The Wedge from Capturing CO_2 at H_2 Plant

A wedge can be achieved through Capturing CO_2 at H_2 Plants

- H_2 output from fossil fuels: 400 Mt
- Current global H_2 output is 40 Mt, which emits at least 100 MtC

Comments

Today, the two-way competition between electricity and secondary hydrocarbon fuels plays out in arenas as disparate as the home water heater and the steel furnace. It is plausible that this two-way competition will become a three-way competition, with the inclusion of hydrogen fuel. Like electricity, hydrogen is a *secondary* fuel. It has to be made from something else, and it can be made from everything else. Much work is being done to examine how hydrogen may enter the energy economy. A recent reference is the National Research Council (NRC) report, *The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs* (S38).

Hydrogen is already in widespread use, but as a chemical, not a fuel. Adding hydrogen at a petroleum refinery improves the product mix, and making hydrogen is a necessary first step in making ammonia (NH_3) and nitrogen fertilizer. Currently these two uses, between them, elicit an annual production of 40 MtH_2. Almost all this hydrogen is made from fossil fuels, because it is cheaper than hydrogen produced from nuclear energy or renewable energy; production from fossil fuels does not require the costly intermediate step of electrolysis of water.

The second output when hydrogen is produced from fossil fuels is CO_2. In a carbon constrained world, this will disadvantage fossil fuels as the source of hydrogen, relative to hydrogen produced from nuclear or renewable energy. Currently, at least 100 MtC is vented annually as CO_2, often at high purity, at H_2 production sites (S38, Chapter 7). Hydrogen produced with capture and storage of CO_2 (CCS hydrogen), discussed above because of the overlap with low-carbon coal-based power via gasification and CO_2 capture, will compete with nuclear hydrogen and renewable hydrogen. A 1 GtC/y carbon flow to the atmosphere in hydrogen production from fossil fuels is associated with only a ten-fold increase, relative to today, in hydrogen production. And the technology exists to capture and store this carbon.

CCS hydrogen and nuclear hydrogen can only be produced at large unit scale. Hydrogen produced at large scale can serve distributed users, like light-duty vehicles and buildings, only if there is a hydrogen infrastructure connecting the large with the small. Such an infrastructure does not now exist, and it may be more difficult to create than many other infrastructures. The reason is that a hydrogen infrastructure to provide fuel to dispersed users is in competition with small-scale hydrogen production downstream from two other already existing infrastructures: 1) the electricity infrastructure that facilitates local hydrogen production in small electrolyzers, and 2) the natural gas infrastructure that facilitates local hydrogen production in small methane reformers. If the second of these – the small methane reformer – dominates hydrogen production, the CO_2 generated at such dispersed sites is unlikely to be captured and stored, because of the diseconomies of CCS

at small scale, and hydrogen production will not serve the goals of carbon mitigation.

Reference

S38 National Research Council, 2004. *The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs*. Washington, D.C., National Academy Press. http://www.nap.edu/books/0309091632/html/