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Cost analysis of blue hydrogen production in 2030

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Abstract

Hydrogen is one of the most promising elements in efforts to accelerate the realization of a low-carbon society and for sector coupling. Although green hydrogen, produced by water or steam electrolysis using renewable energy (power to gas), is preferred as it produces much less CO_2, it is expected to remain very costly in the coming decades and also it requires an enormous and rapid increase in the capacity of renewable energy to satisfy the increasing hydrogen demand. Hence it is considered that hydrogen produced from fossil fuels with CCS, which is so-called blue hydrogen, will play an important role in the coming years in accelerating the realization of a hydrogen society.

This paper first summarizes the cost analysis of gray hydrogen which is produced from fossil fuels such as coal and natural gas without CCS and blue hydrogen as reported by several institutions. Subsequently, some comparisons are made between gray and blue hydrogen, with costs today and in 2030, and the cost of hydrogen produced from coal and natural gas. The summation of capex and opex is increased in the case of blue hydrogen comparing to grey hydrogen as additional capex and opex are required for CCS. The cost of raw material is increased due to that the thermal efficiency is decreased by applying CCS. It is interesting to note that the increase in cost is less by applying CCS in the case of coal gasification because the facility includes separation process of H_2S that can likely be applied to CO_2 separation.

It should be noted that even when CCS is applied, a certain amount of CO_2 that is typically reported as 10%, is released during blue hydrogen production owing to the cost limitations of CCS. It is also expected that the price of blue hydrogen, which is cheaper than green hydrogen without taking into account the price of CO_2, will increase with the increase in the price of CO_2 in coming decades. Therefore, the costs of blue hydrogen produced from coal and natural gas and green hydrogen produced from solar PV and wind power were analyzed with the increase in the price of CO_2 being considered by referring to a life cycle assessment carried out by an international institution. The results showed that blue hydrogen produced from natural gas may be still cost competitive to the cheapest green hydrogen even the price of CO_2 is included in 2030. Thus additional incentives are necessary to accelerate green hydrogen production.