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## Hydrogen and electricity (Hydricity): The *essential* currencies to escape climate catastrophe

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Albert Einstein advised, “*Everything should be kept as simple as possible, but not simpler.*” Following Einstein’s wisdom, the following energy system chain shows services, technologies, sources and currencies within five *functional groups*. The role of *energy currencies* in energy systems is analogous to the role of financial currencies in financial systems. Neither is a *source* of energy or wealth, yet both are essential for facilitating energy or financial transactions. Each step, from left towards the right, is a demand-supply step. So where is carbon dioxide emitted? **Service technologies** emit CO<sub>2</sub> when the *currencies* they use contain carbon. **Harvesting technologies** emit CO<sub>2</sub> when the *energy for harvesting* is carbon based—like fossil-fueled mining machinery. So to develop a carbon-free system we must evolve towards using only carbon-free energy sources and carbon-free energy currencies. There are many carbon-free sources—hydraulic, tidal, solar, wind, nuclear and so on. In contrast, *there are only two carbon-free currencies*. The first is the *electronic* currency, electricity. But electricity is a poor candidate for free-range transportation, such as cars, trucks, ships and especially aircraft. That’s why we also need a *protonic* (material) carbon-free currency. A *protonic* currency must contain only elements found in atmospheric abundance—otherwise when the fuel is burned, the emissions will be environmentally intrusive. Therefore, any candidate fuel can contain *only* oxygen, nitrogen, and hydrogen. Ammonia (NH<sub>3</sub>) satisfies this compositional constraint. But practical issues like low energy mass- density and toxicity make it troublesome. So we’re left with hydrogen as the only practical carbon- free fuel that can be universally employed for all tasks that today use carbon-based fuels. Hydrogen can also be used as a clean, efficient substitute for many material-harvesting tasks, such as using H<sub>2</sub> rather than coke for reducing iron ore in steel making. A hydricity world will be cleaner, systemically more robust and more efficient. It will bring cleaner environments, and is essential to any chance we have to escape climate catastrophe.

### Biography

David Sanborn Scott, PhD, DSc (hon.), DEng (hon.), is a Fellow of the Canadian Academy of Engineering. Formerly, Chair of Mechanical Engineering, University of Toronto, Scott then travelled west to become Founding Director of the University of Victoria’s Institute for Integrated Energy Systems. Dr Scott is the author of *Smelling Land; The Hydrogen Defense Against Climate Catastrophe*. He chaired Canada’s Federal Advisory Group on Hydrogen Opportunities that produced the report *Hydrogen: National Mission for Canada* ESNB 0-662-15544-0. Dr. Scott is currently Vice-President (for North America) of the International Association for Hydrogen Energy. In 2006, he was honored with the IAHE Jules Vern Award for ‘Outstanding Contributions to Hydrogen Physics, and Hydrogen Energy Sociology and Philosophy.’

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