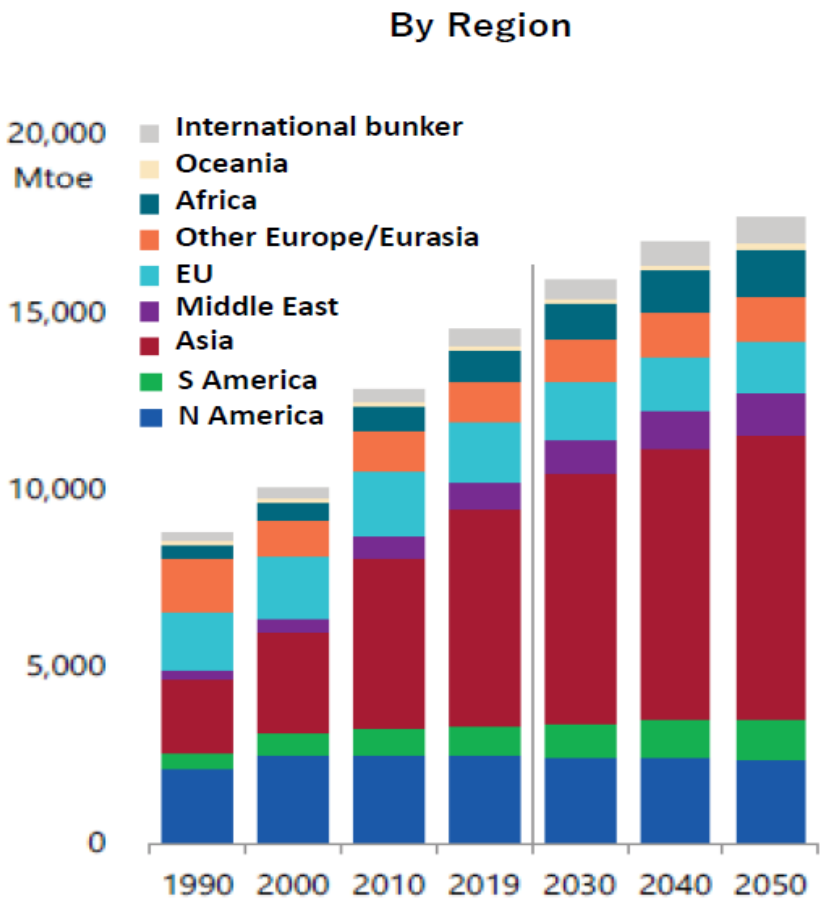
The 31st "Clean Coal Day in Japan" International Symposium (2022). September 5-6, 2022, Tokyo, Japan.

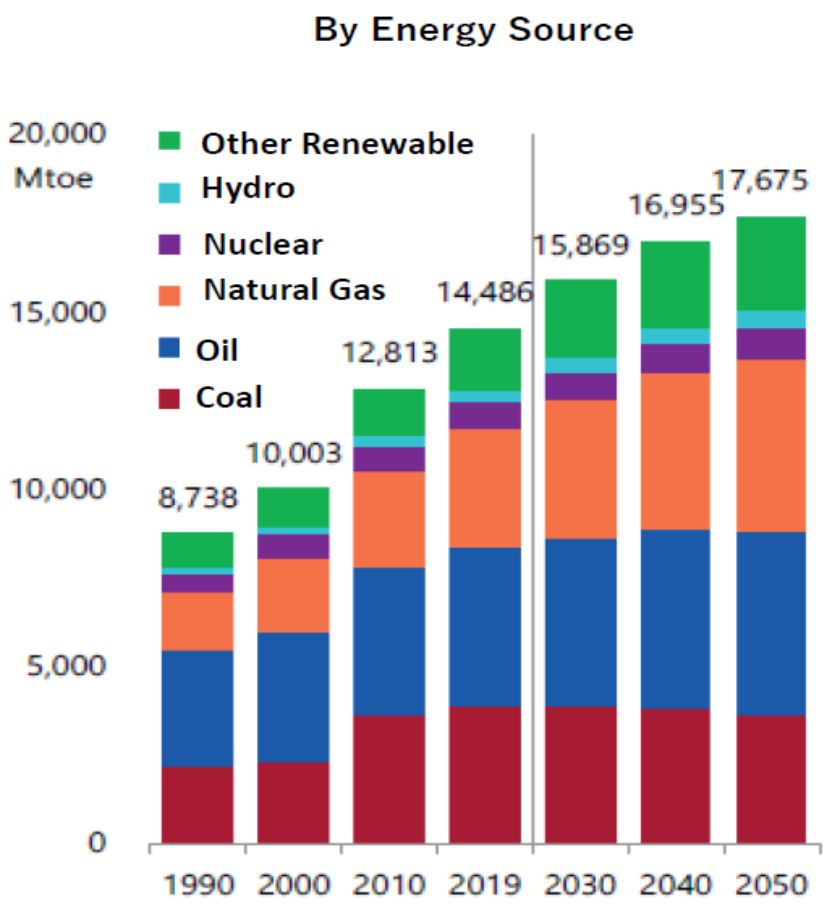
The Importance of CCUS towards Carbon Neutrality in the World

HAN Phoumin, Ph.D.
Senior Energy Economist, ERIA

Global Demand Growth

Asia leads the global demand growth and fossil fuels are dominant

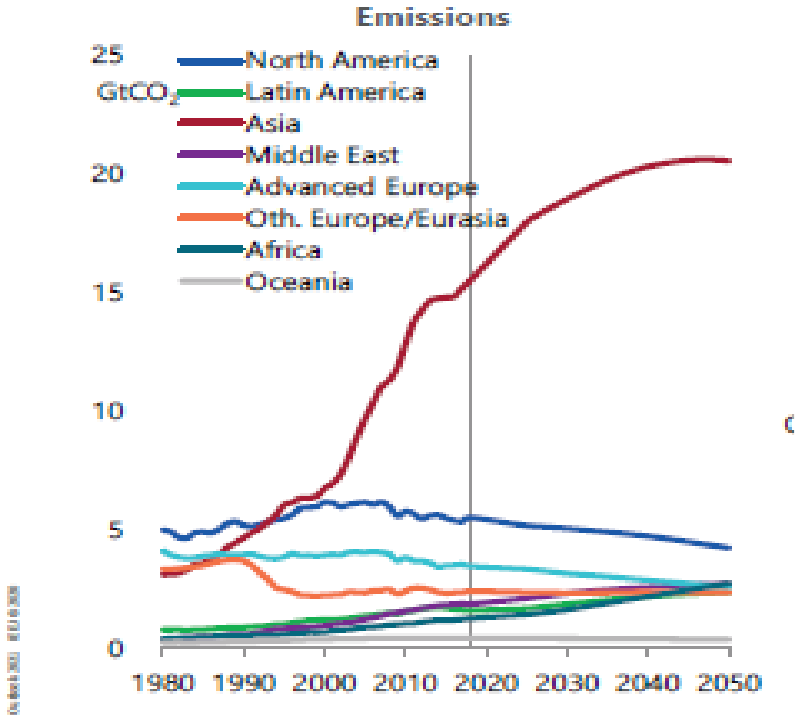


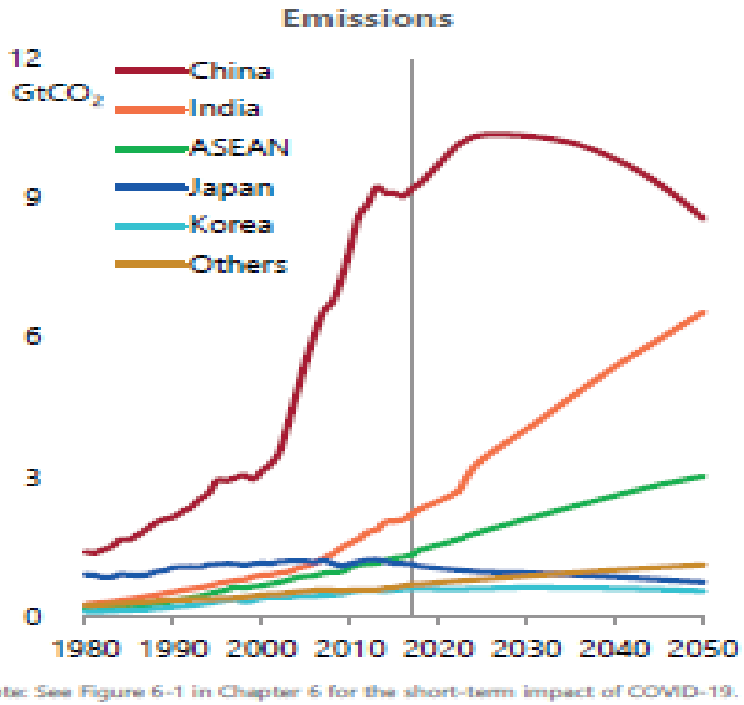


Source: IEEJ Asia and World Energy Outlook 2022

Global Emissions

Asia also leads the emissions growth which need to be addressed

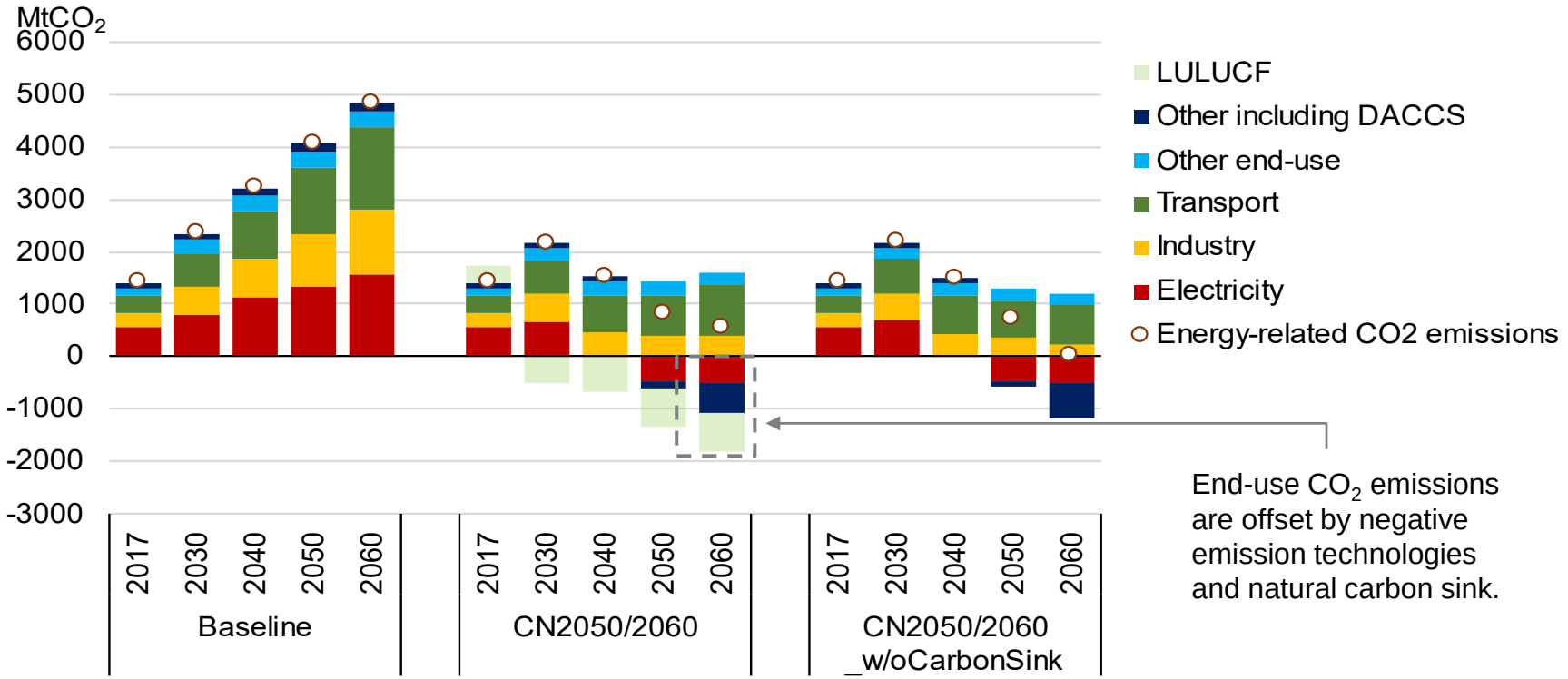




Source: IEEJ Asia and World Energy Outlook 2022

ASEAN's Sectoral Emissions in Decarbonization Scenarios

- End-use emissions reduction, combined with negative emission technologies[1], is estimated to be a cost-efficient strategy for ASEAN carbon neutrality.
- Power sector is almost decarbonized by 2040, while the CO_2 from the transport, especially bus and truck, remain in the *CN* cases because of high costs of alternative vehicles.



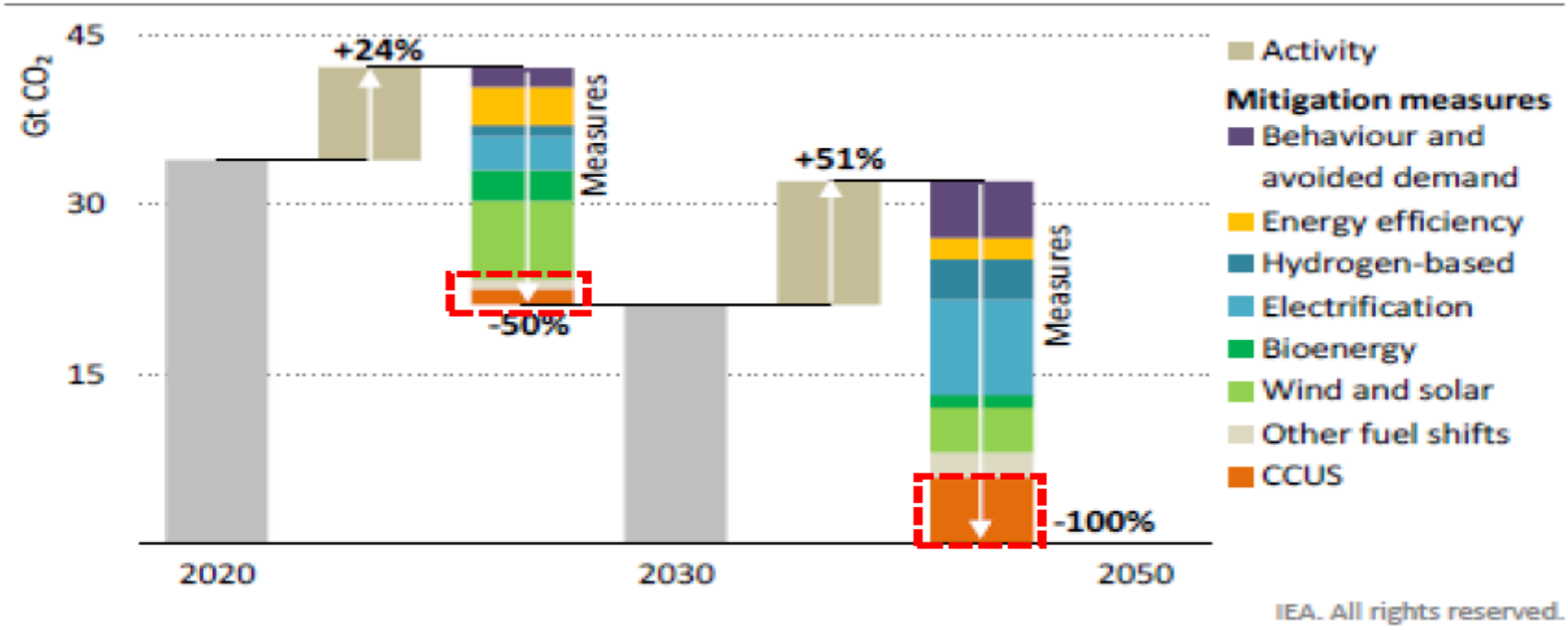
1 BECCS and DACCS

CCUS Rationale in Decarbonization

- **Achieving global deal to accelerate energy transition:**
  - **need to adopt multiple pathways including CCUS' important role for carbon sinks and help to decarbonize emissions in identified hard to abated economic sectors.**
  - **fast development of CCUS around the world and the critical next step for the developing world**
- **Recent 1st G20 ETWG in Yogyakarta :**
  - **3 main priorities in energy transition are accessibility, technology, and financing & the importance of international cooperation**
  - **Further CCUS is one amongst the important pathways for countries to achieve net-zero emission, in which the urgent tasks, are finding ways and means to make CCUS affordable to all.**

The Role of CCUS in Global Net Zero Emission Pathway

- Carbon Capture Utilization and Storage (CCUS) and Direct Air Capture Technologies are vital for the world to achieve the ambition of net-zero emissions by 2050.
- CCUS is part of a portfolio of technologies that support clean energy transitions by reducing emissions from existing assets and hard-to-abate sectors, providing a cost-effective pathway for low-carbon hydrogen production and removing CO_2 from the atmosphere.



Source: IEA Net Zero

Cost perspectives of CCUS_ Initial findings from Module case study (MRI & ERIA, 2022)

	Capture	Transport	Storage	Total
Unit Cost before adjustments (USD/t CO2)	37.27	0.82	12.92	51.01
Unit Cost after adjustments (USD/t CO2)	45.92	0.95	15.93	62.80

Capture Site

USD/tCO2	45.92
%	73.12

Transportation System

USD/tCO2	0.95
%	1.52

Injection Site

USD/tCO2	15.93
%	25.36

- **Significant cost reduction along the value chain of CCUS is critical for the deployment of this technology to developing world.**
- **CO2 Capturing cost represents over 70% of the overall cost and it need to be further reduced.**

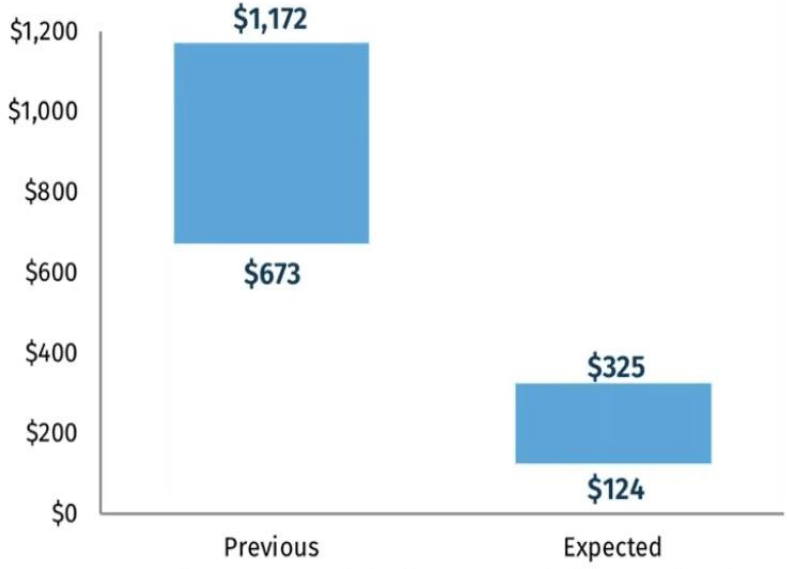
Cost reduction of DAC is expected to go-down drastically

DACCS has no resource constraint and "uniform" costs for application

Cost curve is flat, so cost should vary chiefly as a function of deployment

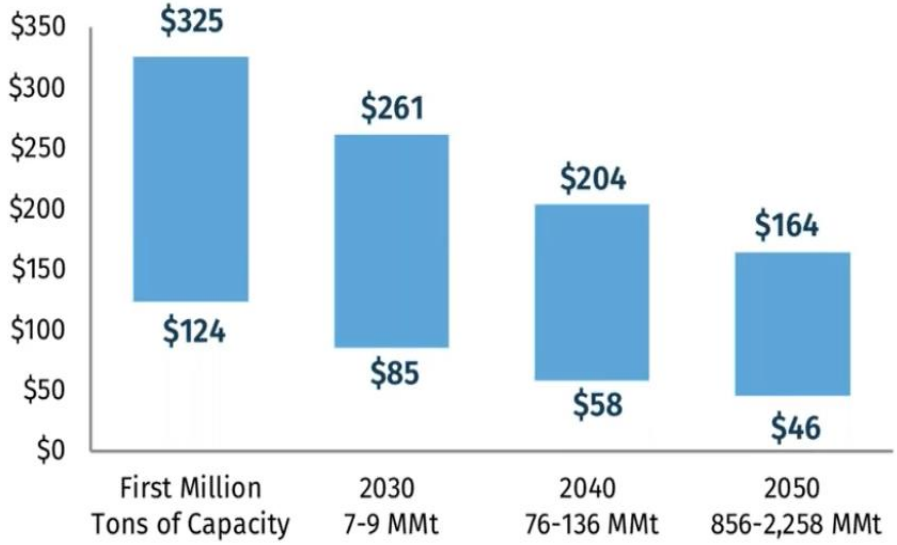
Previous and expected DAC cost estimates

Levelized $2018/metric ton of carbon removed from the atmosphere



Current and projected cost of CO_2 capture using DAC

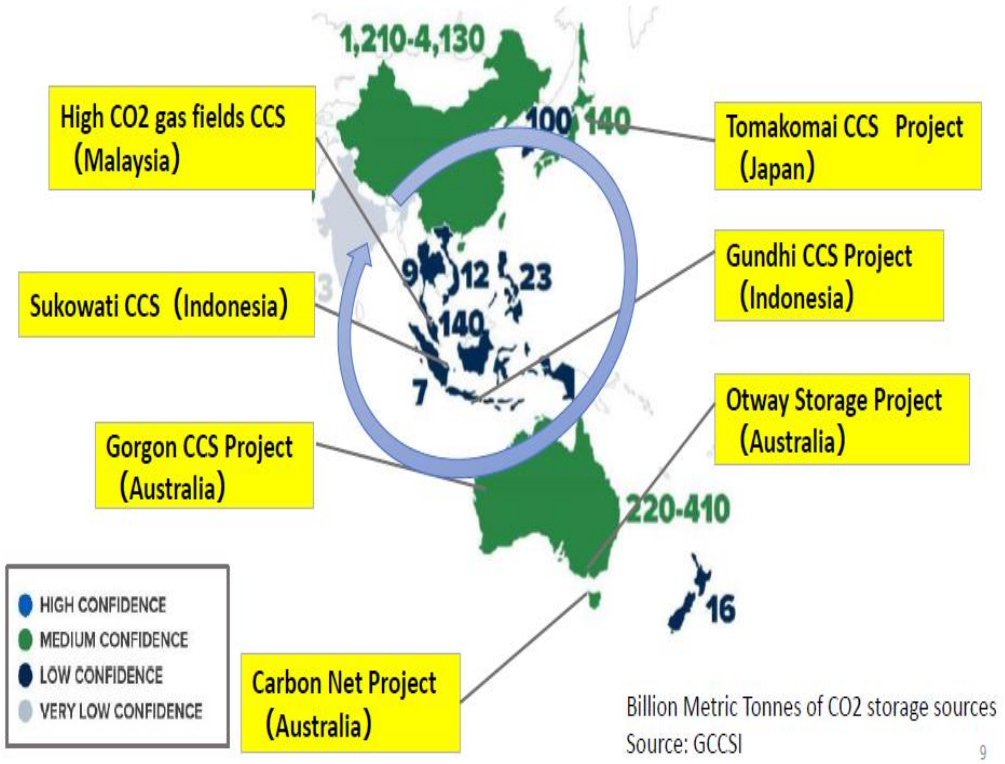
30-year levelized $2018/metric ton

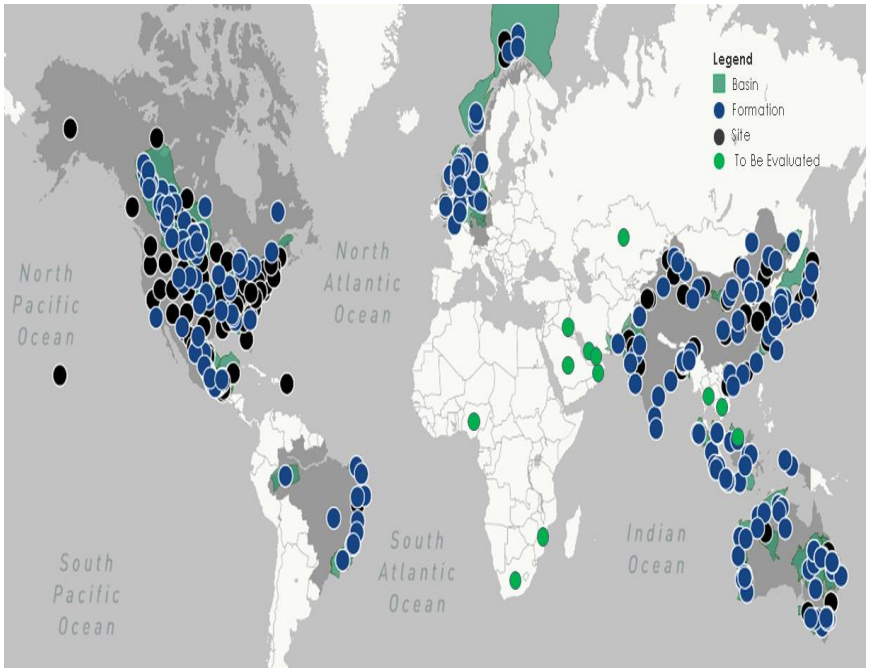


Rhodium Group, 2019

Storage Potential in ASEAN Region

- **CCUS is indispensable component of regional carbon neutrality.**
- **ASEAN region has abundant storage capacity, and the cost could be relative cheaper compared to other part of the world**
- **Regional hub could promote regional cooperation and reduce cost.**

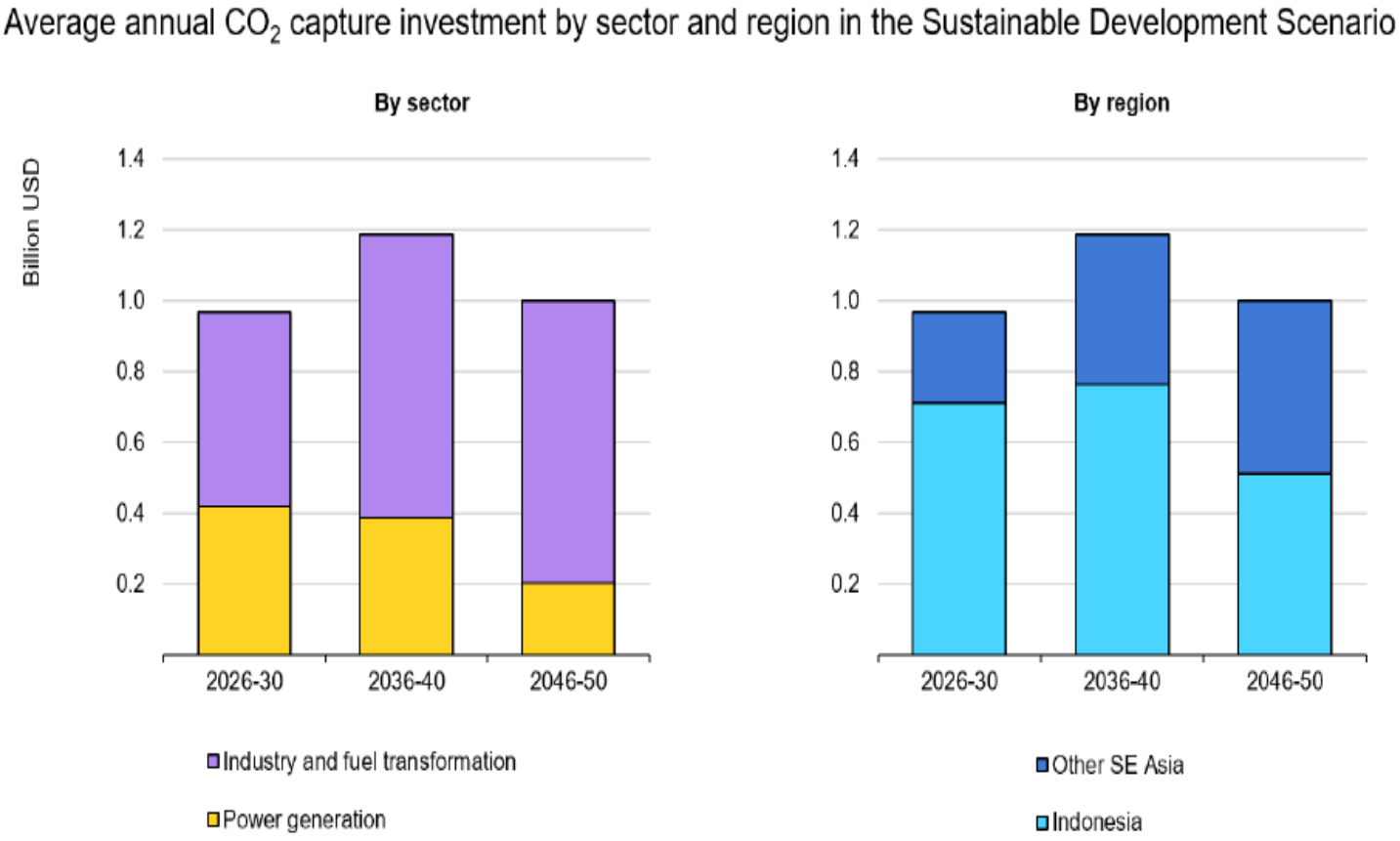




- First independent evaluation of geologic CO_2 storage assessments by OGCI
- Provides investor-level confidence in the maturity of commercial resources available to CCUS projects globally.

CCUS Investment Needs in SE Asia

Ambitious CCUS deployment in ASEAN region will require massive investment, growing to an average of USD 1 billion per year by 2030



Source: Southeast Asia Energy Outlook, IEA

Actions & Recommendations (1)

- To achieve 1.5°C target, the emission reduction must reach over 6 GT per year by 2050.
- IEA has identified the following key milestones for CCUS to stay in line with net zero emissions by mid-century:

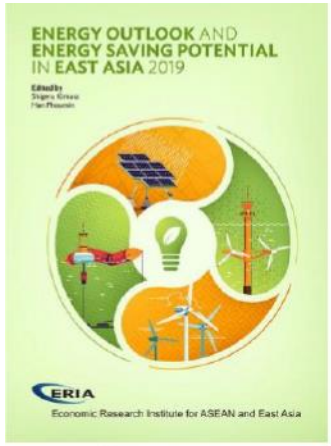
a. Power sector: Global annual CO_2 capture from coal-fired, natural gas-fired, and bioenergy power plants will need to reach 430 Mt by 2030 and 1.4 Gt by 2050.
b. Low-emissions fuels: Global annual CO_2 capture and storage from biofuel production will need to increase to 150 Mt by 2030 and 625 Mt by 2050. Global annual CO_2 capture from hydrogen production will need to reach 680 Mt by 2030 and 1.8 Gt by 2050.
c. Industry: Global annual CO_2 capture capacity must increase to 375 Mt by 2030 and 2.8 Gt by 2050.
d. Direct air capture: Global annual CO_2 capture capacity must increase to 90 Mt by 2030 and 985 Mt by 2050.

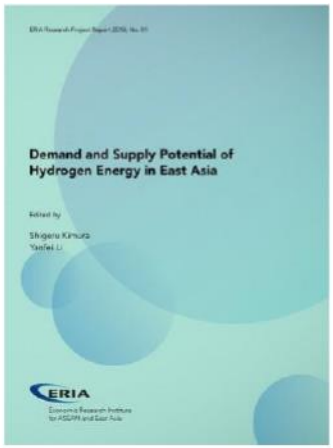
Actions & Recommendations (2)

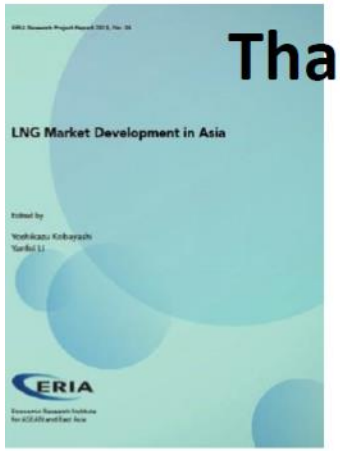
- Research & innovation combined with support from the government, public & private sectors to establish the first initial steps towards CCUS commercialization by 2030 and onwards
- More windows of financial opportunity must be made available to developing countries to build practical CCUS demonstration projects in Southeast Asia and around the developing world
- Oil and gas sector will be the 1st to have commercial CCUS project in Asia: regulatory improvement in oil and gas sector is needed particularly on CO2 venting, along with incorporating CCUS price into production cost
- The development of value chain networks of CCUS could help accelerate deployment of CCUS by reducing costs
- Capacity building & knowledge sharing on CCUS are so critical

Asia CCUS Network

- Asia CCUS Network aims at (1) CCUS knowledge and experiences sharing, potential survey, (2) common rules and developing projects and (3) realizing storage network throughout Asia
- The First Asia CCUS Network Forum was held on 22-23 June 2021, co-hosted by ERIA and METI Japan
- Series of Workshops, capacity building course, research work (model case study in Indonesia, legal framework)







Thank you very much

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