Pros and Cons of HYDROGEN in California's low-carbon fuel mix

Hydrogen is touted as the next big thing for non-carbon energy and energy storage. Yet when we look at the facts, it's not that simple.

Unlike fossil fuels, when hydrogen burns it emits water vapor and NOx, but no CO2. But over its lifecycle, hydrogen is extremely polluting— because making hydrogen is highly energy intensive, and making "green hydrogen" from renewable sources is expensive and likely to displace other uses of renewable electricity. For these reasons, oil and gas interests see the path to hydrogen as a highway to perpetual use of their planet-wrecking products.

The hydrogen rainbow (a marketing coup)

- **Green electrolytic hydrogen**: Hydrogen produced by electrolysis using renewable energy, from wind or solar. This rare and expensive form of hydrogen, as defined in California law,[1] is the only really GREEN hydrogen.
- **Blue hydrogen**: produced through steam reforming, usually fueled by natural gas. This process creates hydrogen and also carbon dioxide, which is partially trapped and stored (carbon capture and storage, CCS)
- **Gray hydrogen**: Blue hydrogen with no carbon capture
- **Pink hydrogen**: Electrolytic hydrogen made using nuclear power as the energy source
- Black and brown hydrogen: The energy source is black coal or lignite (brown coal)

Uses for hydrogen in California's low-carbon economy

Hydrogen will have important—but limited—applications, in energy-intensive applications difficult to electrify from wires or batteries. California should develop green electrolytic hydrogen for

- Aviation fuel
- Heavy-duty, long-haul trucks and agricultural/industrial vehicles
- High-energy industrial heating processes, such as cement and steel
- Long-term energy storage

Climate Action California's positions on hydrogen

- We oppose any use of public funds to support hydrogen fueling stations for light-duty vehicles. Only green electrolytic hydrogen, as defined in law, should be produced in California.
- All references to "green hydrogen" in legislation should refer to the definition of "green electrolytic hydrogen" in PUC 400.2.
- In addition to California's definition, we support the U.S. Department of Energy's definition of "clean hydrogen" as hydrogen production with lifecycle emissions of no more than 2 kg CO2e per kilogram of hydrogen.[2] No type of hydrogen production should be supported that does not meet or exceed that standard.

Hydrogen is a non-starter as a passenger vehicle fuel. Battery electric cars have won the race.

There are 1 million battery electric vehicles in our state[3]; but only 15,000 hydrogen fuel cell (HFC) cars.[4] According to the Hydrogen Fuel Cell Partnership, which provides charging information to HFC drivers, there are only 55 public hydrogen filling stations in California at this writing.[5]. In 2021, the median cost of a new hydrogen fueling station was "approximately $1.9 million in capital."[6]

In contrast, the California Energy Commission reports that there are over 80,000 public and shared private EV charging stations in the state (not counting home chargers).[7] Federal Inflation Reduction Act funding for chargers will further accelerate this growth.

Efficiency is also an issue. A recent journal article showed that the round trip efficiency of renewable electricity powering a battery electric vehicle was 73 percent, vs. 22 percent for a hydrogen fuel cell vehicle.[8]

Finally, there is no credible distribution system for hydrogen, except delivery as a compressed gas or a cryogenic liquid using trucks. Potential spills, or any hydrogen leakage, exacerbates global warming because hydrogen in the atmosphere destroys hydroxyl radicals, the agents responsible for reducing the persistence of methane. Leakage can be over 10 percent. Thus if hydrogen is distributed on a large scale, its use could lead to longer atmospheric lifetimes for methane— increasing the rate of global warming.

End Notes

[1] CA Public Utilities Code section 400.2: *For the purposes of this article, "green electrolytic hydrogen" means hydrogen gas produced through electrolysis and does not include hydrogen gas manufactured using steam reforming or any other conversion technology that produces hydrogen from a fossil fuel feedstock.*

[2] Section 16166(b)(B) of Title 42 of USC

[3] https://www.gov.ca.gov/2022/02/25/california-leads-the-nations-zev-market-surpassing-1-million-electric-vehicles-sold/

[4] https://www.caranddriver.com/features/a41103863/hydrogen-cars-fcev/

[5] https://m.h2fcp.org/

[6] https://www.hydrogen.energy.gov/pdfs/21002-hydrogen-fueling-station-cost.pdf

[7] https://www.energy.ca.gov/data-reports/energy-almanac/zero-emission-vehicle-and-infrastructure-statistics/electric-vehicle

[8] https://insideevs.com/news/332584/efficiency-compared-battery-electric-73-hydrogen-22-ice-13/