



**KEMENTERIAN SAINS,
TEKNOLOGI DAN INOVASI**
MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION

Hydrogen Economy and Technology Roadmap (HETR) 2022-2030

**National Nanotechnology Centre Division (NNC),
Ministry of Science, Technology and Innovation (MOSTI)**

**Technology and Innovation Conclave 1.0
24-26 September 2024, New Delhi, India**

INTRODUCTION NNC

Technology and Innovation Conclave 1.0

MISSION

Nanotechnology for Sustainable Development of Science, Technology, Industry and National Economy

VISION

Driving National Nanotechnology Policy and Strategy through Continuous Strengthening in R&D Management, National and International Cooperation, and Awareness Program

MAIN FUNCTIONS

National Reference Center for coordinating activities Research Development and Technology Development/ Products as well as Safety Standards and Regulations related to Nanotechnology and Advanced Materials in Malaysia

- (i) Implementation of National Policy, Strategy and Roadmaps
- (ii) Advances in research and development (R&D) of nanotechnology
- (iii) Technological development and innovation of nano products
- (iv) Coordination of the development of standards and regulations related to nanosafety

AGENCY UNDER NNC MOSTI



POLICY AND ROADMAPS

Technology and Innovation Conclave 1.0

**NATIONAL NANOTECHNOLOGY
POLICY AND STRATEGY (NNPS)
2021-2030**

**NATIONAL NANO PRODUCTS AND
TECHNOLOGY ROADMAP (NPTR)
2021-2025**

**NATIONAL HYDROGEN ECONOMY
AND TECHNOLOGY ROADMAP (HETR)
2021-2050**



**NATIONAL NANOTECHNOLOGY
POLICY & STRATEGY 2021-2030**
Enabling STI Advancement for a Progressive and Prosperous Nation



**PELAN
HALA TUJU
TEKNOLOGI
& PRODUK
NANO NEGARA**

**2021
2025**

KAJIAN KOMPREHENSIF MENGENAI PROSPEK
EKONOMI NANO NEGARA



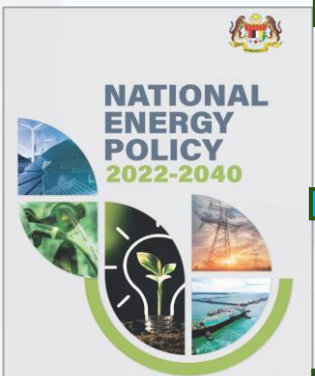
**HYDROGEN
ECONOMY & TECHNOLOGY
ROADMAP**



HYDROGEN ECONOMY: CASE FOR CHANGE IN MALAYSIA

HYDROGEN
ECONOMY & TECHNOLOGY
ROADMAP

Alignment to the targets of the 12th Malaysia Plan (RMK-12), National Energy Policy 2022-2040 (DTN) and the Malaysia MADANI



Factor 1

To increase the revenue & productivity in exports, mobility, power generation, industrial heating and non-energy

- Blue hydrogen as a **transition through CCUS** to reach the ultimate goal of **green hydrogen**.
- Potential in POME biomass of approximately 65 million tonnes per year**^[1]
- Hydropower** as the means to achieve **31% RE capacity mix**. Untapping **RM 7.7 billion** hydrogen potential in **2050** ^[2].

2050 Potential Economic Value of Hydrogen, in USD Billions^{[5][6]}

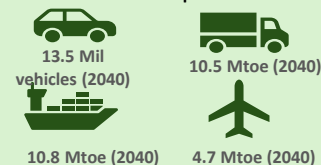
Malaysia 8x,	24.80
Malaysia 4X,	12.40
Malaysia 2X,	6.20
Malaysia,	3.10 - BAU

Factor 2

To push for green growth aspirations in transportation sector (light vehicles, pickup trucks, buses, heavy vehicles)

- Transportation **constitutes 36.4% of the final energy use by sector** in Malaysia ^[3]
- Global trend to **phase out internal combustion engines** in major cities will be the underlying force for Malaysia to adopt cleaner transport fuels.
- Hydrogen demand from transportation sector is forecasted to reach **RM 3.7 billion in 2050** ^[2].

Outlook on the transportation sector



Factor 3

To cement Malaysia's position as the 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.
- Opportunities of **USD 81.12 billion in 2050** equivalent to **249,271 ktoe**^[2].



USD 81.12 billion opportunity in 2050

Factor 4

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

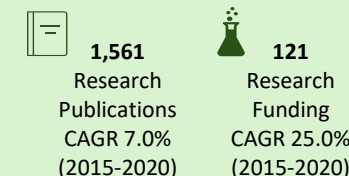
- The COVID-19 pandemic has disrupted the economic growth of Malaysia to **-5.6% in 2020** and **increased unemployment up to 711,000 in 2020** compared to 508,200 in 2019 ^[4].
- Hydrogen economy provides opportunities to rejuvenate our economy as well as to create new jobs in the future.



Factor 5

To increase national intellectual capabilities and capacities in hydrogen technologies

- Since 2000, 1,561 hydrogen related publications** have been published, while research funding related to hydrogen stands at **121 projects since 2006** ^[7].
- The trends shows that Malaysia is actively building its national intellectual capabilities and capacities in hydrogen technologies, creating talents and intellectual property rights (IPRs).



[1]MPOB Palm Oil Development No. 72. 2020.

[2]Perspectives on Hydrogen in the APEC Region. Asia Pacific Energy Research Centre. 2018

[3]National Energy Balance 2018

[4] Department of Statistics Malaysia 2020.

[5] Global figures derived from 80 EJ projected hydrogen demand in 2050. Hydrogen Scaling Up. Hydrogen Council 2017.

[6] APAC, ASEAN and Malaysian figures derived from Table 2.8 Hydrogen Energy Demand in APEC Economies (in Nm3). Based on 7% energy mix scenario, BAU, no intervention from the government. Perspectives on Hydrogen in the APEC Region. Asia Pacific Energy Research Centre (APEREC). 2018.

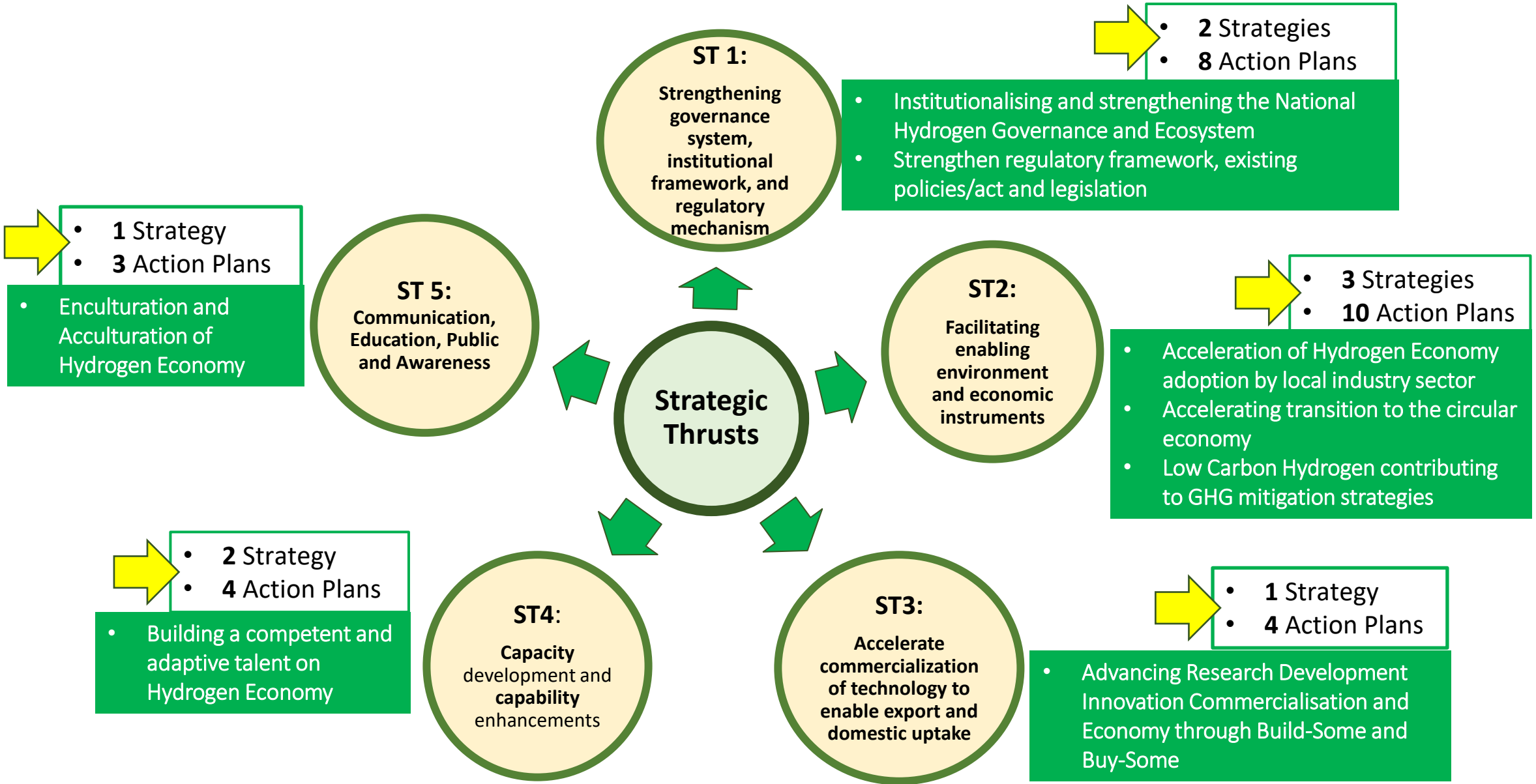
[7] Refer to page 16

Hydrogen Economy and Technology Roadmap (HETR)

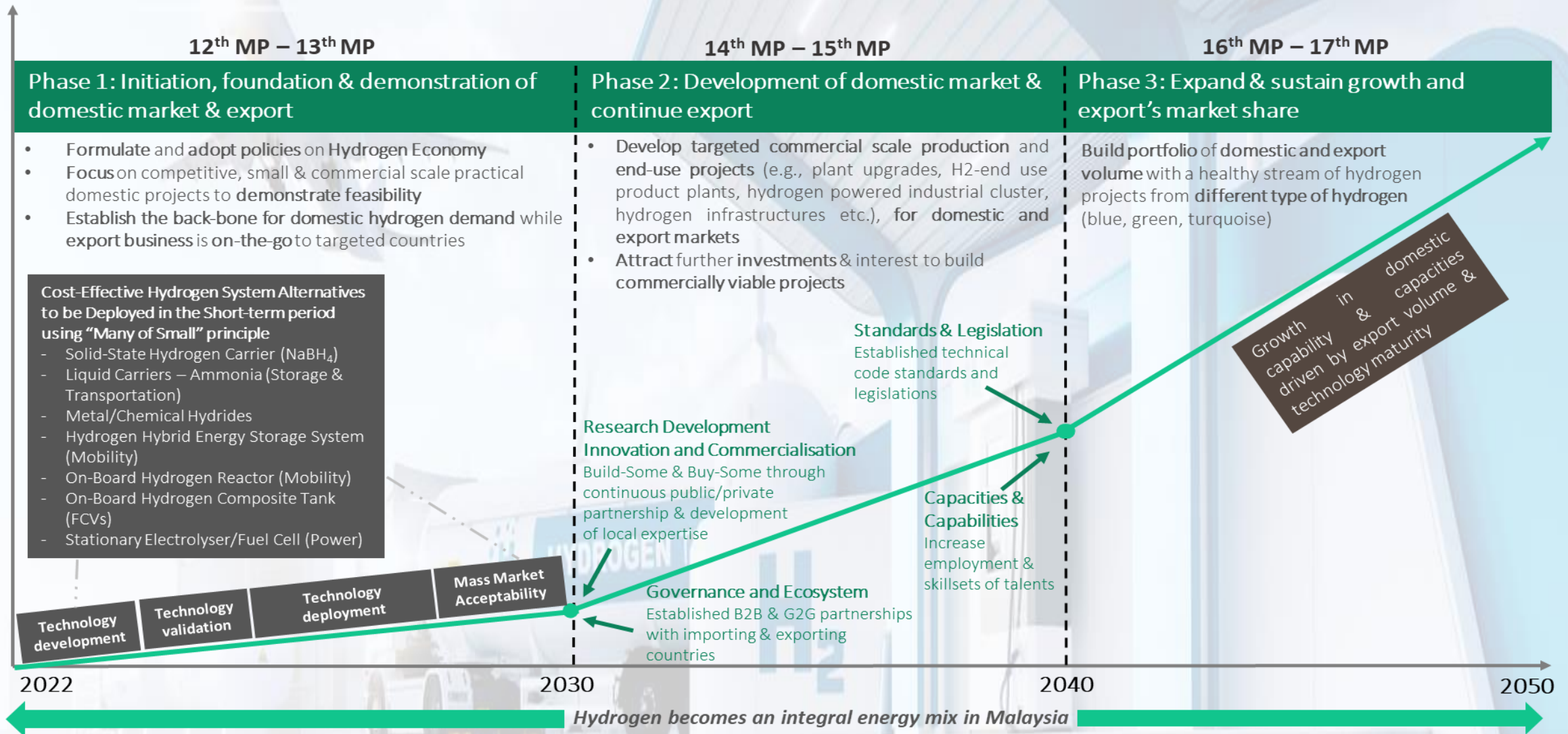
Vision	To be a leading Hydrogen Economy country by 2050 while achieving the world's decarbonisation targets				
Mission	To develop a robust and competitive ecosystem across the hydrogen value chain through accelerated technological advancement				
Goals	Hydrogen to be the cornerstone for new energy economy in Malaysia and take lead among ASEAN countries and establish a strong global presence on hydrogen supply chain and shift from moderate to high significant trade	Malaysia to achieve a sustainable energy mix through diversification of energy types or sources and increase cleaner energy shares in Malaysia's energy mix	Malaysia to invest in hydrogen technologies to address domestic consumption, stability, security of energy, sustaining international energy trading and decarbonize emissions		
Strategic Thrusts	ST1 Strengthening governance system, Institutional framework and regulatory mechanism	ST2 Facilitating enabling environment and economic instruments	ST3 Accelerate commercialization of technology to enable export and domestic uptake	ST4 Capacity development and capability enhancement	ST5 Communication, Education, Public and Awareness

5 Strategic Thrusts, 9 Strategies and 29 Action Plans

OVERVIEW OF THE HETR STRATEGIC THRUSTS AND STRATEGIES



Overview of the Hydrogen Economy and Technology Roadmap (HETR)



IMPACT OF THE HETR IMPLEMENTATION IN MALAYSIA

	Short term (2024 –2030)	Mid term(2031 –2040)	Long term (2041 –2050)
USD / kg Hydrogen Production Cost 	Grey Hydrogen : To be phased out Blue Hydrogen : USD 3.71/kg Green Hydrogen : USD 4.82/kg (Solar) USD 2.50/kg (Hydro) USD 1.72/kg (Biomass) USD 1.35/kg (Biogas)	Blue Hydrogen : USD 4.64/kg Green Hydrogen : USD 2.63/kg (Solar) USD 2.25/kg (Hydro) USD 1.72/kg (Biomass) USD 1.30/kg (Biogas)	Blue Hydrogen : USD 5.62/kg Green Hydrogen : USD 1.45/kg (Solar) USD 2.11/kg (Hydro) USD 1.72/kg (Biomass) USD 1.25/kg (Biogas)
% GHG Reduction Environmental Contribution 	BAU: 0.4% GHG reduction EDS: 1.3% GHG reduction	BAU: 3% GHG reduction EDS: 8% GHG reduction	BAU: 6% GHG reduction EDS: 15% GHG reduction
RM Revenue Generation 	<ul style="list-style-type: none"> Industrial Use (Non-Energy and Heat) RM 7.4 billion Industrial Use (Non-Energy and Heat) RM 12.1 billion Capturing 10% of the hydrogen demand from Japan, South Korea and Singapore resulting in revenue of RM20 billion 	<ul style="list-style-type: none"> Industrial Use (Non-Energy and Heat) RM 37.1billion Industrial Use (Non-Energy and Heat), Power and Mobility RM 151.8 billion Potential and competitive hydrogen export hub generating revenue of RM219 billion 	<ul style="list-style-type: none"> Mobility and Industrial Use (Non-Energy and Heat) RM 151.7 billion Power, Mobility and Industrial Use (Non-Energy and Heat) & Marine RM 367.7billion Position Malaysia to be a major exporter in APAC and generate revenue of RM409 billion
Technology Agenda 	<ul style="list-style-type: none"> Available technologies to demonstrate, scale-up and deploy first (Build Some) Complementary external technologies & solutions to be procured (Buy Some) 	<ul style="list-style-type: none"> Increase in the targeted conversion efficiency of the technologies across the hydrogen economy value chain 	<ul style="list-style-type: none"> Mass deployment in targeted renewable energy sectors (e.g.: solar, hydroelectric, biomass, OTEC)
Infrastructure and Utilisation 	<ul style="list-style-type: none"> Export terminal technologies and hydrogen transport technologies between production sites and export terminals. To pilot utilisation of hydrogen as co-blended fuel 	<ul style="list-style-type: none"> Hydrogen used as energy storage in addressing the deployment of variable renewable energy (VRE) Utilise hydrogen as co-blend fuel for power generation and mobility 	<ul style="list-style-type: none"> Utilise hydrogen in the mobility, industry (non-energy and heat), marine, commercial and domestic sector
Job Creation 		Business-As-Usual 168,000 Emission-Driven 211,680	

Long-term strategic goal is to utilise Green Hydrogen



MALAYSIA PARTICIPATION AT INTERNATIONAL LEVEL

International Renewable Energy Agency (IRENA)

IPEF Hydrogen Supply Chain Workstream

UNIDO - Global Clean H₂ Programme and Malaysia's Child Project



Mrs. Gauri Singh, Deputy Director General IRENA during Hydrogen Power Talk 2024



ACTIVITIES UNDER IMPLEMENTATION HETR

Oct
2023



Visit to Fukushima Hydrogen Energy Research Field (FH2R), JAPAN

Sept
2023



Visit to PETRONAS Reserach Sdn Bhd (PRSB), Selangor

Mar-Apr
2024



Nov
2023



HETR Roundtable Series 1 2023 at CAPE, Permata Sapura KL

Feb
2024



Beyond Zero Initiative, Bukit Jalil



Visit to Yamanashi Hydrogen Company, JAPAN



Demonstration of Hydrogen Recharging Unit (MHRU) and Toyota MIRAI at Complex C, Putrajaya

ACTIVITIES UNDER IMPLEMENTATION HETR

REGULATIONS AND STANDARD RELATED TO HYDROGEN

Korean HYDROGEN ACT 2021



<https://www.mdpi.com/2071-1050/13/19/10686>

Version: 23.11.2023—Act uncommenced

South Australia
Hydrogen and Renewable Energy Act 2023

An Act to facilitate and regulate the generation of hydrogen and renewable energy in the State and coastal waters of the State, to make related amendments to the *Mining Act 1971*, the *Pastoral Land Management and Conservation Act 1989*, the *Petroleum and Geothermal Energy Act 2000* and the *Planning, Development and Infrastructure Act 2016*, and for other purposes.

Contents

Part 1—Preliminary

- 1 Short title
- 2 Commencement
- 3 Objects
- 4 Interpretation
- 5 Application of Act
- 6 Interaction with other Acts

Part 2—Preliminary investigation of renewable energy resources

Division 1—Minister may explore renewable energy resources

- 7 Minister may explore renewable energy resources

Division 2—Renewable energy feasibility permit

- 8 Renewable energy feasibility permit
- 9 Terms and renewal of permit

Part 3—Release area

- 10 Minister may declare release area
- 11 Call for tenders for renewable energy feasibility licence

Part 4—Licensing

Division 1—Requirement for licence

- 12 Regulated activities
- 13 Requirement for licence

Division 2—Licence categories

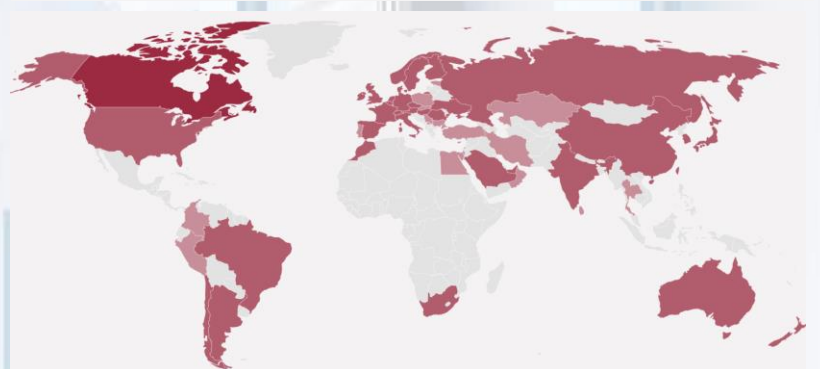
Subdivision 1—Hydrogen generation licence

- 14 Hydrogen generation licence
- 15 Terms and renewal of licence

Published under the *Legislation Revision and Publication Act 2002*



ISO/TC 197 Hydrogen technologies



Malaysia's participation as a Participating Member in the 4th quarter of 2024

TUV RHEINLAND Standard H2.21 Renewable and Low-Carbon Hydrogen Fuels

[Version 2.1 / March 2023]

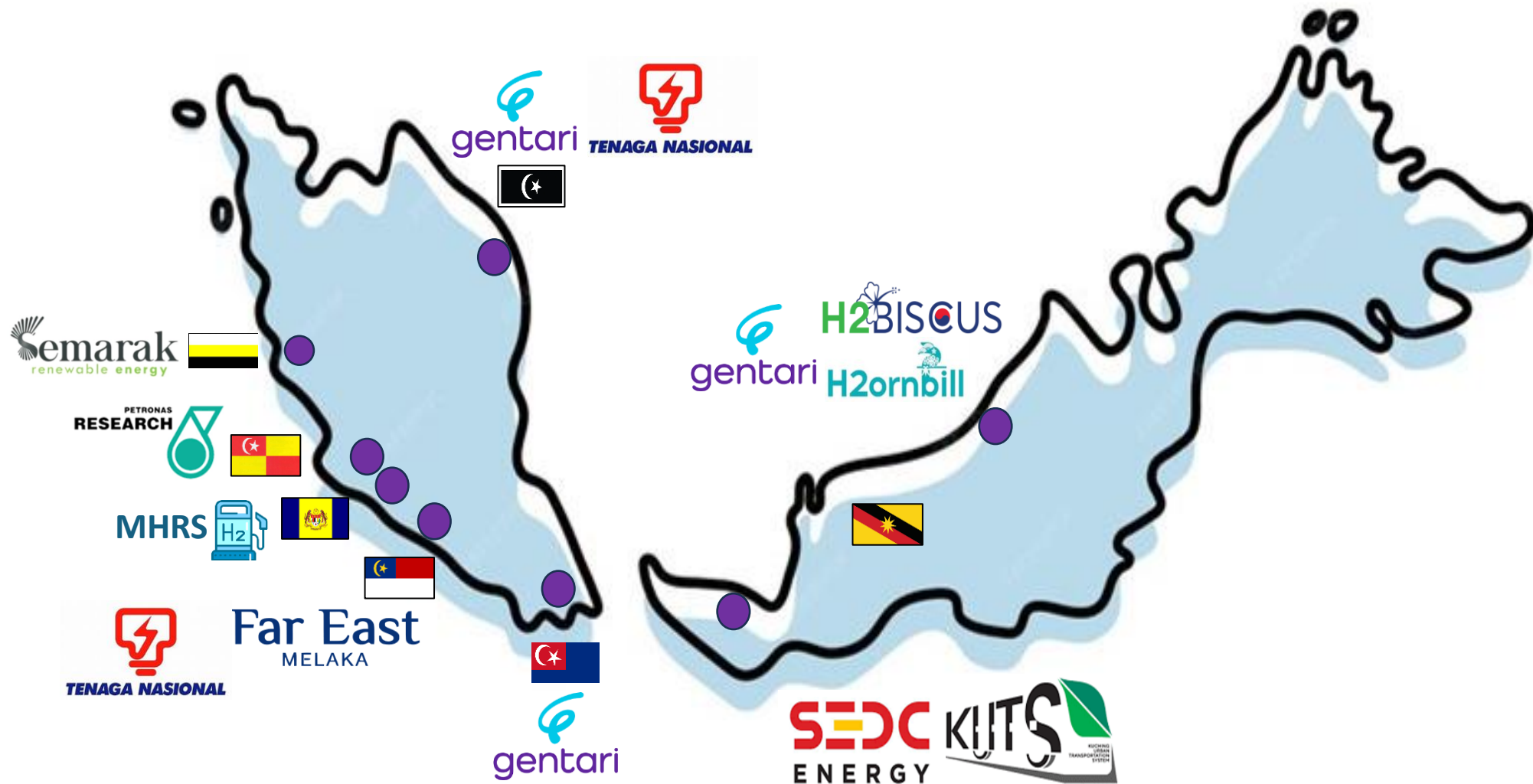


- Japanese government officials highlighted three new features of the refreshed strategy:
 - a new mid-term volume target of 12 million tonnes per annum by 2040 (a six fold increase from current levels);
 - a "pathway" to low-carbon hydrogen - aiming for 3.4kg of CO2 emissions or less for 1kg of hydrogen produced;
 - a 10% target for Japanese companies' share of the global electrolyser market.

[Press Release] Cabinet Decides on Hydrogen Society Promotion Bill and CCS Business Bill (2024/2/13)

📅 2024-02-13 🕒 2024-06-20

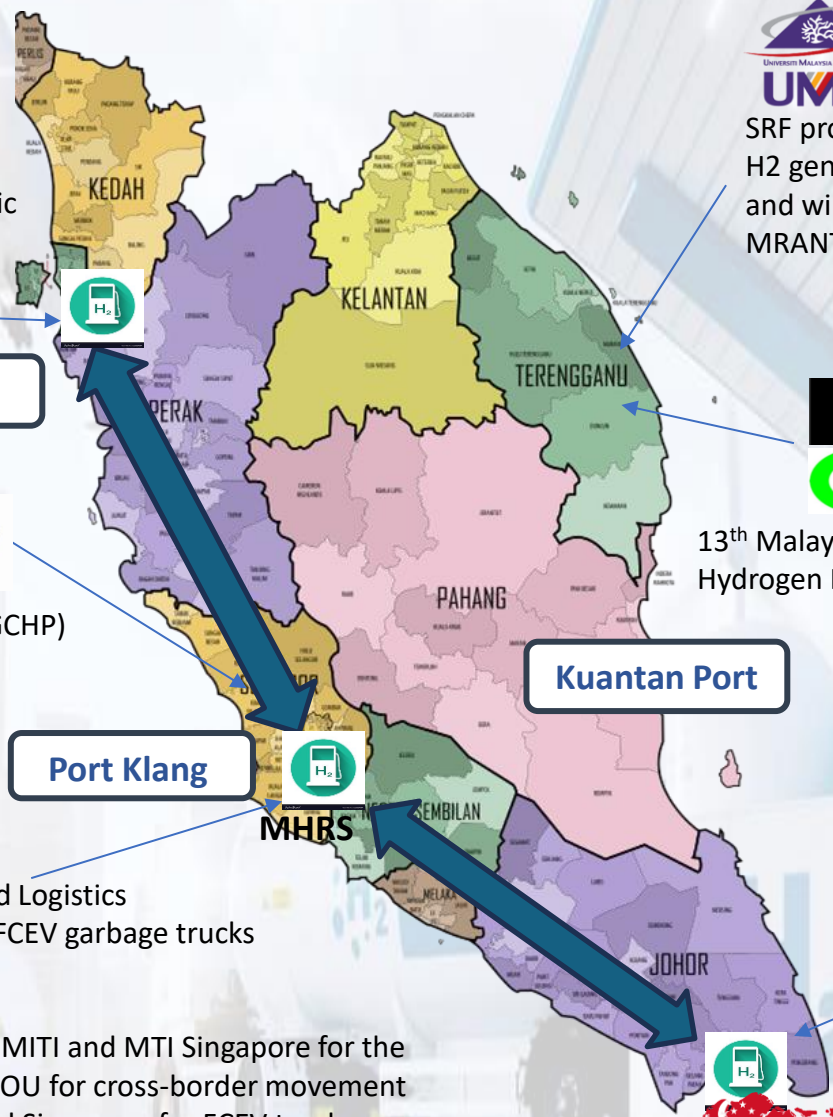
1 SUMMARY OF HYDROGEN PROJECTS IN MALAYSIA



STATUS OF HYDROGEN PROJECTS BY NANO MALAYSIA

NGL TECH
Strategic Research Fund (SRF) project from NGL Tech company using isobaric technology (to improve compression energy efficiency)

Penang Port



Bukit Tagar EnviroPark
Secondary pilot project under the Global Green Hydrogen Program (GCHP)

PETRONAS **IIIG**
Integrated Logistics Solutions Sdn Bhd

Port Klang

MHRS

Sustainable Hydrogen gas and Integrated Logistics collaboration in the MHRS initiative for FCEV garbage trucks

MTI Discussions between MITI and MTI Singapore for the implementation of MOU for cross-border movement between Malaysia and Singapore for FCEV trucks

UMT
SRF project from UMT for green H2 generation from solar, wave and wind sources (under MRANTI)

H2X GLOBAL
Fortescue

13th Malaysia Plan Proposal for East Malaysia Hydrogen Hub/Aviation Ground Service Equipment

Kuantan Port

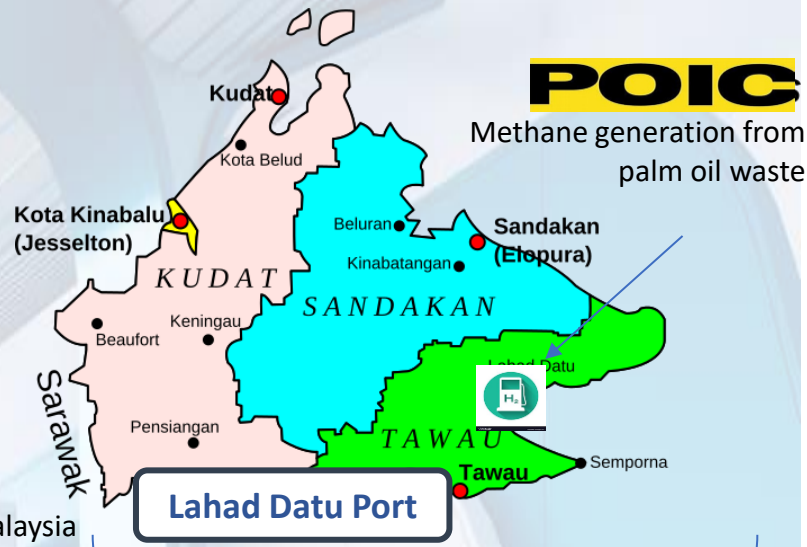
BCN
SMART TECHNOLOGIES

M REFORMER
A Company by MMM Energy

SRF project from BCN SmartTech company using green methanol renewal using MMM Energy technology from Spain

Johor Port

Slide courtesy of **NANOMALAYSIA**



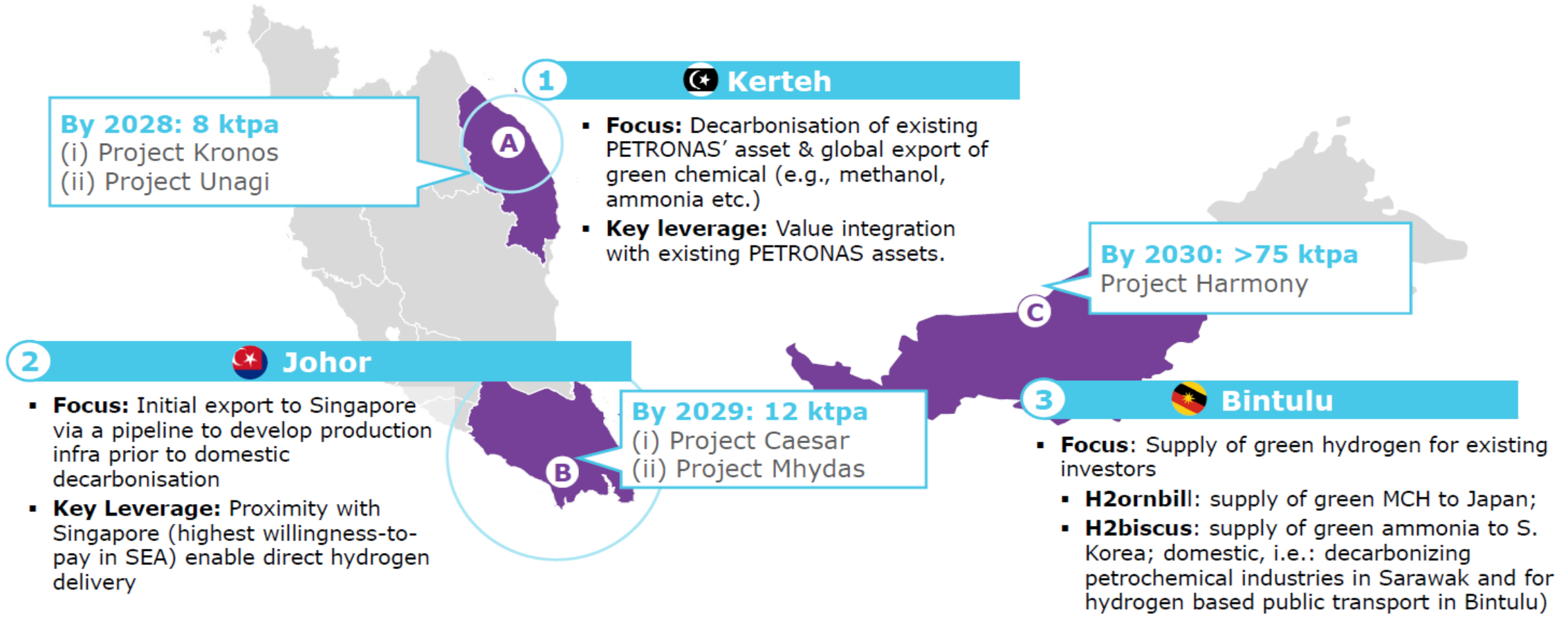
POIC
Methane generation from palm oil waste

Lahad Datu Port

HYPERTECH INDUSTRIES
Rural electrification through solid state hydrogen

Gentari is leading the development of Malaysia's hydrogen economy by establishing three key clean hydrogen hubs

Establishment of **3 clean H₂ hubs** to position Malaysia as the leader in the clean hydrogen sector in the region through strategic partnerships and decarbonization infrastructure development



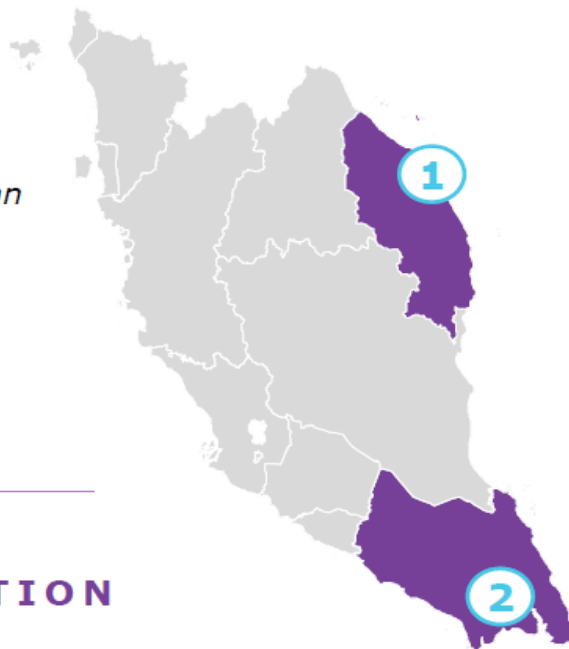
Note: Capacities are for clean Hydrogen

100ktpa of green H2 production by 2030 will boost GDP by RM500 Mil, create ~3,600 jobs and lower GHG by 1.1MtCO2e/year



JOB CREATION

~3,600 direct and indirect jobs created in clean Hydrogen by 2030 from development of the 3 hubs



INVESTMENT

>RM12.0 bil
Total investment value for end-to-end supply chain covering renewable energy plant, hydrogen plant and transportation



DECARBONISATION

1.1MtCO2e / year to decarbonize existing SMR based Hydrogen Production



GDP CONTRIBUTION

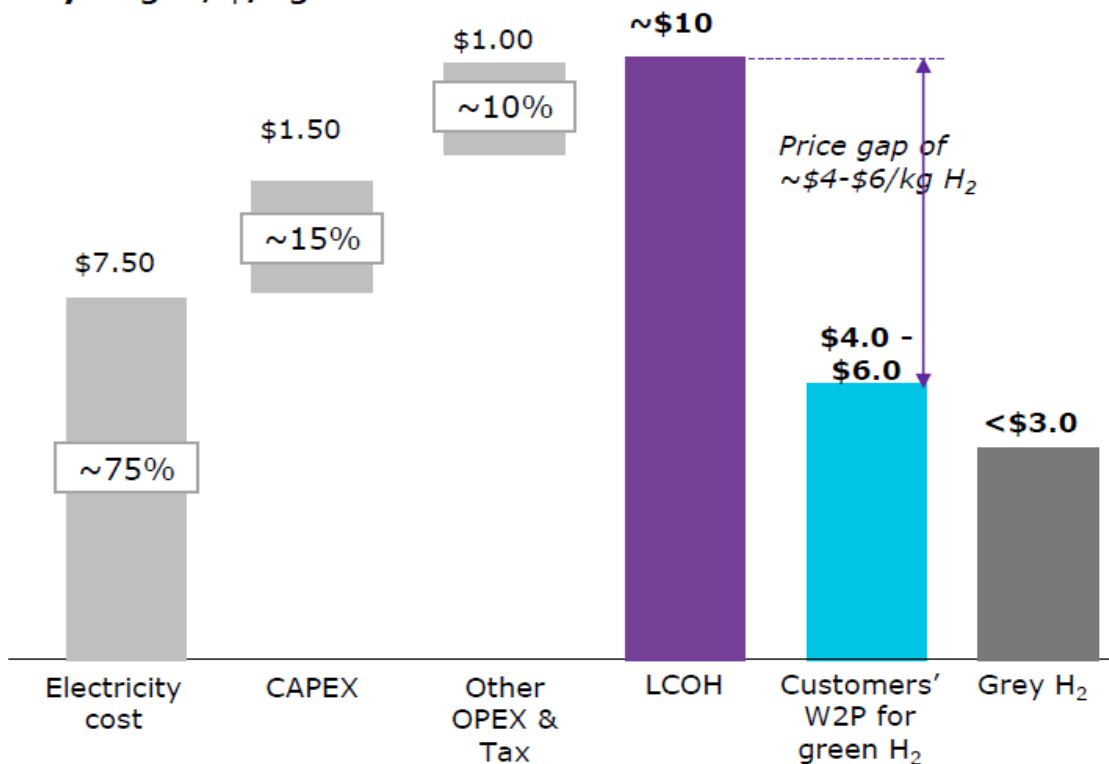
>RM0.5 Bil
Estimated GDP growth post 2030 to the Malaysian Economy

Conducting a comprehensive study on the economic impact will give further clarity to the economic benefits

Challenges: Projects need to overcome key challenges of green electrons and regulatory frameworks to materialise

Levelised Cost of Hydrogen in Peninsular Malaysia exceeds Customer's willingness to pay

Breakdown of Levelised Cost of Hydrogen, \$/kg



Note: Current TNB+REC tariff of RM0.53/kWh

Challenges

AVAILABILITY OF GREEN ELECTRONS



While the current GET program provides immediate solution for sourcing of RTC green electrons, green H₂ projects require significantly higher and more future-proof source of green electron

- Green power import (e.g. from Vietnam)
- Long-term subscription of REC

COMPETITIVENESS OF GREEN ELECTRONS



Electricity cost accounts for ~75% of the LCOH. To bridge the price gap, a tariff of RM0.25 – 0.30/kWh is necessary.

- SELCO of adjacent ground-mounted solar
- National Energy Transition Facility support

FRAMEWORK AND REGULATIONS



Given the nascency nature of green H₂ projects, facilitation on land procurement, licensing matters and regulatory approvals are required to ensure successful project delivery.

- Single-window application



**KEMENTERIAN SAINS,
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MINISTRY OF SCIENCE, TECHNOLOGY AND INNOVATION

Thank You

Terima Kasih

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