Chapter 1

Introduction

June 2022

This chapter should be cited as
ERIA Study team (2022), 'Introduction', in Shigeru Kimura, Alloysius Joko Purwanto, Ichiro Kutani, Takahisa Hiruma, Dian Lutfiana, Citra Endah Nur Setyawati (eds.), *Demand and Supply Potential of Hydrogen Energy in East Asia – Phase 3.* ERIA Research Project Report FY2022 No. 04, Jakarta: ERIA, pp.1-2.

Chapter 1

Introduction

Hydrogen is a low- and/or zero-emissions energy technology. It is produced largely from fossil fuels using carbon capture, utilisation, and storage (CCUS) as well as from renewable energy electricity for water electrolysis. Hydrogen production from unutilised energy sources – that is, energy resources that physically exist but are not being used – is also possible. Unutilised energy sources include:

(i) **Low-ranked coal.** Low-ranked coal, such as lignite and brown coal, is found mostly in Australia and Indonesia, but is not used for environmental reasons, as they emit a lot of carbon dioxide (CO_2). If hydrogen is produced from low-ranked coal through gasification technology using CCUS, blue hydrogen can be produced.

(ii) **Flared gas**. Flared gas at oil and gas fields is classified as waste gas, but hydrogen can be recovered by using CCUS. Many countries in the East Asia Summit (EAS)[1] region – such as Australia, Brunei Darussalam, and Indonesia – produce a lot of flared gas.

(iii) **Hydropower in isolated areas.** Hydropower has significant potential in Sarawak, Malaysia and the North Kalimantan and Papua provinces of Indonesia. It has not been well developed in these areas due to the low electricity demand near these sites and the significant costs to construct transmission lines to urban areas. At these sites, hydrogen can be produced using water electrolysis technology and be transported by tankers.

(iv) **Solar photovoltaic (PV) systems.** To balance electricity supply and demand, surplus electricity generated by solar PV systems can be utilised. With this electricity, hydrogen can be produced through water electrolysis.

This phase 3 study – of the demand and supply potential of hydrogen energy in the EAS region – was conducted based on an analysis of the unused energy resources mentioned above for 2040. Due to technical difficulties, solar PV systems were deleted from the scope.

In the EAS region, some countries have the advantage of hydrogen production. Therefore, hydrogen networks – which connect both hydrogen-advantaged countries and -disadvantaged countries – must be developed. Using tankers, there are three ways to transport hydrogen from hydrogen-producing countries to -consuming countries: (i) ammonia (ii) methylcyclohexane (MCH), and (iii) liquid hydrogen.[2] Transport costs depend

[1] The EAS region includes Association of Southeast Asian Nations (ASEAN) Members (i.e. Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic [Lao PDR], Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam) plus Australia, China, India, Japan, the Republic of Korea, New Zealand, Russia, and the United States (US).

[2] Ammonia consists of hydrogen and nitrogen, MCH consists of hydrogen and toluene, and hydrogen liquefied under –253°C. All have steps before and after transport to make the hydrogen transportable and then to return it to its original state (e.g. mixing hydrogen with nitrogen and toluene, separating hydrogen from ammonia and MCH, and liquification).

on distance and volume. This study also investigated the optimal hydrogen transport method, applying a linear programming approach to MCH and liquid hydrogen. This study omitted ammonia, because ammonia is already tradable.

Under this study, working group meetings, held virtually in 2021, discussed how hydrogen can contribute to carbon-neutral targets. Australia, Japan, and New Zealand emphasised the importance of hydrogen in achieving carbon-neutral status by 2050, but others remain focussed on renewable energy. During these meetings, the Economic Research Institute for the Association of Southeast Asian Nations (ASEAN) and East Asia (ERIA) shared outcomes from this phase 3 study as well as Japan's experience with hydrogen power generation and New Energy and Industrial Technology Development Organization (NEDO) hydrogen projects in Australia and Brunei Darussalam.

Further, two workshops were held in India and Malaysia, which introduced results from the phase 2 study, including a review of hydrogen production and cost, revision of hydrogen demand based on realistic assumptions, and an overview of hydrogen transport and costs for MCH and liquid hydrogen. India is currently conducting several hydrogen studies, so there were many fruitful discussions with Indian hydrogen experts. Yet hydrogen is still not a top energy policy in either country, and the Government of Malaysia intends to increase variable renewable energy, such as solar and wind, on its low-carbon energy transition pathway.