To : President Joko Widodo, The President of Indonesia

Subject : Developing a hydrogen market in Indonesia

Executive Summary

This memo urgently recommends developing the hydrogen market in Indonesia. We suggest introducing a Production Tax Credit to incentivize private organizations to produce low-carbon hydrogen. Developing the hydrogen market will add value to Indonesia's natural gas resources, extend the existing natural gas and ammonia facilities' lifetime, and accelerate the net-zero emission target in the hard-to-abate sector.

Background

Indonesia is the world's ninth-largest emitter of greenhouse gases[1]. It relies on fossil fuels for 90% of its primary energy needs[2]. Hydrogen and its derivative products are key to achieving our net-zero target by 2060. Although producing hydrogen is expensive, it is essential to create a net-zero economy. The marginal cost of abatement curve in the US indicates that hydrogen is a cheaper solution than direct air capture or other conventional solutions in a specific last-mile usage[3]. Hydrogen is particularly valuable in the expensive-to-abate sector, such as industrial, transport, gas replacement, and long-duration energy storage[4].

Developing a hydrogen market can also improve Indonesia's energy security by harnessing untapped renewable energy resources which is located not in the high demand area like the Java Island[5]. Indonesia has massive untapped resources up to 29 GW of renewable electricity from geothermal sources, 208 GW of solar energy, and 95 GW of hydro energy, mostly located in the eastern part of Indonesia[6]. Indonesia can also generate hydrogen from wasted energy such as flared gas and relatively cheap lignite coal[7]. This initiative will create high productivity jobs, increase foreign direct investment, and stimulate economic growth.

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1 Joint Research Centre (European Commission) et al., CO2 emissions of all world countries: JRC/IEA/PBL 2022 report. LU: Publications Office of the European Union, 2022. Accessed: Mar. 25, 2023.
2 BP, "Statistical Review of World Energy 2022," BP, London, 71, 2022.
3 Jamil Farbes, Ben Haley, and Ryan Jones, "Marginal Abatement Cost Curves for U.S. Net-Zero Energy Systems," Evolved Energy Research, Aug. 2021. Accessed: Mar. 03, 2023.
4 U.S. Department of Energy, "Pathway to commercial liftoff: clean hydrogen in the US," U.S. Department of Energy, Washington, DC, Mar. 2023.
5 Beni Suryadi, Adhityo Gilang Bhaskoro, Suwanto, and Li Yanfei, Hydrogen in ASEAN: Economic Prospects, Developments and Applications. Jakarta, Indonesia, 2021.
6 PLN, "PLN Electricity Supply Plan 2021-2030," PLN, Jakarta, Indonesia, 2021–2030, Sep. 2021.
7 S. Kimura, A. J. Purwanto, I. Kutani, T. Hiruma, D. Lutfiana, and C. E. N. Setyawat, "Demand and Supply Potential of Hydrogen Energy in East Asia – Phase 3," Economic Research Institute for ASEAN and East Asia (ERIA), Jakarta, Indonesia, ERIA Research Project Report No. 04, Jun. 2022.

Hydrogen and its derivative products can extend the usage of existing natural gas processing facilities[8]. The existing plant, including Arun, Bontang, Nusantara, and Tangguh liquefaction plans, can still be used after their natural gas feedstock depleted with minimal retrofitting (11-20% of the cost of building new) for ammonia export[9]. Bontang and Nusantara facilities are located close to Indonesia's biggest state-owned fertilizer company, making them ideal for ammonia export hub. Depleted natural gas resources in Arun make it urgent to extend its lifetime[10].

Green hydrogen is produced using electrolysis powered by renewable energy such as geothermal and solar power. However, as a transitional strategy, Indonesia can start by producing blue hydrogen while waiting for the domestic hydrogen market to mature, and the price is increased to the point on par with green hydrogen[11]. Grey and blue hydrogen are made from natural gas, in which Indonesia is currently a net natural gas exporting country[12]. Blue hydrogen uses additional carbon capturing processes to prevent carbon from being emitted into the atmosphere. The captured carbon should be stored in a safe geological formation in the earth crust, which is abundant in Indonesia[13].

Grey hydrogen demand already exists in Indonesia as the intermediate material for producing fertilizer (Indonesia is 6th biggest producer of ammonia[14]) and refining crude oil. However, these two existing demands are not yet sufficient to develop sustainable market. Indonesia needs to implement a suitable policy to induce additional demand from other high potential sectors to adopt clean hydrogen for both domestic and international markets.

Policy Options

1. Export tax subsidy for low carbon hydrogen and its derivatives. Since the domestic market of blue and green hydrogen is not yet matured, the demand can be started from

[8] Anna Shiryaevskaya, "How Germany's LNG Terminals Will Morph Into Green Hydrogen Hubs," *Bloomberg.com*, May 12, 2022. Accessed: Mar. 25, 2023.
[9] IEA, "Global Hydrogen Review 2022," IEA, 2022.
[10] J. Chua, "TotalEnergies to use Indonesia's Arun LNG storage tanks | Argus Media," Sep. 01, 2021. https://www.argusmedia.com/en/news/2249646-totalenergies-to-use-indonesias-arun-lng-storage-tanks (accessed Mar. 25, 2023).
[11] S. Kimura, A. J. Purwanto, I. Kutani, T. Hiruma, D. Lutfiana, and C. E. N. Setyawat, "Demand and Supply Potential of Hydrogen Energy in East Asia – Phase 3," Economic Research Institute for ASEAN and East Asia (ERIA), Jakarta, Indonesia, ERIA Research Project Report No. 04, Jun. 2022.
[12] BP, "Statistical Review of World Energy 2022," BP, London, 71, 2022.
[13] IEA, "Carbon Capture Utilisation and Storage_The Opportunity in Southeast Asia," *Carbon Capture*, Jun. 2021.
[14] U.S. Geological Survey, "Mineral commodity summaries 2023," U.S. Geological Survey, Reston, VA, USGS Numbered Series 2023, 2023. doi: 10.3133/mcs2023.

overseas, particularly Japan[15] and Singapore[16]. Domestic demand can grow when the domestic low carbon hydrogen production cost has touch parity.

- Pros:
  - Improves competitiveness for exports compared to other countries in the region (Malaysia and Brunei)[17]
  - Improves current account deficit and creates value added compared to conventional natural gas exports
  - Good relationship with Japanese and Singapore companies can be leveraged[18]
- Cons:
  - Slower market response
  - Higher demand risk since the government cannot control the demand in the other country
  - Greater international market competition (i.e., Australia with its cheap renewable electricity[19])

2. Monetary and technical support for the state-owned fertilizer companies. This can help PT Pupuk Indonesia to develop the First-of-Its-Kind project. Because the domestic production increases, the cost of production can be reduced following the experience curve up to the point of parity to the current cost of production[20].
   - Pros:
     - Faster implementation by existing skilled worker and companies
     - Easier bureaucracy since the two biggest ammonia plant (Bontang, East Kalimantan[21] and Kujang, West Java[22]) is operated by one national fertilizer company
   - Cons:
     - Possibility to create tension from other competing companies

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[15] J. Nakano, "Japan's Hydrogen Industrial Strategy," Oct. 2021, Accessed: Mar. 25, 2023.
[16] Ministry of Trade and Industry of Singapore, "Singapore's National Hydrogen Strategy," 2023. https://www.mti.gov.sg/Industries/Hydrogen (accessed Mar. 25, 2023).
[17] Beni Suryadi, Adhityo Gilang Bhaskoro, Suwanto, and Li Yanfei, *Hydrogen in ASEAN: Economic Prospects, Developments and Applications*. Jakarta, Indonesia, 2021.
[18] Cantika Rustandi, "Indonesia and Japan: a role model in bilateral relations," *Economic Research Institute for ASEAN and East Asia - ERIA*, Feb. 14, 2019.
[19] S. Kimura, A. J. Purwanto, I. Kutani, T. Hiruma, D. Lutfiana, and C. E. N. Setyawat, "Demand and Supply Potential of Hydrogen Energy in East Asia – Phase 3," Economic Research Institute for ASEAN and East Asia (ERIA), Jakarta, Indonesia, ERIA Research Project Report No. 04, Jun. 2022.
[20] P. Ghemawat, "Building Strategy on the Experience Curve," *Harvard Business Review*, Mar. 01, 1985. Accessed: Mar. 25, 2023.
[21] Gayatri Suroyo and Fransiska Nangoy, "Indonesian fertiliser maker Pupuk Kaltim eyes major expansion | Reuters," Mar. 12, 2023. https://www.reuters.com/markets/asia/indonesian-fertiliser-maker-pupuk-kaltim-eyes-major-expansion-2023-03-10/ (accessed Mar. 25, 2023).
[22] Pupuk Kujang, "PT PUPUK KUJANG CIKAMPEK - Riwayat Singkat Perusahaan," *Company Profile*, May 22, 2021. https://www.pupuk-kujang.co.id/profil-perusahaan/riwayat-singkat-perusahaan (accessed Mar. 25, 2023).

        - Uncertainty around the experience curve projection to determine whether the domestic fertilizer demand is enough to drop the clean hydrogen production cost[23]
3. Hydrogen production tax credit. Promoting the use of clean hydrogen by giving tax credit for every hydrogen produced by a firm[24].
    - Pros:
        - Levels the competition between already matured grey hydrogen and low carbon hydrogen
        - Easier to be supported by the parliament, since it does not create a capital burden to the government
    - Cons:
        - Requires a study to calculate suitable amount of credit and duration[25]
        - Challenging hydrogen production monitoring and auditing

Recommendation

I recommend the government to implement a hydrogen Production Tax Credit. This policy can benefit both domestic and export-oriented hydrogen producer while the other policy only benefits very specific private player. In addition, this policy has lower risk compared to the other two options. However, this policy alone will not make sure the hydrogen market will grow, additional follow up policy to really make sure the market is mature is needed.

[23] P. Ghemawat, "Building Strategy on the Experience Curve," *Harvard Business Review*, Mar. 01, 1985. Accessed: Mar. 25, 2023.
[24] U.S. Department of Energy, "Pathway to commercial liftoff: clean hydrogen in the US," U.S. Department of Energy, Washington, DC, Mar. 2023.
[25] U.S. Department of Energy, "Pathway to commercial liftoff: clean hydrogen in the US," U.S. Department of Energy, Washington, DC, Mar. 2023.

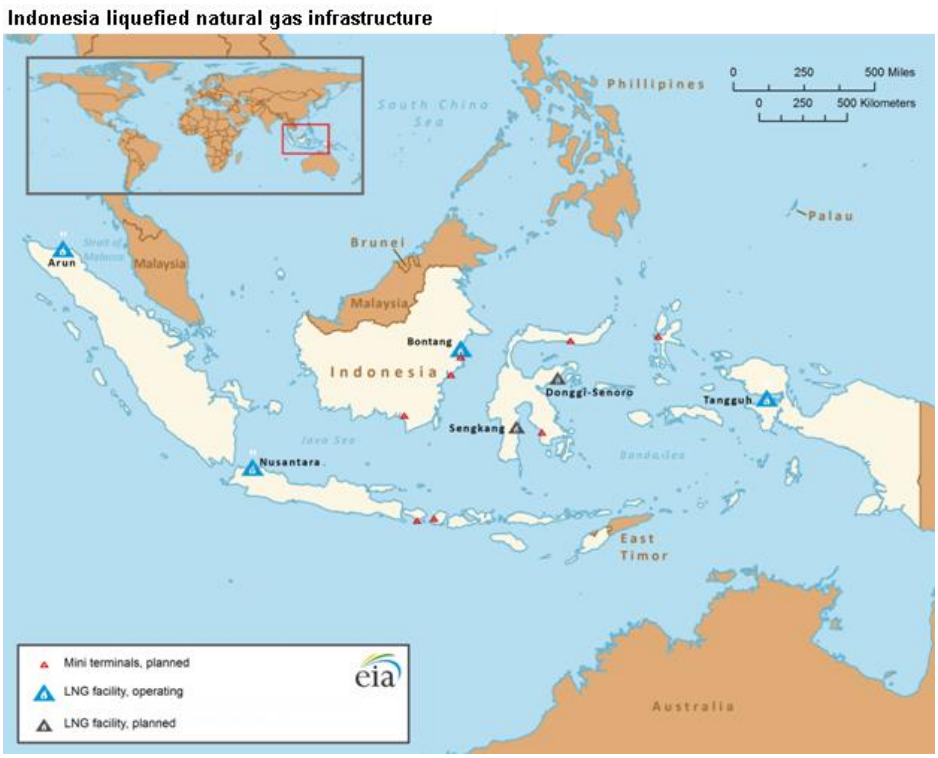

Figure 1 Indonesia liquefied natural gas infrastructure[26]

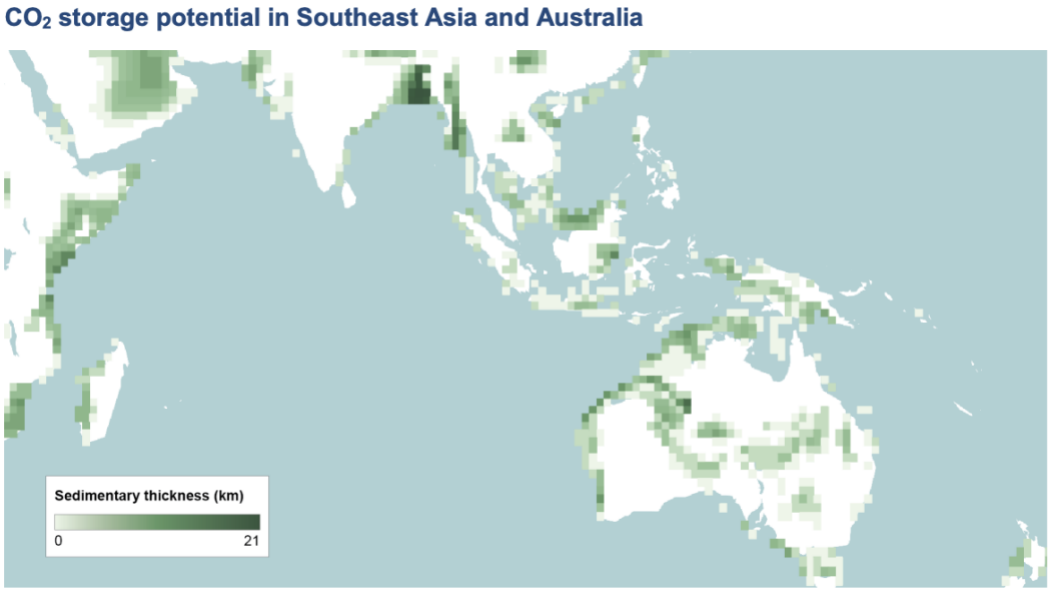

Figure 2 CO2 storage potential in Southeast Asia and Australia[27]

[26] Gregory Gangelhoff and Mark J. Eshbaugh, "Indonesia's share of global LNG supply declines due to global and domestic demand growth," Mar. 10, 2014. https://www.eia.gov/todayinenergy/detail.php?id=15331 (accessed Mar. 25, 2023).

[27] IEA, "Carbon Capture Utilisation and Storage_The Opportunity in Southeast Asia," *Carbon Capture*, Jun. 2021.