Regional Trade Dynamic Study of Green Hydrogen and Derivative Products in SEA Region

ASIA PACIFIC GREEN HYDROGEN 2024 CONFERENCE & EXHIBITION

10 - 12 JUNE 2024

BORNEO CONVENTION CENTRE KUCHING, SARAWAK

Dr. Pramote Puengjinda
GIZ Thailand
Pramote.puengjinda@giz.de

An Event Hosted and Supported by

Ministry of Energy and Environmental Sustainability Sarawak

BUSINESS EVENTS SARAWAK

TRIBE LEGACY SARAWAK CAMPAIGN

SARAWAK More To Discover

Organised by

BORNEO BUSINESS CONNECT

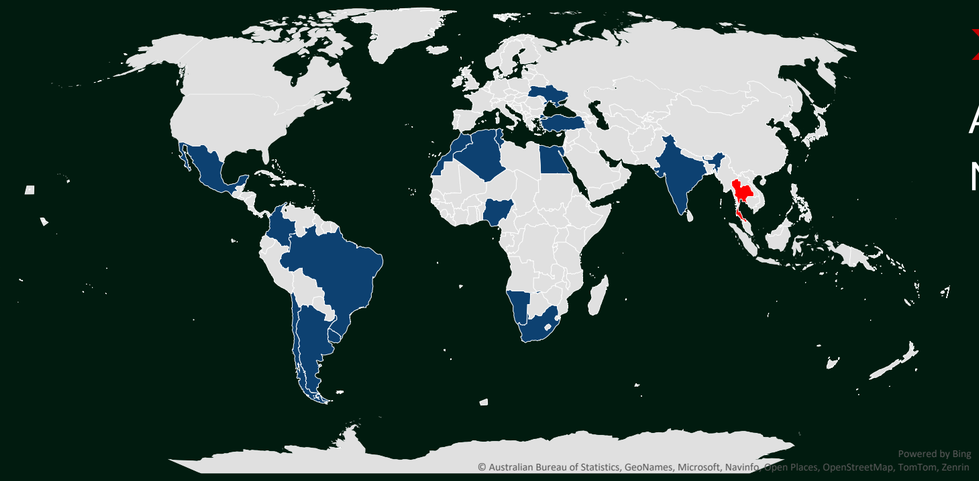
International Hydrogen Ramp-up Programme (H2Uppp)

ASIA PACIFIC GREEN HYDROGEN 2024 CONFERENCE & EXHIBITION
10 - 12 JUNE 2024
BORNEO CONVENTION CENTRE KUCHING, SARAWAK

OBJECTIVE

To accompany and support efforts to ramp up the market for **GREEN HYDROGEN** and **Power-to-X (PtX)** applications in selected developing countries and emerging economies in cooperation with the private sector

- **Commissioning party:** German Federal Ministry for Economic Affairs and Climate Action (BMWK)
- **Implementation partners:** German Chambers for Commerce (AHKs), DIHK
- **Further partners:** Germany Trade & Invest (GTAI) & Industry associations
- **Timeline: Jan 2022 to Apr 2024 (Phase I)**, extension until **Dec 2026 (Phase II)**



- **Focus countries:**

Algeria, Argentina, Brazil, Chile, Colombia, Egypt, India, Mexico, Morocco, Namibia, Nigeria, South Africa, **Thailand**, Tunisia, Turkey, (Ukraine), Uruguay

H2Uppp Thailand: Activities

ASIA PACIFIC GREEN HYDROGEN 2024 CONFERENCE & EXHIBITION
10 - 12 JUNE 2024
BORNEO CONVENTION CENTRE KUCHING, SARAWAK

Potential activities

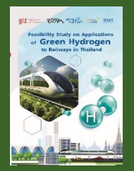
Study and dissemination WS

Green hydrogen Study series

Green Ammonia

Biomass potential for SAF

Aviation stakeholder mapping



H_2 railway study

Recommendations (technical, policy, etc.)

- National Plan
- Policy/ Supports

Capacity building

H_2/PtX Training for Public and Private sectors

Modular electrolyzer Trainings (PPP)

Topic specific training

- Knowledge
- Business development
- Public awareness

Events

Conferences

Business roundtable

Networking

Dialogues

Dialogues and workshops

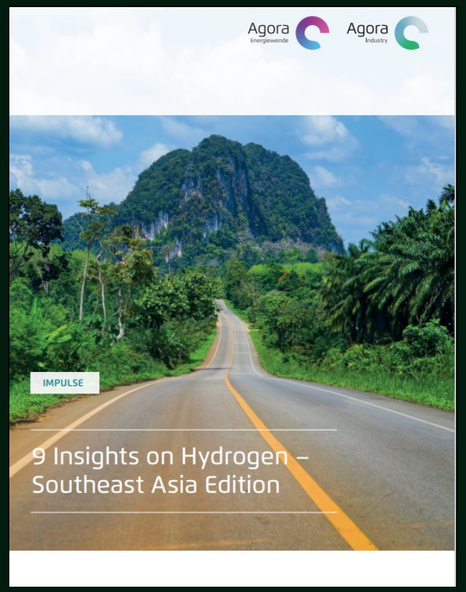
Public-Private Partnership (PPP)

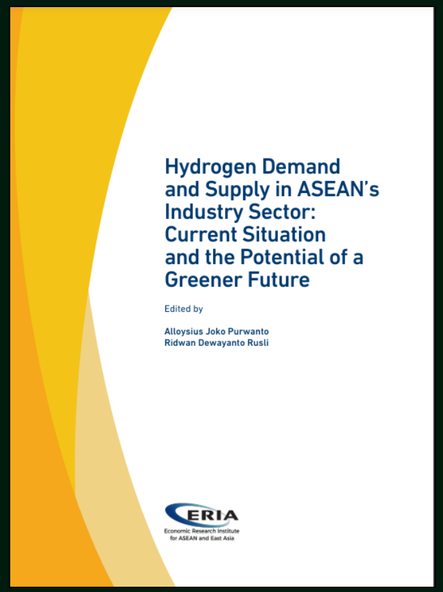
Study / Publication

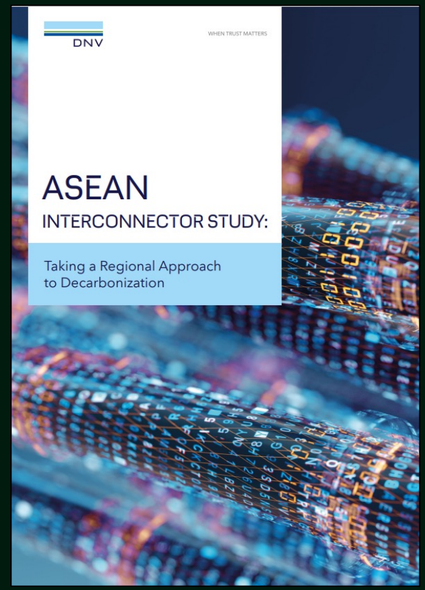
ASIA PACIFIC GREEN HYDROGEN 2024 CONFERENCE & EXHIBITION
10 - 12 JUNE 2024
BORNEO CONVENTION CENTRE KUCHING, SARAWAK

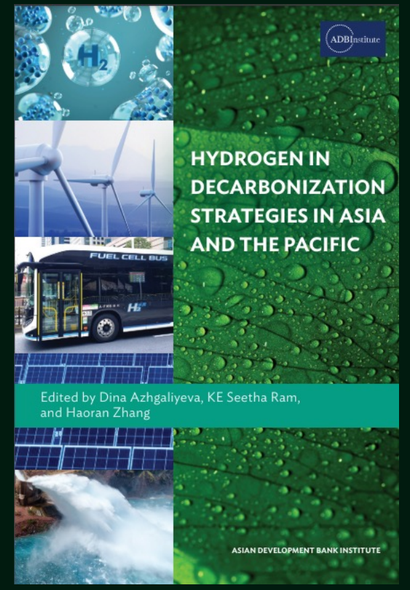
Several studies have been conducted on **Hydrogen and its Derivative Products** in the SEA region

In Progress

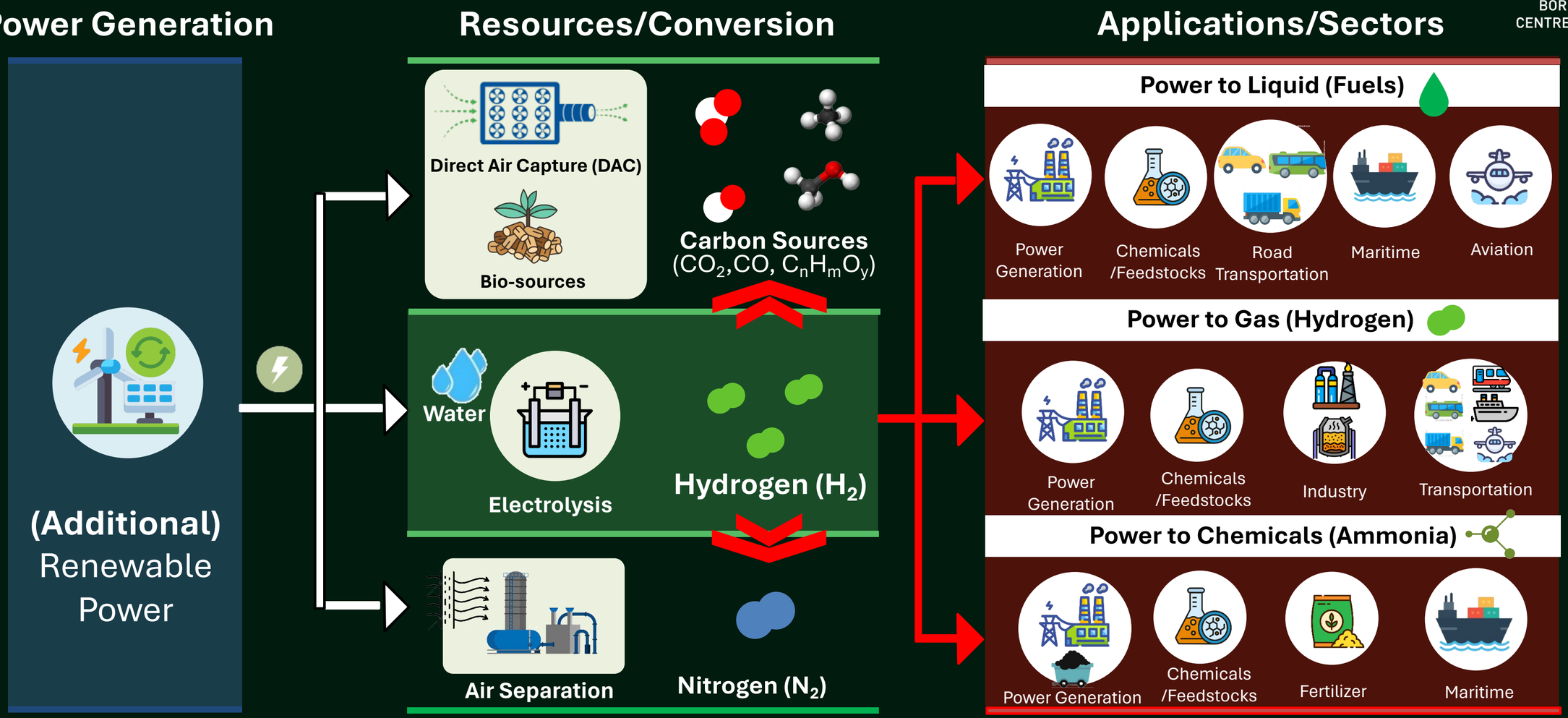






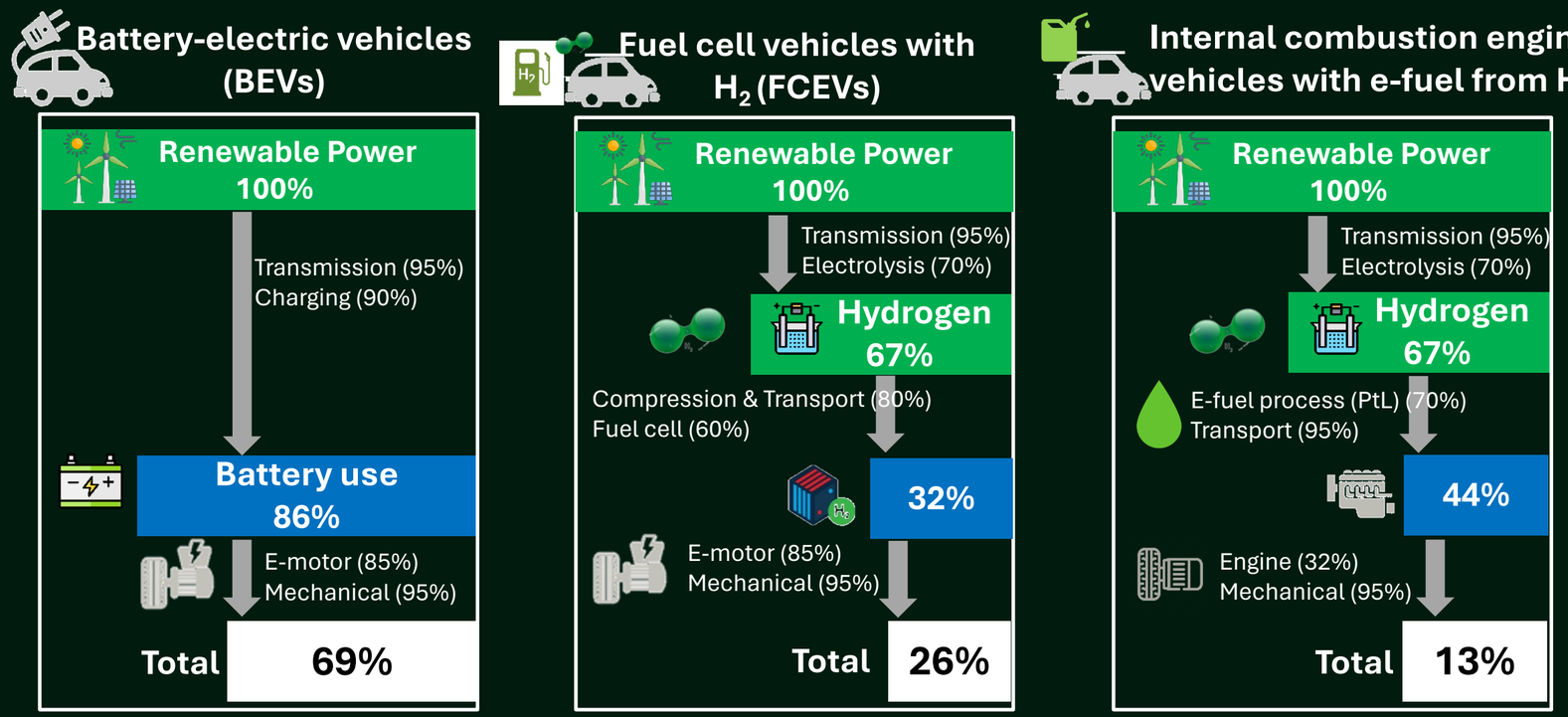


Power-to-X: Steps from RE to Feedstock/ Fuel Supply



Energy efficiency comes first, then electrification of demand

ASIA PACIFIC GREEN HYDROGEN 2024 CONFERENCE & EXHIBITION
10 - 12 JUNE 2024
BORNEO CONVENTION CENTRE KUCHING, SARAWAK



Power-to-X

The conversion of renewable electricity into molecules (as opposed to electrons) that can be used as fossil-free fuels and feedstocks in industry and transport

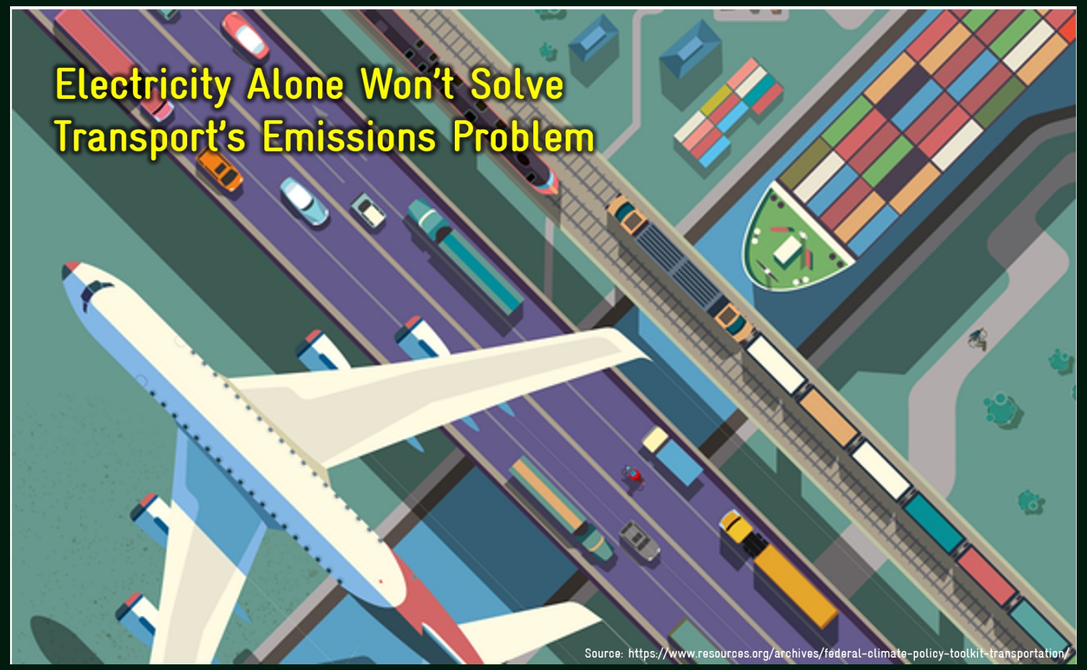
Sector coupling

A measure to integrate renewable electricity into other sectors as heat, industry, and mobility and optimize its use in a multi-energy system

In 2050, Global hydrogen demand could reach **500 MTPA** or **16,500 TWh,** which needs **25,000 TWh of RE.**

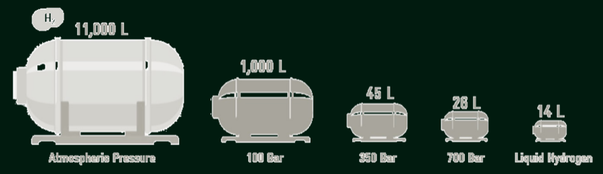
Potential role of H_2 in the Transport Sector

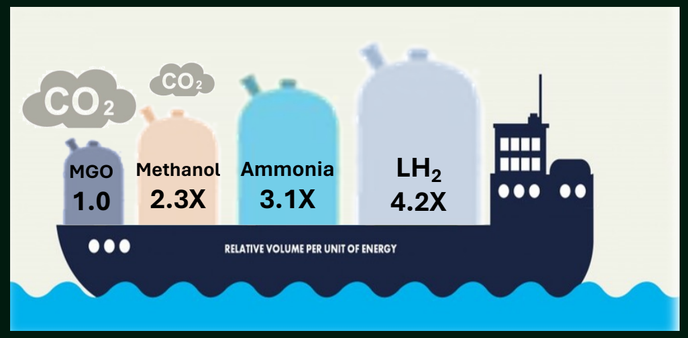
ASIA PACIFIC GREEN HYDROGEN 2024 CONFERENCE & EXHIBITION
10 - 12 JUNE 2024
BORNEO CONVENTION CENTRE KUCHING, SARAWAK



Tank size does matter?

1 kg H_2 Storage Volume



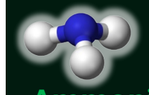


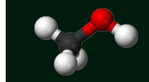
Type	Current Fuels	Future Fuels	H_2-based fuels
Short Haul	Jet Kerosene	ELECTRICITY	Maybe (for medium distance)
		LIQUID H_2	
		SYNTHETIC FUEL	
		BIO-JETFUEL	
Long Haul	Jet Kerosene	ELECTRICITY	Yes (as feedstock for e-fuel SAF)
		LIQUID H_2	
		SYNTHETIC FUEL	
		BIO-JETFUEL	

Type	Current Fuels		Future Fuels	H_2-based fuels
Domestic Passenger	Diesel	Oil	ELECTRICITY	Maybe (for medium distance)
			LIQUID H_2	
	Bunker Oil	LNG	METHANOL	
			AMMONIA	
International Freight (Commodities vs container)	Diesel	Oil	ELECTRICITY	Yes (Methanol & Ammonia)
			LIQUID H_2	
	Bunker Oil	LNG	METHANOL	
			AMMONIA	

Source: Green Hydrogen Study series, GIZ Thailand (H2Uppp 2023)

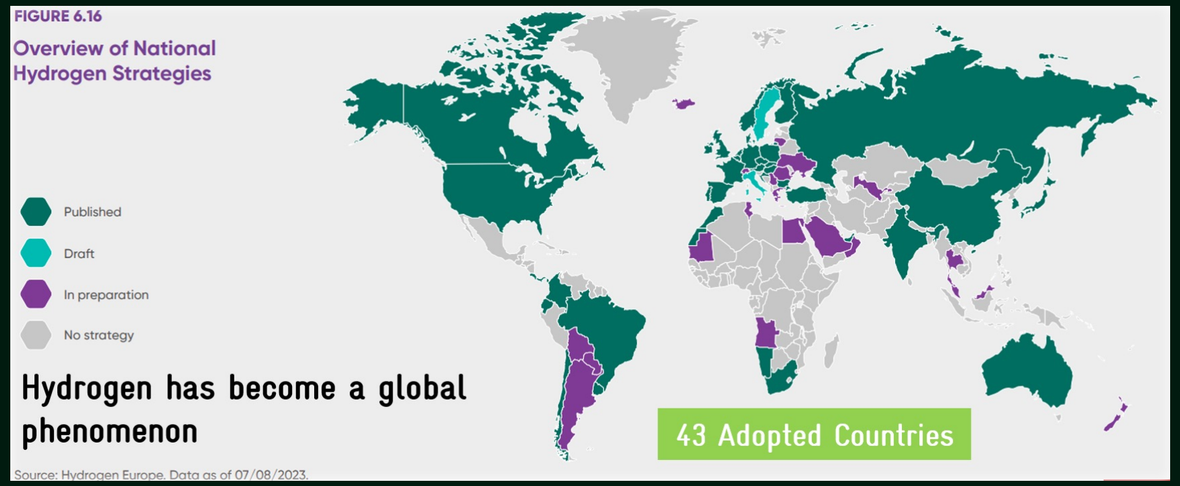
e-kerocene


Ammonia


Methanol

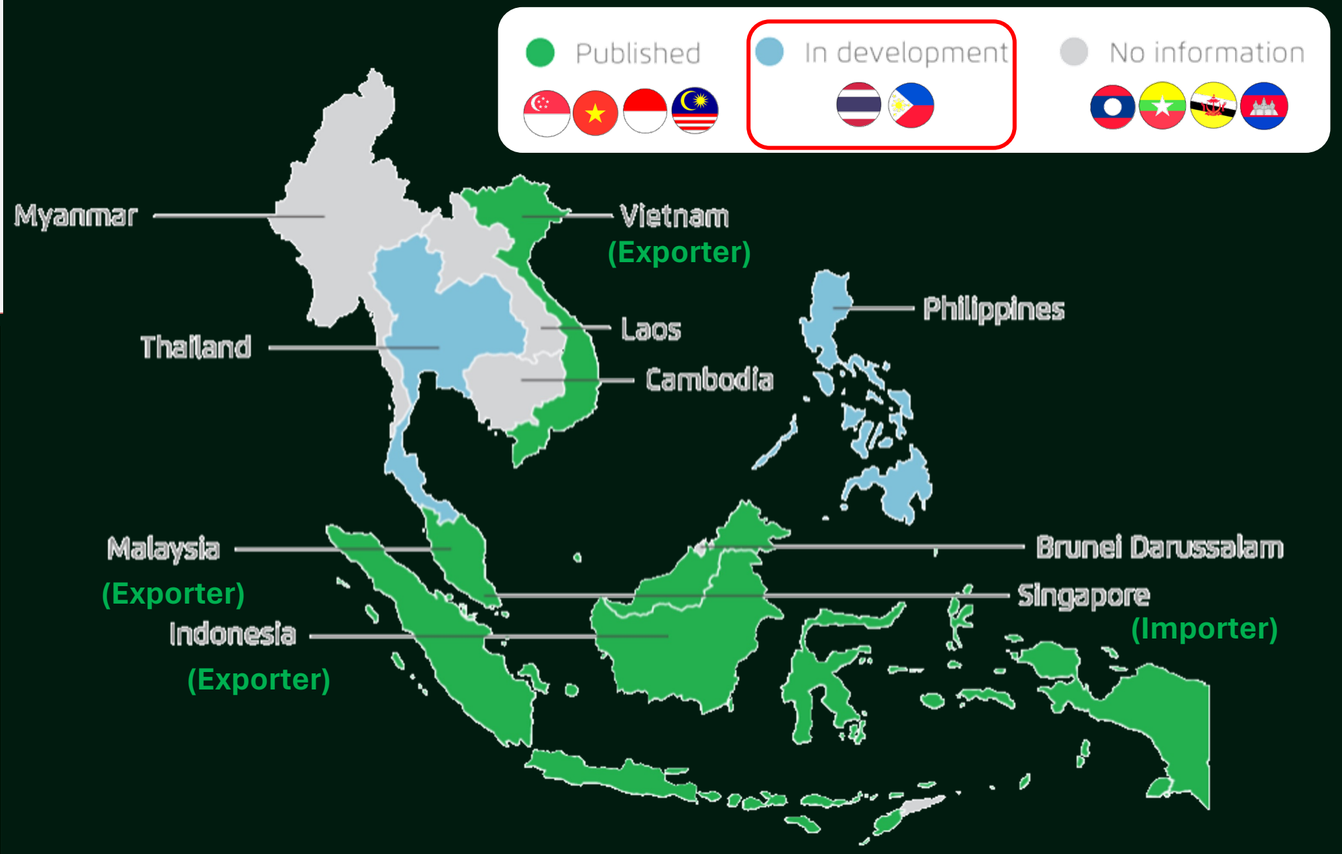
giz

Hydrogen Strategies and Roadmaps for Selected Countries



Country	Document	Year	Importer/ Exporter	Hydrogen targets	Policy instruments
Germany	National H_2 Strategy	Last revision 2023	Importer	- Reach production capacity of 10 GW - Development of a hydrogen transmission grid of more than 9 700 km by 2032 - Develop R&D and build strong international partnerships	- Double-sided auction model H2Global for the import of PtX products. - Carbon Contracts-for-Difference for Industries in Germany, among other subsidies allowed by the European Union
Indonesia	National Hydrogen Strategy	December 2023	Exporter	- Expected demand growth in transport from 2030 and in the industrial sector by 2040 to replace fossil fuels for high temperature heating processes. - Replace current fossil-based hydrogen in the production of fertiliser, ammonia and oil refi ned products.	- Three strategic pillars are outlined in the strategy: i) reduce the dependence on fossil fuels, ii) develop a domestic hydrogen market and iii) export hydrogen products globally. - Among others, the government plans to support state-owned entities such as the national oil company Pertamina, the fertiliser company Pupuk Indonesia and the state utility PLN to implement pilot projects for low-carbon and green hydrogen.
Singapore	National Hydrogen Strategy	October 2022	Importer	- Intends to become a hydrogen hub in the region. - H_2 expected to contribute up to 50% of the country's power needs and especially targets ammonia as an energy carrier and a fuel. - Sectors: industry, aviation, shipping and power.	- Subsidising of R&D through so-called Pathfinder Projects. - Infrastructure for ammonia bunkering and shipping planned. - Targets international markets through existing trading routes and port infrastructure.
Vietnam	Hydrogen Energy Strategy	February 2024	Exporter	- Aims to produce 100 000– 500 000 tonnes of clean H_2 annually by 2030, rising to 10 to 20 Mt by 2050. - Facilitate the transition from fossil fuel to hydrogen use.	- Tax incentives to attract investments in renewable energy and hydrogen projects while directing public investments in research and pilot projects for hydrogen.

Status on the publication of a national hydrogen strategy or roadmap in SEA region

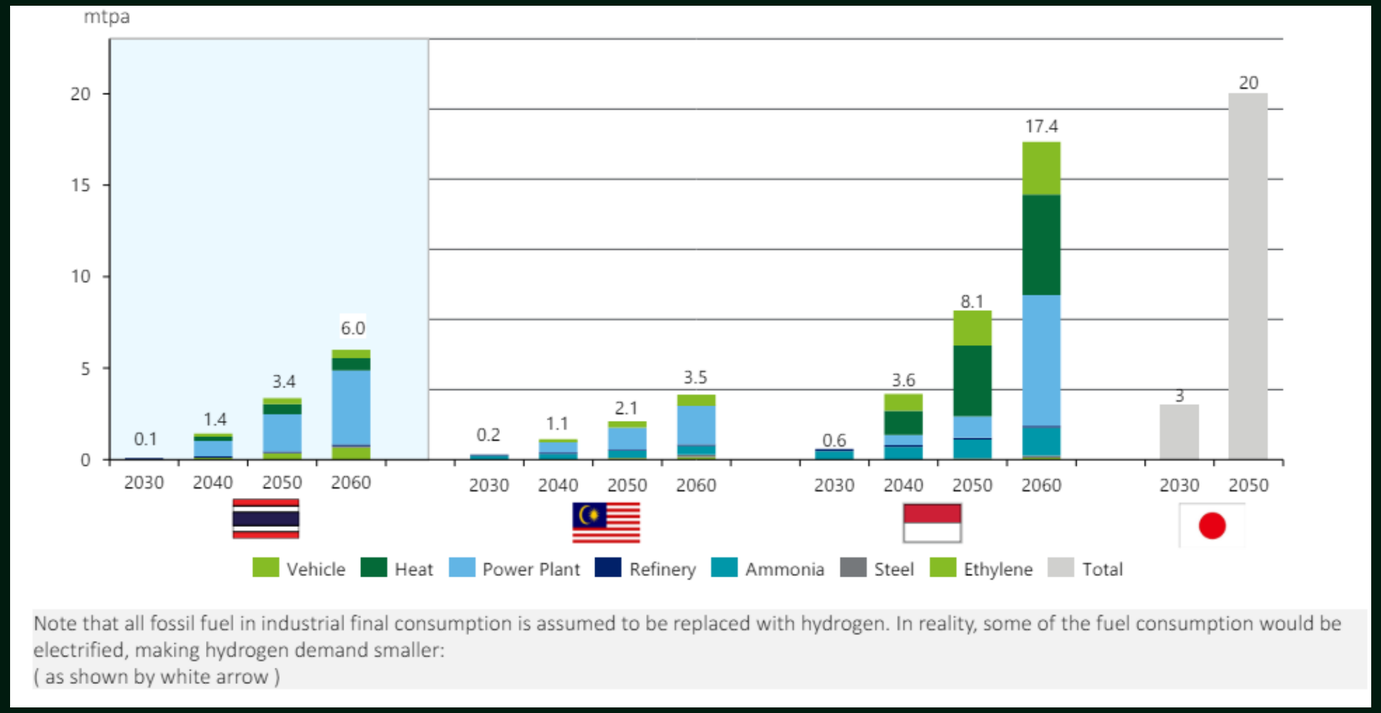


Source: 9 Insights on Hydrogen – Southeast Asia Edition (Agora Industry, 2024)

giz

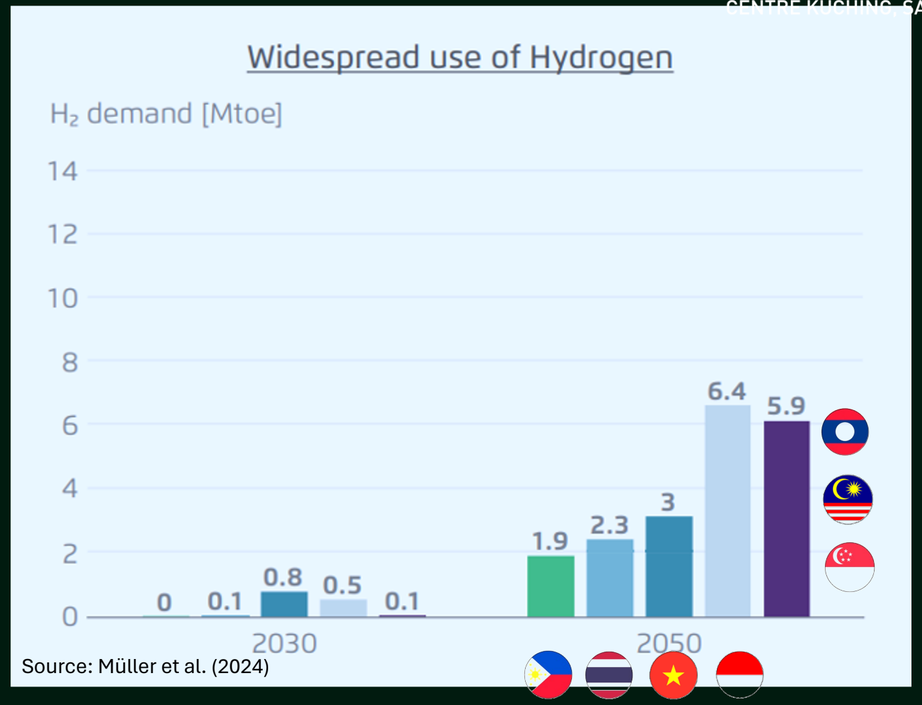
Potential Hydrogen Demand in SEA Countries

The Hydrogen demand forecast, and the expected driver of the demand in SEA countries



Source: Deloitte analysis (2023)

Thailand will reach **3.4 mtpa** and **6.0 mtpa** in 2050 and 2060 respectively in demand forecast, and the expected driver of the demand is the power sector



Source: Müller et al. (2024)

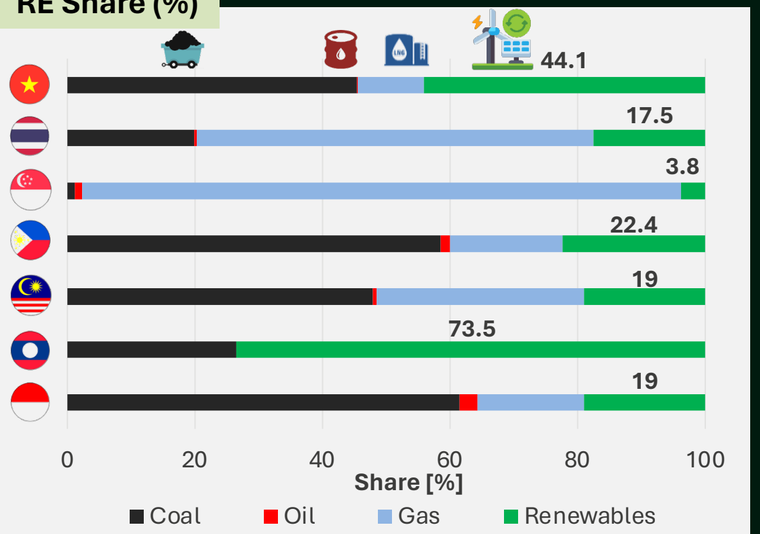
High Demand Potential: Indonesia, Malaysia
- The Industrial sector predominantly utilizes hydrogen through conventional fossil-fuel reforming

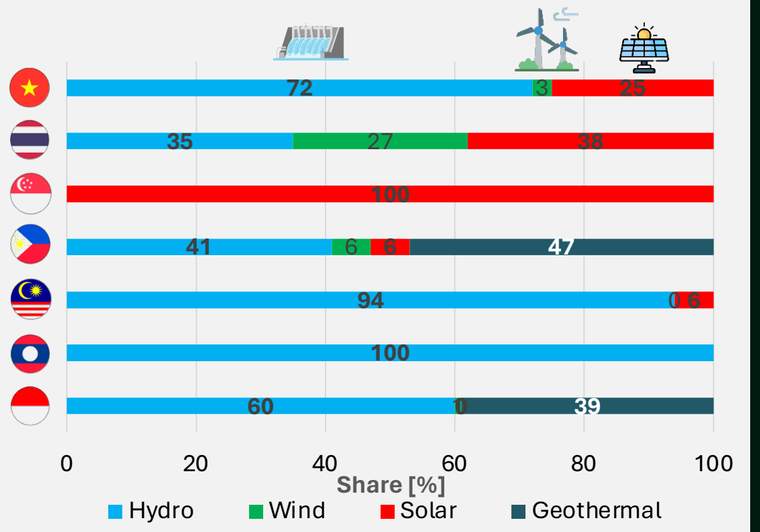
Growing Interest and Strategic Position: Vietnam, Thailand
- The countries have explored hydrogen as a potential energy source and discussion about its use

Urban Hub: Singapore
- Smaller domestic demand but plays a crucial role as a regional trading and logistic center

Renewable Energy in SEA Countries

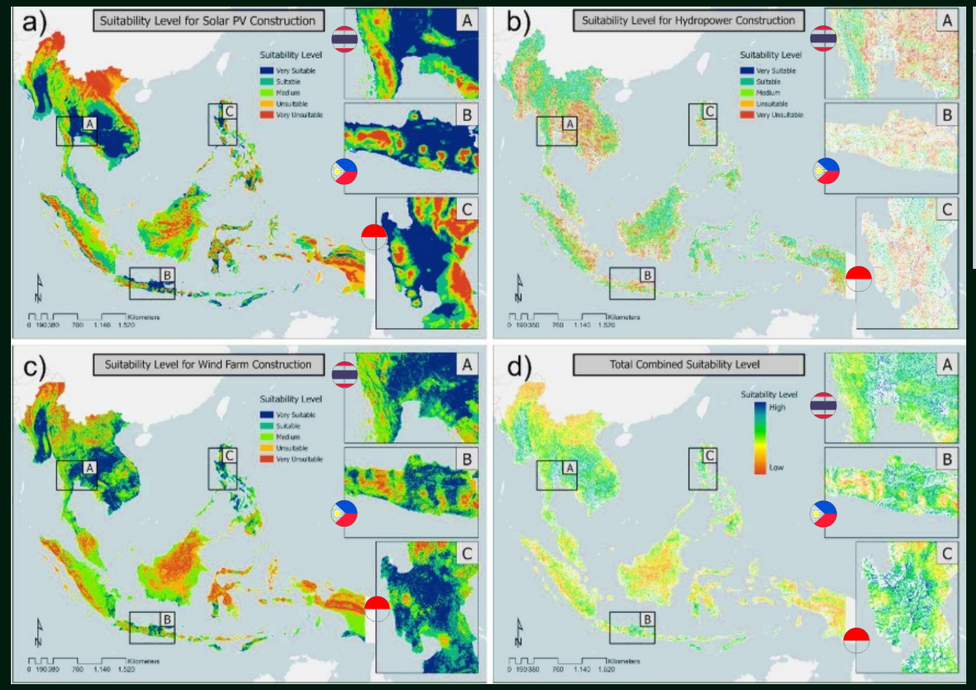
RE Share (%)

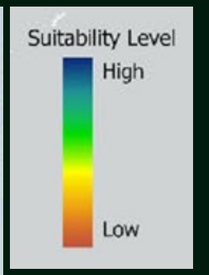




Source: IEA (2021)

Suitability of renewable energy power plant installation in SEA regions
(a) Solar, (b) Hydro power, c) Wind power plants, and (d) Combined suitability





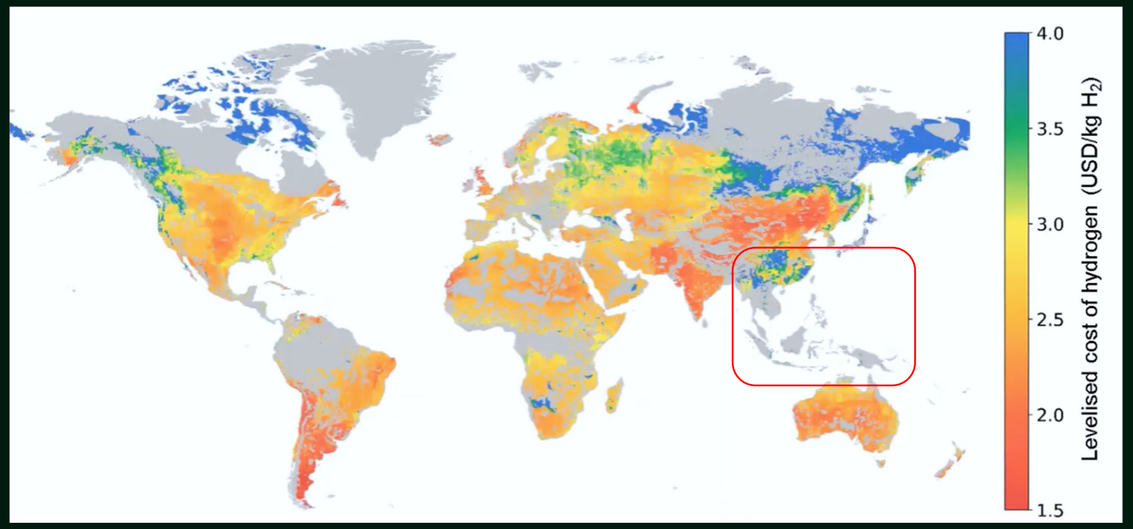
Source: Sakti et al. (2023)

Specific sources of RE for gH2 production will differ at the country level.

- **Indonesia, Myanmar, and Vietnam :** A combination of high potentials in Solar, Hydro, and Wind energy.
- **Thailand and Cambodia:** Solar energy for Green Hydrogen production.
- **Malaysia and Laos:** Abundant hydro resources
- **Philippines:** Solar and Wind energy

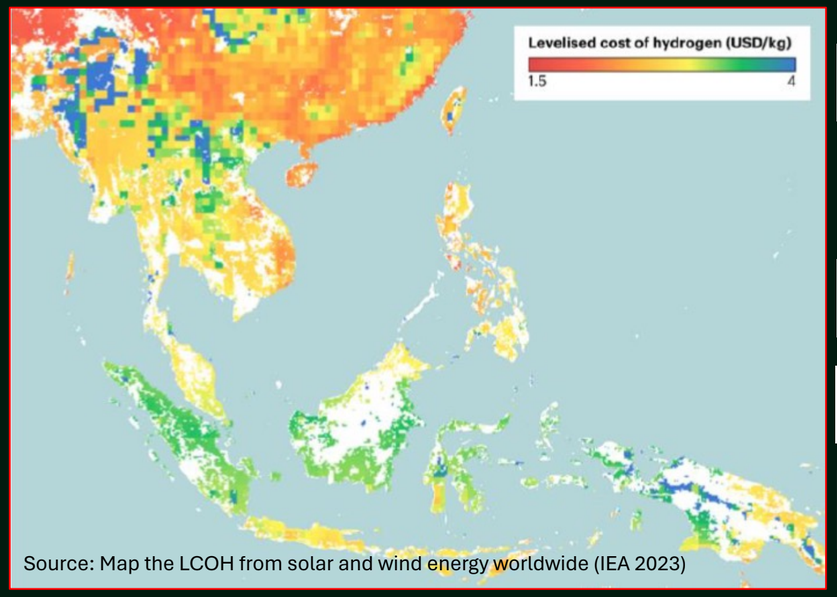
Hydrogen Production Cost: Southeast Asian Region

Hydrogen Production Cost from Hybrid Solar PV and Onshore Wind Systems in 2030



Various regions around the world have excellent Renewable resources for low-cost Hydrogen Production. LCOH could be close to 1.5 USD/kg

Projected LCOH for Hybrid Solar PV and Wind production in 2030



Source: Map the LCOH from solar and wind energy worldwide (IEA 2023)

- Indonesia: **2.4 – 4.1 USD/kg**
- Malaysia: **2.1 – 3.6 USD/kg**
- Philippines: **2.5 – 4.0 USD/kg**
- Thailand: **2.1 –3.1 USD/kg**
- Vietnam: **2.3 – 3.9 USD/kg**

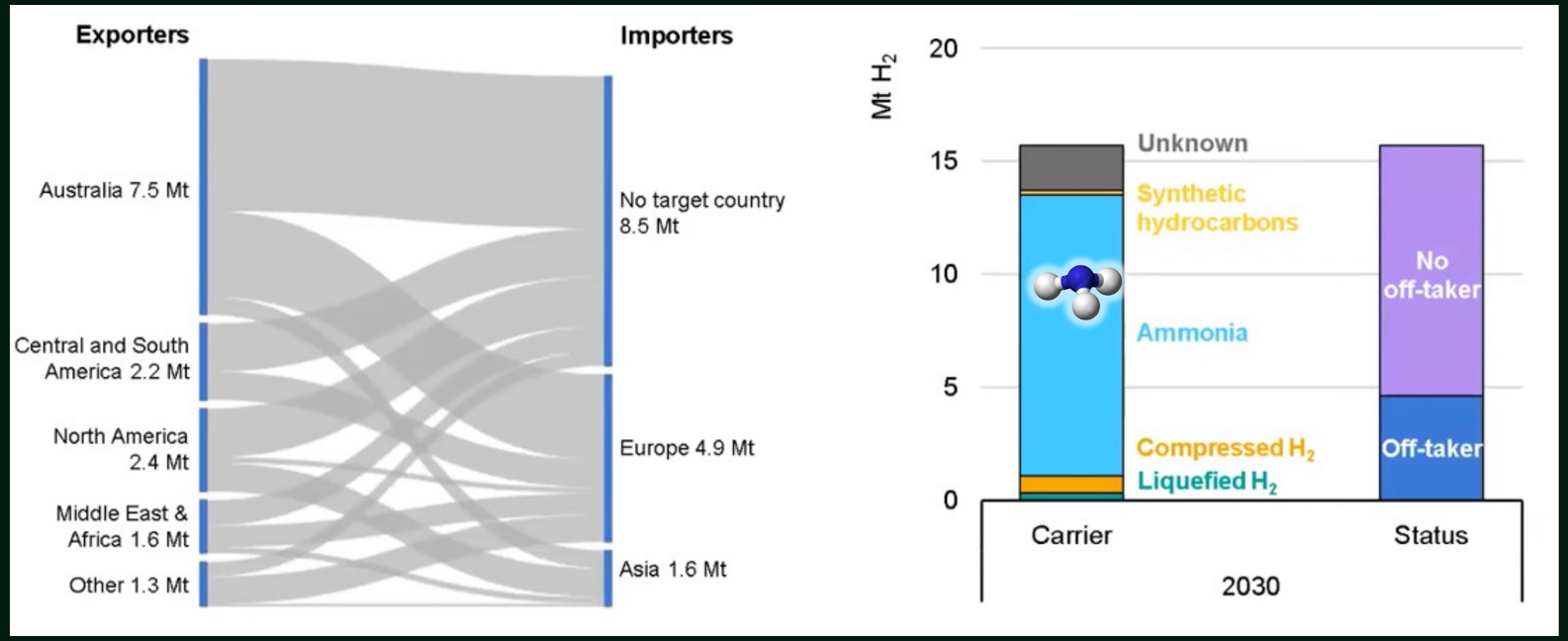
Notes: For each location and its hourly solar PV and onshore wind capacity factors, the cost-optimal capacities for solar PV, wind and electrolysers as well as the need for flexibility options, such as battery storage or curtailment, have been determined using the ETHOS model suite of the Institute of Energy and Climate Research -IEK-3 at Research Centre Jülich.
The base technology CAPEX assumptions are for 2030 and are USD 320-1 025/kW for solar PV, USD 840-2 840/kW for onshore wind and USD 420-615/kW for electrolysis. The ranges reflect regional variations in costs. The base annual OPEX costs are USD 8-23/kW for solar PV, USD 22-73/kW for onshore wind and USD 13-18/kW for electrolysis. WACC is 6 %

According to IRENA, LCOH in SEA will be 1~2 USD/kg in 2050

Potential Low-emissions Hydrogen Trade Flows based on Announced Projects, 2030

ASIA PACIFIC GREEN HYDROGEN 2024 CONFERENCE & EXHIBITION
10 - 12 JUNE 2024
BORNEO CONVENTION CENTRE KUCHING, SARAWAK

Announced low-emission Hydrogen trade flows in 2030



Low-emissions hydrogen trade

Planned and completed trade pilot projects for low-emission hydrogen and hydrogen-based fuels, 2020-2023

Trade Pilot Project		Hydrogen Carrier	Year	Quantity traded
From	To			
Saudi Arabia	Japan	Ammonia	2020	40 Ton NH_3
Brunei	Japan	LOHC	2020	102 Ton H_2
Australia	Japan	LH2	2022	75 Ton H_2
Saudi Arabia	Korea	Ammonia	2022	25,000 Ton NH_3
UAE	Germany	Ammonia	2022	13 Ton NH_3
Brunei	Japan	LOHC	2022	n/a
Chile	UK	Synthetic Gasoline	2023	2,600 L
Saudi Arabia	Japan	Ammonia	2023	n/a
	India		2023	5,000 Ton NH_3
	China		2023	25,000 Ton NH_3
	Korea		-	25,000 Ton NH_3
	Bulgaria		2023	25,000 Ton NH_3
	EU			50,000 Ton NH_3
	Taiwan		2023	n/a

Sources IEA (2023), Global Hydrogen Review

>> Planned hydrogen exports could reach **16 Mt by 2030**, though almost all projects are at the early stages and less than one-third have identified a potential off-taker

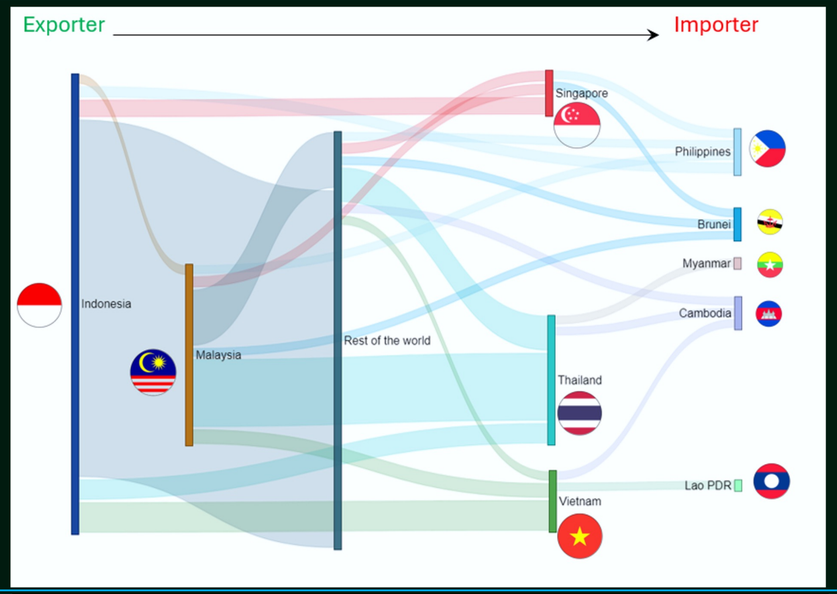
>> Ammonia is the promising Hydrogen carrier for international trade.

giz

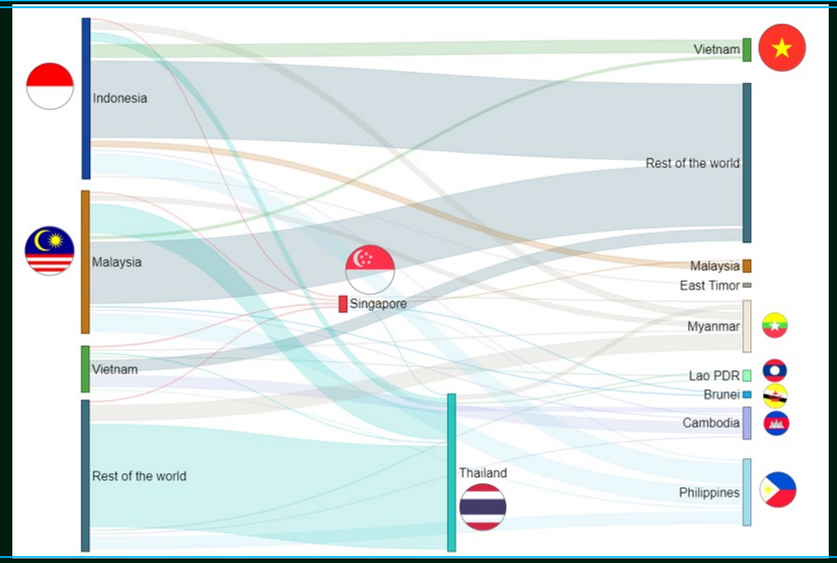
Trade Flows of Anhydrous Ammonia and Urea within the SEA region and the rest of the world

ASIA PACIFIC GREEN HYDROGEN 2024 CONFERENCE & EXHIBITION
10 - 12 JUNE 2024
BORNEO CONVENTION CENTRE KUCHING, SARAWAK

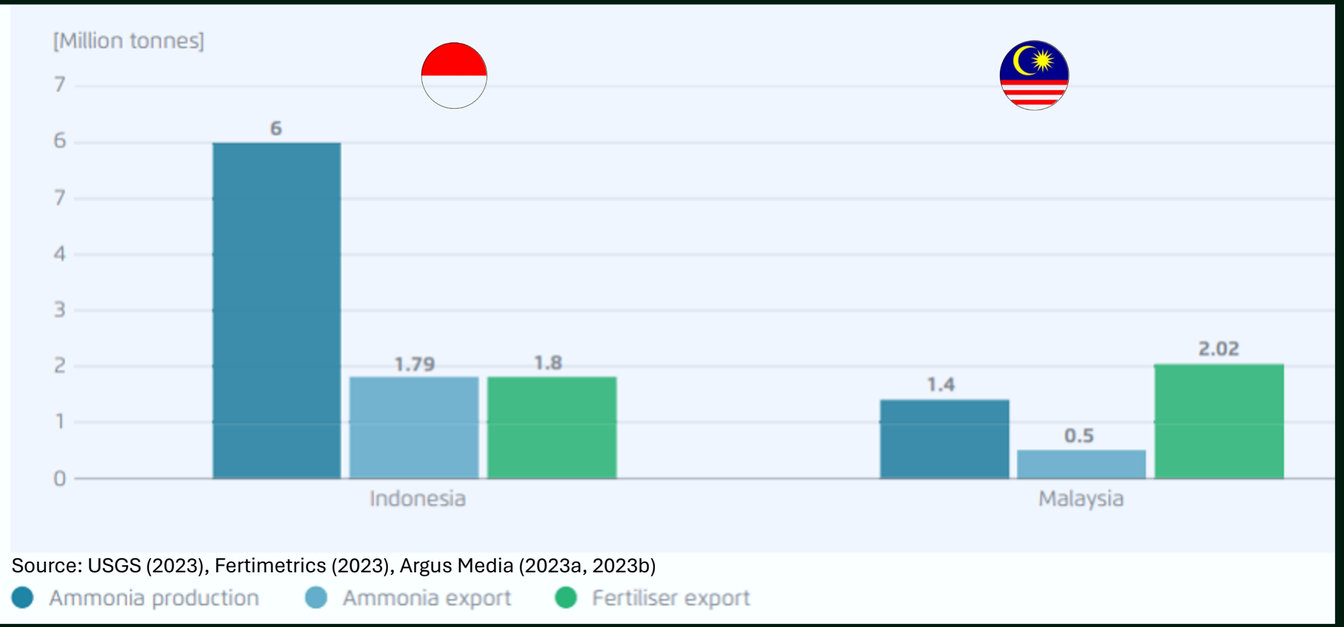
Anhydrous Ammonia



Urea



Annual Ammonia and Fertilizer Production, consumption and Exports

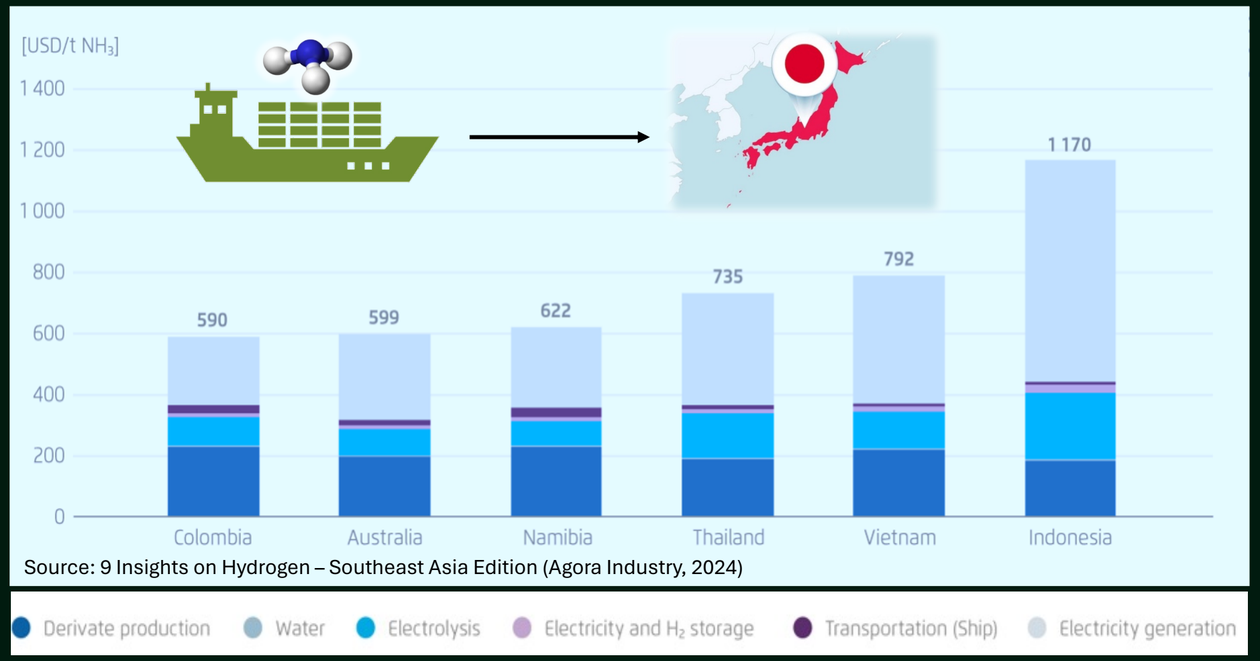


>> **IND** and **MY** export **2.3 Mt of Ammonia** and **3.82 Mt of Urea** and major producers and exporters of **Methanol** (MY is 4th largest)

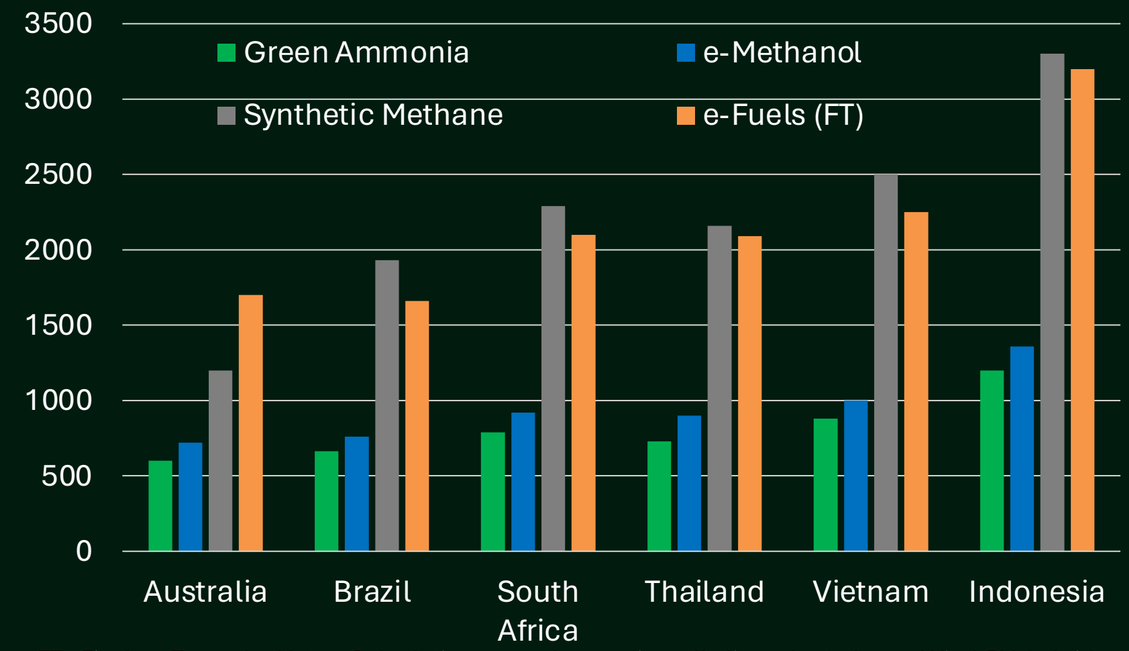
>> Green hydrogen can boost the industrial competitiveness and diversify the supply chain for green derivative products (ammonia, fertilizers, e-methanol, and synthetic fuels)

Comparison of Costs of Production and Delivering PtX Products to Japan in 2030

Cost Comparison of Exporting Ammonia from Selected Countries to Japan in 2030



Source: 9 Insights on Hydrogen – Southeast Asia Edition (Agora Industry, 2024)



FT: Fischer Tropsch. Note: Calculations are done using alkaline electrolyser, Wind-PV hybrid as renewable electricity source, year 2030 using low-cost reduction pathway, Direct Air capture as carbon source, water desalination as water source and shipping as transport mode.

Source: 9 Insights on Hydrogen – Southeast Asia Edition (Agora Industry, 2024)

>> SEA has a competitive edge in shipping due to significantly lower transport costs **to JP and KR** (60% cheaper than Colombia), while the higher electricity costs in IND (60%), VN (50%), and TH (40%) offset this advantage.

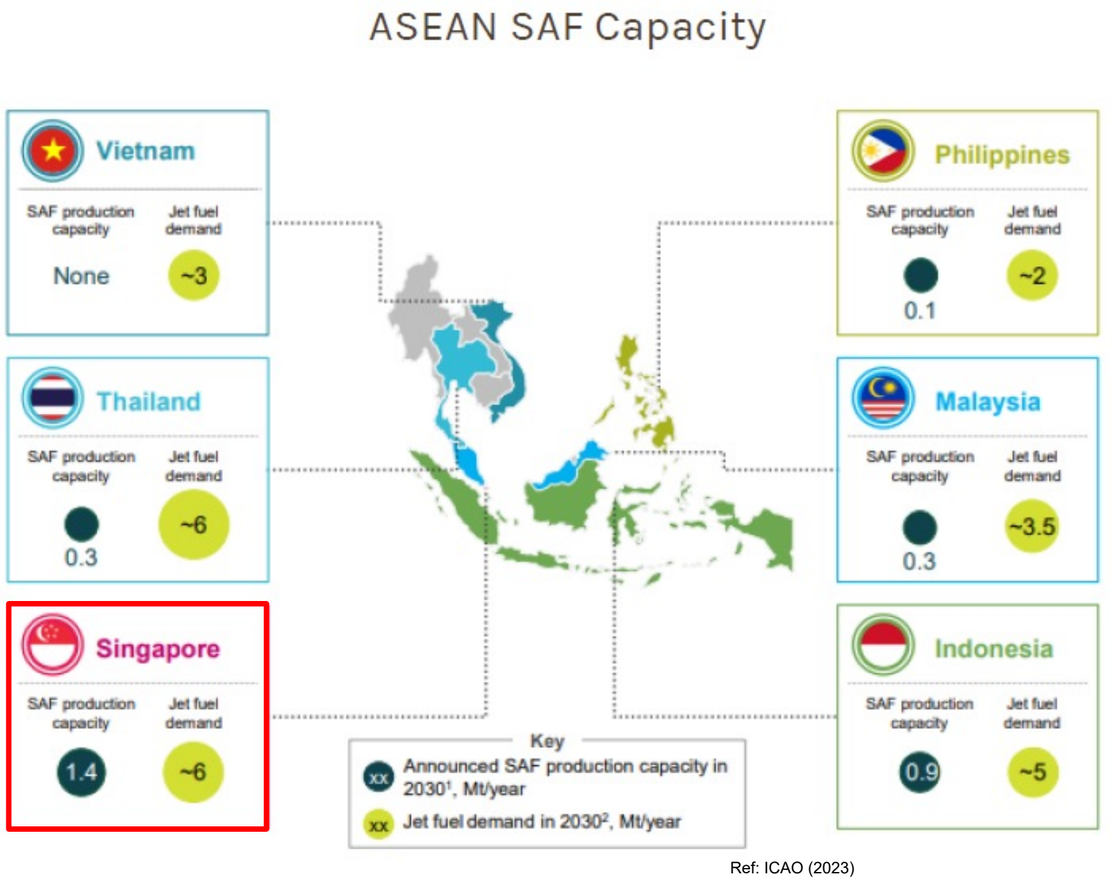
>> **Supporting RE development** is crucial for enhancing SEA competitiveness in the global PtX trade.

Sustainable Aviation Fuel Policies in ASEAN

Status adopted under development

Singapore: Sustainable Air Hub

Indonesia: Mandate of 5% SAF use by 2025



Ref: ICAO (2023)

Highest SAF capacity & jet fuel demand in Singapore

What are the Future Trends for SEA Market?

Sources IEA (2023)

Green Hydrogen production site in operation (51 t/y) at a gas power plant site

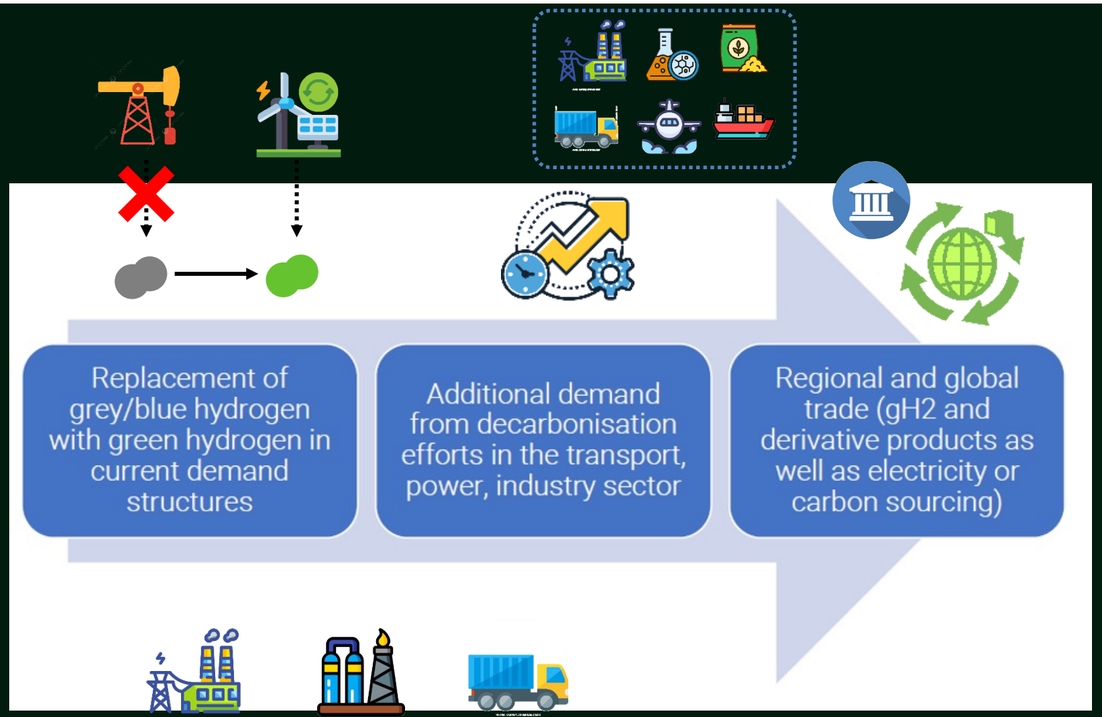
Japanese investors have developed a **Green Hydrogen** production facility, mainly to supply the export demand to Japan.

- A **Green Hydrogen** production plant is under construction which should serve the demand in refinery processes (oil industry).
- There are also attempts to develop **Green Hydrogen** production sites to start replacing current coal-based power generation

A first **Green Hydrogen** production plant is planned with a capacity of 9 MW (electrolyser) as showcase project to supply a chemical company (Evonik) to produce methionine (animal feed).

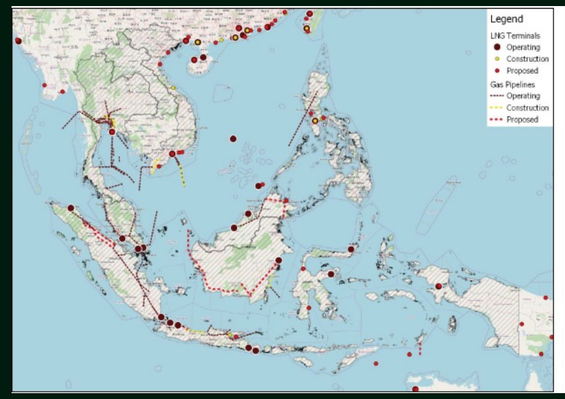
Pilot plants were and are being developed for **Green Hydrogen** production and its use in the electricity and transport sector (e.g. H2 learning centre developed by EGAT and refuelling stations for FCEVs).

Opportunities for Southeast Asia Countries

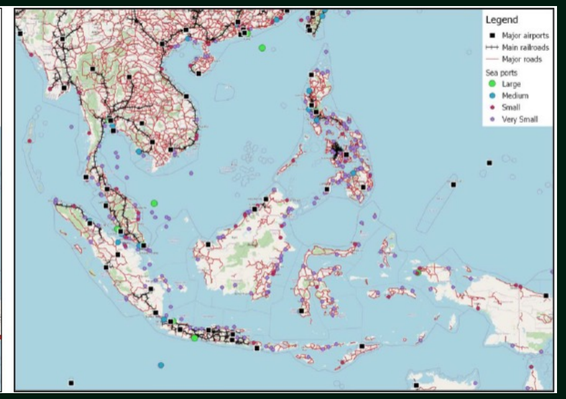


Infrastructure

Gas pipelines and LNG terminals

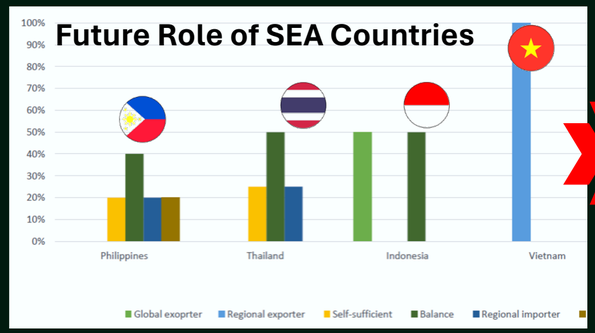


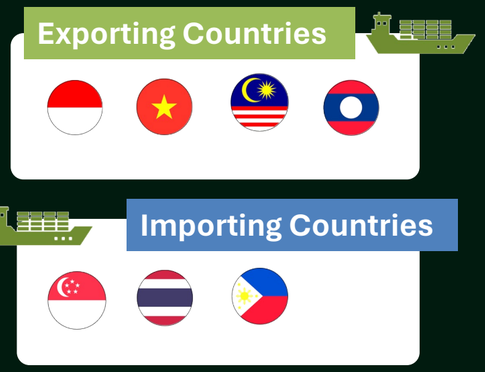
Main airport, railways and roads and sea ports

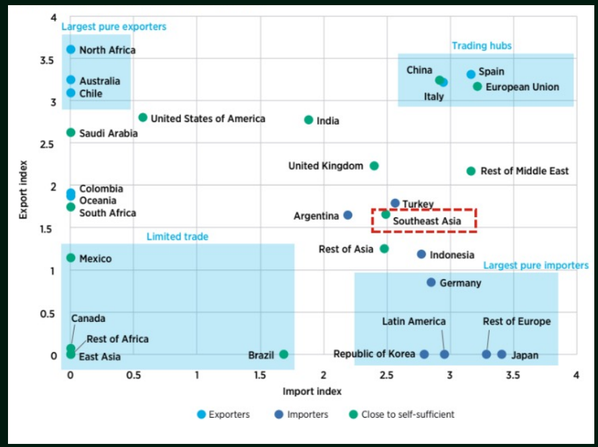


What are the future trends for Southeast Asia's green hydrogen and derivatives market?

Country	Power	Industry	Transport







The SEA countries, in general fall in-between close-to-self-sufficient and importers

Source: Global hydrogen trade to meet the 1.5°C climate goal: Part I – Trade outlook for 2050 and way forward, International Renewable Energy Agency (2022)

Examples of Potential Use Cases in SEA Countries

ASIA PACIFIC GREEN HYDROGEN 2024 CONFERENCE & EXHIBITION
10 - 12 JUNE 2024
BORNEO CONVENTION CENTRE KUCHING, SARAWAK

Green Hydrogen and derivative products

- Gas Power Plant (HDF)
- Cement Clinker (Siam Cement Group)
- Green Steel Production (Planned)
- Green Fertilizer Production (PT Pupuk Indonesia)
- Green Fertilizer Production (Planned)
- Green Methanol Production (Petronas)
- Sustainable Aviation Fuels (Sustainable Air Hub)

Key Actions to Foster Green Hydrogen and Derivatives Trade

ASIA PACIFIC GREEN HYDROGEN 2024 CONFERENCE & EXHIBITION
10 - 12 JUNE 2024
BORNEO CONVENTION CENTRE KUCHING, SARAWAK

Address Regulatory Barriers

>> Policies need to show **a long-term strategy for deployment, with clear targets**, as an integral part of a country's climate and energy plan to avoid investment uncertainties.

Public Awareness and Education

>> To highlight the benefits of low-emission hydrogen, addressing misconceptions and emphasizing **its role in reducing carbon emissions**.

Commercialization Support

>> Support pilot projects and demonstration programs that showcase the **practical applications of hydrogen** in various sectors, providing its viability and benefits.

Implement Support Schemes

>> This can serve **multiple purposes**, from reducing the cost of production and infrastructure development to creating market incentives and ensuring regulatory support.

Stimulate Demand

>> Governments can commit to long-term procurement contracts for hydrogen, **ensuring stable demand and encouraging suppliers to invest in production capacity.**

Foster International Co-operation

>> International cooperation is important to accelerate sustainable market growth and encourage technology development and innovation.

TH$_2$ANK YOU