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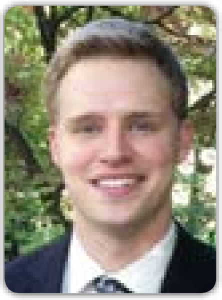

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Thermal hydrogen: An emissions free hydrocarbon economy

Thermal Hydrogen is an energy system engineered to enable hydrocarbons as both an emissions free energy supplier and energy carrier. It is based upon the principle of using both products of water (or CO_2) splitting: hydrogen (or CO) and oxygen. The H_2 (CO) enables chemical energy storage and is intended primarily to provide heat, EV range, and timely/distributed electricity. The purpose of (pure) oxygen is to pre-empt the gas separation work inherent to Carbon Capture and Sequestration (CCS). Pure oxygen also enables hydrocarbons to become increasingly competitive with decarbonization because it enables simpler and more efficient thermodynamic cycles: the Allam cycle for electricity generation and auto-thermal reforming for hydrogen/syngas generation. The supply and presence of hydrocarbon related chemicals also enables emissions free hydrogen energy carriers. Methanol (CH_3OH, derived from syngas) is envisioned to serve as a substitute for gasoline to be used in solid oxide fuel cells. The resulting exhaust, carbonated water, is envisioned to be recollected and recycled. Ammonia (NH_3) is envisioned to replace natural gas and is produced via the Haber-Bosch process. The nitrogen comes from an air separation unit where the oxygen is used to enable emissions free hydrocarbons. Overall, 90% of the hydrocarbons in the system are oxidized by oxygen from electrolysis. All chemical energy is stored and distributed as liquids, thus enabling the densest energy storage and distribution system possible.

Biography

Jared Moore is an independent Energy Consultant based in Washington, DC advising on deep decarbonization of the energy sector. He has published in multiple peer-reviewed journals including *Environmental Science and Technology*, E*nvironmental Research Letters, Energy Procedia* (GHGT-12), and the *International Journal of Hydrogen Energy.* He is also a contributing author of the book *"Variable Renewable Energy"* and the *"Electricity Grid".* He holds a BS in Mechanical Engineering from Rose-Hulman Institute of Technology (2008) and a PhD in Engineering and Public Policy from Carnegie Mellon University (2014).

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