Analysing the Macroeconomic and Decarbonisation impacts of Green Hydrogen Mandates in key Asian economies: China, Japan, India and South Korea

Topic: Input-Output Analysis
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Green hydrogen is expected to play a key role in achieving the goals of the Paris Agreement by mid-century. Further, in the context of global net zero trajectory, strong growth in hydrogen market and green hydrogen deployment is envisaged to potentially offset over 60 gigatons of CO2 (~ 6.5% of total reduction) in accumulated emissions between 2021-2050 (IEA,2023).

Presently, hydrogen is mainly produced from natural gas, with modest trade volumes. However, trade in hydrogen-derived commodities, such as ammonia and methanol, is substantial, valued at $17.5 billion and $14.1 billion respectively in 2022(IRENA & WTO, 2023). In a net-zero scenario, trade dynamics for green hydrogen and its derivatives will differ markedly from today's fossil fuel markets due to widespread production potential linked to solar and wind power.

Under the pretext, four major Asian economies i.e. Japan, China, India and South Korea have proactively come up with ambitious targets to promote manufacturing, use and trade in green hydrogen supply chain. This research work initially evaluates the targets, policy incentives and existing ecosystem for green hydrogen manufacturing in the four economies. This is followed by quantitative analysis including constructing economy specific green hydrogen production block. The production block estimates required investment in specific electrolyser capacities, hydrogen pumping and storage infrastructure along with renewable energy capacity requirements for fulfilling the existing targets for green hydrogen manufacturing with the data corroborated from various technical sources and existing literature as appropriate. Further, using E3ME model (Cambridge Econometrics, 2022): a global integrated dynamic macro-econometric simulation model we evaluate and compare the following:

1. Macro-economic impacts of scaling up green hydrogen manufacturing aligned to the existing policy target in the four economies in terms of GDP, employment and sectoral outputs
2. Decarbonization potential of mandated green hydrogen manufacturing targets for the four economies with the manufactured green hydrogen replaces equivalent blue /grey hydrogen in the economy
3. Impacts on trade in terms of reduction in fossil fuel imports for the four economies and increase in exports for commodities, technologies and services
4. Impacts of import substitution in key hydrogen value chain sectors for the economies

As the technical and economic challenges of long-distance hydrogen transport remain significant, trade in green hydrogen is likely to manifest predominantly through commodities produced with hydrogen, like ammonia, methanol, synthetic fuels, or iron. The potential for cost-competitive green hydrogen production in regions abundant in high-quality renewable energy could lead to the relocation of energy-intensive industries and the emergence of new commodity trade routes. Additionally, as green hydrogen scales up for decarbonization, there will be a notable increase in trade flows for the technologies and services needed for its production, such as electrolyzers, compressors, pipes, and valves.

The ability to capitalize on the advantages of the emerging global green hydrogen value chain will vary among economies, contingent upon their respective technological, economic, and policy frameworks. This comprehensive analysis delves into the macroeconomic implications, decarbonization potentials, trade dynamics, and import substitution effects of the green hydrogen

scale up in four different Asian economies. This research works aims to contribute to new body of literature providing a quantitative evidence for the diverse opportunities associated with the transitioning to green hydrogen, not only limited to advancing the objectives of the Paris Agreement but also tending to sustainable economic growth opportunities across Asian economies.