil & Gas



Intellectual Properties

Among the emerging technologies, nanotechnology is one of the most prominent examples, and it raises high expectations in a wide range of areas affecting daily life. Nanotechnology is a science that operates at an extremely small scale, as it uses the size of a so-called nanoscale, approximately between 1 and 100 nanometres, or 1 to 100 billionths of a meter. There are two main ways of applying nanotechnology so far: one is the top-down approach, whereby structures are made smaller and smaller until they reach a nanometric scale. The other approach is the bottom-up approach, by which elements at the nanoscale are chosen and assembled to form some sort of matter or mechanism. This way of manipulating matter at the atomic level bears the potential for enormous developments.

While the commercialisation of nanotechnology products so far has been relatively modest, recent and current research activities allow to forecast extraordinary results for the benefit of humankind in the foreseeable future. While inventions in the field of nanotechnology would, as a general rule, appear to qualify for patent protection, subject to the fulfilment of the relevant conditions of patentability, several issues may need further consideration, including the granted claims are overly broad, due at least in part to a lack of available prior art, which could allow patent holders to lock up huge areas of technology. In this context, there is also a perceived risk of overlapping patents.



Nanotechnology advancements and trends are impacting the way Intellectual Property (IP) is defined and administered. Questions relating to classifying these new technologies and protecting a company's interest in nanotechnology inventions are among the issues which weigh the most heavily on the minds of industry players. Within a relatively new nanotechnology industry, the commercialisation of nanotechnology products has remained relatively modest. However, future potential in terms of applications and business growth have resulted in an increasing number of patent protection applications for nanotechnology-enabled products.

Patents

Patents apply to new inventions that solve a specific problem in any field of technology or industry. To protect against competitors exploiting an individual or business' work product, it is prudent to have the invention patented. In order to qualify for a patent, Section 11 of the Patent Act 1983 provides that an invention is patentable if it is new, involves an inventive step, and is industrially applicable.

Copyright

We see copyright in our daily lives, such as books and works of art. Authors of works covered by copyright have rights over their literary and artistic works. This extends only to expressions and not to ideas, procedures, methods of operation, or mathematical concepts.

Utility Innovations

Utility Innovations protect new technical inventions by granting an exclusive right to prevent others from commercially exploiting the protected inventions without consent. In particular, Utility Innovations protect inventions that make minor improvements to and adapt existing products or that have a short commercial life. In addition, the requirement to obtain protection is less stringent than patent protection, as the need for an inventive step is omitted.

Trademarks

A trademark is registered to protect a brand, a name of a product or a service. Registration of a trademark gives an exclusive right to the use of the registered trademark by its owner or licensed to another party.

Trade Secrets

A trade secret is a piece of information that includes a formula, pattern, compilation, program, device, method, technique, or process. It must be used in business and allows obtaining an economic advantage over competitors who do not know or use it. As information is not known to the public, the owner of a trade secret can undertake reasonable efforts to maintain secrecy.

IP Achievements as at end 2021

43

Patents

4

Utility Innovation

30

Copyrights

9

Trademarks

38

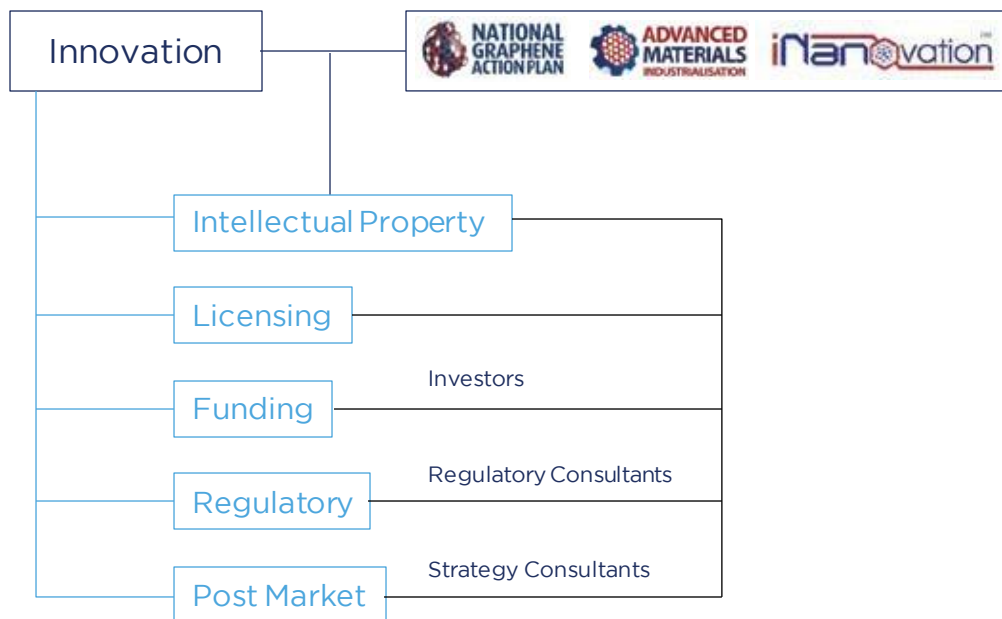
Trade Secrets

Capitalising Intellectual Property

Essentially, nanotechnology centres on the capitalisation of IP. Nanotechnology products or processes which have IP can be developed or further commercialised for future projects, enabling continuous cycles of licensing, funding, market penetration, and market expansion.

Top 30 Malaysian Patent Filers of 2020

NanoMalaysia's Group Legal Office has been selected as one of the finalists in the Technology, Media, and Telecommunications In-House Team of the Year category for the ALB Malaysia Law Awards 2021 by the Asian Legal Business (ALB). The awards pay tribute to the outstanding performance of private practitioners and in-house teams in Malaysia and around the region.



Our Ecosystem

Universities



Research Institutes



Our Ecosystem

Agencies



Funding and Incentives Authorities



Our Ecosystem

International Partners



BAE SYSTEMS



QinetiQ



Our Ecosystem

Programme Collaborators



Our Ecosystem

Programme Collaborators

SOL POLYMERS
SDN BHD



JENURIS
LUBRICANTS
SDN BHD



MALAWIRA

retailitics



NANOSKUNKWORKX





05

**Newly Introduced
Programmes Under
Nanomalaysia**

NanoMalaysia's EV and Energy Storage Programme



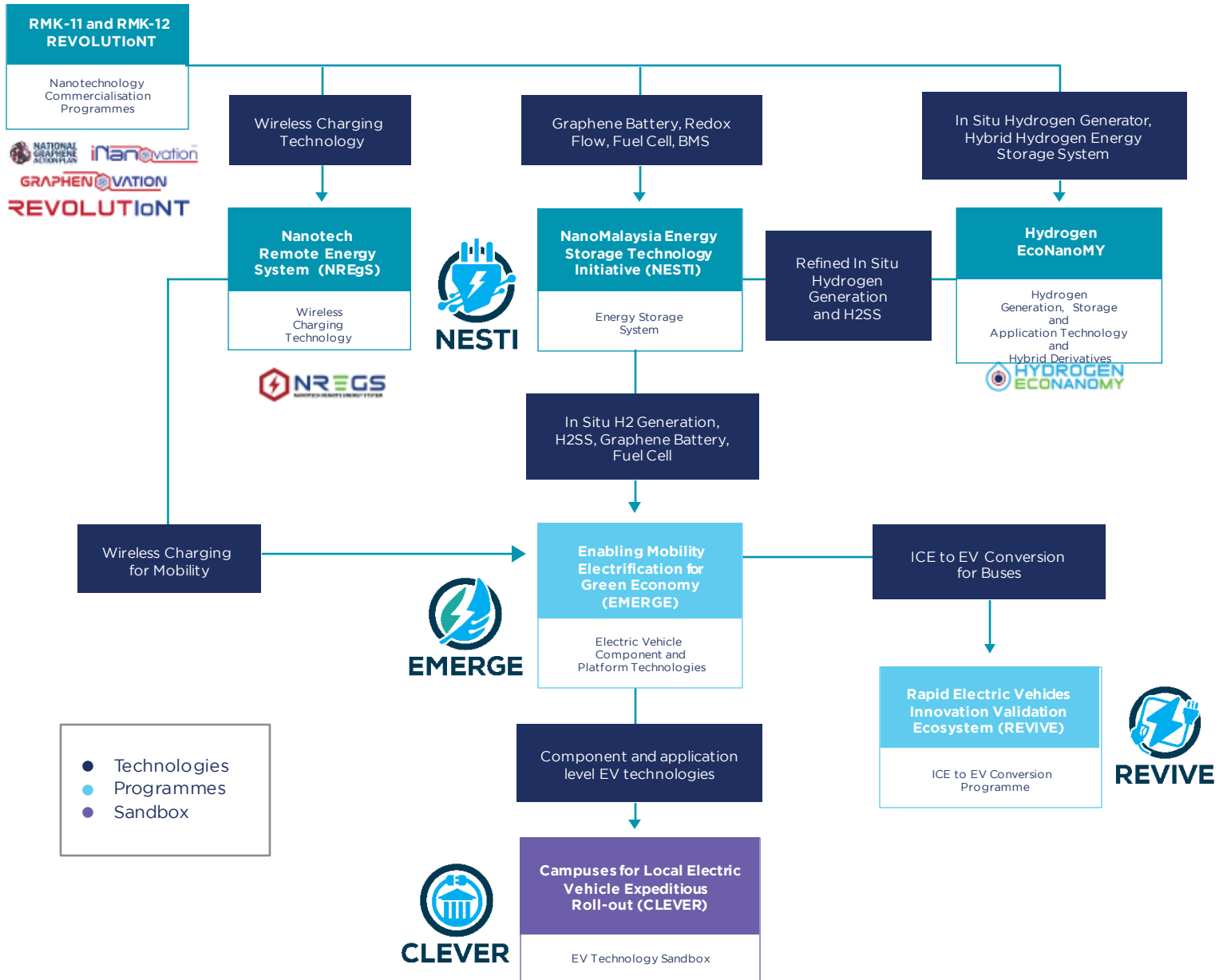
NanoMalaysia has worked hard over the past five years since the 11th Malaysia Plan to develop the essential components of energy and its technology with industry partners and universities, as well as formulate strategies to realise all programs related to electric vehicles and energy storage technology. As a result, all efforts in this technology are now being leveraged in a variety of commercial and industrial projects covering mobility, stationary and portable uses, which we aims that this program can help in moving Malaysia into a high capability market in terms of electric vehicles and energy storage technology.

NanoMalaysia aims to transform Malaysia into a country that produces high-tech electric vehicles and energy storage components and systems for the uses mentioned above for domestic use and the export market. This is where nanotechnology plays an important role in improving overall performance, reliability, and efficiency. NanoMalaysia will play an integral part in developing and deploying energy storage technologies (batteries, ultra-capacitors, solid-state hydrogen, energy management, and monitoring systems) and a high-performance motor controller for mobile applications with various partners through NanoMalaysia Energy Storage Technology Initiative (NESTI).

With the active support of MOSTI and other stakeholders, NMB will coordinate and consolidate leading Electric and Micro E-Mobility players in Malaysia as crucial ecosystem partners for R&D, pilot deployment, testing, certification, and eventual commercialisation. Furthermore, as a principal player in the creation of secondary use of batteries for stationary applications as life cycle extenders through existing projects and new partners, NanoMalaysia will further facilitate the integration of Green Charging Station, Battery Swapping, and Nano/Micro-Grid Systems into Micro and Electric Mobility ecosystem.

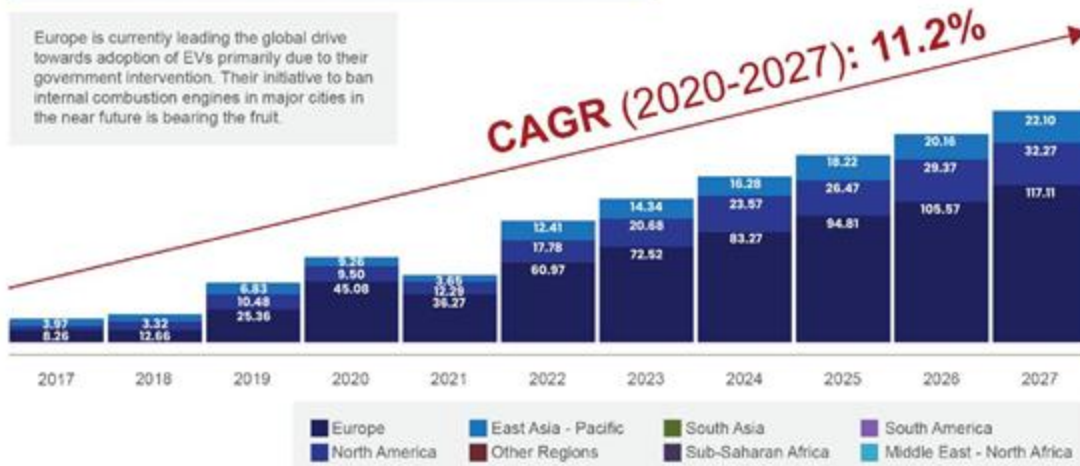
With the rapidly evolving EV market and growing sales of EVs worldwide, the market will witness significant growth in the near future. This initiative by NanoMalaysia is essential to the fast, widespread adoption of electric micro-mobility, which will evolve into full-scale electric mobility. The creation of this micro-mobility ecosystem in Malaysia towards considerable electric mobility through this initiative will not only benefit Malaysia. Still, it will also energise the future of transportation, leading other nations on low carbon mobility, safer road transportation, and ease of commute for all market sectors.

NanoMalaysia's EV and Energy Storage Programme



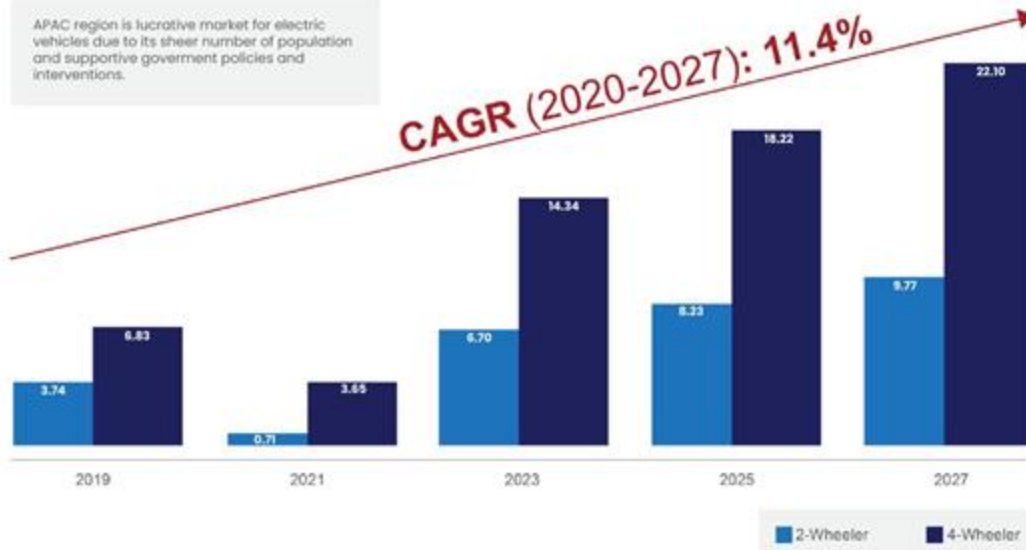
Global EV Market Value (2017-2027) in USD Billion

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



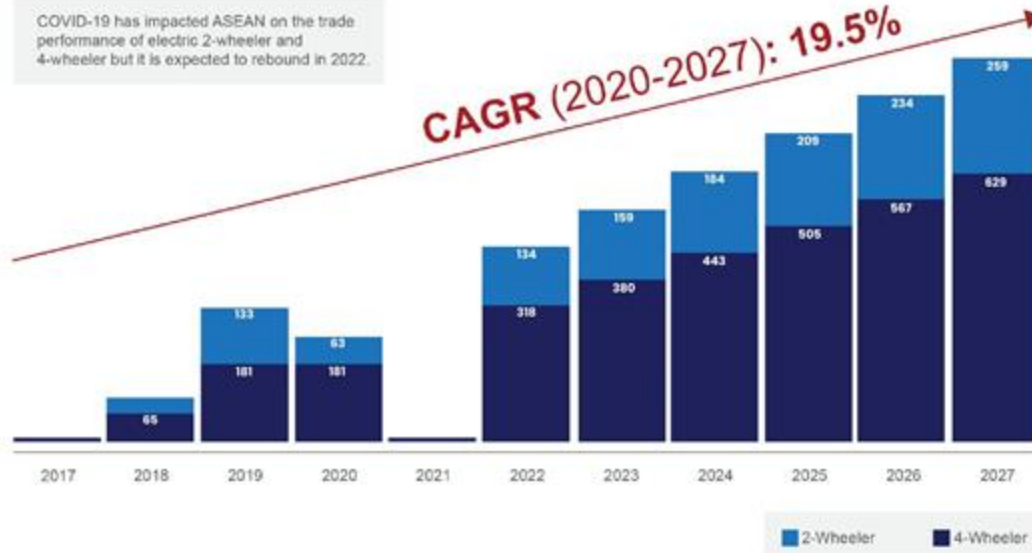
APAC Electric 2-Wheeler and 4-Wheeler Market Revenue (2019-2027) in USD Billion

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



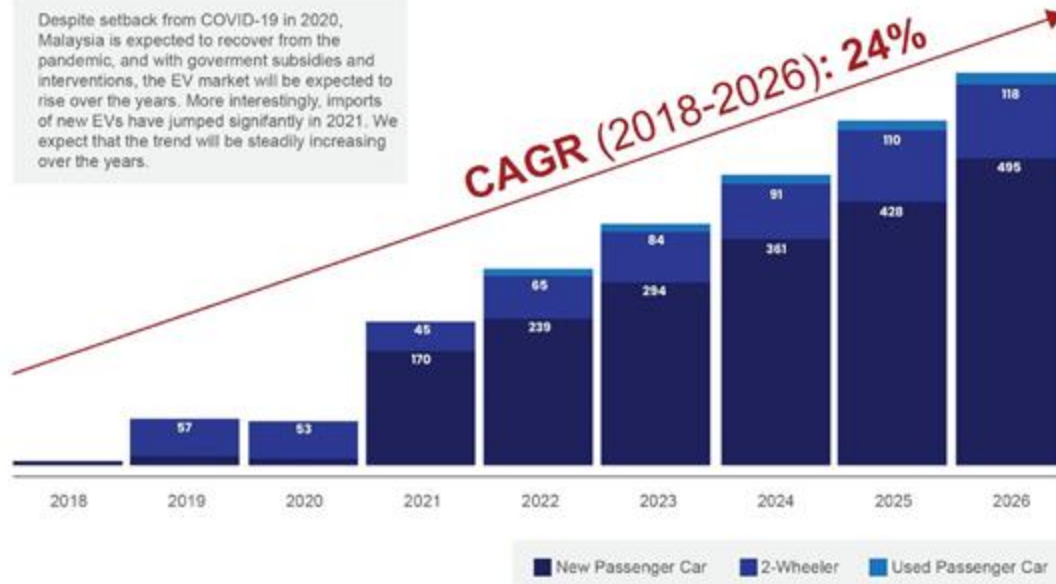
ASEAN Electric 2-Wheeler and 4-Wheeler Market Revenue (2019-2027) in USD Billion

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 with government subsidies and interventions, the EV market will be expected to rise over the years. More interestingly, imports of new EVs have jumped significantly in 2021. We expect that the trend will be steadily increasing over the years.



Current Energy Storage Related Initiatives

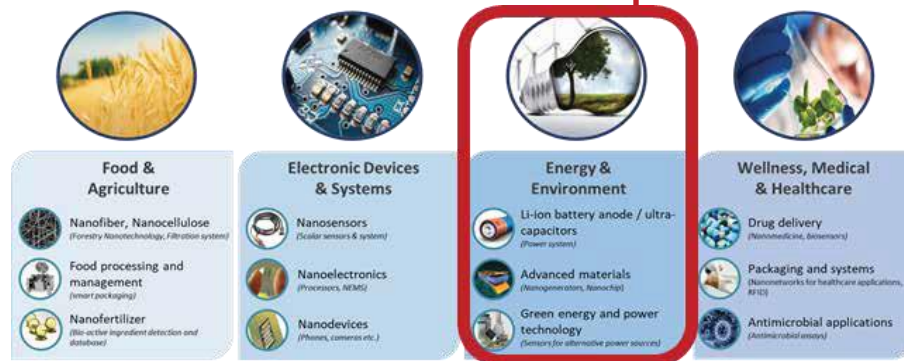
RMk-11: 2016-2020



5 application areas were prioritised:

- Lithium ion battery & ultracapacitors
- Rubber additives
- Plastic additives
- Conductive Ink
- Nanofluids

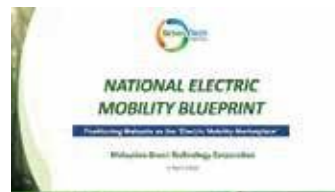
iNanovation™



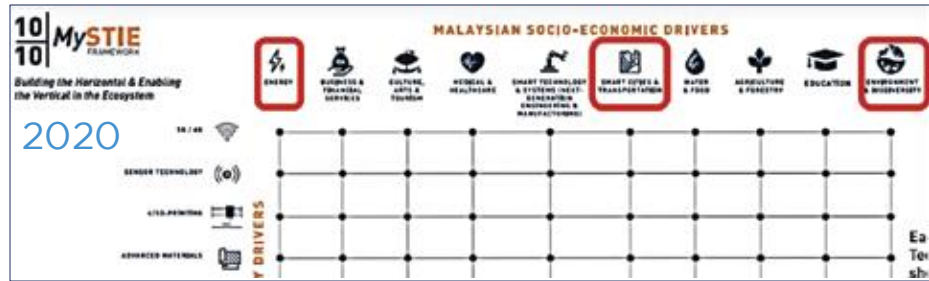
2012



- Lithium Phosphate Battery
- Battery Prototyping & Testing Facilities at Permatang Pauh
- EV Prototype (Proton Iriz)



RMk-11: 2016-2020



*Global Renewable Energy and Electric Vehicles Policies

Tengaga:

- ii. Pendidikan;
- iii. Air dan Makanan;
- iv. Pertanian dan Perhutanan;
- v. Alam Sekitar dan Biodiversiti;
- vi. Bandar Pintar dan Pengangkutan;
- viii. Kebudayaan, Kesenian dan Pelancongan;
- ix. Perkhidmatan Perniagaan dan Kewangan; dan
- x. Teknologi dan Sistem Pintar (Kejuruteraan dan Pembuatan Generasi Baharu).



Through the facilitation of REVOLUTIONT programs namely NGAP (Graphenovation) and iNanovation, Malaysian industry will produce complex and high-value intellectual property, products and solution systems to lead the 4th Industrial Revolution, Industry 4.0 and STIE 10-on-10 to create job opportunities, entrepreneurship and new business development,..... Electric Vehicles, Energy Storage Systems, Green Energy (Solar and Hydrogen).....

NATIONAL TRANSPORT POLICY 2019-2030 5 THRUSTS & 23 STRATEGIES

THRUST 1	THRUST 2	THRUST 3	THRUST 4	THRUST 5
<p>STRENGTHENING GOVERNANCE TO CREATE A CONDUCTIVE ENVIRONMENT FOR THE TRANSPORTATION SECTOR</p> <ul style="list-style-type: none"> Strengthen governance of transport agencies & transport bodies Improve the legal, regulatory and institutional framework for transport services Strengthen the regulatory and institutional framework for transport services Strengthen the regulatory and institutional framework for transport services Strengthen the regulatory and institutional framework for transport services 	<p>OPTIMISING, BUILDING & MAINTAINING TRANSPORTATION INFRASTRUCTURE NETWORKS TO MAXIMISE EFFICIENCY</p> <ul style="list-style-type: none"> Optimise the efficiency of transport infrastructure networks Build and maintain transport infrastructure networks Optimise the efficiency of transport infrastructure networks Build and maintain transport infrastructure networks Optimise the efficiency of transport infrastructure networks 	<p>ENHANCING SAFETY, INTEGRATION, CONNECTIVITY & ACCESSIBILITY FOR A SMOOTHER JOURNEY</p> <ul style="list-style-type: none"> Enhance the safety of transport services Integrate transport services Improve connectivity and accessibility of transport services Enhance the safety of transport services Integrate transport services 	<p>PROGRESSING TOWARDS A GREEN TRANSPORTATION ECOSYSTEM</p> <ul style="list-style-type: none"> Progress towards a green transportation ecosystem Improve the efficiency of transport services Build and maintain transport infrastructure networks Optimise the efficiency of transport infrastructure networks Build and maintain transport infrastructure networks 	<p>EXPANDING GLOBALLY & PROMOTING THE INTERNATIONALISATION OF TRANSPORTATION SERVICES</p> <ul style="list-style-type: none"> Expand globally and promote the internationalisation of transportation services Improve the efficiency of transport services Build and maintain transport infrastructure networks Optimise the efficiency of transport infrastructure networks Build and maintain transport infrastructure networks

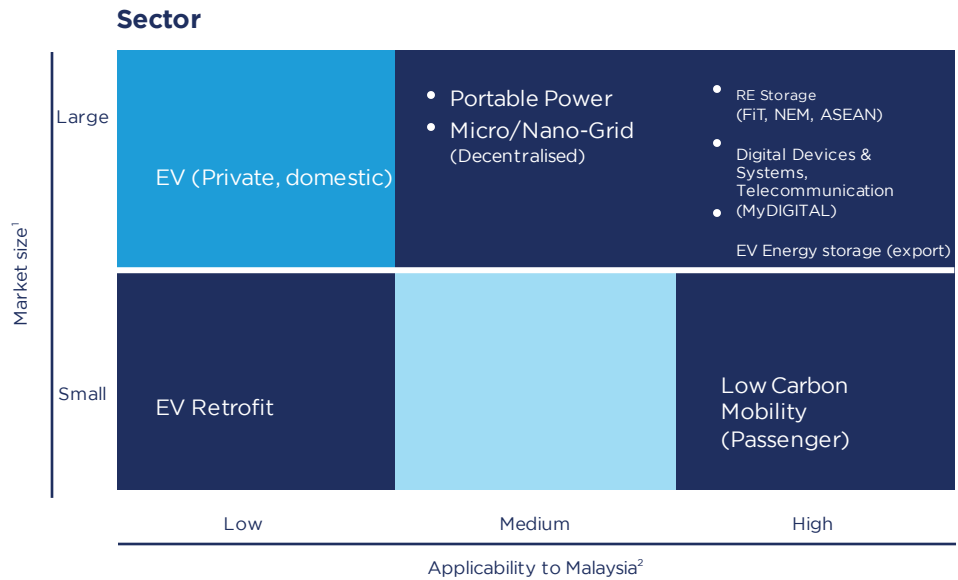
Source: National Transport Policy 2019-2030

Source: National Transport Policy 2019-2030



- On-board Telematics
- Battery Swap Technology for Electric Motorbikes

Energy Storage - Focus Area



The five applications (markets) areas for further consideration are:

- Renewable Energy Storage
- Digital Devices & Systems, Telecommunications
- EV energy storage (export & passenger vehicles)
- Portable Power
- Systems Decentralised Grid

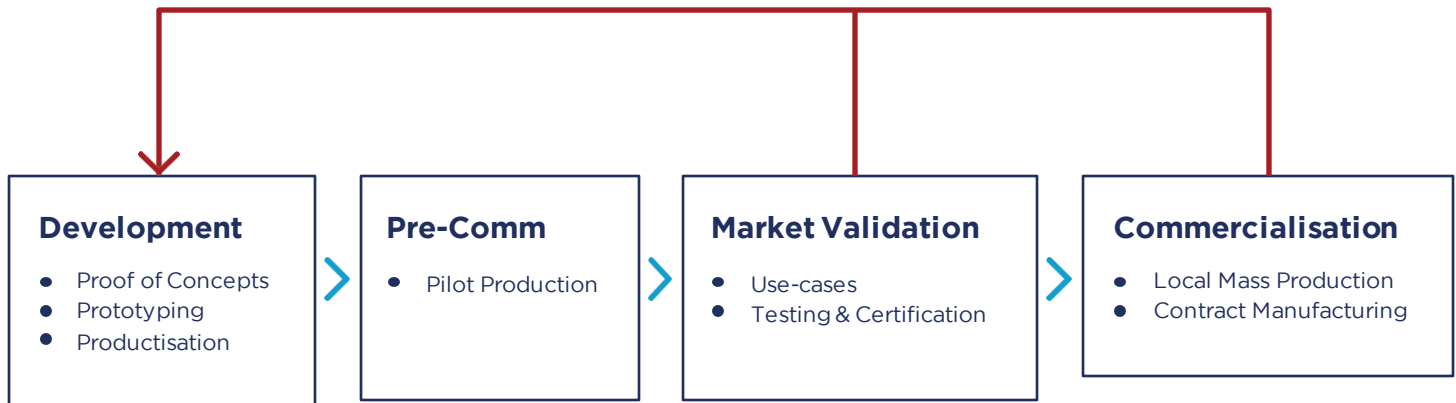
¹Market size is high if addressed Energy Storage market size is -\$1B or higher.
²Applicability to MY is based on current downstream players, upcoming policies and focus of neighboring countries.

R&D&C Opportunities

Energy Storage Cell			Energy Storage System	Rare Earths Recycling
<p>Battery</p> <ul style="list-style-type: none"> • Elektrodes • Elektrolytes • Structures 	<p>Ultracapacitors</p> <ul style="list-style-type: none"> • Elektrodes • Elektrolytes • Structures 	<p>Solid State Hydrogen</p> <ul style="list-style-type: none"> • Chemical Storage Adsorption 	<p>Monitoring & Management System</p> <ul style="list-style-type: none"> • Internet of Nano-Things • Data Analytics Intelligence • Energy & Power Storage & Delivery 	<p>Urban/Phytomining</p> <ul style="list-style-type: none"> • Rare Earths • Precious Metals



Potential Game Plan



Components, Cell, Pack



Investments

Market Disruption Approach: Technology & Market Readiness Levels – R&D&C

Long-Term (>5y)

Emerging Energy Storage
Materials R&D

TRL 2-3
Proof of Concept

Mid-Term (3-5y)

Advanced Energy Storage
Cell Development

TRL 3-4
Prototyping
Product Development

Immediate Term (1-3y)

NanoMalaysia Energy Storage
Projects Completion

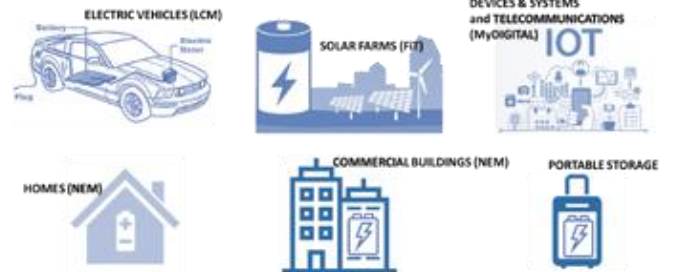
TRL 4-9
Market Validation & Scale-Up

KPI



- **Ecosystem Development & Coordination**
- **Opportunities**
- **Start-ups/SMEs impacted**
- **Intellectual Properties**
- **Products Commercialised**

ENERGY STORAGE - Applications



Ecosystem Development & Coordination

- Value Chain-Local & Regional (Manufacturing)
- Supply Chain-Local & regional (Production)
- Interfacing-Cross-pollination (Technology Development)

Mission Oriented

Cost Target

- USD100/kWh(2025) from 137/kWh(2020)
- USD80/kWh(2026-2030)
- USD0.05/kWh levelised cost of storage for stationery apps (90% reduction from 2020 baseline)
- H2 Storage <USD8/kWh

Energy Density Target
>250Wh/kg

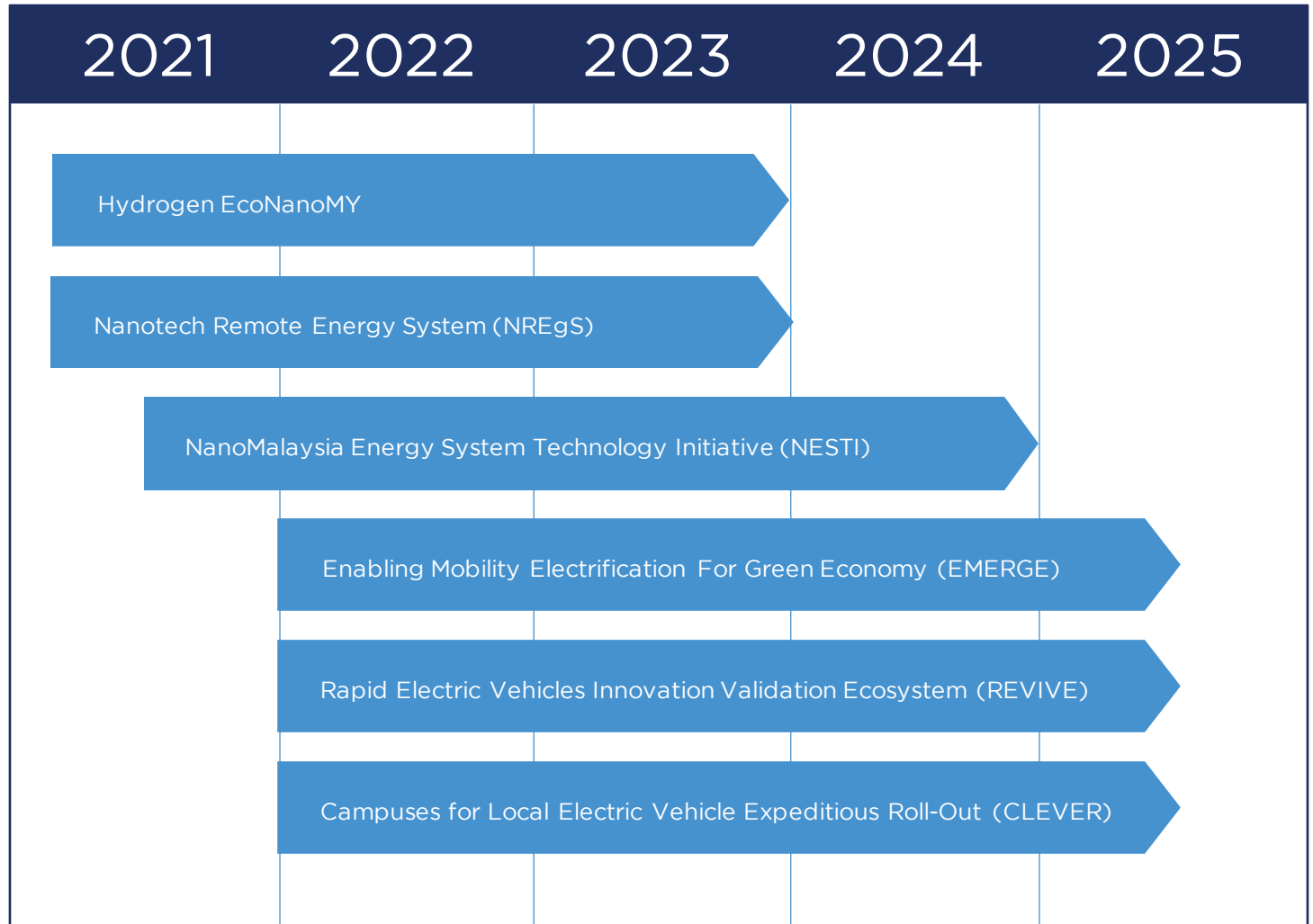
Demand Driven

Industrial Specifications

- Applications
- Performance Advantage
- Form Factor
- Cost Effectiveness

**Pre-Captured Markets
via Substitutional Model**

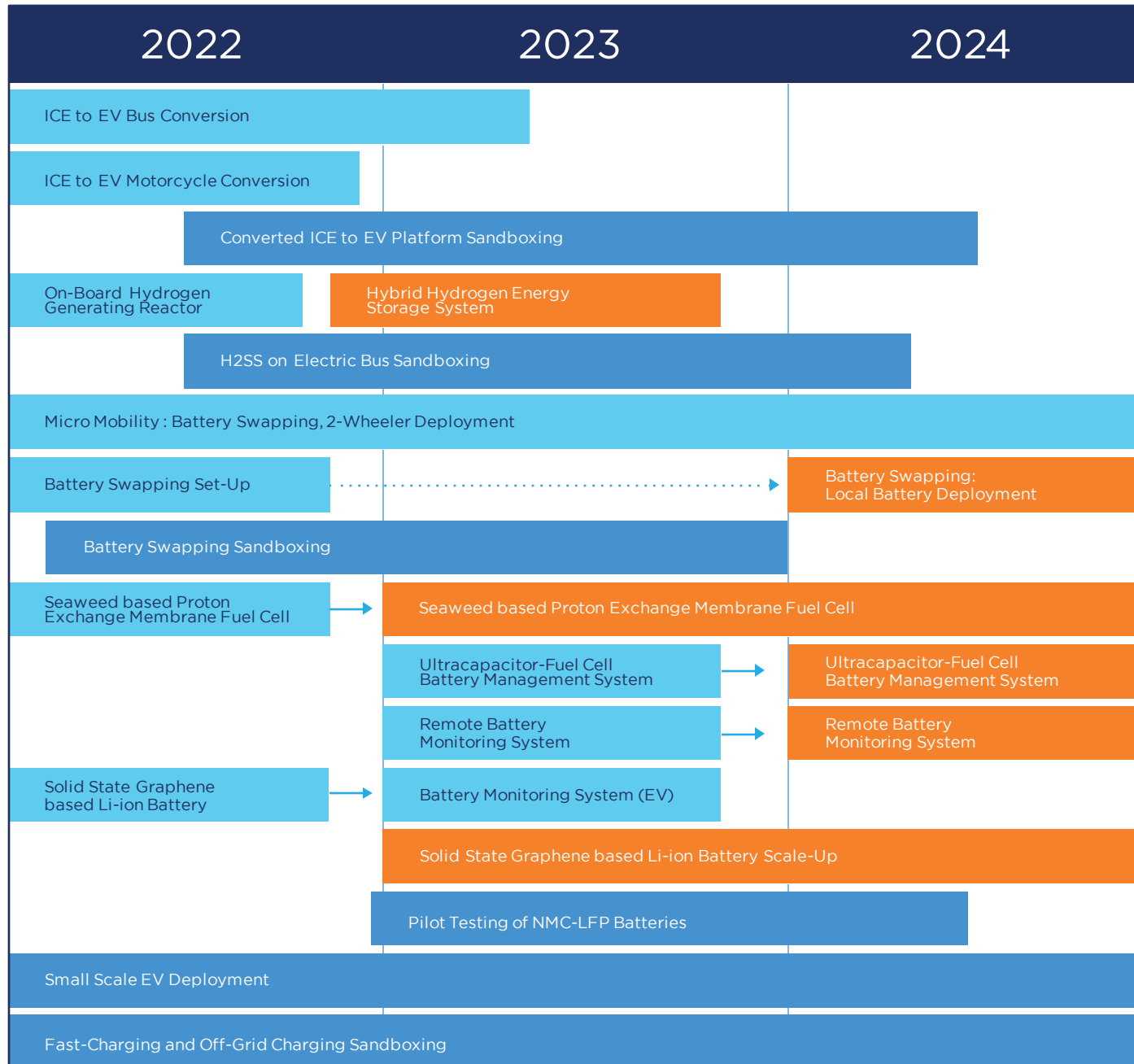
High Level Implementation Schedule



Alignment to Pre-Existing EV-Related Policies

Programme	NESTI	EMERGE	REVIVE	CLEVER
Scope & Key Strategic Sectors / Applications	Energy storage devices and systems --electrodes, electrolytes, overall structure designs and management systems.	Electrification of mobility and smart mobility for various electric vehicles (EV) -- component-level and application-level for development and deployment of energy storage systems, energy generation, power transfer and power management.	Electrification of Mobility through conversion of Internal Combustion Engine (ICE) vehicles to Electric	Deploy EV-related technologies at selected university campus grounds as technology sandboxes for closed environment studies.
Target / Objectives	To make Malaysia one of the leaders in the global energy sector capable of offering a durable energy storage solution (> 1,000,000 charge cycles), fast charging rate (full chargeable in 15 minutes), easy to use by the public, smart, sustainable and environmentally friendly.	<ul style="list-style-type: none"> • Conversion of ICE Buses to BEV & FCEV's • Graphene Super Batteries for EV Bikes • Renewable Energy Charging/ Refueling Station • Nanotech-Enhanced Membranes and Electrodes into Fuel Cells • Nano-based Liquid Cooling for Thermal Management System • Autonomous Smart Mobility and Charging DC-DC Converters for e- • Mobility and Nanogrid Hydrogen Hybrid Electric Motorcycles 	Facilitate sandboxing and deployment data for retrofitting and conversion of commercial two- and four-wheelers for short term carbon reduction and medium-term fleet electrification.	Facilitate technology development, set up regulations, amendment of insurance and user acceptance data before mass scale investment and deployment to Malaysia market within: <ul style="list-style-type: none"> • Battery • Swapping ICE-to-EV • Conversion • Small-scale EV deployment • EV Fast Charging & Off-Grid Charging • Pilot Testing of EV Battery
Policy Alignment	<p>NAP: Manufacturing and application of local battery equipped with Battery Management System and Thermal Management System</p> <p>NTP: Adoption of cleaner fuel – such as biodiesel and electric vehicles</p>	<p>NAP: Manufacturing and application of local battery equipped with Battery Management System and Thermal Management System, battery swapping and wireless charging, autonomous vehicle</p> <p>NTP: Adoption of cleaner fuel – such as biodiesel and electric vehicles</p> <p>LCMB: Providing support to manufacturers of local EV bus</p>	<p>NTP: Adoption of cleaner fuel – such as biodiesel and electric vehicles</p> <p>LCMB: Providing support to manufacturers of local EV bus</p>	<p>NAP: Manufacturing and application of local battery</p> <p>NTP: Adoption of cleaner fuel – such as biodiesel and electric vehicles</p> <p>LCMB: Adopting the electric car, bus and motorcycle, providing support to manufacturers of local EV bus etc</p>

Tentative Technology Development Timeline



NESTI Consortium (NESTIC)



Existing Initiatives

Low Carbon Mobility Blueprint



Battery-powered Vehicles Project



- On-board Telematics
- Battery Swap Technology for Electric Motorbikes



- Lithium Phosphate Battery Battery Prototyping & Testing
- Facilities at Permatang Pauh
- EV Prototype (Proton Iriz)



Solid State Battery technology Production



- Electrode materials
- Ultracapacitor System for EV



Battery Monitoring System



NANOMALAYSIA™ & Partners



ECLIMO®



- Lithium Phosphate Battery
- Battery Prototyping H2SS Electric Car
- H2SS Electric Bike
- H2SS Electric Truck
- Battery Monitoring System for Electric Scooter
- Ultracapacitor-Battery Management System
- Hydrogen Storage-Reactor System
- Ultracapacitor Battery Storage System for Nano-Grid
- Battery Electrode Technology (Superbattery)
- Flow Battery Technology for Utility
- EV hybrid fast charging system
- Malaysia Advanced Battery Center (UMORIE)
- Battery Swapping System (pilot) & Testing
- Facilities at Permatang Pauh
- EV Prototype (Proton Iriz)

Estonian Company based in Germany

Business Model & Investments: Licensing, Mass Production & Manufacturing Regional Market (ASEAN, ASIA PACIFIC)

R&D&C – Improvements & New Technologies

Graphene Ultracapacitor



NanoMalaysia's Hydrogen Economy & Technology Roadmap

This initiative is championed by MOSTI's National Nanotechnology Centre (NNC) with NanoMalaysia Berhad (NMB) as its strategic partner, in collaboration with NanoVerify Sdn. Bhd. (NVSB), Malaysian Green Technology and Climate Change Centre (MGTC) and Akademi Sains Malaysia (ASM). The Hydrogen Economy & Technology Roadmap shall outline the "what," "why," "when," "where," "who," and "how" of technological solutions relating to The New Hydrogen Economy and its implementation to move the country forward while engaging with all stakeholders and related active parties.

The Roadmap's action plan will highlight the roles and goals of each stakeholder in the short (2021-2030), medium (2031-2040), and long-term (2041-2050).

Current Projects under NREgS:

- To be anchored on decarbonisation agenda as the over-arching long-term objective by 2050.
- Creation of a new engine of economic growth through Hydrogen Economy towards Carbon Neutrality/Net Zero Carbon by 2050, supported by Technological Advancements.

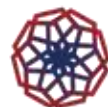
Goals of the Roadmap

- To develop an ecosystem across the hydrogen value chain and to ensure price competitiveness of our Levelised Cost of Hydrogen (LCOH) through accelerated technological advancement
- Malaysia to achieve a sustainable energy mix with all type of energy sources and increase cleaner energy shares in Malaysia's energy mix
- Malaysia to invest in hydrogen technologies to address domestic consumption, stability, and security of energy, sustaining international energy trading, reduce dependency on importing economies and decarbonise emissions

HYDROGEN ECONOMY & TECHNOLOGY ROADMAP



**NATIONAL
NANOTECHNOLOGY
CENTRE**



NANOMALAYSIA®



Economic Driver



Rise in Economic Power

Hydrogen economy increases the economic growth with revenues of more than USD 2.5 trillion/year (SDG 12 – Responsible Consumption and Production)

Technology Driver



Paradigm Shift in Automotive Industry

Hydrogen as an enabler to shift from internal combustion engine vehicles into FCVs (~ 800k) and FCEVs (6.2 mill unit) (SDG 9 – Industry, Innovation and Infrastructure)



Rapid urbanisation, Demographic & Social Change

Application of hydrogen in mobility, heating system and power generation empowers the Global Hydrogen Society (SDG 11 – Sustainable Cities and Communities)



Sustainable Environment

Reliable and sustainable energy for all (SDG 7 – Affordable and Clean Energy) and alternative source to address net zero carbon emissions (SDG 13 – Climate Change)

Factor 1

To increase the revenue & productivity in oil and gas, agriculture and power generation sector



Malaysia to actively building its national intellectual capabilities and capacities in hydrogen technologies, and creating talents

Factor 2

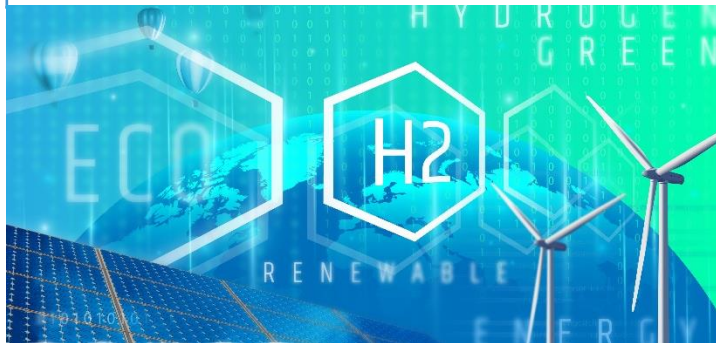
To push for green growth aspirations in the transportation sector (light vehicles, heavy vehicles, marine and aviation)



Hydrogen demand from transportation sector is forecasted to reach RM 3.7 billion in 2050.

Factor 3

To cement Malaysia's position as a key hydrogen player in Asia Pacific



- Malaysia as a potential hydrogen exporter in South-East Asia to fulfill hydrogen demands from APAC.
- Japan, South Korea and China as the main importer of hydrogen.

Factor 4

To strengthen the labour market by creating job opportunities from the hydrogen economy



- The COVID-19 pandemic has disrupted the economic growth of Malaysia and increased unemployment
- Hydrogen economy provides opportunities to rejuvenate our economy as well as to create new jobs in the future.

The Twelfth Malaysia Plan (12MP), with a 5-year time scale, focuses on three major sectors, namely economic empowerment, environmental sustainability, and social re-engineering, that provide the initial strategic phase of initiative towards the overarching target of green technology initiatives. The Hydrogen Economy and Technology Roadmap with a 30-year time frame up to 2050 identifies and provides the development and deployment pathways for disruptive hydrogen technology to enable the green energy transition in Malaysia.

Accelerates green initiatives

that will boost sustainable socio-economic development through the expansion of the green market with the targeted 25 % of Government Green Procurement (GGP) by 2025.

National Energy Policy

HETR chart ways in achieving NEP aspirations for a long-term low carbon target in the energy sector & address the energy transition trends from fossil fuel to RE sources

Acceleration of R&D&C&I

Unlock opportunities for local hydrogen technology innovation to penetrate the market on-par with demand from industries.

Realising the Potential of Biomass Industry

Promoting utilisation of high value-added biomass products through generation of hydrogen eventually increase investments in the biomass industry to RM 10 billion.



Reduce GHG emissions

Hydrogen as an alternative energy share contribution in reducing the GHG emission intensity to GDP up to 45 % by 2030, in line with the aspiration towards becoming a low-carbon nation and ultimately achieve Carbon Neutrality by 2050

Supports circular economy

in addressing the challenge of balancing socio-economic development and environmental sustainability while creating green job opportunities.

Enhance green mobility

in advancing next-generation vehicles for airline, marine and land transportation (FCEV) to meet the carbon offset target.

Addressing unsustainable consumption and Production Practices

Most economic sectors have been practicing the linear economy; inefficient in its use of resources, generating high volumes of waste.

Description of 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

NREGS focuses on developing, commercialising, and implementing far-field and near-field wireless power transmission technology in Malaysia. Under this program, NREGS aims at the component level of wireless technology systems and technologies that overcome limitations faced by wired technologies as limited user experience, which is hard to reach in certain areas. NREGS also aims to expedite wireless power transfer (WPT) project that has a proven TRL 3 into commercialisation. This program also enables to improve range anxiety faced by wired charging solutions. Under this program, NanoMalaysia is looking to help to commercialise wireless power transfer and wireless powered device projects that have a minimum TRL 3 in which these initiatives are enable to provide funding and, at the same time, get a proper partner channel to help during experimentation and also after commercialisation.

Current Projects under NREGS:

1. Graphene-enhanced filaments for 3D printing
2. Autonomous charging devices
3. Wireless charging for IOT devices
4. Static Charging
5. Dynamic Charging



What is NanoMalaysia Energy Storage Technology Initiative (NESTI)?

NanoMalaysia Energy Storage Technology Initiative or NESTI focuses on technological development and commercialisation of core components of energy storage devices such as electrodes, electrolytes, and overall structure designs, where energy storage is the capture of energy produced or supplied for use at a later time. NESTI also explores new battery chemistries with alternative accessible raw materials and nanomaterials. Lastly, NESTI will look into innovative recycling and urban- or phytomining technologies to extract conventional rare-earth battery materials. In this regard, the Government has approved the establishment of a one-stop centre for commercialisation and technology transfer for energy storage under NESTI

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.

Current Projects under NESTI:

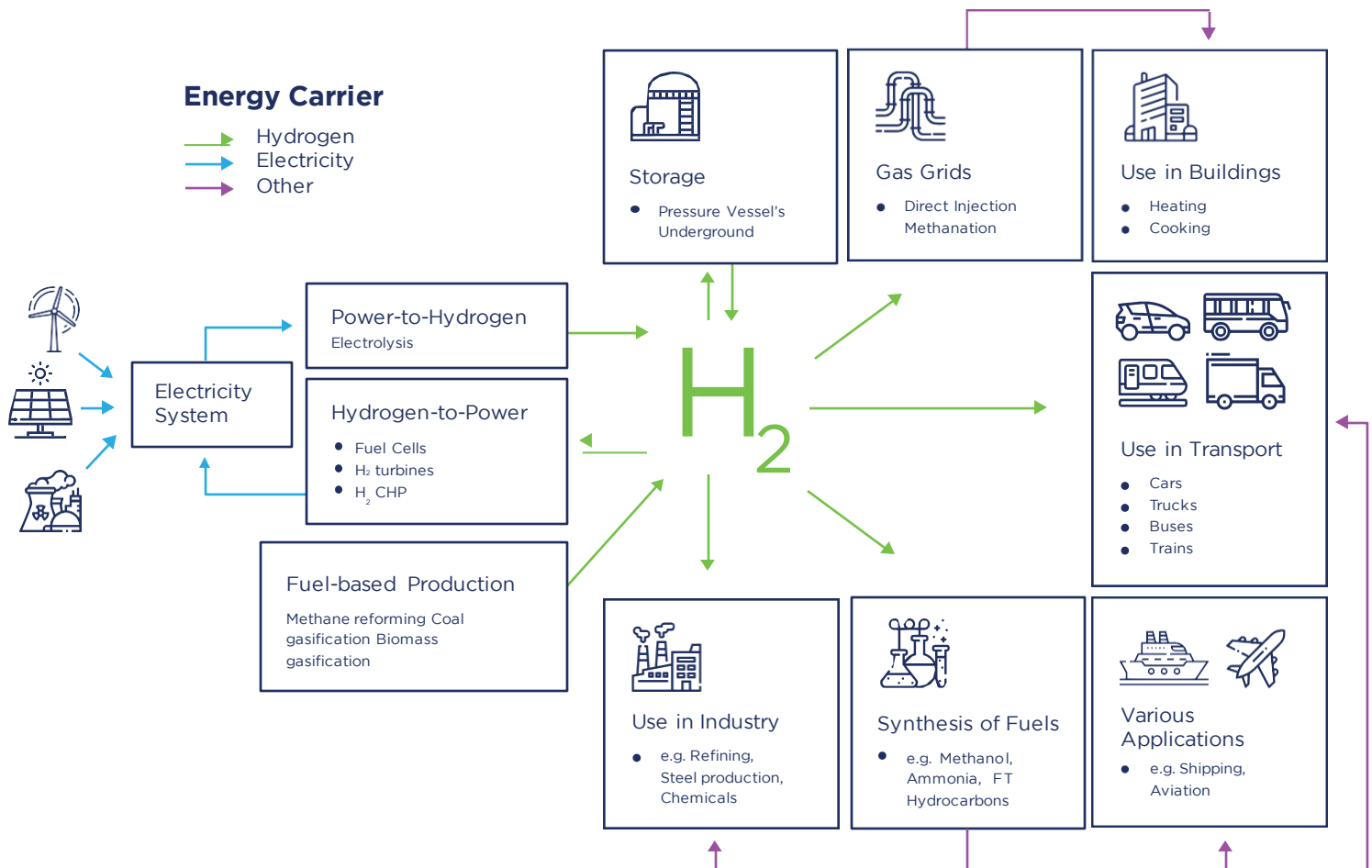
1. Phytomining of Battery Active Materials
2. Pilot Production of Battery Manufacturing Plant

Description of NanoMalaysia's EV and Energy Storage Programme



What is Hydrogen EcoNanoMY Programme



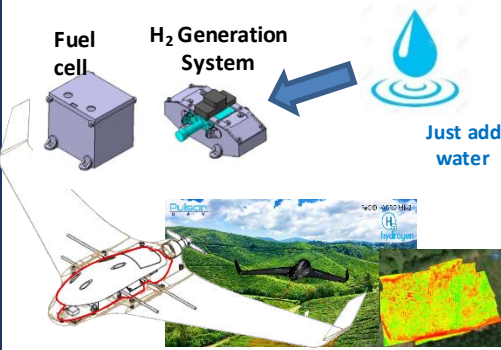
The Hydrogen EcoNanoMY programme under the facilitation of NanoMalaysia Berhad aims to develop and produce local game-changer technology enabling cost-efficient hydrogen on-demand and on-site production while also looking into the ecosystem surrounding the value chain and addressing market interest in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



Description of NanoMalaysia's EV and Energy Storage Programme



Technology Initiatives

 <p>Hydrogen Paired Electric Race Car</p>	 <p>Hydrogen Paired E-Bikes</p>	 <p>On-Board H2 Generation System for UAV and Precision Agriculture</p>
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 <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>
 <p>End-to-End Ecosystem Development from Nanomaterials to Applications</p>					

Description of NanoMalaysia's EV and Energy Storage Programme

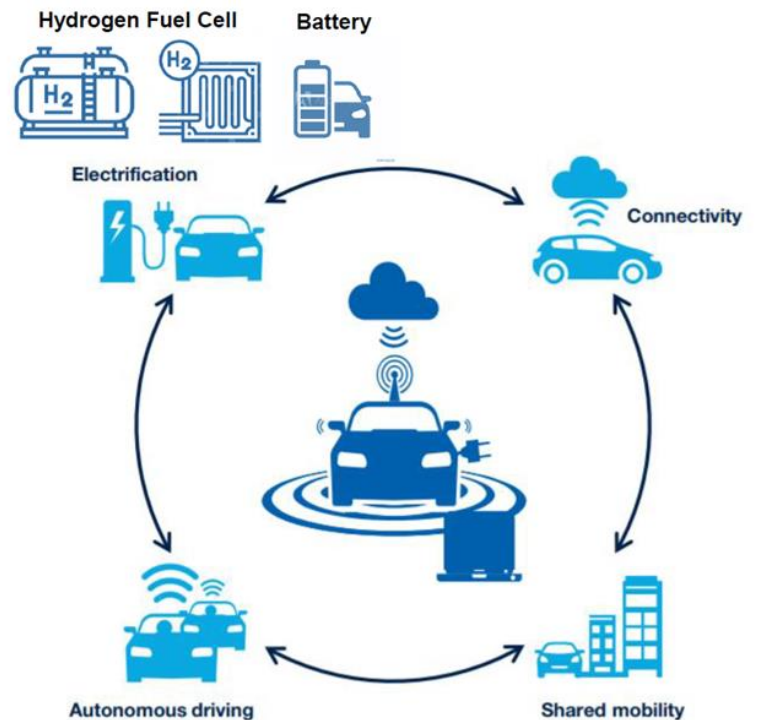


EMERGE

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 for 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



Description of NanoMalaysia's EV and Energy Storage Programme



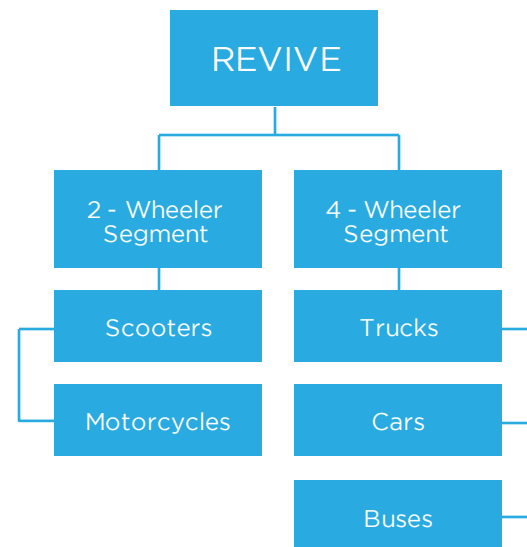
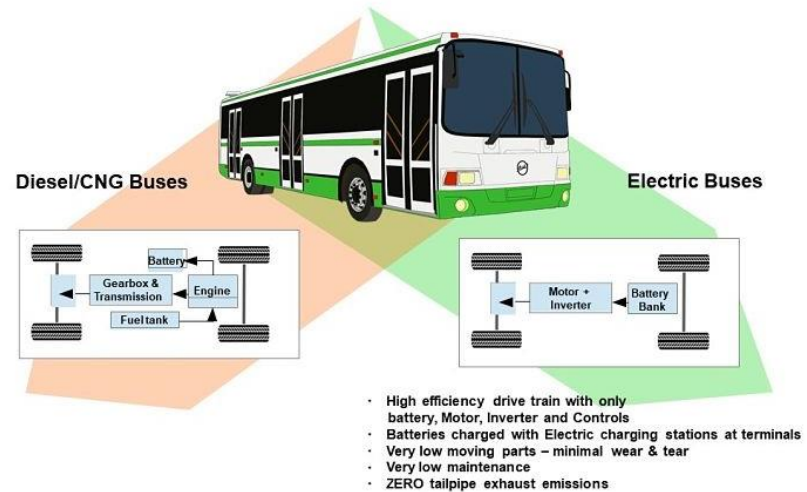
What is Rapid Electric Vehicles Innovation Validation Ecosystem (REVIVE)?

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.











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.

Proposed Initiatives under CLEVER

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



06

**Monetising
Technology**

Business Objectives

Spearheading The Nanotechnology Revolution by Re-energising Industries

Driving Economic Growth
and Commercialisation

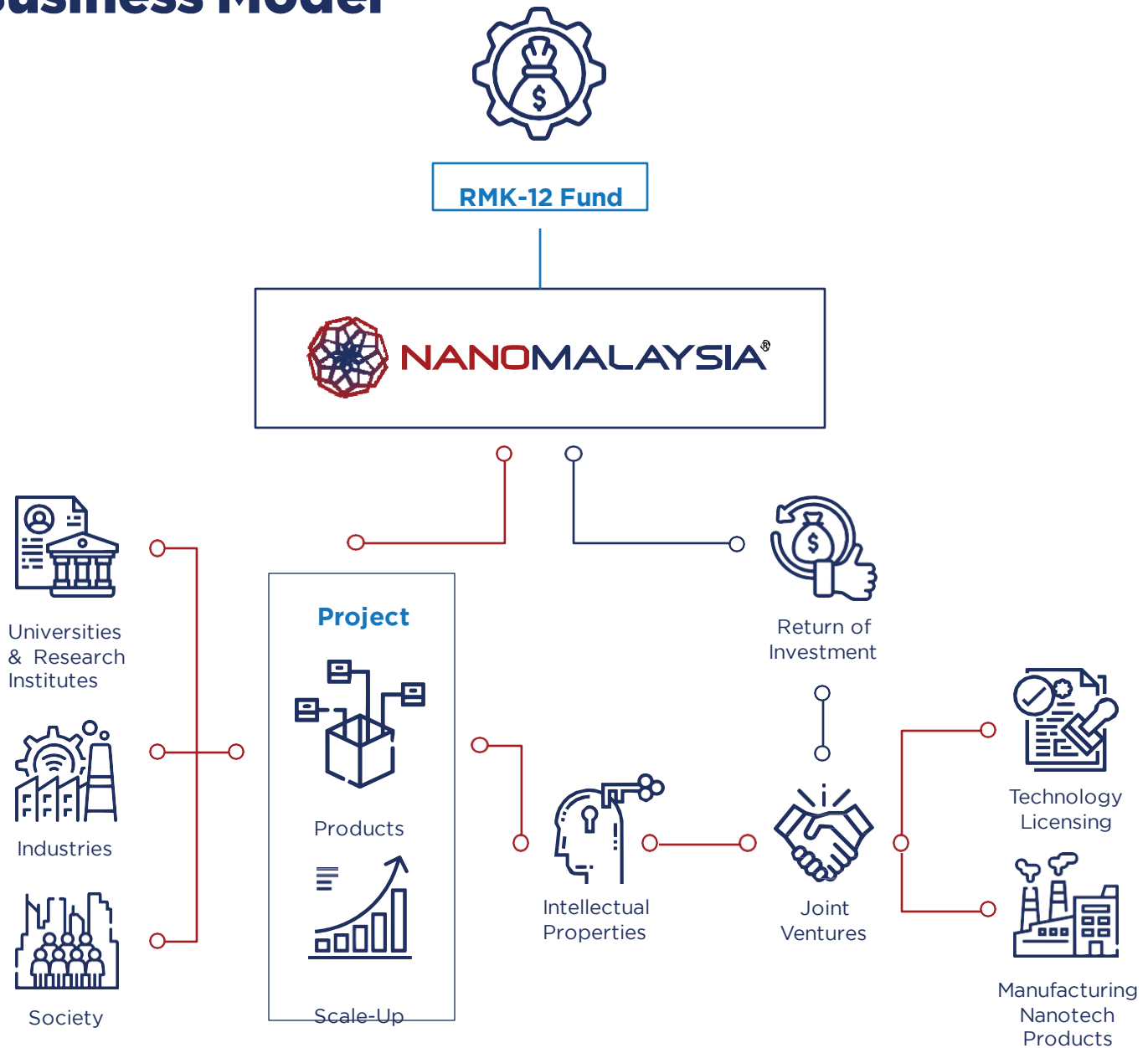
Strengthening The Ecosystem
and Enhancing Competitiveness

Increasing Public Awareness

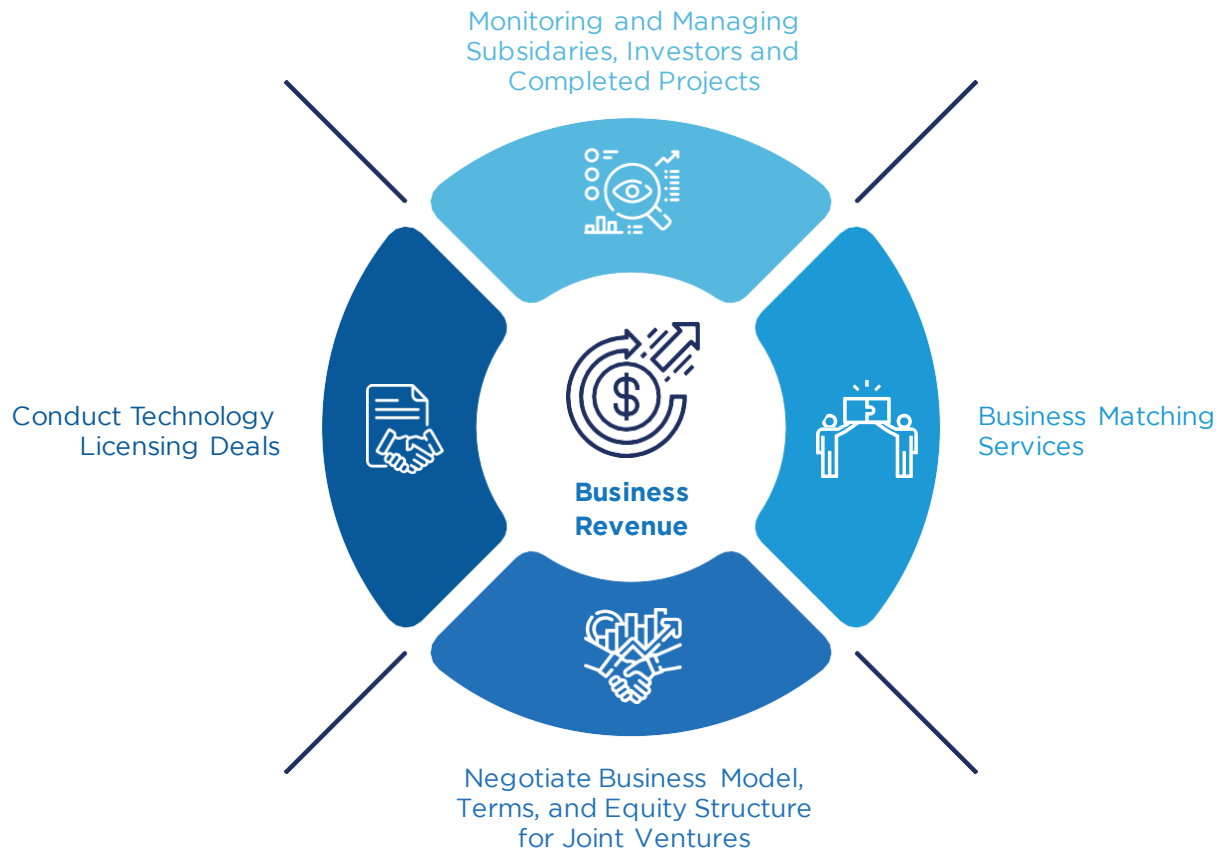
Our six core business areas are focused on generating long-term sustainable growth within the four key strategic Jumpstart sectors identified as providing the most significant potential for value creation and profitability.

We represent our strategic intent through business activities conducted by NanoMalaysia throughout the year. To ensure that we can maximise value creation and generate outcomes that are aligned with our objectives, we have implemented a comprehensive and structured project management workflow process. Our disciplined commitment to remain on course with executing our strategy through our comprehensive business model has contributed to our robust business fundamentals and the long-term resilience of our business.

Business Model



Enabling Growth Through Strategic Partnership



NanoMalaysia has successfully delivered on commercialisation activities through various collaborations and joint ventures, which are contributing to our business revenue and the ongoing sustainable development of the local nanotechnology sector. For more information on our diverse programmes and commercialisation activities and their outcomes, please refer to the section titled “NanoMalaysia Programmes” in this Strategic Report.





07

**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 Value

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.

NanoMalaysia Growth Phases



Phase **01** | Positioning and Branding

Incorporated
on 1 August 2011

2011

Signed MOU with Advanced Energy Research and Technology Centre (AERTE) New York and Malaysian Industry – Government group for High Technology (MIGHT).

Conducted Nanotechnology Enabler Lab to design programmes and identify commercialisation projects.

2012

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 applications.

General nanotechnology commercialisation partnership with Russian based RUSNANO capital.

2013

NanoMalaysia Growth Phases

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

2014

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

2015

- 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.

2016

NanoMalaysia Growth Phases

Phase 02 | Creating Economic Value

11th Malaysia Plan Nanotechnology Commercialisation Programme

- 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 China Innovation Alliance of the Graphene Industry.

2017

- 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

2018

NanoMalaysia Growth Phases

Phase
03

**2020
& Beyond**

REVOLUTIONT
A Revolution 4.0 the Internet of Nano-Things

- 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

2019

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

2020

NanoMalaysia Growth Phases

Phase
03

**2020
& Beyond**

- 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

2021

New programmes
introduced on 2021

HYDROGEN
ECONOMY & TECHNOLOGY
ROADMAP



NESTI



EMERGE



REVIVE



CLEVER



08

**4TH Industrial
Revolution
Strategy**

Our Strategy Beyond RMK-12

NanoMalaysia was founded as Malaysia's leading agency for the commercialisation of nanotechnology. To achieve our business objectives, we are providing the industry with technology and business leadership crucial for the sustainable long-term development of the nanotechnology industry.

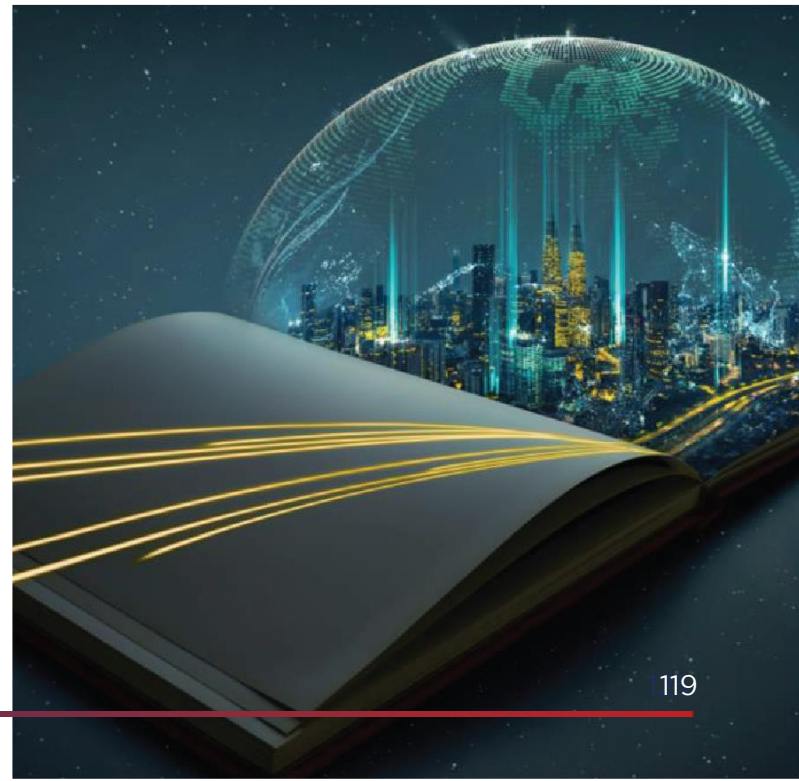
NanoMalaysia's strategic growth ambitions are guided by our strategy, which leverages the opportunities available due to the Fourth Industry Revolution's (4 IR) Internet of Nano Things (IoNT). IoNT refers to the interconnection of nanosensors and nanodevices with the Internet which has led to the development of next generation standards based on the Internet of Things (IoT). Our strategy is premised on our firm belief that IoNT will be the core driver of 4 IR and catalyse transformational and revolutionary changes in the industry, business, and society.

Our primary goal is to capture revenue streams associated with nanotechnology and IoNT enabled products and applications. We do this by focusing our financial and human resource investments on business ventures and projects that are feasible and offer realistic and high-value returns in the medium to long-term. We also stress the importance of national agendas relating to job creation and an environmentally greener future.

In the short to medium-term future, our focus is on our RevolutIoNT strategic campaign as the key driving force to mobilise the local industry, in line with our ambition to Spearhead the Nanotechnology Revolution in Malaysia. Our RevolutIoNT strategic blueprint considers the myriad benefits of nanotechnology through enhanced and efficient solutions within various applications in food and agriculture; wellness, medical and healthcare; electronic devices and systems; and 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, And we are providing support for prominent local and multinational companies based in Malaysia and local SMEs..

These programmes were developed under the 12th Malaysian Plan (12MP), which identified nanotechnology's commercialisation as a potentially high-growth sector to drive national economic growth. Accordingly, we are driving nanotechnology commercialisation through product development and scale-up projects.



Our Strategy

NanoMalaysia Programmes

REVOLUTION A Revolution 4.0 the Internet of Nano-Things



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



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

REVOLUTION
A Revolution 4.0 the Internet of Nano-Things

RevolutionNT Strategic
Blueprint

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

People, Planet, Profit



NANOVerify Certification Programme

- Strengthen product reputation and credibility in local and international markets by creating positive brand association
- Increase consumer awareness



09

2021

Highlights



NanoMalaysia Celebrates 10th year of its establishment

NanoMalaysia is essentially a story of entrepreneurship, a narrative that captures the initial startup and current growth phases. NanoMalaysia was incorporated after securing approval from the National Innovation Council on the 14th of February 2011, which led to the eventual incorporation under the Company's Act as a company limited by guarantee (CLBG) on the 1st of August 2011. Looking back at our short history, NanoMalaysia began with a small government grant of RM7M with no sign of other annual support. But it has an extensive plan to fulfill its intended mission. It survived the few initial years by aggressively pushing itself forward to get noticed and buy-in from stakeholders through seminars and awareness among public and private circles. At the same time, efforts were made to participate in crucial meetings and discussion circles for long-term strategic visibility and positioning in seeking Malaysia Plan inclusion. The exciting period 2016-2020 under the 11th Malaysia Plan saw NanoMalaysia's effort and competencies rewarded with a funding allocation to implement the venture builder Nanotechnology Commercialisation Programme uniquely designed based on a triple-helix concept congregating agency, industry, and academia.



MYIPO recognises our high productivity in developing new intellectual properties as NanoMalaysia made it into Malaysia's Top 30 Patent Filers for the year 2020. Despite a very challenging period, by the end of last year, NanoMalaysia developed 55 Intellectual Properties, 25 patents; 17 copyrights, five trademarks; 4 trade secrets, and four utility innovations. And despite the current COVID-19 crisis, our team has persevered to reveal our resilience and strength. To add, we are together with the Ministry of International Trade and Industry to help manage four COVID-19 projects, namely nanotech-enhanced PPEs and anti-viral systems. The accomplishments of NanoMalaysia's 11th Malaysia Plan programme became a successful pitch for continuing the national nanotechnology commercialisation agenda, working closely with MOSTI. The pandemic has highlighted the pressing need for Malaysia to embrace the digital economy and Fourth Industrial Revolution to remain globally competitive. Industries will have to reevaluate strategies and consider how technology can help businesses evolve. The government recently launched the National 4IR Policy to anticipate and acknowledge this need. It will utilise 4IR technologies for a strategic socio-economic transformation.

NanoMalaysia embraces another significant role with its position as one of the implementing agencies for key segments of this policy, namely Advanced Materials and Technologies, Internet of Nano-Things, Blockchain, and Artificial Intelligence. It is expected to generate more job opportunities as the 4IR is forecasted to boost all sectors' productivity by 30 percent by 2030. This will contribute to our country's increase in skilled workers and the production of higher value-added products. Nanotechnology was duly acknowledged by the World Economic Forum (WEF) as one of the primary drivers of 4IR. In fact, Internet of Nano Things, including nanosensors were ranked number 1 by WEF in 2016 to jumpstart 4IR.



NanoMalaysia has in place the REVOLUTIoNT programme which mirrors the National 4IR Policy, that will be crucial in the production of complex and valuable intellectual properties, products, and systems solutions, especially in the applications of sensors, communication devices, flexible electronics, Internet of Nano Things, smart cities, autonomous systems for transportation, electric vehicles, green energy, and robotics. The programme has also enabled partnerships with local universities, start-ups, SMEs, and end-users to drive forward the advancement of technology in our race towards becoming a high-income nation. The National 4IR Policy, built on people-private-public partnerships, demonstrates our government's commitment to embracing the digital revolution. MOSTI will provide all the necessary support to high-tech companies through NanoMalaysia – from the product development phase right up to the commercialisation stage. The new 4IR-based REVOLUTIoNT programme under the 12th Malaysia Plan focuses on the Internet of Nano Things; two high-impact scale-up projects, namely Hydrogen EcoNanoMy building on our hydrogen reactor technology; and Nanotech Remote Energy Systems. In addition, supporting MOSTI's High Tech Nation aspiration, NanoMalaysia is leading the National Energy Storage Technology Initiative and Hydrogen Technology and Economy Roadmap. We were also given a leadership role at Asia Nano Forum and appointed as International Advisor for China Graphene Industry Alliance.



As part of the globalisation of NanoMalaysia and Malaysian nanotechnology products, we formed international partnerships with IBM (USA), BAE Systems (UK), Rusnano (Russia), Nanopolis (China), China Graphene Industry Alliance (China), TANIDA (Taiwan), Phantoms Foundation (Spain), NanoNEXTNL (Netherlands), NanoCanada (Canada), Nanotechnology Business Creation Initiative (Japan), Nanotech Center (Indonesia), National Nanotechnology Coordination Office (USA), 10000Startups (India) and SUNUM Sabanci University Nanotechnology Research and Applications Center (Turkey). Thank you for your trust in NanoMalaysia.

Our achievements could not have been made possible without our staff's sheer dedication and teamwork. We have recorded our achievements and milestones and the story of the development of NanoMalaysia and its role in driving the commercialisation of nanotechnology in a table book entitled Greatness from Small Beginnings.



The introduction of Dasar Sains Nanoteknologi Negara 2021-2030 (DSNN 2021-2030)

This policy outlines the country's nanotechnology development agenda's strategic direction by further boosting the local technology development through programs and action plans that have been drawn up. To ensure that Malaysia's nanotechnology industry can remain competitive and move forward, DSNN 2021-2030 aims to coordinate the sustainability of development across various sectors through nanotechnology. In addition, research, technology, products, talent, and commercialisation activities specialised in nanotechnology can increase the country's economic contribution. Next is to spur the growth local nanotechnology industry through programs and action plans and create safety frameworks and comprehensive rules for developing nanotechnology. To realize this desire and carry the vision of DSNN 2021-2030, which is Nanotechnology: Shaping the nation high -tech 2030, the policy encompasses 4 Strategic Thrusts supported by 15 Strategies and 32 Initiatives across various sectors of the economy.



“Nanotechnology is positioned as a new technology that have and will contribute significantly to economic growth and job creation in the next few decades as well as revolutionising future.”

— YB. Dato' Sri Dr. Adham Bin Baba
Minister Of Science, Technology And Innovation





The implementation of this policy will benefit the ecosystems and build progressive national nanotechnology. In addition, it can increase resource utilisation more efficient while optimising research costs as well as technology and product development for national progress for the people, industry, and economy. The commitment and dedication of all parties involved have led to the successful formulation of DSNN 2021-2030. This policy goal can be achieved if the country's issues and challenges can be overcome through strategic measures and close collaboration between the public, private, academic, and community sectors. This policy will also lead Malaysia towards a developed and high-tech nation, especially with nanotechnology as dreamed.



Background



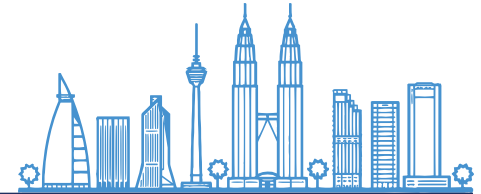
The National Nanotechnology Policy & Strategy (DSNN) 2021-2030 is a long-term strategy document designed to drive the national economic agenda towards 2030.

To meet this vision, a dynamic nanotechnology ecosystem will be formed to ensure that all governance, research institutions, universities, and industries can capitalise on it and explore their potential in the field of nanotechnology.

Policy Statement



'Malaysia: Shaping a High-Tech Nation 2030'



Vision



Nanotechnology: Shaping the High-Tech Country 2030

Mission



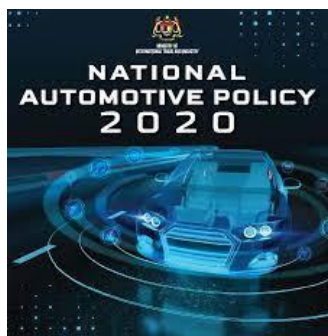
- Nanotechnology mainstreams everyday life. Nanotechnology is an enabler in various fields to support broad-based technologies to achieve mass adoption by 2030.
- Nanotechnology to improve the well-being of society and the environment.
- Nanotechnology for the sustainable development of science, technology, industry and economy.

Objective



- To seek development between sectors and their sustainability through nanotechnology
- To increase the economic contribution of nanotechnology through specialised research, development, talent, and commercialisation activities.
- To facilitate the growth of the local nanotechnology industry through specific programs and action plans.
- To develop a comprehensive safety and regulatory framework for the development of nanotechnology.

National EV and Energy Storage Initiatives (Malaysia)



National Automotive Policy 2020

Phase 1	
Continuation of NAP 2014	2020-2024
<ul style="list-style-type: none"> • Engine transmission, control system • Tool, Die and Mould (TDM) • Aluminium and other Non-Ferrous Casting • Design engineering and prototyping • Vehicle, sub-system and component testing • Automotive grade steel • Engineering Plastics 	<ul style="list-style-type: none"> • Big Data Analytics (BDA) • Internet of Things (IoT) • Additive Manufacturing • Advanced Material • Battery Management System (BMS) • Thermal Management System (TMS) • Battery Pack & Capacity • Recycling Processes • Light Detection and Ranging (LiDAR) • Cloud Computing • Cybersecurity • System Integrator • Artificial Intelligence 1 • On-board Charging • Charging Infrastructure

Motorcycles

- EEV specification for engine capacity above 250 cc
- Develop standards for Battery Swapping technology
- Develop standards for motorcycle NxGV
- Conduct research and study to promote R&D in the aspect of motorcycle safety

Air Mobility

- The use of UAV and Air Mobility will be part of connected mobility in the future
- There is a need to coordinate and develop regulations before mass utilisation

Commercial Vehicles

- Interim EEV standards for Euro 5 engine for vehicle with Kerb Weight over 2,500 kg
- New EEV standards will be developed by year 2021
- Upgrade green engine specification from Euro 2 to Euro 5
- Promote use of telematics and IoT technology for safety enhancement and efficient fleet management

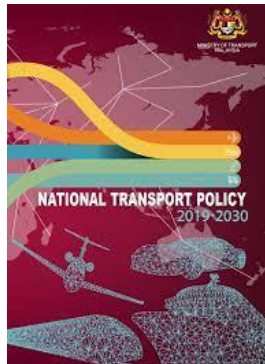
Electric Vehicles

- Promote manufacturing and application of local battery and battery pack together with development of Battery Management System (BMS) and Thermal Management System (TMS)
- Develop standards to encourage battery swapping and wireless charging
- Develop standards for recycling and disposal of battery
- Conduct feasibility study on Hydrogen Fuel Cell technology
- Develop EV Smart Grid Interoperability Centre
- Apply well-to-wheel concept in the calculation of emission from EV

Autonomous Test Bed

- Develop standards or code of practice for Autonomous Vehicle based on domestic conditions (Propose for NxGV Standards with minimum of level 3 Autonomous Driving)
- Establishment of Digitalised Testing Environment by leveraging IR4.0 (e.g. HD Mapping) technology
- Promote localisation of master controller and critical components of AACV (e.g. sensors, V2X module, etc)

National EV and Energy Storage Initiatives (Malaysia)



National Transport Policy 2019-2030

Strategy 4.3

The measure of Success:

- Achievement of 45% reduction of greenhouse gas emission intensity of GDP by 2030 across all its key emitting sectors
- Adoption of cleaner fuel - such as biodiesel and electric vehicles
- Increase in public transport modal share

Accelerate Implementation of Low Carbon Mobility Initiatives

Mobility, in particular private transportation, has traditionally been viewed as carbon-intensive with significant efforts focused on mitigating fuel consumption and carbon emissions. Private transportation has led the way in developing low-carbon alternatives such as hybrid and all-electric vehicles, this, in turn, has spread to the commercial sector. Future policies take into account the need to minimise unsustainable consumption patterns.

Objectives:

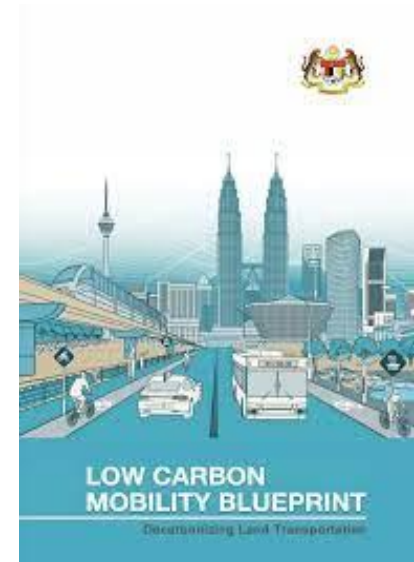
- Reduce greenhouse gas (GHG) emissions from transport sectors
- Increase adoption of energy-efficient vehicles (EEVs_ as a preferred mode of transport Increase utilisation of
- public transport and non-motorised transport

Action Items:

1. Execute implementation of Low Carbon Mobility Blueprint Action Plan
2. Study current regulation in Act 333 to support the growth and the use of EEVs/electric vehicles (EVs) in Malaysia
3. Develop sustainable and economically viable infrastructure for EEVs e.g. charging stations for EVs
4. Provide incentives for EEV manufacturers and users, and consider different models of EEV
5. Formulate and implement fuel economy policy
6. Develop cleaner fuel or improved fuel standard
7. Develop green index and incentives to encourage transport operators to go green
8. Mandatory requirement for purchase of low carbon emission vehicles in Government Green Procurement

National EV and Energy Storage Initiatives (Malaysia)

Low Carbon Mobility Blueprint 2021-2030



Focus Area 2: GHG emission & energy reduction via electric vehicle adoption



(i): Adopting Electric Mobility in Strategic Applications - Electric Car Adoption

- Government lead by example
- Adopt EV cars for taxi fleet as part of taxi service modernisation and rebranding
- Provide EV incentives for the market
- Ensure EV charging infrastructure sufficient for private EV penetration
- Provide R&D grants and support to manufacturers of local EV cars
- Building a holistic EV ecosystem



(ii): Adopting Electric Mobility in Strategic Applications - Electric Bus Adoption

- Establish e-bus central procurement agency
- Public transport electricity tariff and electricity subsidy
- Providing support to manufacturers of local EV bus



(iii): Adopting Electric Mobility in Strategic Applications - Electric Motorcycle Adoption

- Procure electric motorcycles for government enforcement fleet
- Use electric motorcycles for delivery service
- Development of battery swapping standard for electric motorcycle in Malaysia
- Provide support to manufacturers of local electric motorcycles

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:



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.



Volvo Car Malaysia to produce reusable anti-microbial face masks with NanoTextile Sdn Bhd (NANOTEXTILE)

In pursuit of sustainability, Mr. Nalin Jain, Managing Director of Volvo Car Malaysia has spearheaded the initiative to produce reusable anti-microbial face masks with NanoTextile Sdn Bhd (NANOTEXTILE) to reduce pollution by disposable ones.

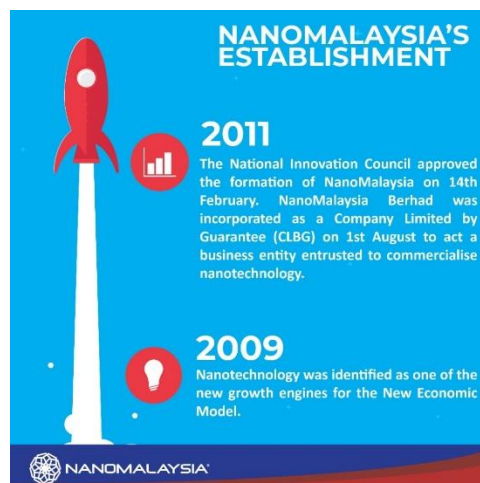
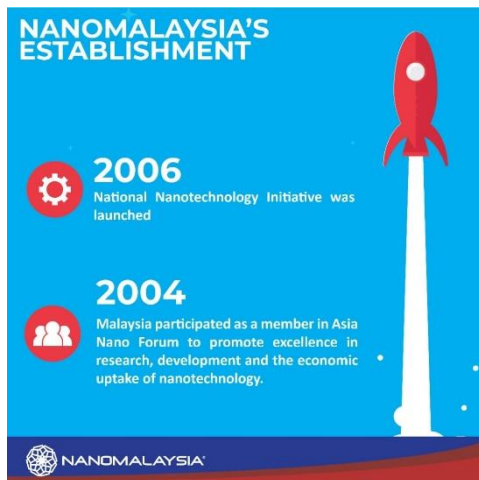
The EV Race can Malaysia keep up?

NanoMalaysia's CEO, Dr Rezal Khairi Ahmad, believes Malaysia should develop technologies that will be part of the EV ecosystem. – The Edge Malaysia



Rezal: We have activated a number of projects. We are looking at battery technology, fuel cell technology, hydrogen technology, charging technology, autonomous vehicles and so on.

with the industry. They are asking whether the government can be more flexible for EVs and allow EVs to come in with measures that do not require so much calculation of



NanoMalaysia's Tenth Anniversary

In 2009, the National Innovation Council had identified nanoscience and technology as an important growth engine for the New Economic Policy (NEP) that would stimulate and accelerate the development of home-grown nanotechnology into beneficial technologies. That same year, the National Nanotechnology Statement was developed, signifying the Government's commitment to advance the sector in our country.

NanoMalaysia was incorporated in 2011 as a Company Limited by Guarantee (CLBG) under the then Ministry of Science, Technology, and Innovation (MOSTI). The mandate given to NanoMalaysia was to consolidate and spearhead the commercialisation and industrialisation of nanotechnology activities in Malaysia.

2021 marks the 10th anniversary of NanoMalaysia in the Nanotech industry.

Help A Child To Learn

Access to education is a birthright for all children. The **Help A Child to Learn** campaign aims to provide quality learning opportunities throughout school closure by providing laptops and digital education contents for B40 children. Support us in achieving the fundraising goal of RM65,000 by 31 March 2021. Every Ringgit crowdfunded will be matched by MaGIC and Nano Malaysia for a total amount of RM65,000.

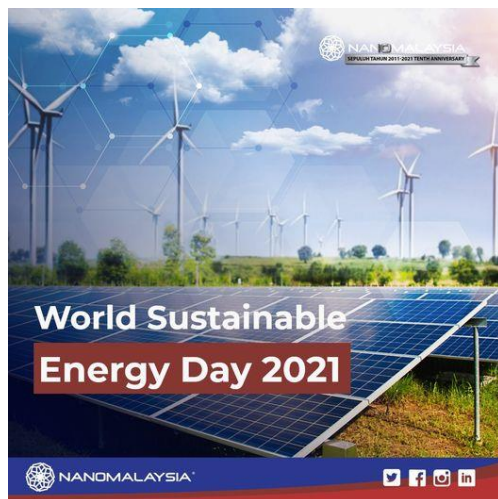
Donate now at
www.sedunia.me/campaigns/help-a-child-to-learn

Help A Child to Learn Campaign
by



Help A Child to Learn Campaign by MaGIC & NanoMalaysia Berhad

We believe that access to education is a birthright for all children, hence why MaGIC and Nano Malaysia are bringing the 'Help A Child to Learn' campaign, an effort to provide quality learning for children of B40 families affected by school closure.



World Sustainable Energy Day 2021

Renewable energy sources like solar energy, wind energy, and hydropower use little to no emissions, which is a massive step in the right direction for the health of our planet. Renewable energy sources are healthier for all of the living things on this planet as well, like humans, animals and plant life. Happy World Sustainable Energy Day from NanoMalaysia!

Happy International Women's Day!

NanoMalaysia believes in gender harmony. On account of Women's Day, we celebrate by admiring and acclaiming the valuable contributions made by the extensive strength of women in NanoMalaysia.



NANOTECH TALK Webinar series Volume 5

Nanotech Talk Webinar. This virtual session consists of NanoMalaysia's strategic partner and speakers. Nanotech Talk is a yearly event by NanoMalaysia Berhad that focuses on Four (4) key strategic sectors; Electronics, Devices & Systems, Food & Agriculture, Energy & Environment, and Wellness, Medical & Healthcare.

This year's theme is aligned with the National initiative to empower the Industry Revolution 4.0 and the Internet of Nano-Things (IoNT). This webinar aims to showcase valuable insights by featuring the nanotechnology, market trends, and issues mainly for industry, companies, and startups who would like to venture into Nanotechnology and understand what NanoMalaysia offers.



NanoMalaysia Berhad ranked #24 among the Top 30 IP applicants with MyIPO in 2020.

The road ahead is still long. Plenty of room for improvement. This achievement is made possible through collaborations with our university, startup, and SME partners. A big thank you to all! Let's commercialise together



World Water Day 2021

The theme for World Water Day 2021 is "Valuing Water: No Water, No Life. No Blue, No Green." Everyone around the world should pay attention to the importance of water in our communities!

2021 Highlights



COVID-19 Relief for PPR Batu Muda Residents

NanoMalaysia Berhad and the NGO, All Women Empowerment Association (AWETA) donated Nanofacemask, Hand Sanitiser, and dry food supplies to single mothers at the Batu Muda PPR Flat, Jalan Ipoh



THE TECHNOLOGY SHOW by Biztech Asia

THE TECHNOLOGY SHOW by Biztech Asia, with special guest, our very own Dr. Rezal Khairi Ahmad, CEO of NanoMalaysia Berhad.

biztech.asia
THE TECHNOLOGY SHOW

**Thursday
1 April**

8pm Singapore/Kuala Lumpur/
Manila/Perth
7pm Jakarta/Bangkok/
Ho Chi Minh

Featuring:
NANOMALAYSIA

Guest:
Dr Rezal Khairi Ahmad
CEO of NanoMalaysia Berhad

Host:
Brian Fernandez

LIVE facebook.com/biztech.asia www.biztech.asia

Nano Webinar, 23rd April 2021

Remember the NanoMalaysia-10000Startups-Foodie Box partnership announcement?

The real fun is the action beyond the media release.

The webinar is about synergising Malaysian and Indian nanotechnology enterprises for faster growth..

NANO WEBINAR
FROM LAB TO MARKET
AN OPENING SESSION

Inviting Startups, MSMEs
in Nanotechnology

23rd April 2021, 11 am-12 pm IST

+91 88281 06690 **Register Now**

www.10000startupsindia.com/events

STARTUPSINDIA
A member of 10000Startups

Dr. Rezal Ahmed
CEO, NanoMalaysia Berhad

Jimmy Lee
CEO, Foodie Box Group

Honey Kithani
Co-founder,
StartupsXchange &
10000StartupsIndia

Leenesh Singh
CEO, 10000StartupsIndia

2021 Highlights

THE TECHNOLOGY SHOW by Biztech Asia

THE TECHNOLOGY SHOW by Biztech Asia, with special guest, our very own Dr. Rezal Khairi Ahmad, CEO of NanoMalaysia Berhad.

WEBINAR

Developing and Commercializing Nanotechnology
via International Collaborations

Dr. Rezal Khairi Ahmad
NanoMalaysia

June 16th, 2021 @ 10:00 (GMT+3)

Sabancı
Universitesi

SU|NUM



Nanoopen

SESI PANEL SEMPENA MAJLIS PELANCARAN
DASAR 4IR NEGARA
4IR: Equitable Wealth Creation Game Changer
1 JULAI 2021 | KHAMIS | 9.45 PAGI

Moderator
Dr. Rezal Khairi Ahmad

Panelist 1	Panelist 2	Panelist 3	Panelist 4	Panelist 5
The Government's Direction and Support for 4IR Dato' V Valluvan Veloo	Innovation and Industry in the 4IR Dr. David Lacey	Talent and Skills for Innovation in the 4IR Datuk Ir. Ts. Dr. Siti Hamisah Tapsir	Socio-Economic Transformation in the 4IR Era Professor Mahendhiran Sanggaran Nair FASC	People's Needs and Expectation on 4IR and Future of Malaysia Mr Jufitri Joha

www.mosti.gov.my f @officialmosti mosti

National 4IR Policy Launch

Panel session in conjunction with the National 4IR Policy Launch. Features five (5) panelists who will cover the topic of '4IR: Equitable Wealth Creation Game Changer'.

NanoMalaysia Berhad Strategic Report 2020

The content included in NANOMALAYSIA Strategic Report 2020 combines detailed and responsible disclosures to provide a comprehensive overview for our stakeholders. With this report, we aim to provide our stakeholders with a consolidated review of our spectrum of programmes and initiatives to enable sustainable growth of Malaysia's nanotechnology sector as guided by our strategy.



NanoMalaysia Energy Storage Technology Initiative (NESTI) in the Parliament

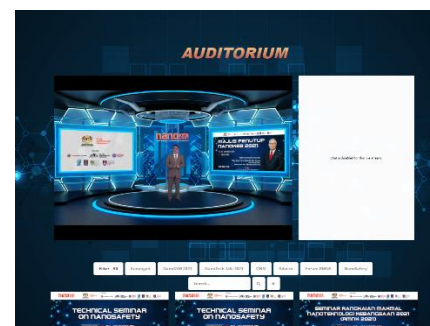
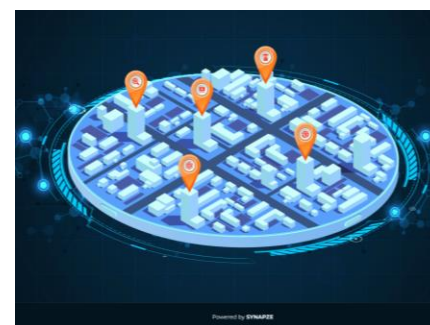
As our Prime Minister Datuk Seri Ismail Sabri Yaakob, said in the Parliament on 23rd September 2021, Our program, NanoMalaysia Energy Storage Technology Initiative (NESTI), has been identified to be one of the government's research and experimental programs that have the potential to be commercialised in Malaysia.

2021 Highlights



NANOKEB 2021 Nano Summit - Conferences and Exposition

NANOKEB 2021 is an annual event organised by the National Nanotechnology Center (NNC) and NanoMalaysia Berhad with the aim of knowledge and information sharing on national nanotechnology development, encouraging discussion and engagement on issues and the direction of nanotechnology research and development, and also a medium of awareness about nanotechnology to the society especially university and school students



2021 Highlights

NANOTECHNOLOGY INITIATIVES UNDER THE TWELFTH MALAYSIA PLAN (RMK12)

23RD OCTOBER 2021
10.00 AM - 11.00 AM

ADAM RAMSKAY
HEAD OF STRATEGIC UNIT, CRADLE FUND,
DEPUTY SECRETARY OF
MALAYSIA NANOTECHNOLOGY ASSOCIATION (MNA)
MODERATOR

DR. REZAL KHAIRI AHMAD
CHIEF EXECUTIVE OFFICER,
NANOMALAYSIA BERHAD

DR. RUSLINDA BINTI A. RAHIM
DIRECTOR OF NATIONAL NANOTECHNOLOGY CENTRE (NNC),
MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION (MOSTI)

PANELIST

MEGAT MIZAN NICHOLAS DENNEY
EXECUTIVE DIRECTOR OF GROUP BUSINESS DEVELOPMENT DEPARTMENT,
KENANGA INVESTMENT BANK BERHAD

PROF. DR. MANSOR HJ. AHMAD
PRESIDENT
MALAYSIA NANOTECHNOLOGY ASSOCIATION (MNA)

NANOMALAYSIA

Logos: MNA, MOSTI, NANO, and other partners.



Nanotechnology Initiatives under the RMK12 Forum

Moderator: Adam Ramskay (Head of Strategic Unit, Cradle Fund, Deputy Secretary of Malaysia Nanotechnology Association (MNA))

- Panelist:
1. Dr. Rezal Khairi Ahmad (Chief Executive Officer, NanoMalaysia Berhad)
 2. Megat Mizan Nicholas Denney (Executive Director of Group Business Development Department, Kenanga Investment Bank Berhad)
 3. Dr. Ruslinda A. Rahim (Director of National Nanotechnology Centre (NNC), Ministry of Science, Technology And Innovation (MOSTI))
 4. Prof. Dr. Mansor Hj. Ahmad (Malaysia Nanotechnology Association (MNA))

2021 Highlights



Industry Revolution 4.0, the Internet of Nano-Things: REVOLUTIONT

NanoMalaysia, together with the Ministry of Science Technology and Innovation (MOSTI), has launched an initiative under the Industry Revolution 4.0, the Internet of Nano-Things: REVOLUTIONT. This event was officiated by the Minister of MOSTI, YB Dato' Sri Adham Bin Baba at: <https://revolutiont.cloudexpo.my/> In this digital platform, visitors can learn about NanoMalaysia's initiatives, projects, potential markets, and potential applications of REVOLUTIONT program.



2021 Highlights

Twelfth Plan: Empowering Technology Development & Commercialisation

Empowering Technology Development and Commercialisation Twelfth Plan: Empowering Development & Commercialisation.

The 12MP is supported by the National Science, Technology and Innovation Policy (DSTIN) 2021-2030 and the 10-10 MySTIE Framework.

MOSTI is fully committed to empowering Malaysia through the enhancement of economic sectors in agriculture, manufacturing, services, and disaster mitigation through technologies such as the use of digital big data analytics solutions, artificial intelligence, blockchain, and sensor technologies.



WEBINAR TWELFTH PLAN: EMPOWERING TECHNOLOGY DEVELOPMENT & COMMERCIALISATION

OPENING REMARKS
YB DATO' SRI DR. ADHAM BIN BABA
MINISTER OF SCIENCE, TECHNOLOGY AND INNOVATION

MONDAY | NOVEMBER 15TH, 2021 | 10.00 AM - 11.30 AM
PLATFORM : FB LIVE & YOUTUBE MOSTI
THEME: A PROSPEROUS, INCLUSIVE, SUSTAINABLE MALAYSIA

MODERATOR
DR. REZAL KHAIRI AHMAD
Chief Executive Officer, NanoMalaysia Berhad (NMB)

SPEAKERS

- DZULEIRA ABU BAKAR**
Chief Executive Officer, Technology Park Malaysia
- HAZAMI HARIB**
Chief Executive Officer, Academy of Sciences Malaysia
- ERIC CHENG**
Co-founder & Group CEO of Cersome

NANOMALAYSIA





Memorandum of Understanding (MOU) with Intellectual Property Corporation of Malaysia (MyIPO) for the Technology and Innovation Support Center (TISC) programme

NanoMalaysia Berhad (NanoMalaysia) has signed a Memorandum of Understanding (MOU) with the Intellectual Property Corporation of Malaysia (MyIPO) for the Technology and Innovation Support Center (TISC) programme. This MOU is one of the intermediate steps for NMB to become a Centre of Excellence for Intellectual Property (IP) strategic management through participation in IP training programmes, such as patent searching, patent drafting, IP commercialisation, and IP marketing, conducted and coordinated by MyIPO, in cooperation with the World Intellectual Property Organisation (WIPO).

The MOU Exchange Ceremony was held at MyIPO and was attended by Prof. Emeritus Dato' Ir. Dr. Mohamad Zawawi Bin Ismail, Chairman of NanoMalaysia; En Abdul Haris bin Haji Lakar, Director General of MyIPO and Dr. Rezal Khairi Ahmad, CEO of NanoMalaysia.



2021 Highlights



Majlis Pelancaran Dasar Dan Strategi Nanoteknologi Negara 2021-2030

The Ministry of Science, Technology, and Innovation (MOSTI) has launched the National Nanotechnology Policy and Strategy 2021-2030 (DSNN), which focuses on nanotechnology. The launch of DSNN is in line with the goal of DSTIN 2021-2030 to make Malaysia a high-tech country to transform the country from a technology user to a technology developer.

YB Dato 'Sri Dr. Adham Baba, Minister of Science, Technology, and Innovation, stated that the launch of DSNN highlighted the potential of nanotechnology to solve challenges facing the country, such as environmental pollution, renewable energy generation, agricultural products, and food security as well as various national priority areas.



2021 Highlights



Majlis Pelancaran Dasar Dan Strategi Nanoteknologi Negara 2021-2030

The NanoMalaysia Energy Storage Technology Initiative (NESTI) programme has been launched in Malaysia by minister of science, technology and innovation Datuk Seri Dr Adham Baba. Led by the ministry of science, technology and innovation (MOSTI) and with NanoMalaysia as the implementing agency, the programme will serve as a national-level platform aimed at developing and commercialising energy storage systems.

These will be used for electric mobility, excess grid, renewable energy and uninterrupted power supply for commercial and domestic use, covering areas like batteries, ultracapacitors, hydrogen storage, energy management systems and battery recycling.



2021 Highlights



Media Launch Of NanoMalaysia Autonomous Vehicle Initiative (NAVi) And NanoMalaysia Autonomous Delivery (NAVi-D) Demonstration

NanoMalaysia Berhad (NMB) launched NanoMalaysia Autonomous Vehicle (NAVi) and NAVi-D (Delivery) as an initiative to produce novel Level 4 Autonomous Vehicles (AVs) or driverless vehicles in Malaysia, geared towards the development of technologies related to the 4th Industrial Revolution 4.0 (4IR).

NAVi is focused on the transportation sector while NAVi-D will be equipped for the last mile delivery sector. NAVi-D (Delivery) is an evolution from NAVi focusing on the delivery of parcels and food products. NAVi-D's core technology is based on NAVi's software architecture enhanced for this specific application.

2021 Highlights



MOA EV Micro Mobility Ecosystem In Malaysia

Memorandum of Agreement (MoA): EV Micro-Mobility between NanoMalaysia Berhad, Hyundai KEFICO Corporation, CURO CO. Ltd., Hyundai Electric and Energy Systems Co Ltd, Daegu Mechatronics & Materials Institute (DMI), SK-SIGNET EV, THAM Corporation.



2021 Highlights



NanoMalaysia And Eclimo Launch E-motorbike With A Monitoring System

NanoMalaysia Bhd (NMB) and Eclimo Sdn Bhd launched an electric motorbike with a Nano-Structured Battery Monitoring System (BMS), known as the ES-11. The BMS can monitor battery health; send out alerts when the battery voltage drops, and come with a tracking and geo-fencing system that can be controlled via a mobile app.

The launch was officiated by the Minister of Science, Technology and Innovation (MOSTI), Yang Berhormat Dato' Sri Dr Adham bin Baba.



10

**Building Trust:
NANOVerify
Programme**



NANOVERIFIED MARK ONLY FOR GENUINE NANOTECHNOLOGY PRODUCTS

Assures sales of genuine
nanotechnology
products

Creates greater
market acceptance in
other countries

Boosts consumers'
confidence and trust

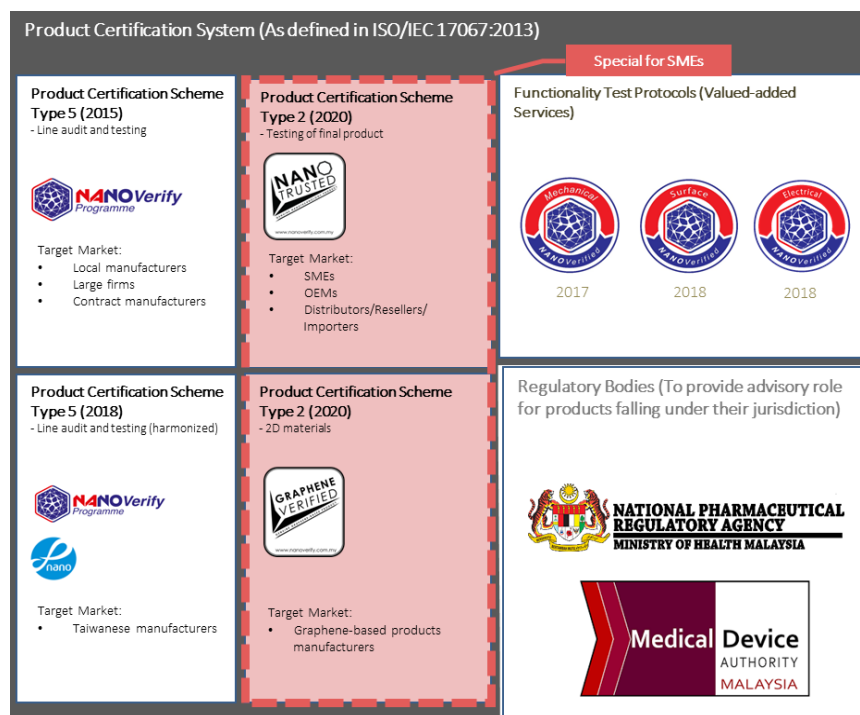
Increases value of
products



NANOVerified Mark

Today, nanotechnology products and applications are available in the market for commercial use. Product manufacturers have realised that even the usage of small amounts of nanomaterials in their existing products can lead to significant enhancements of existing properties, or even resulted in new properties. These provide consumer goods manufacturers with a unique selling point for their products, thus differentiating them in the marketplace. Applications cover items such as clothing to food packaging materials. While consumers have much to gain from this market trend, the overriding concern is to ensure that these nanotech products are credible and reliable. As nanotechnology is still a relatively new area, it is important to protect consumers from irresponsible manufacturers who may claim their product incorporates nanotechnology-enabled benefits, when it does not. Hence, NanoMalaysia embarked on 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 certifies processes and products which have incorporated nano elements within the 1 to 100 nanometre range. Apart from size and type certification, the NANOVerify Programme offers certification on the functionality enhancements obtained as a result of embedding nano elements, covering mechanical, surface and electrical properties. Since its introduction in 2020, the GRAPHENEVerify and NANOTrust Schemes were developed to strengthen local SMEs' abilities to successfully market their nanotechnology-enabled products for local and international market. These programmes were developed as Type 2 Certification scheme which did not require a production line audit. Instead, it focuses on the testing of final product. Since its launch, the programme has verified a spectrum of nanotechnology products, ranging from daily use items such as cosmetics, fertiliser and clothing to more specialised technology related applications such as technology wafers with carbon nanotubes. Upon certification, the products are awarded with either NANOVerified, NANOTrust and 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

To create greater awareness within the industry on the NANOVerify programme and its benefits, we have in place a comprehensive media and public relations plan. NANOVerify Programme has further categorised into several type of product certification scheme which are NANOTrust and GRAPHENEVerify depending on the nature of the companies and products/processes. Our continuous communication plan focuses on spreading the word on NANOVerify both within traditional media, as well as social and digital media. These involve conducting frequent interviews on television shows

and news programmes, as well as interviews with print media and business publications. We also collaborate with other Government agencies to conduct cross marketing activities. To garner wider industry exposure, we conduct ongoing workshops and conferences, which disseminates information on NANOVerify to industry players.

NANOVerify Achievements As At End 2021

- Participation of 105 companies
- 156 NANOVerified products (spanning over three (3) certifications schemes)

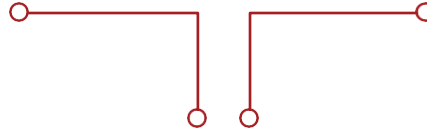
- 1 Assures sales of genuine nanotechnology products
- 2 Boosts consumers' confidence and trust
- 3 Creates greater market acceptance in other countries
- 4 Increase value of products

NANOVerify

STANDARDS
MALAYSIA

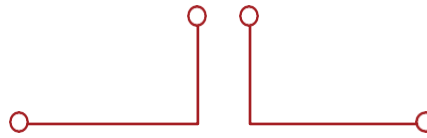
**International
Standardisation
of The Programme**

Standards Malaysia



**Programme
Guardian & Driver**

NANOVerify Sdn Bhd



Programme Owner

NanoMalaysia Berhad



Programme Operator

SIRIM QAS International

**Smart Partnerships
for a Robust Nanoverify
Certification Platform**

NanoMalaysia formed a smart partnership with several Government Ministries and agencies to ensure that the programme practices the highest levels of international governance and compliance with regards to the certification of nanotechnology enabled products and applications. Our direct engagement ensures a robust certification platform, which offers applicant companies the value proposition of international recognised certification standards which they can rely on to drive their business growth and expansion.

NANOVerified is the endorsement mark awarded to processes and products which have successfully completed the programme. Moving into the future, NVSB has in place the NANOVerify Enhancement Programme, a five-year plan focusing on developing functionality for the NANOVerify programme within the areas of mechanical, electrical and surface properties.

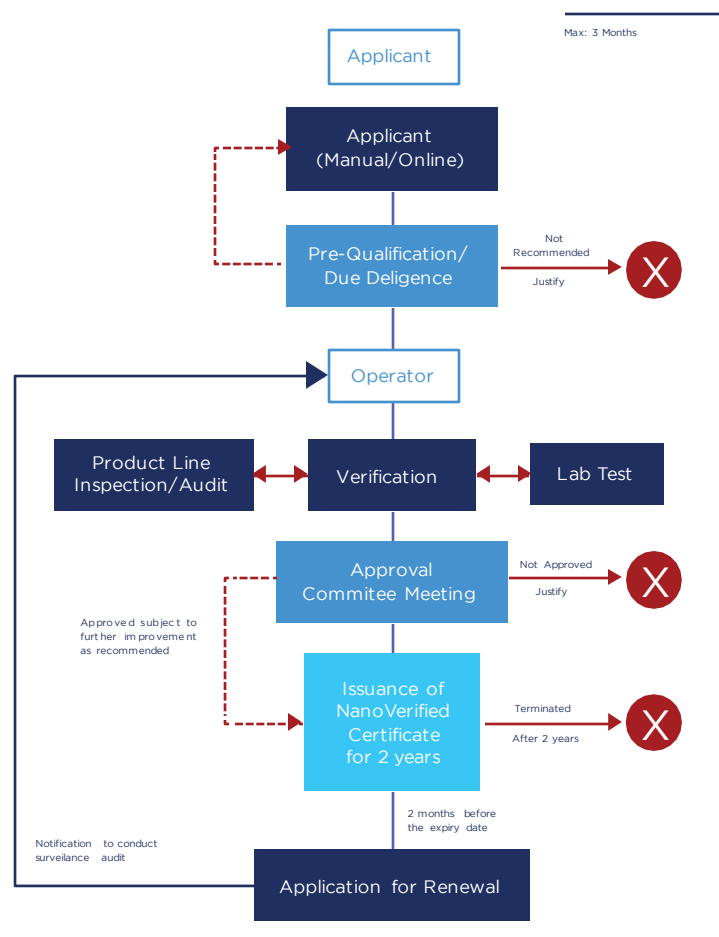
NanoVerify Programme Certification Process

The application process of the NANOVerify Programme is straightforward: companies to submit their application forms and payment receipts to the programme manager. NVSB will then conduct a pre-qualification and due diligence to ensure the eligibility of the product to be verified. Upon satisfactory completion of the due diligence process, a memo is issued to the company and the application is forwarded to the programme operator, SIRIM to initiate the product certification process.

SIRIM will then conduct an audit at the applicant's factory to witness the incorporation of nanomaterials in the product. SIRIM collects samples of the product to be tested at an MS ISO/IEC 17065 accredited laboratory to characterise and test the functionality of nanomaterials in the product. Upon receiving the lab report and clearing any non-compliance issues, the application is then brought to the attention of the Approval Committee for review and approval. Applicants will receive their certificate and will be permitted to use the NANOVerified mark upon approval.

The application process for NANOTrust and GRAPHENEVerify Schemes are similar to NANOVerify Type 5, initiated by submission of application forms, relevant documents and payment to NVSB. The absence of production line audits in NANOTrust and GRAPHENEVerify requires a strict and thorough testing on the end product. The test requires sizing, characterisation and identification of the nanomaterial in the final product through the use of Transmission Electron Microscope (TEM) for the sizing and characterisation of the nanomaterial, accompanied by Raman Spectroscopy, Gas-chromatography-mass Spectrometry (GCMS) and Dynamic Light Scattering (DLS) method to identify the composition of the nanomaterials.

Applicants will receive their certificate and permitted to use NANOTrusted and GRAPHENEVerified mark upon approval. NANOVerified, NANOTrusted and GRAPHENEVerified certification shall be valid for 2 years upon the receipt of the mark.



5 Years of The Nanoverify Programme

MoU Mutual Mark Recognition

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

Introduction of Functionality Testings

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



Birth of The NANOVerify Programme

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

Mutual Nano-Verification Verification Mark Programme

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

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.

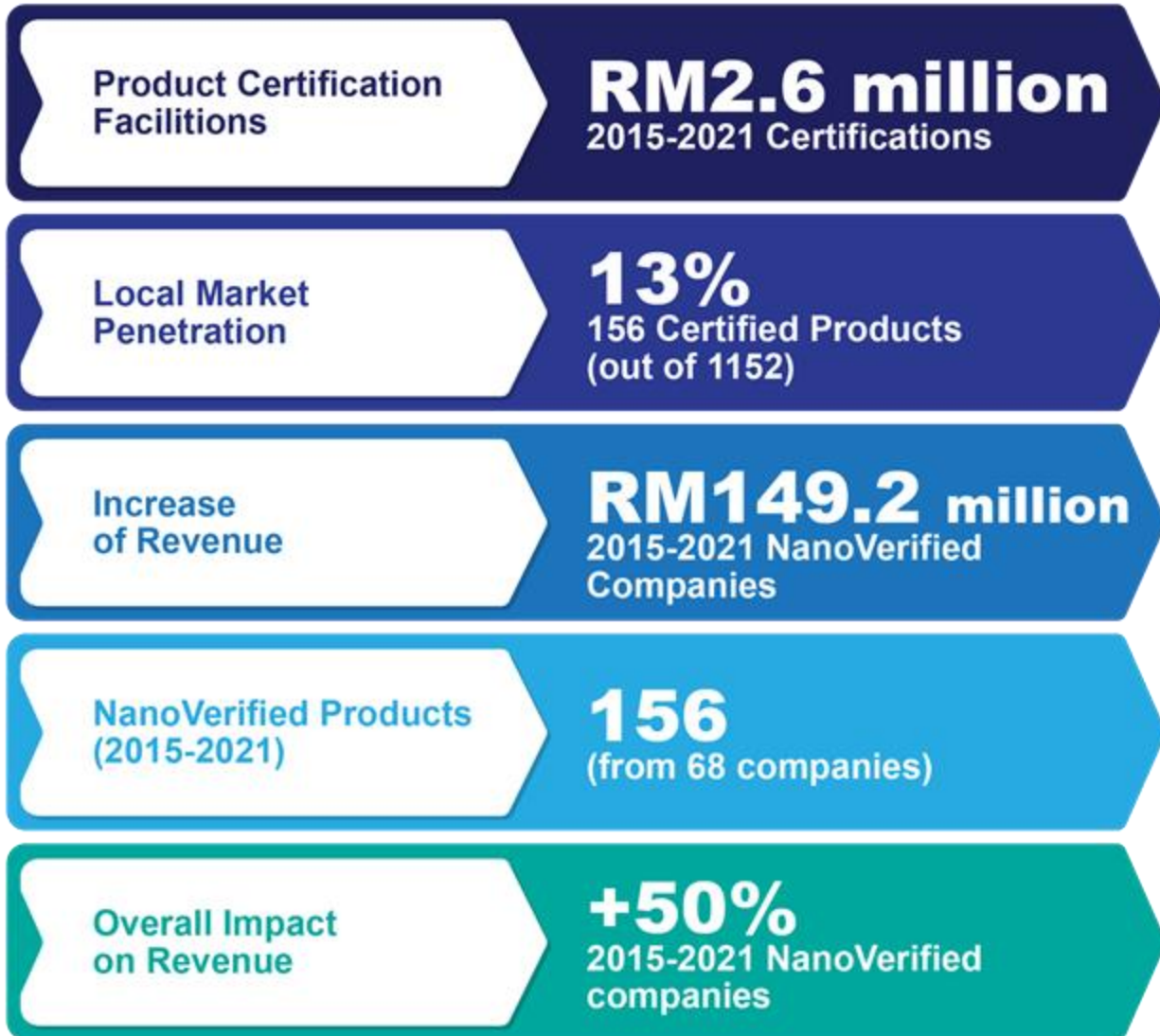


Antimicrobial Coating

STOIKA Sdn Bhd

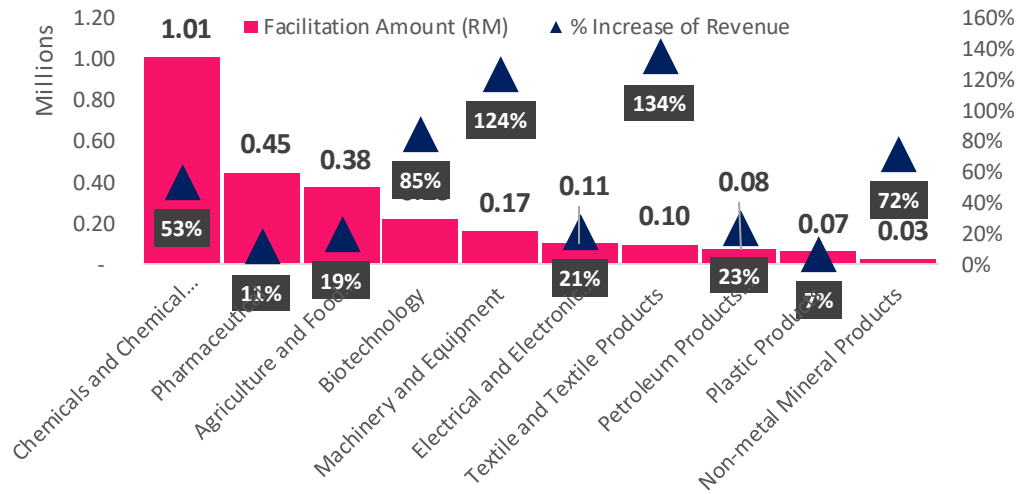
- Kills 99.999% germs & effective against Covid-19 virus
- Non-toxic, non-alcoholic & no heavy metal
- Applicable to any types of surfaces

Outcomes of The NANOVerify Certification Programme

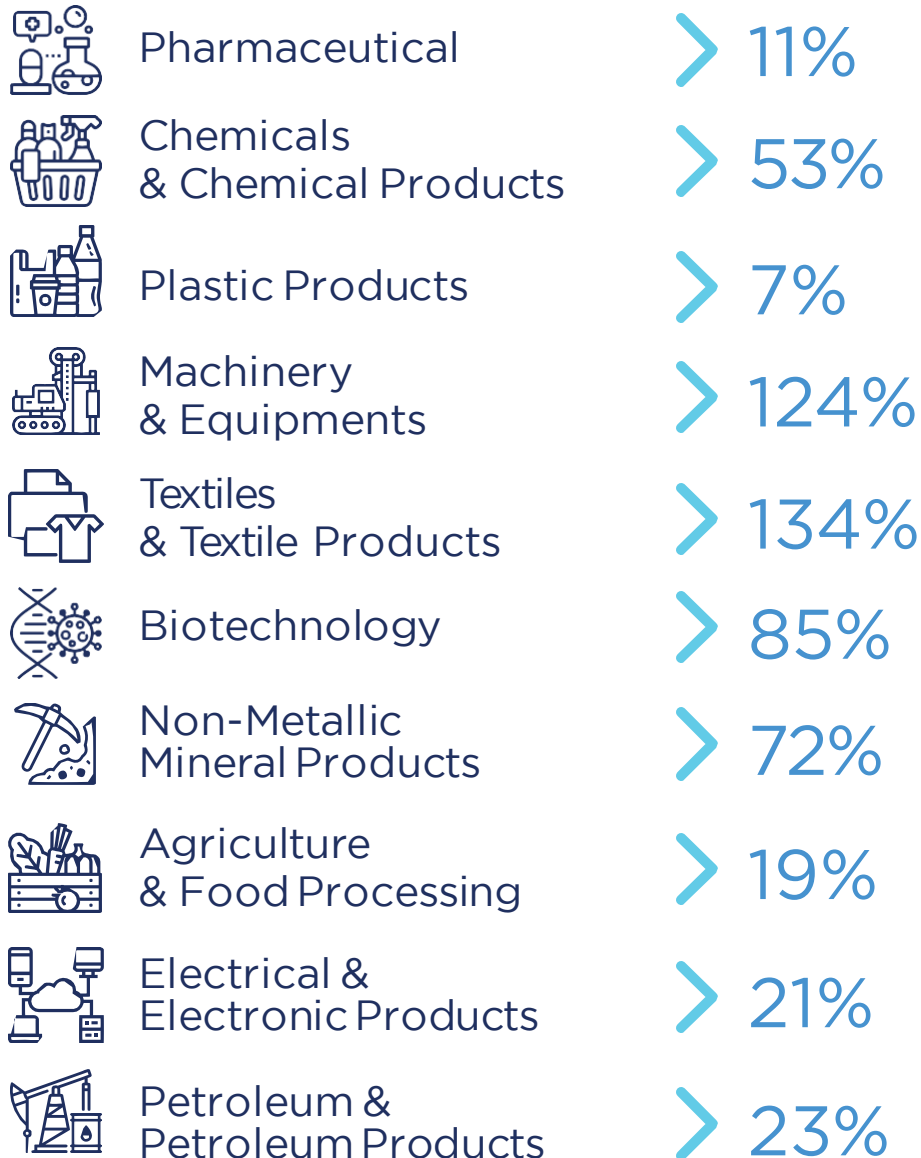


Revenue Increase (2015-2021) and Facilitation Amount (2015-2021), By Industry

NANOVerify Programme Facilitation Amount (RM Million) vs Impact on Revenue (%) 2015-2021 of NANOVerified Participants



Impact on Revenue, by Industry 2015-2021 NANOVerified Companies



NANOVerified Companies





11

**Creating Value:
Economic,
Environmental
& Social**

Overview

We are highly committed to contribute positively to the continuing socioeconomic development of communities and the nation, bearing in mind the need to balance economic objectives against social and environmental imperatives. Our corporate social responsibility agenda is borne through outcomes we aspire to achieve within the Economic, Environmental and Social (EES) spheres.

We believe that the long-term sustainability of our business is inextricably linked to our ability to embed the triple bottom line into our business. Our projects and initiatives are geared towards helping to bring about a greener planet, whilst ensuring economic growth and contributing to development of underprivileged communities. In doing so, we are cognisant of aligning our EES outcomes with the 17 principles of the United Nations Sustainable Development Goals.



Creating Economic Value

Nanotechnology is a powerful creation of science that contributed to the global economy, environment and social. Companies and manufacturers from various industries are able to expand their growth and capture greater market share by applying Nanotechnology in their applications and products. At NanoMalaysia, we focused on the monetisation of nanotechnology through our investments in SMEs that we have identified with potential for growth and future profitability.

	Numbers of Companies	GNI Contribution over 5 years	Job creation over 5 years
 Electronic Devices and Systems	50 Companies	RM 7.50 billion	6,520 jobs
 Energy and Environment	45 Companies	RM 4.2 billion	4,970 jobs
 Food and Agricultural	23 Companies	RM 0.95 billion	1,395 jobs
 Wellness, Medical and Healthcare	25 Companies	RM 1 billion	965 jobs

Creating Environmental Value

Nanotechnology products, processes and applications are expected to contribute significantly to environmental and climate protection by saving raw materials, energy and water. NanoMalaysia believes that we play an important role in ensuring a more sustainable approach towards the environment, by supporting the commercialisation of projects which promote a greener future for all.

Our nanotechnology projects include those which practice the sustainable waste-to-wealth concept that helps conserve valuable natural resources and energy, and reduces environmental damage caused by socioeconomic development. These include collaborations which utilise waste from oil palm empty fruit bunches and rice husks which would otherwise be discarded by plantations and paddy farmers, by transforming them into innovative nanotechnology value added products and applications. We are also championing more sustainable energy production and consumption patterns by engineering efficient nanotechnology enabled solar energy and fuel applications.



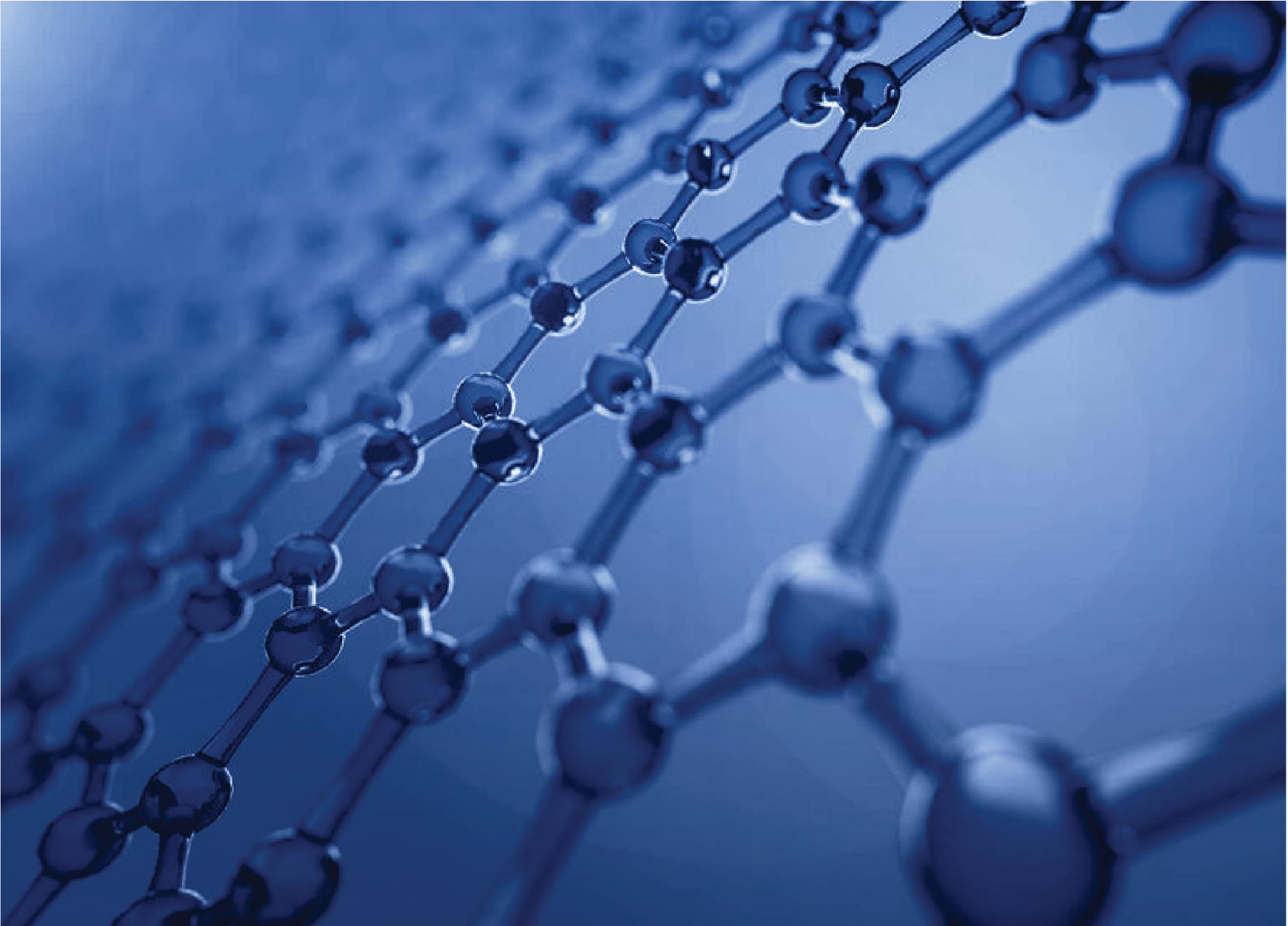
Creating Social Value

COVID-19 Screening Booth (CSB) is deployed at Pusat Kesihatan Daerah Putrajaya on May 2020. It is aimed at minimising the use of personal protective equipment (PPE) as well as contact between frontliners and patients to reduce the risk of COVID-19 infection. This project is implemented by the National Nanotechnology Center and NanoMalaysia Berhad which the cubicle was developed by Syarikat iDeria Sdn Bhd, a subsidiary of Universiti Malaysia Perlis (UniMAP).

The screening cubicle was one of eight units developed in the first phase to be placed in selected hospitals and district health offices. The CSB is equipped with a positive pressure chamber with the Nanotech based HEPA filter system for healthcare personnel, a wall surface with anti-viral nano-coating and a separation chamber between the patient and the healthcare worker. Nanotechnology Anti-Viral coating is applied to our CSB to reduce transmission probability on frequently contacted surfaces. The anti-viral properties are proven to work against the H1N1 virus belonging to the coronavirus family, categorised as gramme negative of which body is very thin and fragile. SAR-COV-2 (the virus causing CoVid19) being a gramme negative coronavirus should be deactivated by the same nano-coating.



On June 2020, another effort set to work in which the deployment of COVID-19 Screening Booths was completed with the handover of the I3S Screening Booth at Klinik Kesihatan Section 7, Shah Alam. The booth was developed by a group of healthcare professionals from The Malaysian Medical Mythbusters, Awfa Clinic in Kotasas, architects and biomedical engineers from Universiti Teknologi Malaysia (UTM) including the Facebook Community 'Ini Sains Beb'. Both efforts are jointly supported by Ministry of Science, Technology & Innovation, Ministry of Health with funding received from the Ministry of International Trade and Industry.



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

