PROSPECTS FOR HYDROGEN IN APEC

Manuel Heredia, Asia Pacific Energy Research Centre, +81-3-5144-8551, manuel.heredia@aperc.or.jp

Overview

There is an increasing interest in the potential use of hydrogen as a clean energy source, due to the need for effective measures of decarbonization to combat climate changes. APEC is an important region in the future global energy matrix as it consumes approximately 60% of the world's energy. Our modeling suggests that hydrogen could satisfy around 4% of APEC's final energy demand by 2050. Additionally, APEC's member economies have access to different energy sources which, in turn, can enable the production of different types of hydrogen according to their characteristics. Furthermore, some member economies have published documents that show their visions and goals regarding hydrogen while others do not have such plans. This paper presents the prospects for hydrogen in two scenarios, estimates potential demand, identifies economies that potentially can produce hydrogen, and analyzes the implications that such demand represents for those economies. Our work indicates that APEC economies can play important roles in the future global hydrogen market as consumers and producers.

Methods

The model was developed in OSeMOSYS, the Open Source Energy Modelling System, that is a systems optimization model for long-run energy planning. The projections timeline covers from 2018 to 2050 and each APEC member economy was individually modelled. Information such as hydrogen domestic plans, roadmaps, strategies, etc. were incorporated if they were available but only data on hydrogen as an energy sources was modelled. Different technologies for hydrogen production were considered: brown hydrogen, gray hydrogen, blue hydrogen, green hydrogen, and hydrogen obtained as byproduct from other industrial activities. The conditions of each member economy, such as renewable energies or natural gas supply availabity, were incorporated into the model as restrictions for each type of hydrogen production in each economy.

Two scenarios were developed: the Reference (REF) scenario and the Carbon Neutrality (CN) scenario. The hydrogen demand in REF considers exclusively domestic demand with emphasis in transport and industrial sector. In contrast, CN reflects higher ambitions for hydrogen consumption in final energy demand sectors and incorporates potential exports. Additionally, more stringent environmental standards for bunkers are implemented in the CN.

Finally, the OSEMOSYS model solves for the optimal mix of different types of hydrogen for each individual member economy in both scenarios.

Results

Hydrogen accounts for 1 % of APEC's final energy demand in REF, approximately 3 000PJ, equivalent to two thirds of agriculture energy consumption in 2018. In CN, hydrogen demand is higher at around 9000 PJ or 4% of APEC's energy demanding 2050.

Transport is the largest hydrogen consuming sector, being responsible for 76% of the demand in 2050 in REF and for 56% in CN. Industry is the second largest hydrogen consumer with 24% and 41% of hydrogen demand in 2050 in REF and CN respectively .

Hydrogen demand is initially led by Japan, USA and Korea but, by 2030, China and USA are the main hydrogen consumers in the APEC region. China will consume more than half of the hydrogen in APEC region, followed by USA with almost a third of that consumption in REF by 2050. In CN, the share of other economies grows and reaches 40%.

Blue, gray and brown hydrogen supply more 70% of hydrogen production in 2030. Later, green hydrogen becomes the dominat type of hydrogen supplying 64% in 2040 and almos 85% in 2050 in REF. In CN, almost a quarter of the domestic hydrogen production is dedicated to exports and bunkers. Almost 15% of the hydrogen demand is satisfied by imports and a quarter of these imports can be satisfied by exports from other APEC economies.

Conclusions

APEC will continue to be an important player in the global energy sector. After initial leadership by Japan and Korea in hydrogen demand, China and US will lead hydrogen consumption in the long run. The importance of their vision regarding hydrogen can shape the future of hydrogen market in APERC.

Although the share of hydrogen in final energy demand may seem modest in the projections, hydrogen demand growth is very substantial, several-fold higher than in the past, even in the REF. This growth requires increased investments in hydrogen production capacity, namely blue hydrogen, at the beginning, and, in later years, green hydrogen.

Hydrogen is not only a source of energy but also a driver for investment in other sources of energy such as natural gas and renewable energy.

Transport, the second of the biggest CO_2 emitter after power, is the sector that leads hydrogen consumption, particularly in long distance heavy freight and passenger transport.

Even though exports were implemented in CN because there are member economies such as Australia and Chile that are studying potential export markets, the estimated APEC hydrogen demand still requires additional imports from other sources. This results show potential opportunities for trading, especially in economies that have not yet developed a vision regarding hydrogen.

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