



1 & 2 October 2024
Menara Felda, Platinum Park KLCC

PETRONAS Proton Exchange Membrane Electrolyser for Green Hydrogen

PETRONAS Research Sdn Bhd (PRSB) is PETRONAS' Technology Home Ground



PRSB
Staff



500+
Personnel



>50%
Postgraduate
Degrees



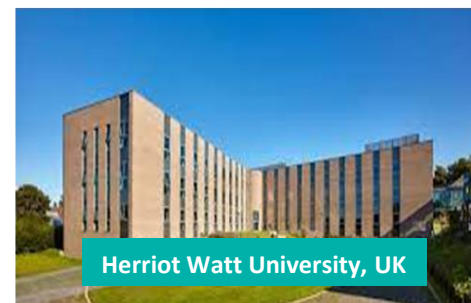
66%



34%

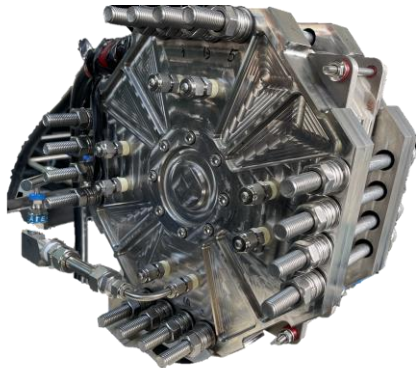
83%
Local
Scientists

17%
Foreign
Scientists



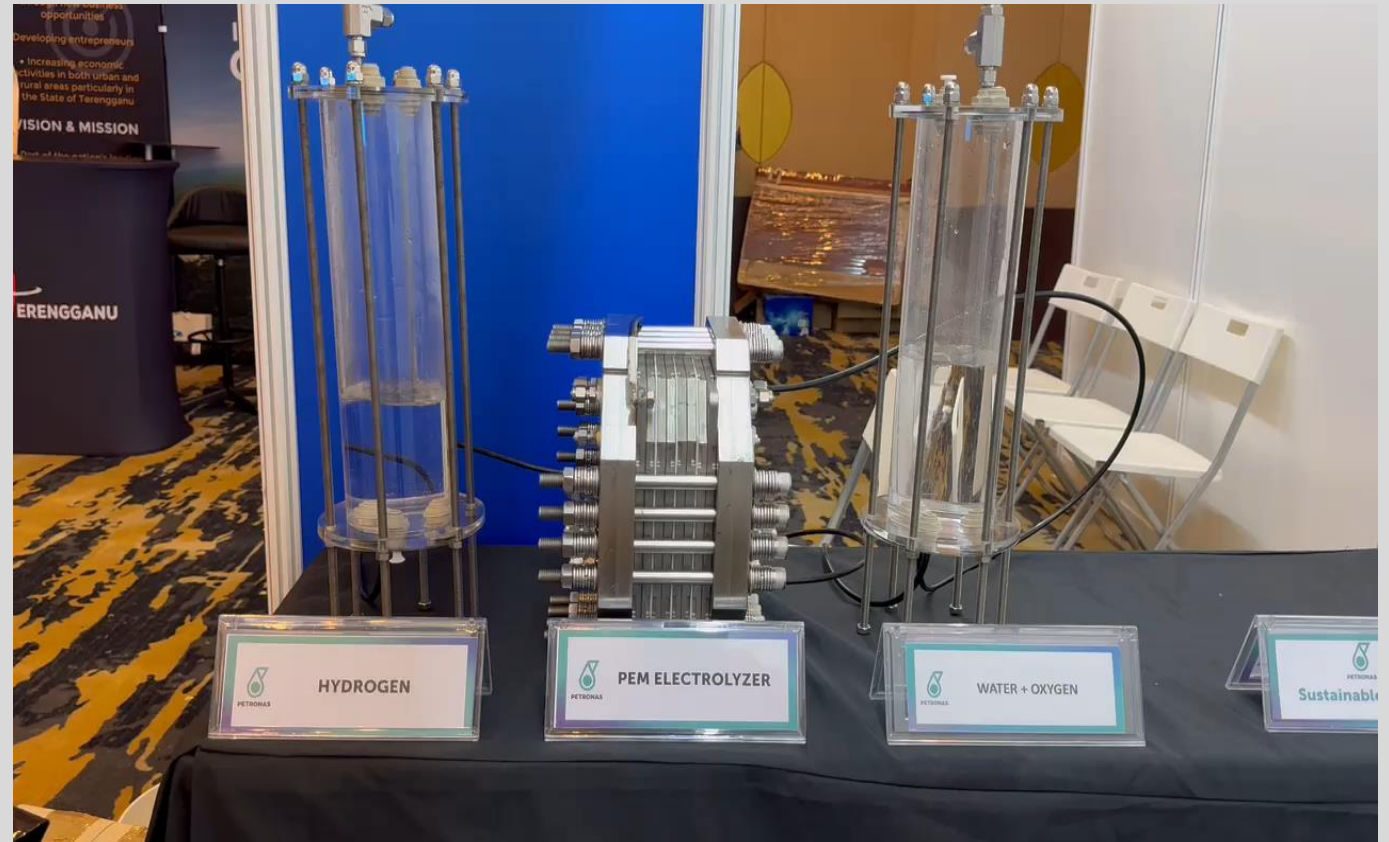
PETRONAS develops in-house technology to produce green hydrogen

PETRONAS Proton Exchange Membrane (PEM) Electrolyser



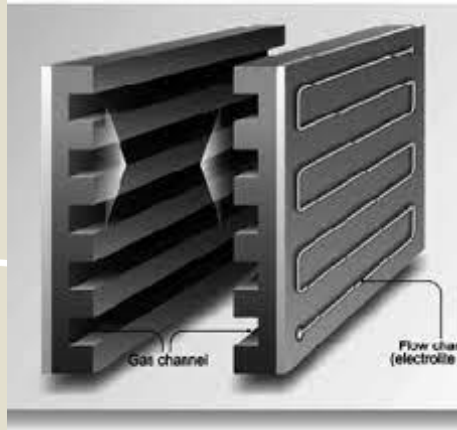
PEM Version 1

- Novel engineering design enhances electrolyser efficiency with lower power consumption
- Vast opportunity to produce green energy carrier with highest feedstock security



PEM deliver better efficiency by reducing the power consumption

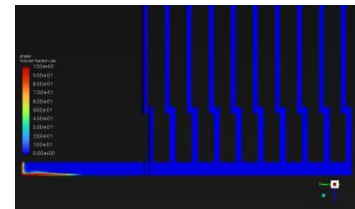
The challenge



Traditional flow field engraving:

Expansion of the contact surface area causing decrease in the volume of the channel through which the reactants flow.

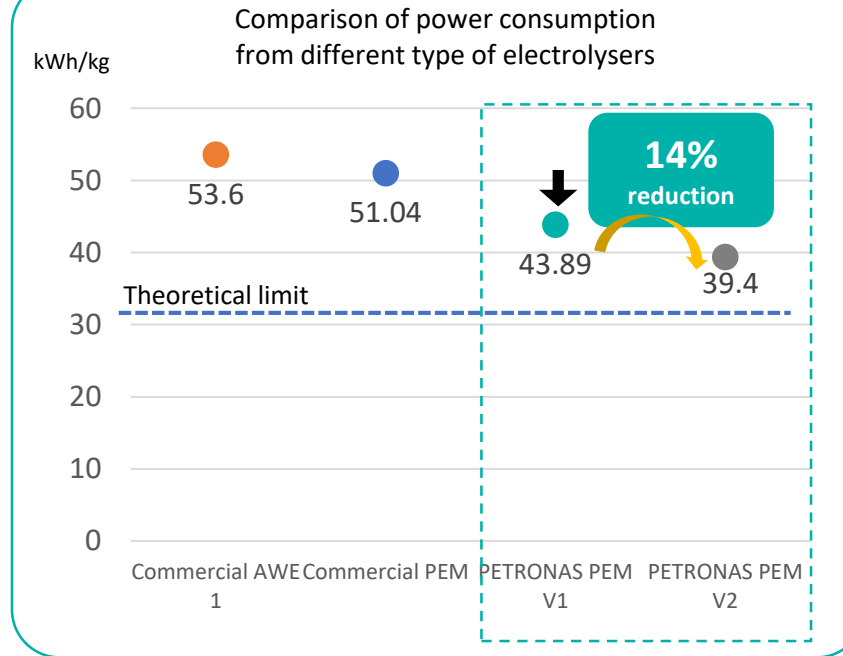
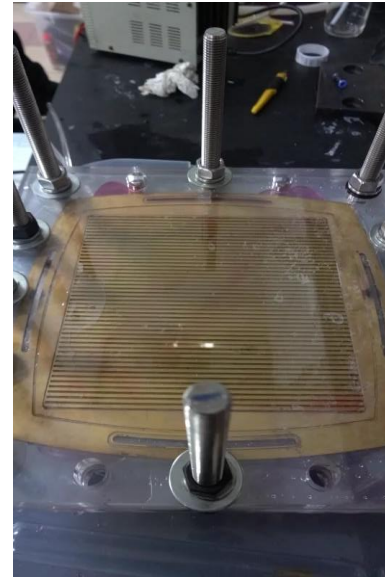
How do we solve it



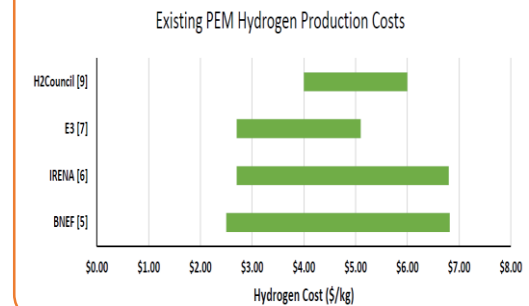
Simulation of water flow distribution

Flow field 3D (triangle) engraving:

- Achieved optimum surface contact at maximum reactant flow
- Even flow distribution across all channels
- Low/no pressure drop



H2 production cost

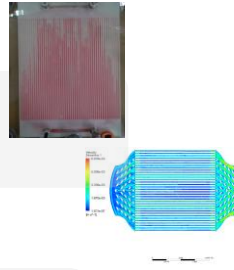


Low power consumption of PETRONAS PEM electrolyser shows that the H2 production cost is at **USD 3.98/kg**

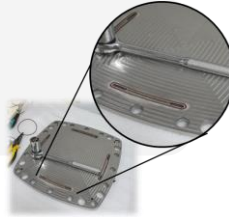
PEM endured more than 3000 hours and rigorous tests validating its performance

Testing & Qualification

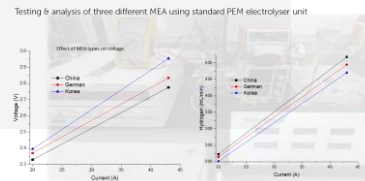
Simulation and flow design test to validate the pressure and liquid distribution



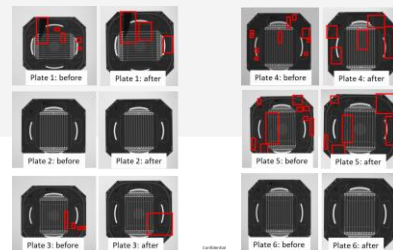
Adapting the O-ring design to increase the stack pressure and reduce any potential leaks



MEA performance & selection test for higher current density and production rate



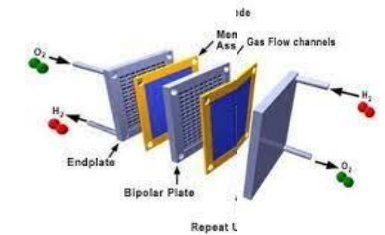
Radiography testing for plate embrittlement and material corrosion



Pilot & Scale Up

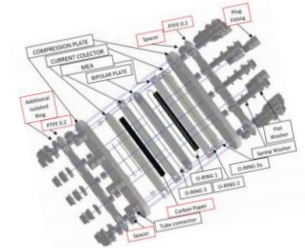
Unit Cell/Component (Lab)

- Validate unit cell/plate efficiency
- Select & freeze the design for stack



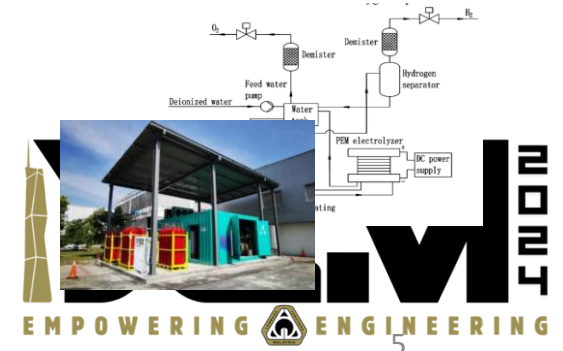
Qualification Testing (Pilot)

- Optimise and select the best configuration based on efficiency and cost



System Integration (Upscale)

- To qualify the electrolyser as a system (stack & balance of plant)



Significant milestones achieved to spur the hydrogen economy

Delivery of Multi-Fueling Station (Darul Hana, Sarawak)



1st in SEA

Multi-fueling station

150kg/day

hydrogen produced

450 kW

power requirement

Notable achievements

Finalist for 2 IChemE Awards

- Winner Industry Project Award
- Highly Commendable Energy Award



Winner for Anugerah Kecemerlangan Inovasi
Kejuruteraan BEM 2023

Enabling strategic collaboration for economic growth



PEM value chain as a launch pad to drive hydrogen economy for Malaysia

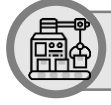
Localization of supply chain to produce PEM



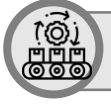
Localisation Aspects



Material Supplier



Machining of plates



Assembly



Integration

Local manufacturing, inspection and assembly



Local manufacturing, inspection and assembly



Other on-going efforts



Capability enhancement



Operationalisation



Policy & standard shaping

The hydrogen market is expanding globally and across the value chain enabling energy transition

PETRONAS



- Competitive green and blue H₂ solutions provider
- Scale as a low carbon H₂ producer



Gaining market entry

- Projects in existing assets



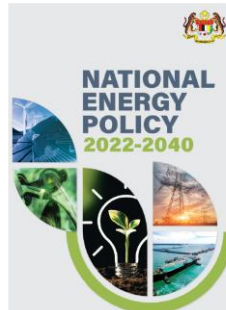
Increasing demand & supply nodes

- Green H₂ in targeted market globally
- Capacity: >1.0 MTPA

~2 GW
Electrolyser
Capacity

~RM14 Bil
Potential
Value

National



Adoption of Green Hydrogen Production and Transportation Technologies e.g., electrolyser, H₂ transportation

Potential commercial solutions

Transportation:
Multi-fueling Stations,
Hydrogen ART



Power:
Peak Shaving,
Decarbonizing



~1 GW
Electrolyser
Capacity

~RM12 Bil
Potential
Value

Global

Hydrogen Demand Forecast 2050 (MTPA)

US\$ 1 Trillion
excluding equipment & services

Heat & Power



Steel
Paper
Aluminum

Cement
Food



Residential
Commercial

Power



Co-combustion
with coal
Generation



Storage &
Peaking

Industrial

Chemicals



Plastics
Fertilisers
Fuel refining

Products



Metallurgy
Steel



Trucking Vehicle Train Ship
3CEM
EMPOWERING ENGINEERING

Sources: BNEF, team analysis



PETRONAS

Passionate about Progress