



NMB's Catalytic Role in Hydrogen Ecosystem Development in Malaysia

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NMB (NanoMalaysia Bhd.) At A Glance

Background & Introduction



2006

The National Nanotechnology Initiative was launched

2010

The National Nanotechnology Directorate (NND) was established and laid out the NanoMalaysia Programme 2011-2020

2014

National Graphene Action Plan (NGAP) 2020 was launched



2016

RMK-11 Nanotechnology Commercialisation Programme including NGAP and iNanovation



2022

The NanoMalaysia Energy Storage Technology Initiative (NESTI) was launched



2026

RMK-13 NICER, NasHETR & NoSE



2004

Malaysia joined Asia Nano Forum



2009

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



2011

Incorporation of NanoMalaysia Berhad as a CLBG under the Ministry of Science, Technology and Innovation Mandated for pre-commercialization and commercialization of nanotechnology (Cabinet Paper)



2015

NANOVerify product certification programme was launched



2021

RMK-12 REVOLUTIONT Programme, Hydrogen EcoNanoMY (Build Some and Buy Some) and Nanotech Remote Energy System

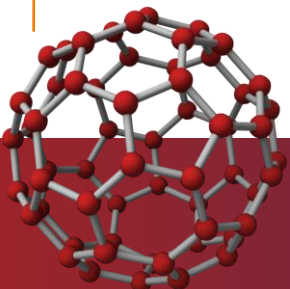


2023

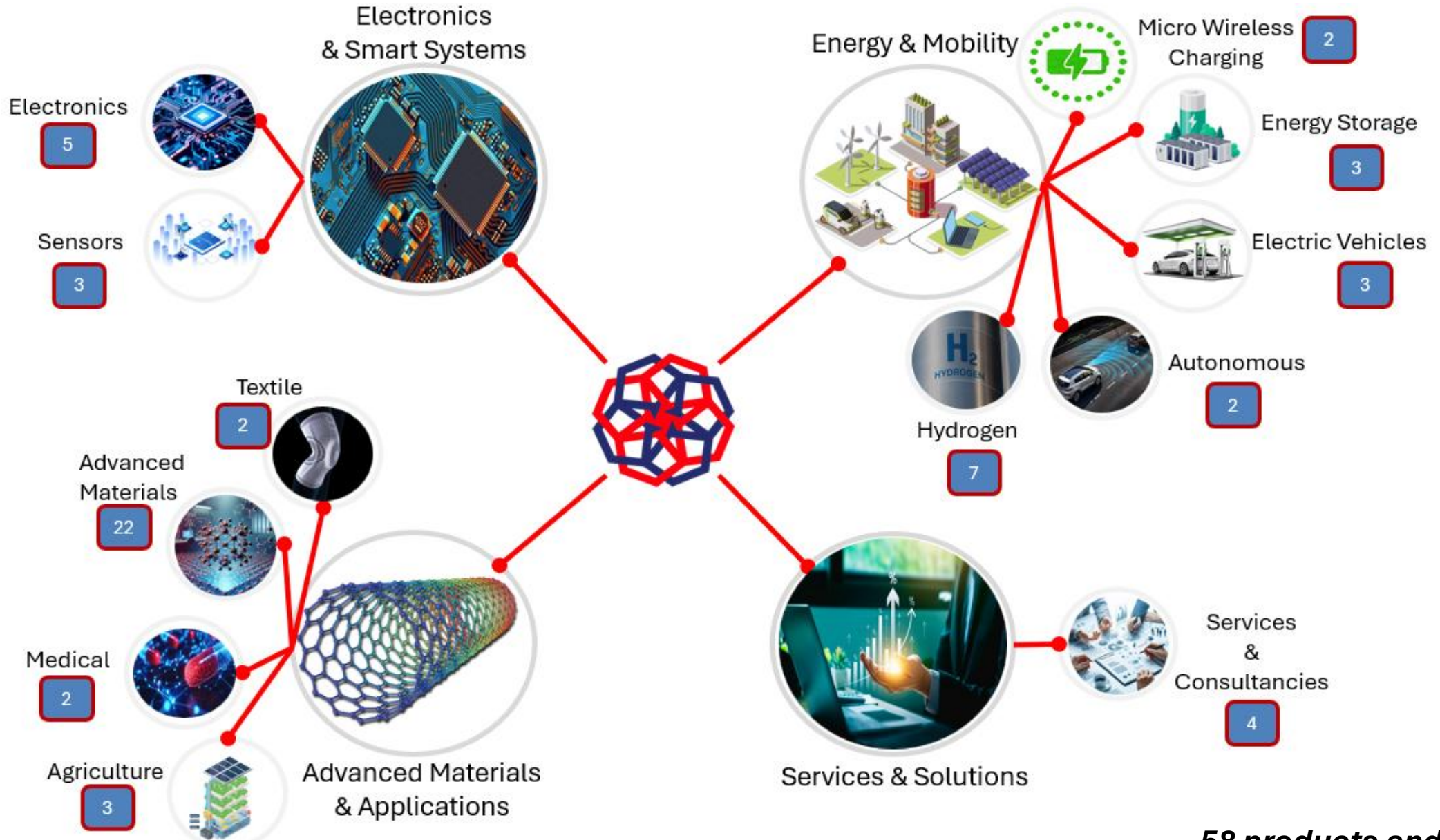
HETR was launched by Deputy Prime Minister Dato' Sri Haji Fadillah Haji Yusof



NMB (NanoMalaysia Berhad) was incorporated in 2011 as a Company Limited by Guarantee (CLBG) under the Ministry of Science, Technology and Innovation (MOSTI) to act as a business entity entrusted with driving the development of nanotechnology, EV components technology, energy storage and spearheading the hydrogen economy through NMB's Venture Builder model with academia, institutions and industries to achieve sustainability, prosperity and Technology Sovereignty for Malaysia.



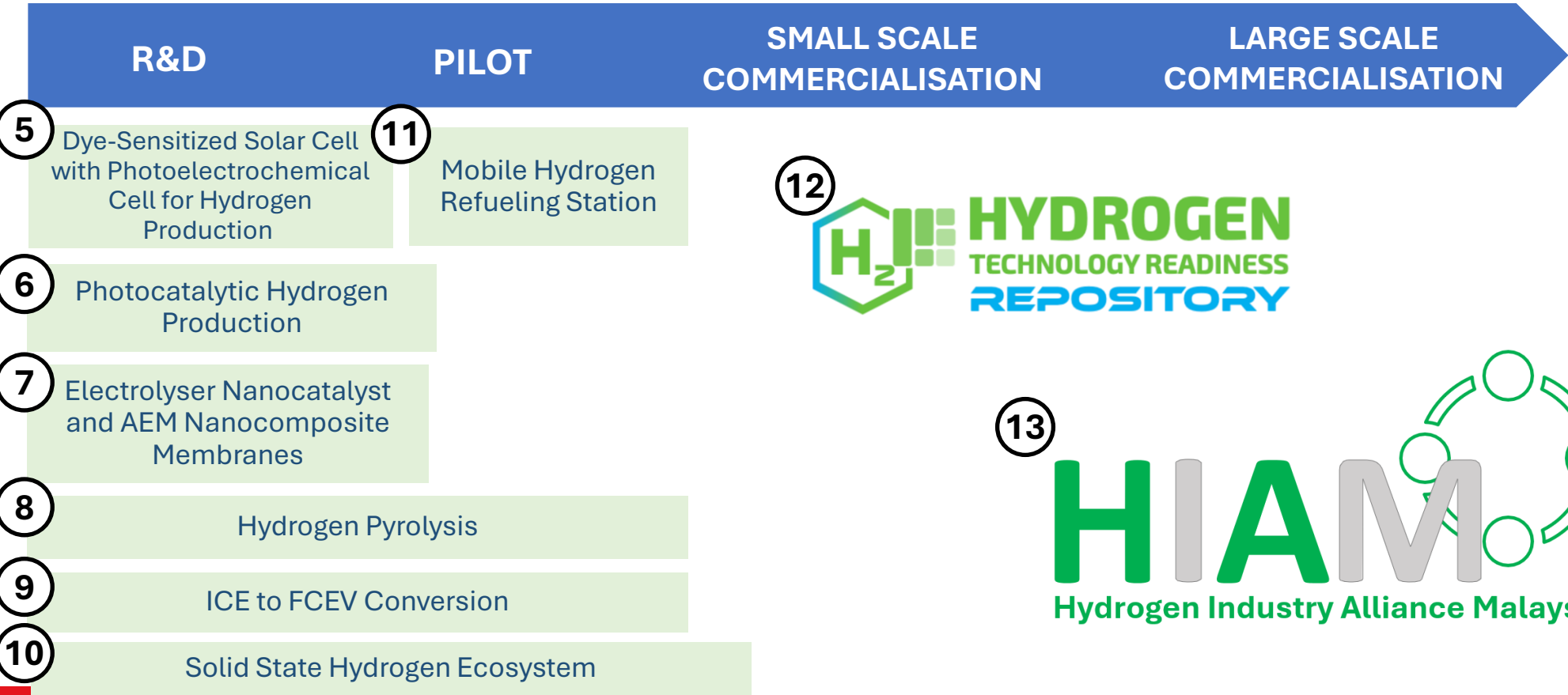
NMB's Products & Services



58 products and services

NMB's Role in the H2 Economy and Technology from R&D to Commercialisation

POLICY FOUNDATION



① Hydrogen Economy and Technology Roadmap

- **Launched** by Deputy Prime Minister, Dato' Sri Haji Fadillah Haji Yusof at IGEM 2023 at the Kuala Lumpur Convention Center on **5th October 2023**.
- HETR is a long-term roadmap (till **2050**) that focuses on all aspects of the energy trilemma for H₂. It is in line with Malaysia's National Energy Policy (NEP) 's vision, objectives, and strategic thrusts:
 - energy security;
 - energy affordability; and
 - environment sustainability.
- Enabling H₂ eco-system environment will be streamlined with HETR's strategies



A levelised cost of hydrogen (LCOH) of **USD 1/kg**

- **Low-carbon** H₂ economy
- Encourage private sector investment in H₂-related technologies.



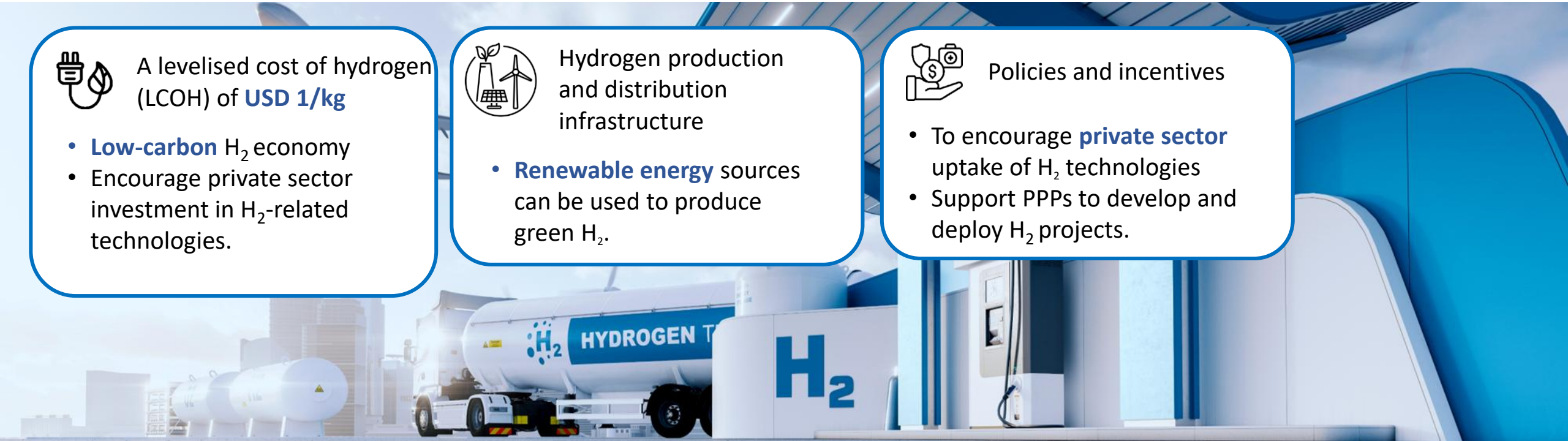
Hydrogen production and distribution infrastructure

- **Renewable energy** sources can be used to produce green H₂.



Policies and incentives

- To encourage **private sector** uptake of H₂ technologies
- Support PPPs to develop and deploy H₂ projects.





② GEF-8 Global Clean Hydrogen Programme (GCHP)

Overview

- ❑ **Objective:** To enhance national **institutional capacities, enabling policy frameworks, improve technological readiness and financial mechanisms** for the successful **uptake of clean hydrogen in developing countries and economies in transition**, ensuring their net zero development with social considerations and benefits.
 - Includes **global and country-level components**
 - Programme size: 18.1 Mio USD (incl. agency fees, PPG grants)
 - **Total co-financing: 213.5 Mio USD**
 - **Participating countries:** Algeria, Ecuador, Egypt, Malaysia, Namibia, Nigeria, Pakistan, Philippines, South Africa

Core components of the Programme

- The project will span over **5 years** beginning June 2026, and its components include:
 - **Green H₂ Policy Support**
 - **Technical Assistance and Capacity Building**
 - **Green H₂ Industrial Clusters and Pilot Project(s)**
 - **Knowledge Sharing and Management**
 - **Monitoring and Evaluation**

3 Technical Committee on H2 Technologies

- Established in 2025 by JSM (Jabatan Standards Malaysia), the committee seeks to identify and develop H2 standards for Malaysia; representative from NMB was voted as the Vice Chairman of the Committee.

JAPAN'S H2 POLICY

Target: H2 as significant contributor to achieve Net Carbon Zero by 2050



Government's Investment: USD99b over 15 years



COMPARISON WITH MALAYSIA

Potential role for H2 Technical Committee **Threshold for Clean H2** (for funding & incentives): 3.4 kg of CO2 per 1kg of H2



Primarily fueled by Government's Budget Allocation (rather than carbon tax)



Incentives on CAPEX: Green Innovation Fund (GIF) that sets USD 2b for H2 supply chains and USD 0.5b for water electrolysis alone



Issuance of GX (Green Transformation) Economic Transition Bonds



Incentives on OPEX: Contract for Difference (CfD) of USD 19b for 15 years beginning 2024



- In preparation for potential incentives for H2 in the future, there is a need to identify clean H2 threshold for Malaysia, with the following possible scenario:

Carbon Intensity (kg of CO2 per 1kg of H2)	<ul style="list-style-type: none"> Tier 1 (0.1) Tier 2 (0.11 – 1) Tier 3 (1.01 – 2) Tier 4 (2.01 – 4) Tier 5 (4.01 – 6)
Benefits	Eligible initiatives can receive incentives that are tied with the tiering level

4. Low Carbon Hydrogen Certification Scheme (LCHCS)

Integrated compliance suite for low carbon hydrogen

LCHCS is a strategic compliance framework that enables trusted low carbon hydrogen claims by integrating methodology, assurance, traceability and certificate governance into one market-facing pathway. It is designed to build confidence, support export readiness and strengthen the hydrogen ecosystem.

Positioning



Trusted low carbon claims

Creates confidence that hydrogen claims are evidence-based and independently supported.



Market access and export readiness

Helps align products and claims to buyer and cross-border market expectations.



Investment and policy confidence

Provides clearer signals for investors, regulators and strategic decision-makers.



Scalable national compliance pathway

Establishes a structured model that can grow across projects, facilities and markets.

Carbon Quantification

Measure and calculate emissions

Renewable Electricity / Feedstock

Qualify energy and inputs

Market Use / Trade

Support credible transactions and claims

Evidence & Laboratory Testing

Generate trusted technical evidence

Chain of Custody & Registry

Track attributes and certificate integrity

Conformity Certification

Independent review and certification

A connected compliance pathway from production data to trusted market claims.

What LCHCS brings together



Governance & scheme rules

Defines roles, conformity pathways and oversight.



Carbon methodology

Sets the accounting basis for low carbon claims.



Electricity sourcing

Addresses power inputs and attribute treatment.



CCS & residual emissions

Covers capture, transport, storage and remaining emissions.



Chain of custody & registry

Protects traceability, transfers and certificate integrity.



Evidence & laboratory support

Provides sampling, testing and technical substantiation.



Hydrogen derivatives & conversion

Extends the framework to derivative products and conversion pathways.



Market claims and supporting instruments

Supports claim classes, annexes and operating tools for implementation.

How value is created



Measure

Quantify emissions and energy inputs



Verify

Independently assure data and evidence



Trace

Track attributes end-to-end



Certify

Issue trusted low carbon certificates



Trade

Enable credible claims and transactions



Strategic outcomes



Credible certificates

Trusted proof for low carbon claims



Traceable attributes

Visibility across the value chain



International confidence

Better alignment with global expectations



Readiness for hydrogen and derivatives markets

Supports future market expansion



Stronger ecosystem governance

Clearer rules, assurance and accountability

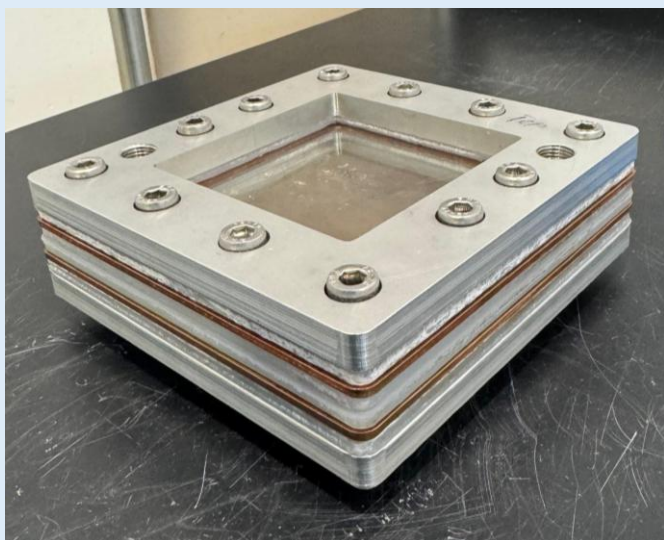
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Dye-Sensitized Solar Cell with Photoelectrochemical Cell for Hydrogen Production

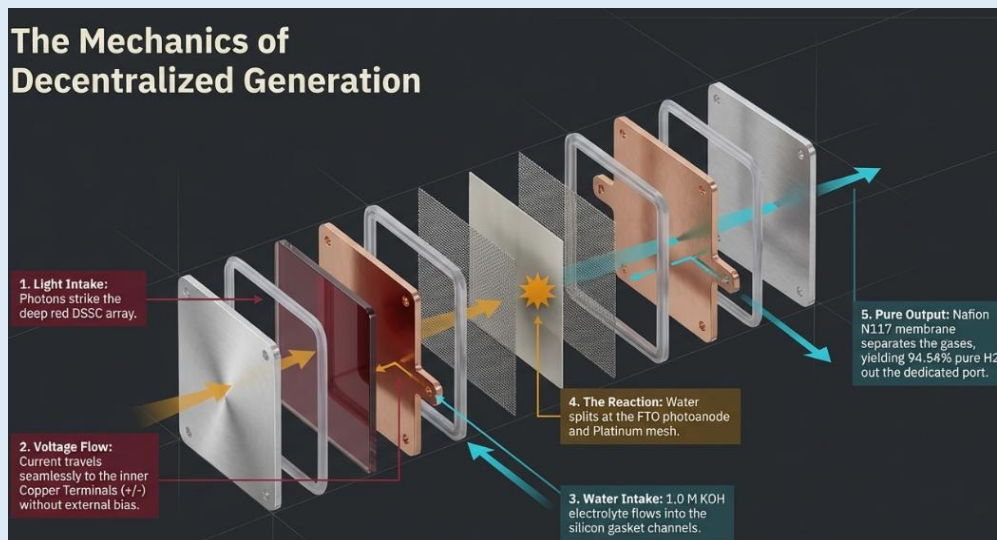


Product Description

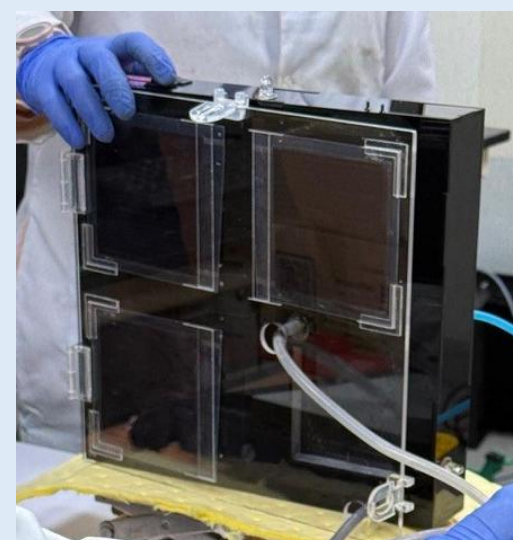
PEC Cell (Top View)



The Mechanics of Decentralized Generation



Indoor Solar-PEC Module



- A fully integrated module **combining flexible, plastic-based indoor solar cells** with a **photoelectrochemical cell (PEC)**
- Designed for **localized**, on-demand hydrogen generation without relying on an external electrical grid
- **Compact** and modular architecture engineered specifically to function **under low light** and **indoor** condition

Unique Value Proposition

- ✓ **Self-powered:** No external power required
- ✓ **Low-light efficient:** Works at 200–750 lux
- ✓ **Lightweight & flexible:** Easy to install anywhere
- ✓ **Eco-friendly & scalable:** Sustainable, low-cost materials

Decentralized, clean hydrogen production powered entirely by ambient and indoor light

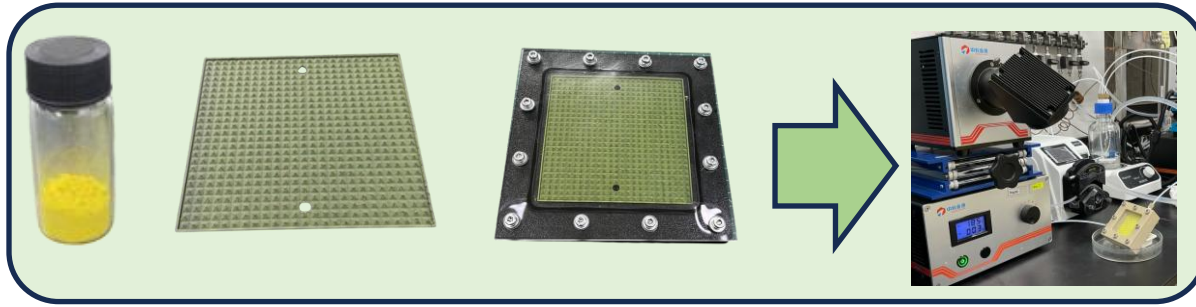
Performance yield: Up to 140 mmol/g·h H₂ production
Hydrogen purity: ~94.5% H₂

TRL: 5

6 Photocatalytic Hydrogen Production

TRL: 5

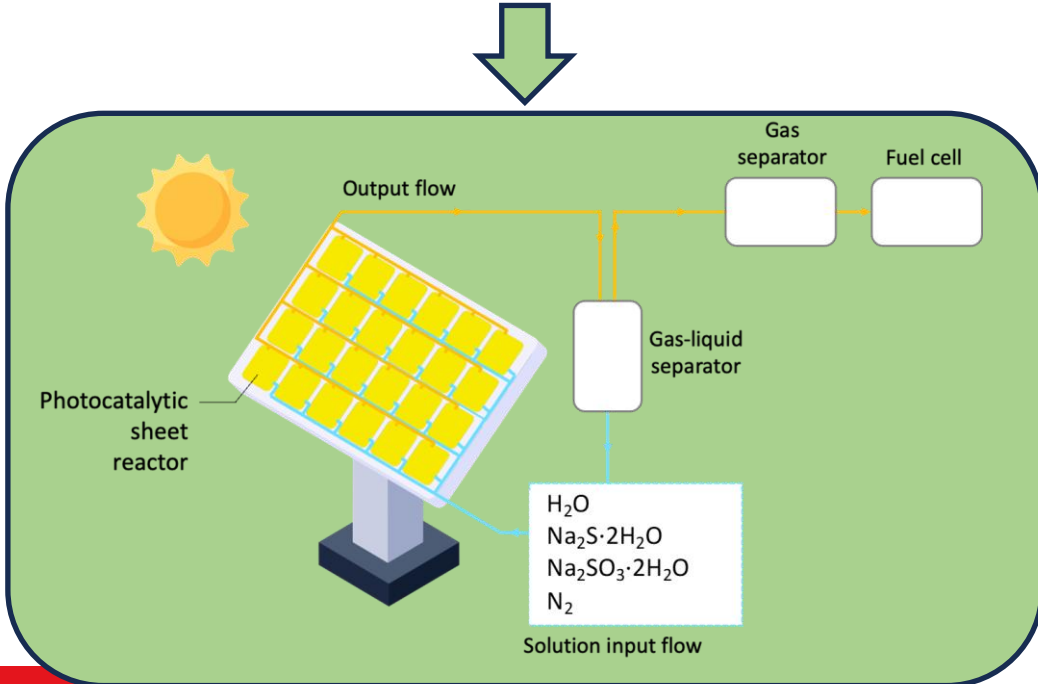
Product Description



- Hydrogen (H₂) production from photocatalyst panels (photocatalytic H₂ production), using solar energy to split water via photocatalytic reactions as a sustainable, renewable method for H₂ generation.
- Overcome lab-scale limitation by scaling up the photocatalytic H₂ production and coupling it with storage systems for fuel cell use and energy storage applications
- System consists of multiple small-scale reactors connected in series.
- LCOH at ~ USD 22/kg.

Unique Value Proposition

- H₂ production **without solar PVs nor electrolyzers**
- Suited for large-scale applications with direct sunlight
- Non-noble metal catalyst (zinc cadmium sulfide - ZnCdS) could possibly **greatly reduce material cost** for mass production
- Solar tracker system that follows the sun's path, ensuring **maximum sunlight exposure** during the day time
- High-precision spraying technology for catalyst synthesis, a step **towards automated mass production.**



7 Electrolyser Nanocatalyst and AEM Nanocomposite Membranes



Electrolyser Nanocatalyst

TRL: 5



Product Description

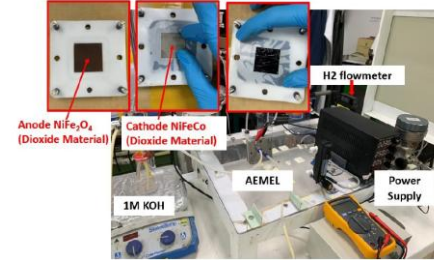
- A high-performance **non-noble metal nanocatalyst system** (Ni/Fe/Co-based) designed for **Alkaline Anion Exchange Membrane (AEM) electrolyzers**, enabling efficient hydrogen production while significantly reducing reliance on expensive platinum-group metals.
- The catalyst is engineered for integration into **electrode structures**, supporting stable electrochemical reactions under alkaline conditions.

Unique Value Proposition

- **Cost Disruption:** Eliminates dependence on platinum/iridium → major CAPEX reduction
- **Scalable Materials:** Uses abundant transition metals for large-scale deployment
- **AEM-Compatible:** Optimised for alkaline environment → broader material flexibility
- **System-Ready:** Direct integration into electrode assemblies for electrolyser systems

AEM Nanocomposite Membranes

TRL: 5



Product Description

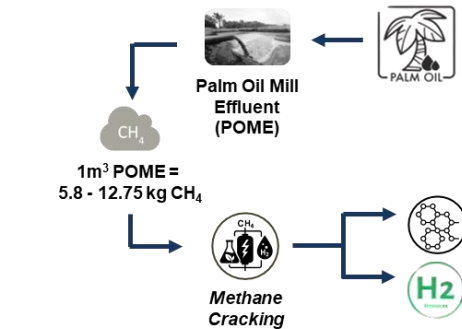
- An advanced **nanocomposite AEM membrane (QGO/QPVA & GCN/QPVA)** developed for hydrogen electrolysis, offering **high ionic conductivity (63.4 mS/cm)**, strong **chemical/mechanical stability**, and proven **durability (~1000 hours)**.
- The membrane is engineered at optimal thickness (50–55 μm) and validated in a **working AEM electrolyser single-cell prototype**.

Unique Value Proposition

- **High Performance:** Achieves >63 mS/cm conductivity with stable operation
- **Durability Proven:** Demonstrated long-term stability with minimal degradation
- **Cost Advantage:** Uses low-cost polymer (PVA-based) vs commercial membranes
- **Competitive Edge:** Outperforms benchmark membranes in performance vs cost
- **Validated Technology:** Achieved **NRL 5 (product validation stage)**

The project produces high-quality graphene and hydrogen from biomethane via microwave plasma pyrolysis, generating solid carbon instead of CO₂ with minimal emissions.

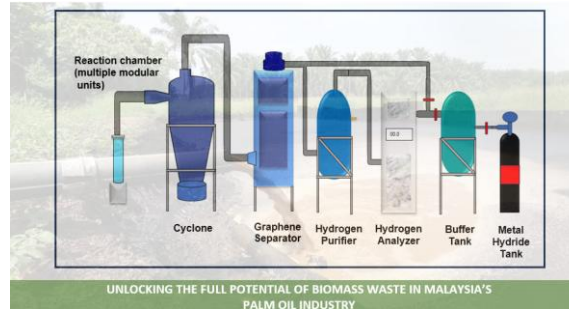
From Conceptual Idea to Actual System Realization



Operating temperature: 750–1,000 °C



Integrated cyclone system for carbon separation



Based on microwave plasma pyrolysis technology



Unique Value Proposition

- Revenue-generating CCUS through graphene production (instead of carbon storage cost)
- Sustainable hydrogen production for the growing clean energy market
- Commercial-grade graphene for electronics, composites, energy storage, and advanced manufacturing

9 ICE to FCEV Conversion

TRL: 7



Both BEV (Battery Electric Vehicle) and FCEV (Fuel Cell Electric Vehicle) conversions offer complementary solutions to support Malaysia's green mobility ambitions under HETR & NETR.

Unique Value Proposition

- Bus is first converted to EV --- *a first for Malaysia*
- **Hybrid Hydrogen Storage System (H2SS)** is then added, developed by NanoMalaysia using solid state hydrogen reactor produces on-demand hydrogen onboard the vehicle through hydrolysis and is a potentially **safer, lighter and cheaper** solution compared to compressed hydrogen technology.
- H2SS acts as a **range extender** and will enable the bus to travel further without requiring frequent recharging, making it more efficient and reliable.



By deploying both technologies in tandem, Malaysia can accelerate green mobility across all transport segments — urban and long-distance — while promoting local innovation and reducing emissions.

Combustion Engine to Electric Powertrain



Conversion from commercial vehicle to FCEV using NMB's propriety IP so as to minimize cost of purchasing new FCEV vehicles

NMB is in a unique position as it is now the only entity that has the technology and prototype on FCEV converted vehicles (bus and lorry).

10 Solid State Hydrogen Ecosystem



Technology Overview

The HyPEReactor is a **modular, solid-state hydrogen generator** that uses **sodium borohydride (NaBH₄)** for on-demand H₂ generation. It eliminates high-pressure storage risks while delivering zero-emission power via fuel cells. This process also offers zero tree clearance without deforestation.

Power Output

1 kW to 5 kW+ scalable

Energy Source

NaBH₄ + Water → H₂

Key Innovation: "Just add water" system generates hydrogen on-demand, avoiding complex storage infrastructure

Hypertech Industries
Sdn. Bhd.
Technology Recipient

RM1b
Target Market
(Power for Rural)

3-8
TRL

Unique Selling Proposition

- ✓ In-situ H₂ production and based on demand.
- ✓ Cheaper than conventional compressed green H₂ with Sodium Borate recycling technology able to generate sodium borohydride at 1/3 of its original cost.
- ✓ Safer compared to conventional compressed H₂ due to it operating within < 10 bars as opposed to 350 / 700 Bars.
- ✓ Lighter with high potential for aviation based (lighter UAV i.e. 30% less compared to a compressed H₂ system, as the energy density is 30% higher i.e. 325 vs. 250 Wh/kg.

Challenges

- Lack of enabling infrastructure being a game-changer.
- Still at higher costs compared with other conventional hydrogen technologies due to unavailable economies of scale in both the manufacturing, recycling facilities and end-use application



11 Mobile Hydrogen Refueling System



(a) Mobile Hydrogen Refuelling Station



Unique Value Proposition

- Mobile and flexible (relocation-ready)
- Used for market readiness and technology validation

(b) Strategic Partner

PETRONAS Technology Ventures Sdn Bhd (PTVSB)

Malaysian Green Technology Corporation

Sime UMW & Toyota Motor Sdn. Bhd.

NanoMalaysia Berhad

(c) Investment Profile and Capacity

Project Value
~RM12 million

Capacity
200kg storage

(d) Ecosystem Projection

Expansion of more refuelling activity

+ 45% Malaysia EV Station (4,161) VS Market 2025 (10,000)

Government incentive: tax exemption for CBU EVs until 2025 (4 years)

12 Hydrogen Technology Readiness Repository (HTRR)



PROJECTED MALAYSIA GREEN H2 MARKET REVENUE (2030)
USD 84.15 BIL

PROJECTED MALAYSIA BLUE H2 MARKET REVENUE (2030)
USD 5.01 BIL

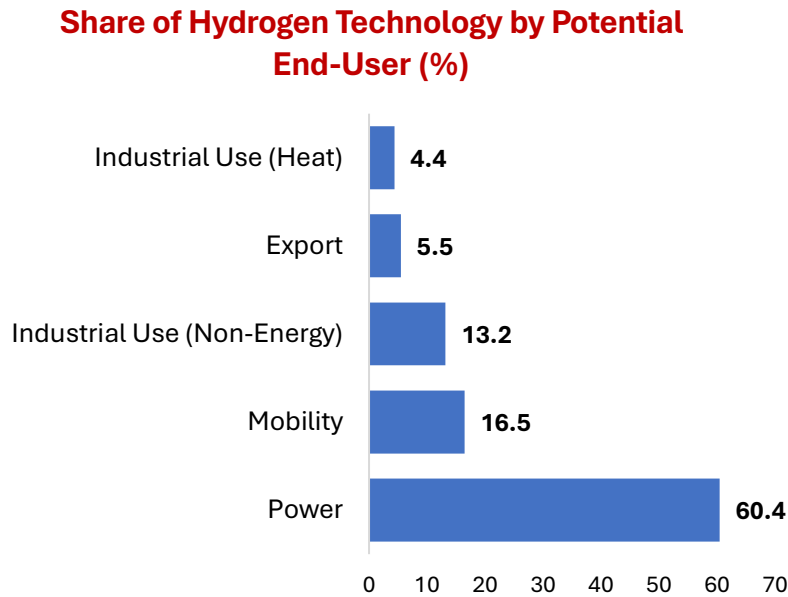
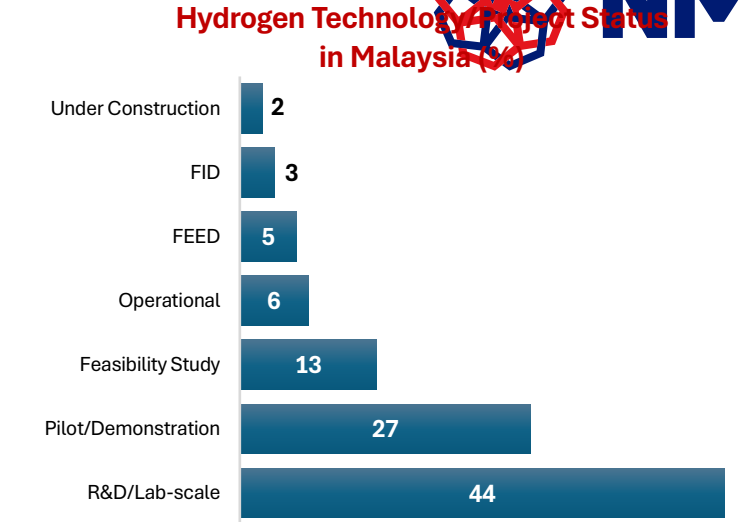
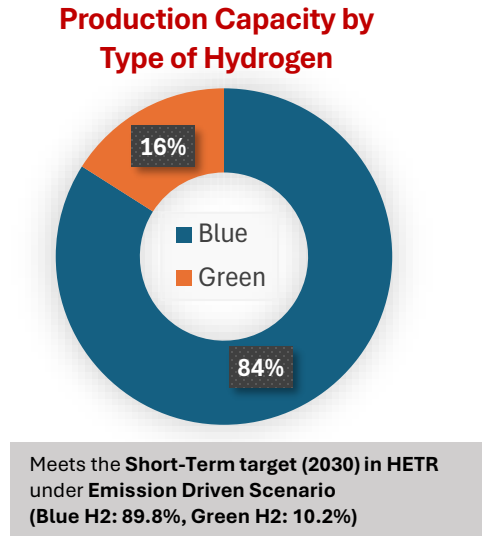
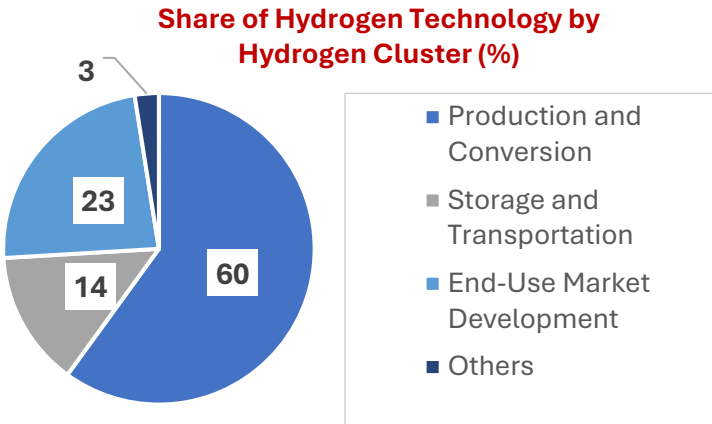
Largest Share by H2 Cluster in Malaysia
Production and Conversion (60%)

Largest End-Use Share (2030)
Power (60%)

Largest Share by Production Capacity
Blue Hydrogen (84%)

H2 Tech Ownership	%
Locally developed	80
Procured/Imported	11
Leased	9

SOURCES:
1. Public domain (DOSM, MITI, NRES, KRSTE.my, MyIPO, Lens.org)
2. Malaysian Hydrogen Industrial Alliance (MHIA)
3. Hydrogen Economy and Technology Roadmap



GHG Emissions Reduction (t CO₂e/yr) by Hydrogen Type

Type of H2	HTRR Projected GHG Emission Reduction by 2030 (tCO ₂ e) (based on claims made by the project owner)	HETR Target on Total GHG Emissions Reduction by 2030 (tCO ₂ e)	
		Business-As-Usual	Emission-Driven
Blue (CO ₂ Captured)	911,340	456,835	4,799,132
Green (GHG Avoidance)	8,186,718		

HTRR pipeline would deliver ≈ 9.1 Mt CO₂e abatement by 2030—already 2 times of the 4.8 Mt roadmap target. 2030 target hit hinges on aggressively scaling green projects or rapidly adding CCS capacity to blue projects.

Malaysia's Hydrogen project pipeline mapped in the HTRR is already large enough to generate ~USD 89 billion in annual revenue by 2030—well above the "early-market" value envisioned for Phase 1 (Short-Term target) of the Hydrogen Economy & Technology Roadmap (HETR)

Hydrogen Industry Alliance Malaysia (HIAM): Members



Key Enablers



NNC

Key Members (44)



NGL Tech Sdn Bhd



BCN Smart Technologies Sdn Bhd



NAZA / Enviro Berjaya Parks Sdn Bhd



HyPERtech Industries Sdn Bhd



Elektro Modula Sdn Bhd



SPIC Energy Malaysia Sdn Bhd



Asia Energy Advanced Sdn Bhd



HICOM Engineering Sdn Bhd



TUV Rheiland Malaysia Sdn Bhd



Prasarana Malaysia Berhad



Gentari Hydrogen Sdn Bhd



H2 Energy Sdn Bhd



Sarawak Metro Sdn Bhd



UZMA Enviroenergy Sdn Bhd



Limpahan Engineering Sdn Bhd



UMW Industrial Power Services Sdn Bhd



TNB Genco Sdn Bhd



Petronas Technology Ventures Sdn Bhd



Forward Energy Sdn Bhd



Semarak Renewable Energy Sdn Bhd



KemuncaK Lanai Sdn Bhd



Essem Corporation Sdn Bhd



SEDC Energy Sdn Bhd



Hydrexia Sdn Bhd



H2NexGen Sdn Bhd



Sany International Developing (M) Sdn Bhd



Linde Engineering Malaysia Sdn Bhd



Pensera Energy Sdn Bhd



RXA Associates Sdn Bhd



Schmierer SEA Sdn Bhd



Biforst Logistics Sdn Bhd



NOVA RE Suria Sdn Bhd



Mutiara Perlis Sdn Bhd



ACE Gases Sdn Bhd



Interglobal Green Sdn Bhd



Forte Greenergy Sdn Bhd



Universtiti Tenaga Nasional Sdn Bhd



Solarvest Energy Sdn Bhd



Green Hydrogen Asiacap Sdn Bhd



Trident Nova Sdn Bhd



Ricardo Malaysia Sdn Bhd

Inaugural Stakeholder Workshop

- Industry stakeholders' focus
- Hydrogen remains expensive.
- Main solution: "Carrot and stick" approach to adopt H2 as compared to fossil fuels so as to reduce the cost difference

10 SEP 2024

HETR Steering Committee Meeting

- Requested for incentives to be proposed



4 NOV 2024

HIAM Stakeholders' Workshop 1-2025

- Brainstormed and produced proposed incentives for H2



22 JAN 2025

MOSTI Post-Cabinet Meeting

- Requested for a Special Task Force to be mobilised



12 FEB 2025

Special Task Force on Incentives

- Zoomed to priority incentives and cost to Government



9 JUL 2025

Mesyuarat Jawatankuasa Kluster Penghasilan & Penukaran Hidrogen Kebangsaan Bil 1/2025

- Presented representing the voice of the H2 industry

16 JUL 2025

HETR Steering Committee Meeting

- Proposed the Special Task Force members on incentives

23 JUL 2025

HIAM Stakeholders' Workshop 2-2025

- Agreed to incorporate HIAM under RoC
- Official request "Surat Mandat" has been submitted to NNC/MOSTI for the use of Malaysia in HIAM

22 SEP 2025

MoU with H2 Korea

- Strategic partnership to accelerate hydrogen economy through governance & tech-transfer.



16 OCT 2025

Global Hydrogen Industry Alliance Association (GHIAA)

- HIAM became the national hydrogen partner



31 OCT 2025

HIAM, Registered in RoC

- HIAM has been incorporated as a company and successfully registered by SSM



24 DEC 2025

HIAM Stakeholders' Workshop 1-2026

- Formalisation of HIAM Committee structure
- Incentivisation & self-sustained hydrogen economy

4 FEB 2026

HIAM Stakeholders' Meeting 2-2026

- Branding, TOR, fees
- New policy lead election
- CFAA & J2HA Collaboration

18 JUN 2026

**NMB**

Thank you

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