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# 9 Insights on Hydrogen – Southeast Asia Edition

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Report Launch Webinar

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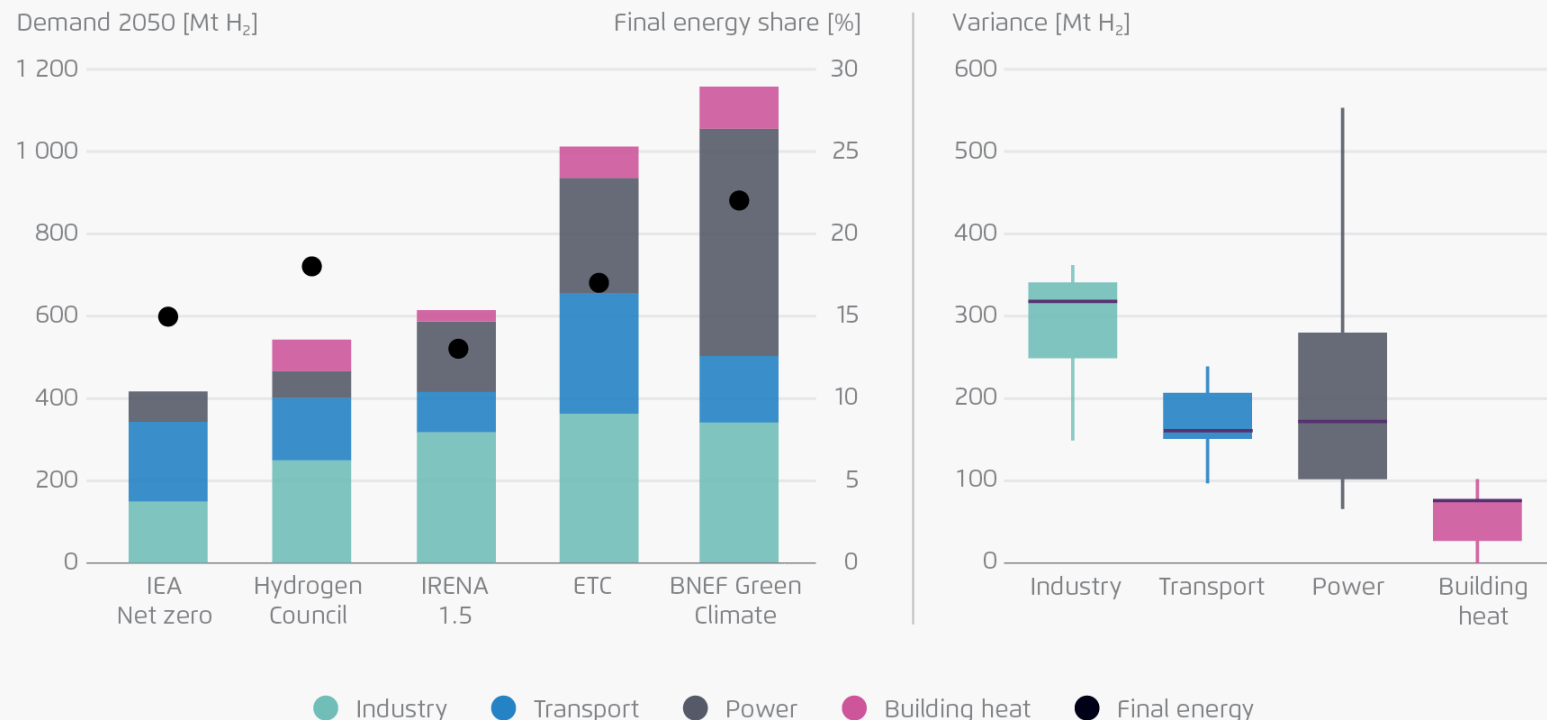
# Key Findings

- 1 Without increased support to develop renewable energy in Southeast Asia, the affordability of electricity and renewable hydrogen will be at risk.**
- 2 Low-carbon hydrogen should be reserved for ‘no regret’ applications where no electrification alternatives exist.**
- 3 Southeast Asia’s rapidly growing heavy industries offer a timely opportunity to establish a low-carbon industrial sector.**
- 4 Southeast Asian countries should avoid overestimating their role as renewable hydrogen exporter in the dynamic global Power-to-X (PtX) market.**



# Understanding the drivers and interests for hydrogen globally and in Southeast Asia

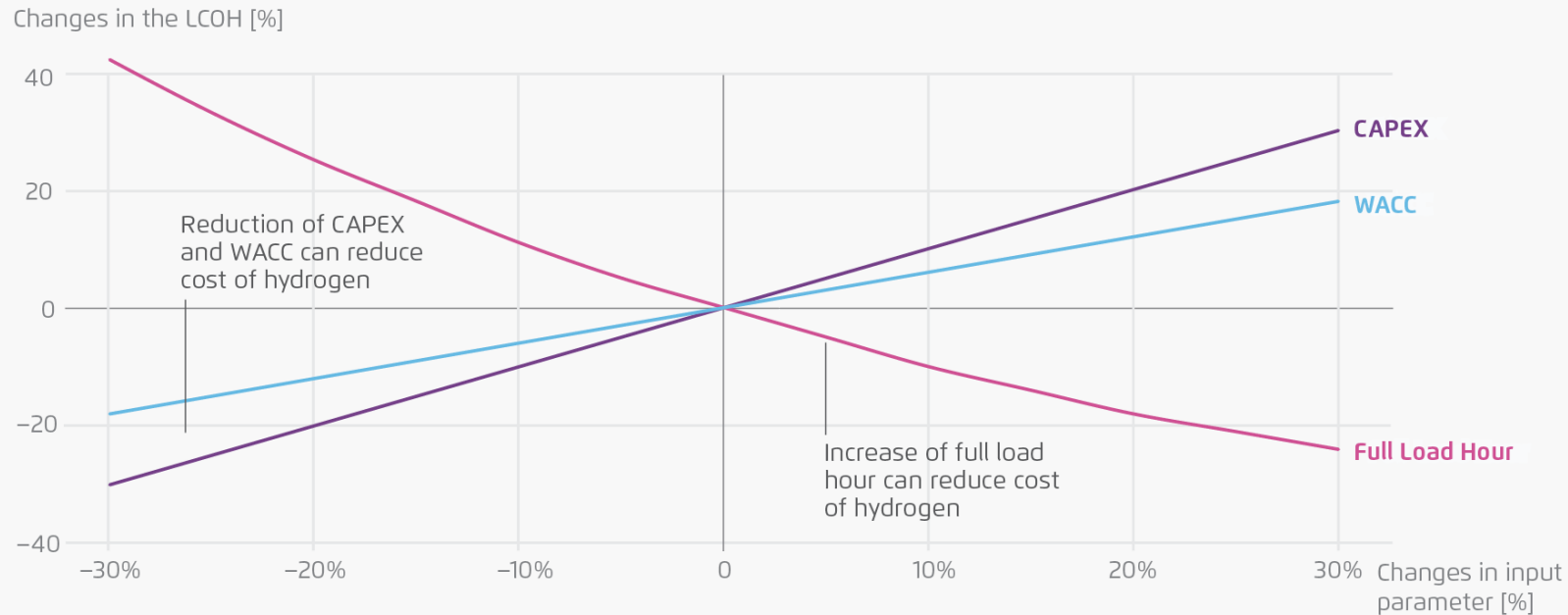
## Estimates of global hydrogen demand in 2050: selected scenarios



- Hydrogen hype – over 50 countries worldwide developed a hydrogen strategy.
- Geopolitical challenges affecting global supply chains for energy and industrial products.
- Strong dependence on fossil fuels in Southeast Asia, especially on coal and moving towards fossil gas (LNG).
- Half of existing pilot projects in the region funded by international sources.

# Insight 1: Clear long-term support for the development of renewables is crucial to reduce the cost of electricity and hydrogen production





## Sensitivity of hydrogen cost depending on CAPEX, WACC, and FLH



- Despite good renewables resources, the costs of wind and solar power in Southeast Asia are high today compared to other countries
- Future competitiveness of renewable H<sub>2</sub> will be influenced by electricity costs (including FLH), CAPEX (especially electrolyser) and financial risks (WACC).
- **Priority:** a supportive regulatory/policy framework for renewables electricity will help increase the competitiveness of hydrogen

# Insight 2: The role of clean H<sub>2</sub> for climate neutrality is crucial but secondary to direct electrification

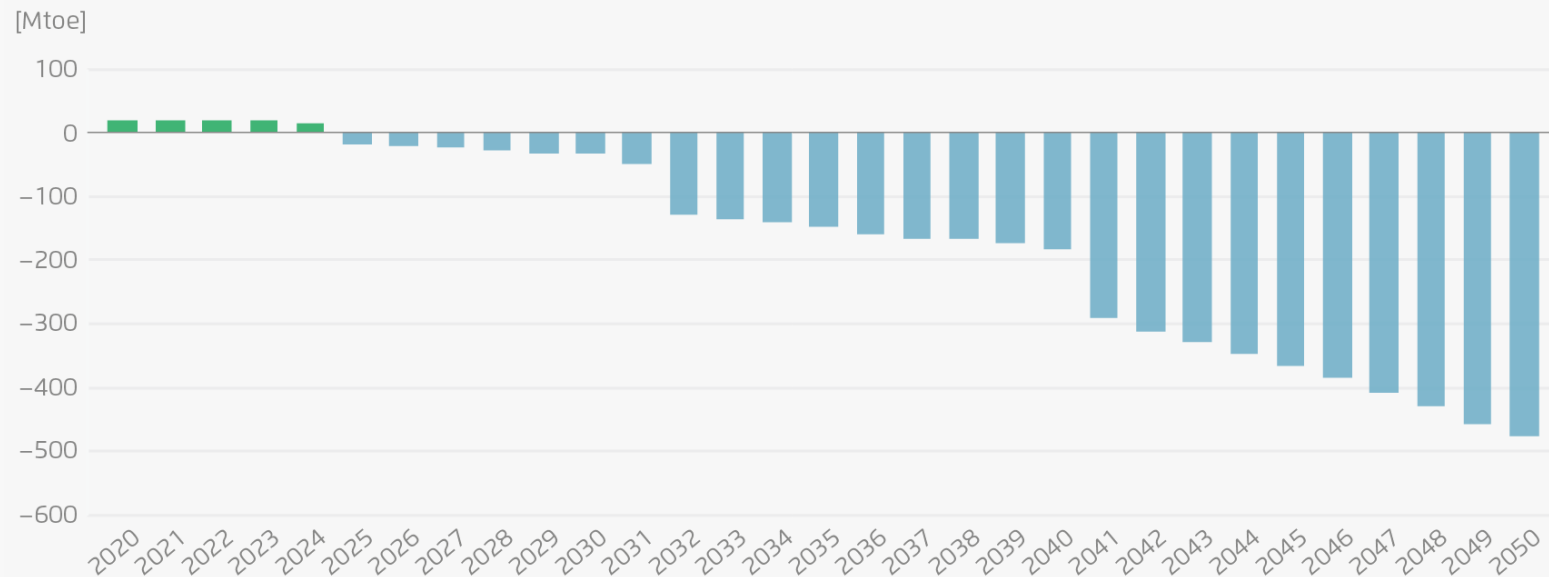
Need for molecules in addition to green electrons

Green molecules needed for climate neutrality by 2050?	 Industry	 Transport	 Power sector	 Buildings
<b>'No-regret'</b>	Non-energy use <sup>1</sup> : <ul style="list-style-type: none"> <li>• Feedstock: ammonia, chemicals, fertilisers</li> <li>• Reaction agents: DRI steel</li> </ul>	<ul style="list-style-type: none"> <li>• Long-haul aviation</li> <li>• Maritime shipping</li> </ul>	<ul style="list-style-type: none"> <li>• Renewable energy back-up, depending on wind and photovoltaic share and seasonal demand structure</li> </ul>	<ul style="list-style-type: none"> <li>• Heating grids (residual heat load<sup>2</sup>)</li> </ul>
<b>Controversial</b>	<ul style="list-style-type: none"> <li>• High-temperature heat</li> </ul>	<ul style="list-style-type: none"> <li>• Trucks and buses<sup>3</sup></li> <li>• Short-haul aviation and shipping</li> <li>• Trains<sup>4</sup></li> <li>• Non-road mobile machinery</li> </ul>	<ul style="list-style-type: none"> <li>• Absolute size of need given other flexibility and storage options</li> </ul>	–
<b>Bad idea</b>	<ul style="list-style-type: none"> <li>• Low-temperature heat</li> </ul>	<ul style="list-style-type: none"> <li>• Cars</li> <li>• Light-duty vehicles</li> <li>• Two- and three-wheelers</li> </ul>	–	<ul style="list-style-type: none"> <li>• Building-level heating</li> </ul>

Agora Energiewende and Agora Industrie (2024), <sup>1</sup>Hydrogen may also be used as a reaction agent and/or feedstock in bio-refineries. <sup>2</sup> After using renewable energy, ambient and waste heat as much as possible. Especially relevant for large existing district heating systems with high flow temperatures. Note that according the UNFCCC Common Reporting Format, district heating is classified as being part of the power sector. <sup>3</sup> Series production currently more advanced on electric than on H<sub>2</sub> for heavy duty vehicles and buses. H<sub>2</sub> heavy duty to be deployed at this point in time only in locations with synergies (ports, mines, industry clusters). <sup>4</sup> depending on distance, frequency and energy supply options.

# Insight 3: Renewable H<sub>2</sub> can enhance energy security by mitigating dependency on fossil fuel imports

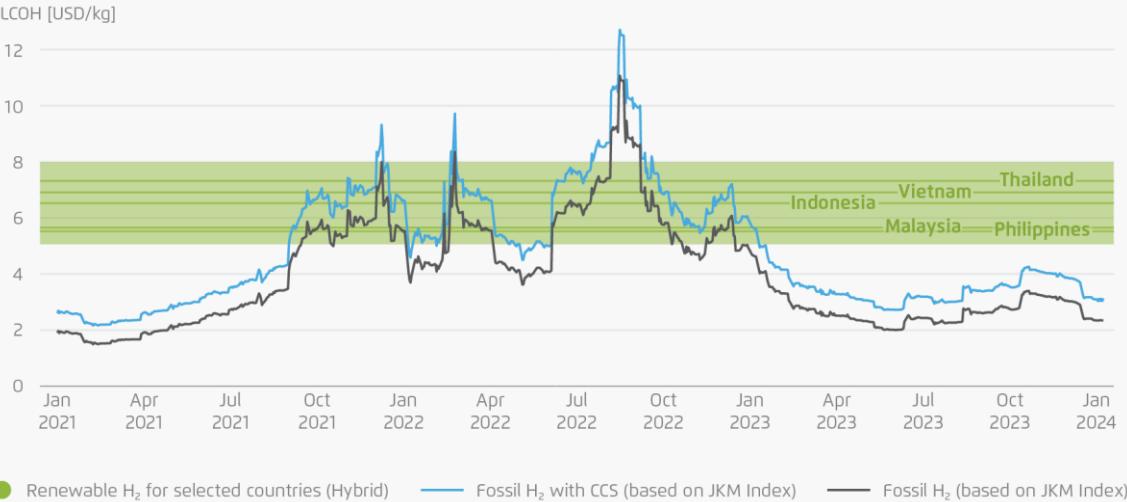
ASEAN's fossil gas trade balance



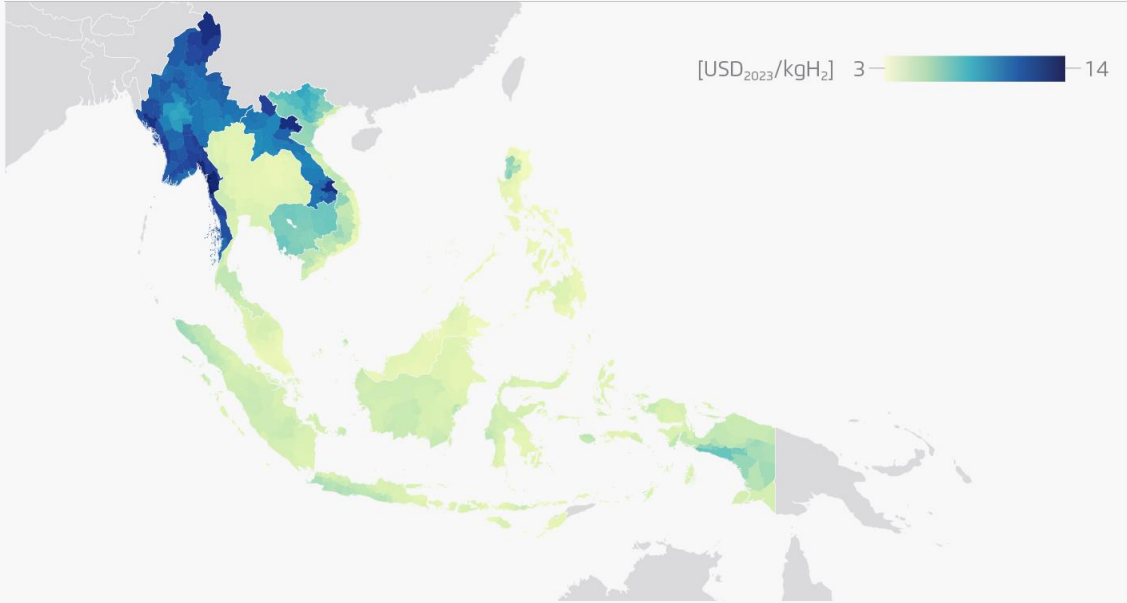
- SEA expected to become a net importer of natural gas by 2025
  - LNG market expected to tighten
  - Exposition to fossil gas price shocks
- Fossil gas is also not compatible with long-term climate goals (fugitive upstream emissions)
- Prioritising fossil-based H<sub>2</sub> with CCS increases gas demand
- Domestic renewable hydrogen mitigates the region's energy imports and diversify value chains

# (II) Fossil-based H<sub>2</sub> with CCS is unlikely to be a competitive option for the region; the potential for cost declines in renewable H<sub>2</sub> is bigger.

Costs of renewable H<sub>2</sub> and fossil-based H<sub>2</sub> with CCS for selected countries in Southeast Asia



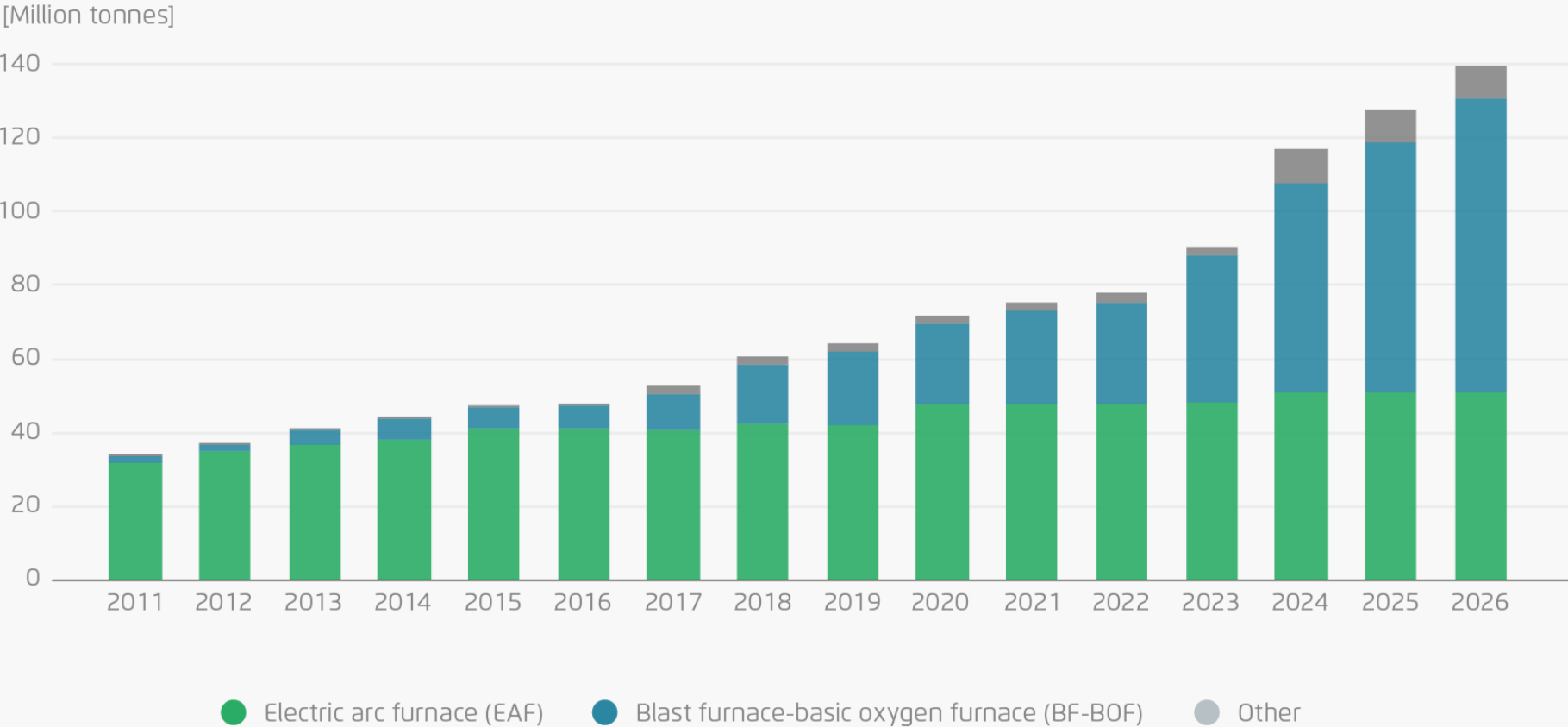
Levelised Cost of hydrogen (LCOH) for hybrid (photovoltaic and wind) production in selected regions of Southeast Asia, 2030



7 | Oeko Institut, Agora Energiewende % Agora Industrie (2023). Note: Agora H<sub>2</sub> PyPSA model, Full load hours of renewables are collected for optimal locations in respective countries. Natural gas prices: JKM LNG Index, Fossil H<sub>2</sub> with CCS is based on steam methane reforming with 95% of capture rate. Renewable H<sub>2</sub> is based on the optimised hybrid capacities of wind & solar PV, including electricity and hydrogen storage costs, but excluding transport costs / Agora Industrie (2024) based on Agora H<sub>2</sub> PyPSA model. Note: Island system (renewables not connected to the grid) with underground pipeline storage to maintain near constant hydrogen delivery for industrial off-take.

# Insight 4: Targeted use of renewable H<sub>2</sub> can provide a boost to the decarbonisation of industry in Southeast Asia

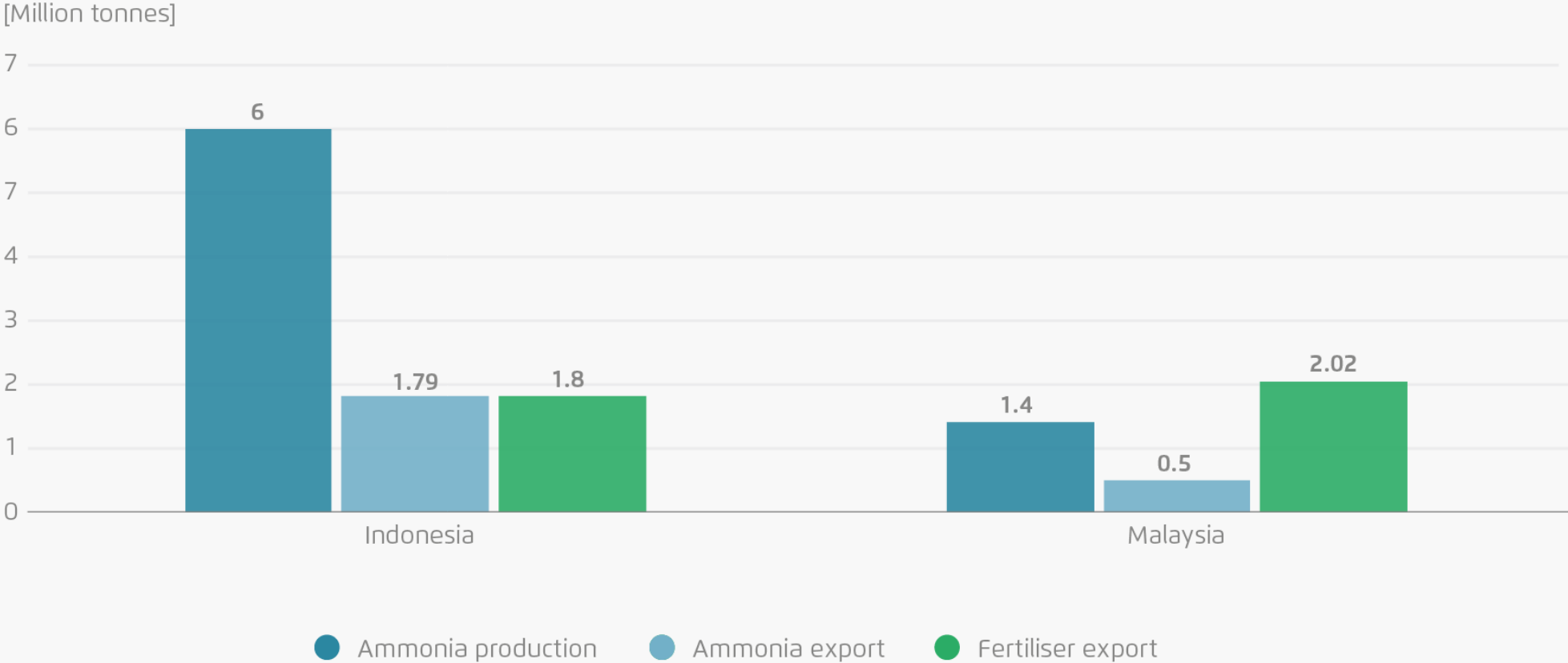
Historical and forecasted crude steel capacity in ASEAN-6





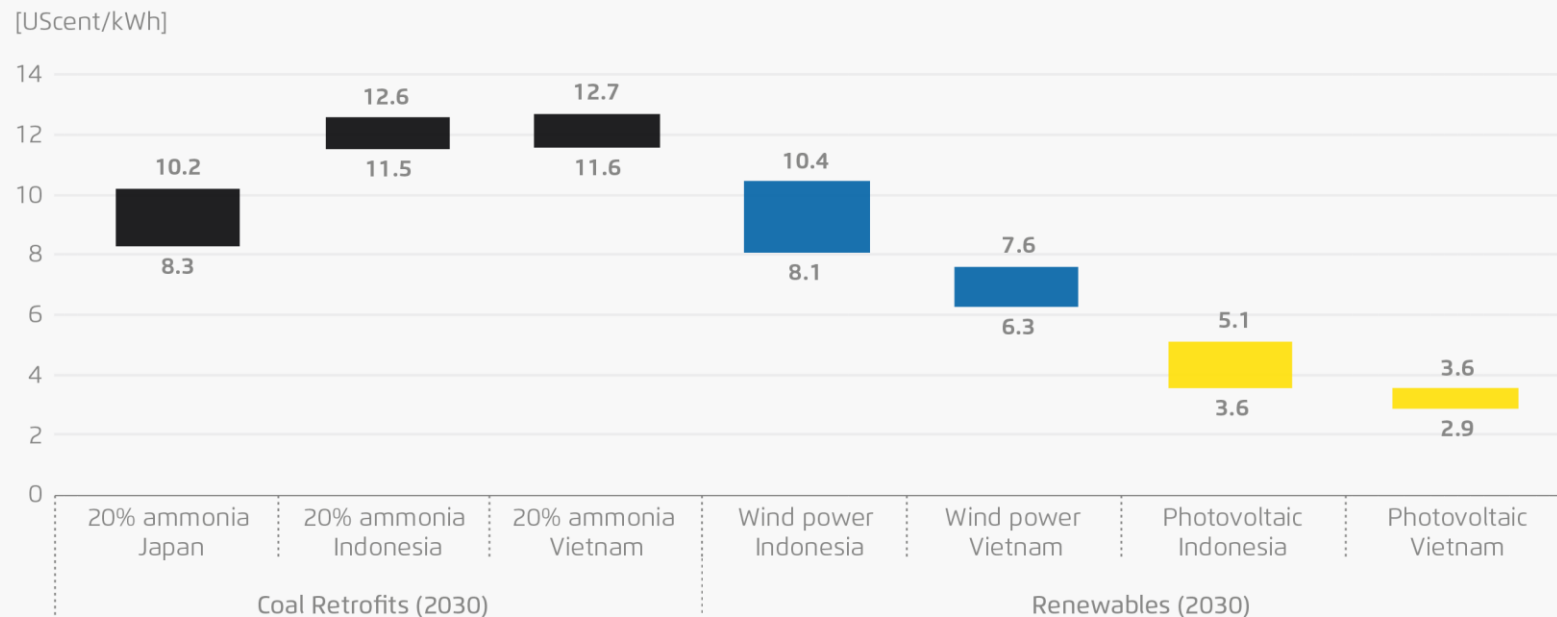
# (II): Targeted use of renewable H<sub>2</sub> can provide a boost to the decarbonisation of industry in Southeast Asia

Annual ammonia and fertiliser production, consumption and exports: Indonesia and Malaysia



## Insight 5: Green ammonia should be reserved to the decarbonisation of the fertiliser and shipping industries. Its use in coal-power plant co-firing is inefficient and costly.

LCOE for different technologies including ammonia co-firing in selected countries

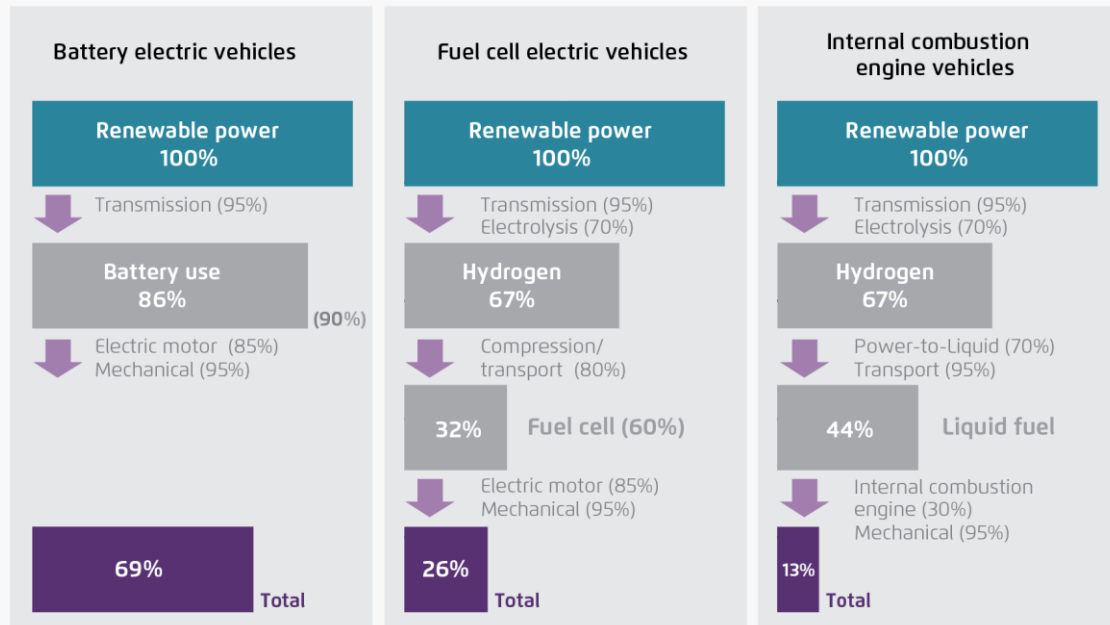


Recent interest in SEA for ammonia co-firing to decarbonise young coal power plants fleet

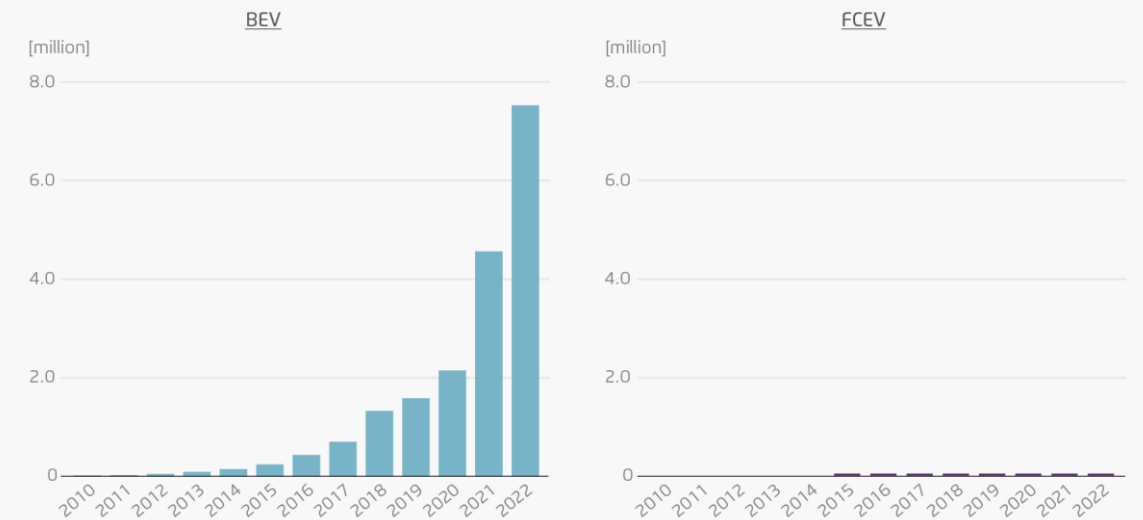
- **Economically inefficient:** high retrofitting costs
- **High emissions:** ammonia used as a 20-50% co-firing in SEA leads to higher CO<sub>2</sub> emissions than existing gas-fired plants
- **Application priorities** lie in the chemical, fertilisers industry and shipping.
- High demand levels for ammonia could have important implications for food prices and security

# Insight 6: The potential future market for hydrogen vehicle is shrinking daily.

Individual and overall efficiencies for cars with different vehicle drive technologies

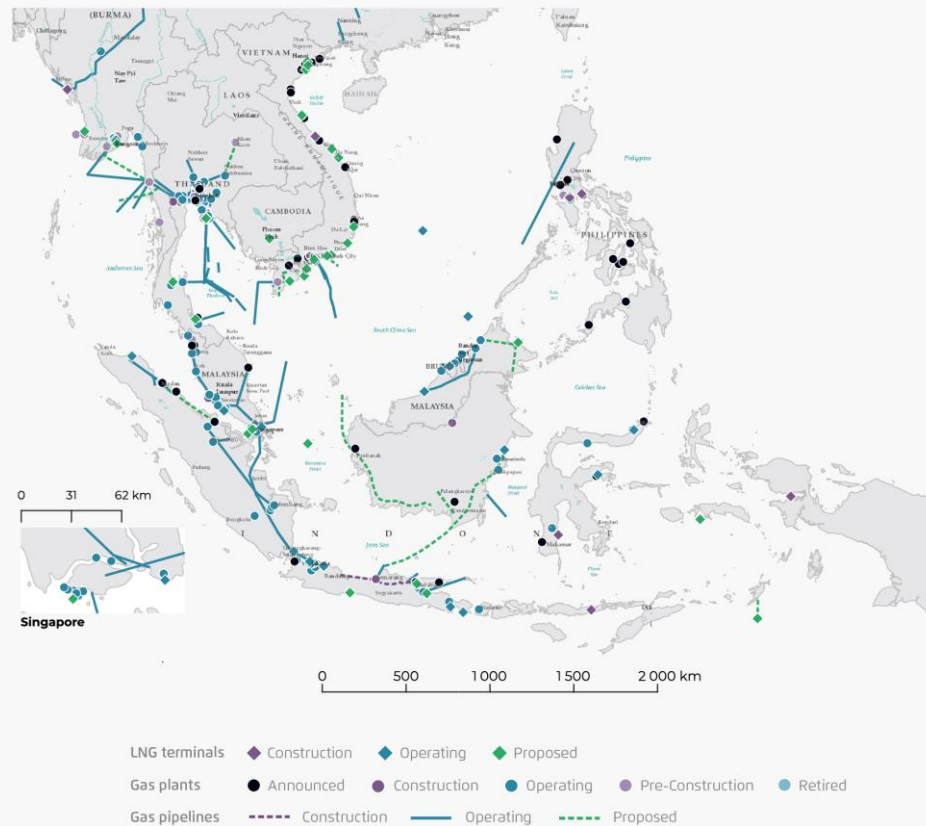


BEV versus FCEV annual sales globally (passenger vehicles)



## Insight 7: Power infrastructures should be prioritised in the short-to-medium term and H<sub>2</sub> infrastructure development should integrate energy, industrial, climate and trade considerations.

Overview of existing, planned and proposed fossil gas and LNG infrastructure in Southeast Asia

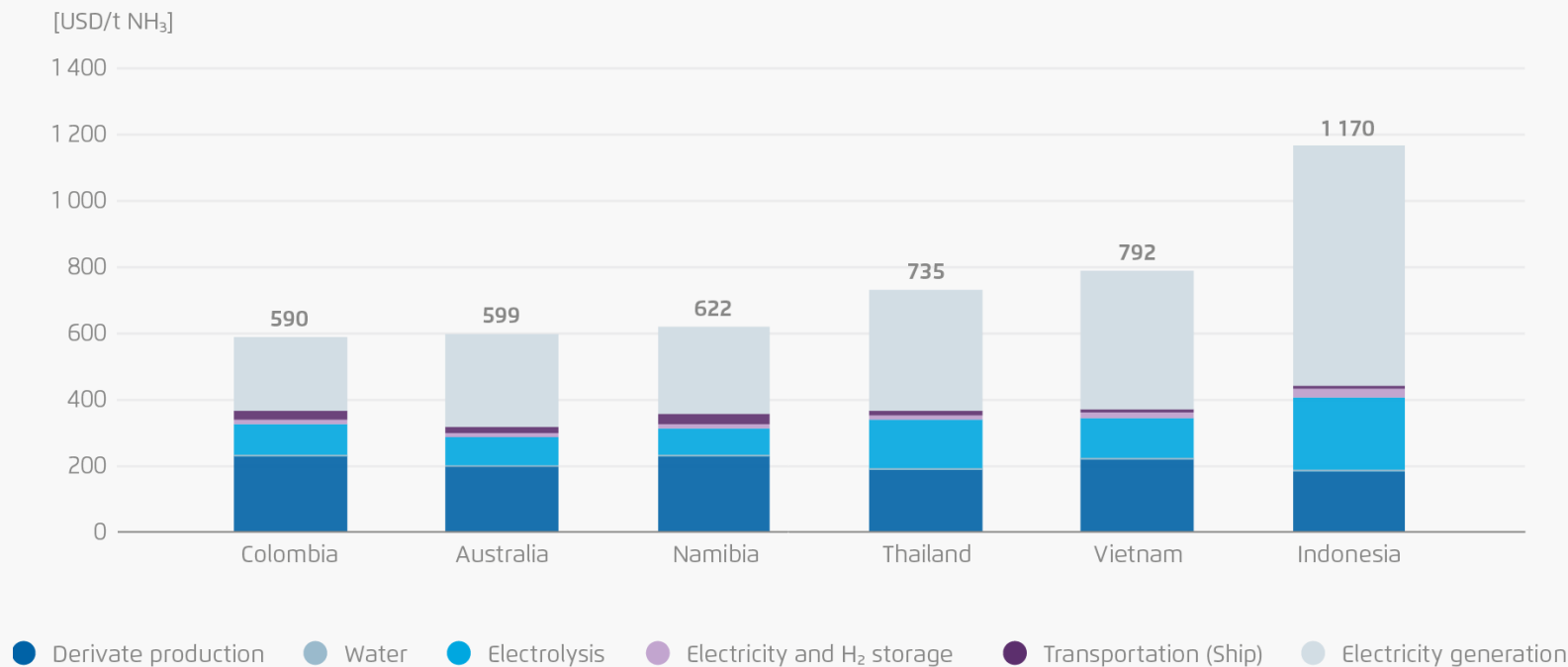


Given the importance of electricity in decarbonisation goals, **power infrastructure (especially national ones) should be prioritised**

- Investment in (fossil) gas infrastructures should **consider the future H<sub>2</sub>-economy**, as to avoid higher costs, stranded assets and carbon lock-ins.
- H<sub>2</sub> infrastructure planning need to consider **interaction with power sector and industry development**, as to define a resilient “no-regret” low-carbon hydrogen infrastructure.
- Initially, **off-grid H<sub>2</sub> projects** can help develop local infrastructure that would later be integrated into a broader system plan.

## Insight 8: Hydrogen trade will be regional but Southeast Asian countries could capitalise on their proximity to key demand centres in East Asia for the export of PtX products.

Cost comparison of exporting ammonia from selected countries to Japan in 2030



### Hydrogen and PtX trade in SEA

- Techno-economic factors render PtX more competitive than compressed H<sub>2</sub> over long distances
- PtX products more competitive when used directly
- Socio-economic benefits of value-added products (green steel, fertiliser)

### High renewables costs to the disadvantage for the region

- *Short-term*: focus on domestic and regional demand
- *Long-term*: use proximity advantage to East Asia, to export PtX products



# Insight 9: Clear and resilient long-term policy frameworks will attract investors and increase local value creation.

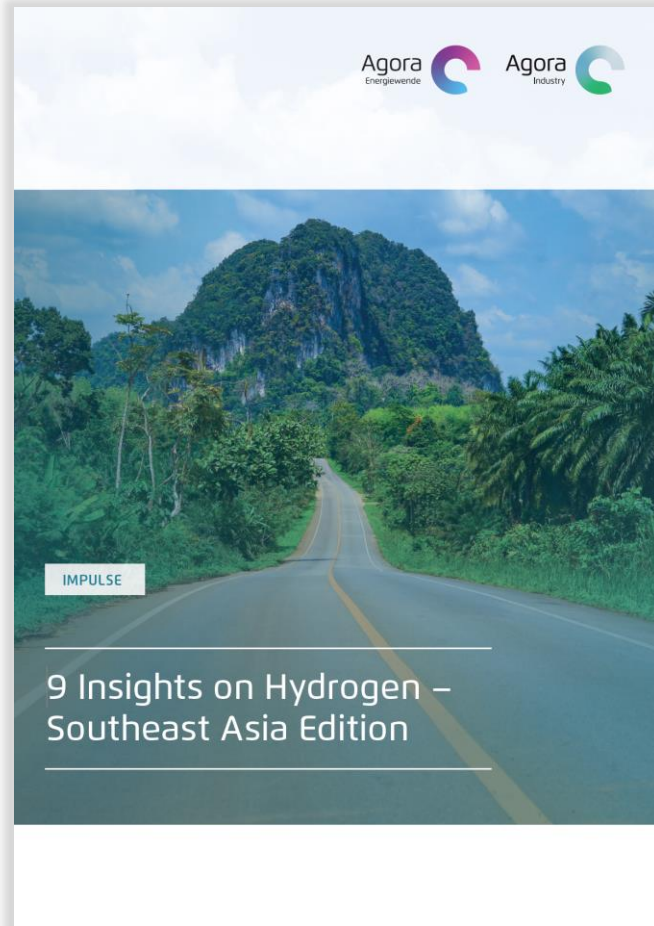
## Hydrogen strategies in Southeast Asia as of March 2024



## Key Points

- **National and regional hydrogen strategy** and governance to attract investments
- **R&D and capacity building** to accompany the uptake of hydrogen and the transformation of the value-chains in the region
- **Financing of hydrogen projects**
  - Various types of financing mechanisms (equity vs. debt)
  - Help of international financial institutions to reduce first-mover's risks (World Bank, ADB)

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# Thank you for your attention!

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Do you have any questions or comments?

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