Hydrogen
Facilitating Renewable Energy

by Monterey Gardiner and Jamie Holladay

As a nation we can no longer afford to be dependent on foreign sources of energy and future generations should not be asked to deal with the consequences of the "status quo" use of fossil fuels. Renewable energy must be a key part of the energy solution. However, most renewable energy is intermittent by nature. Hydrogen can be used to store intermittent renewable energy to balance or replace electric power we normally use. Hydrogen can be used to directly heat our homes, cook our food, and power our vehicles. All of this can be done with little to no carbon footprint or emissions other than water at the point of use.

Hydrogen can be made from any primary energy source. Electricity can be used to generate hydrogen at the point of use by splitting water into hydrogen and oxygen via water electrolysis at a cost of $5.20/kg. Natural gas can be processed to form hydrogen at a cost of $2.50/kg. Hydrogen can also be produced from many sources we consider waste: biomass at $2/kg, or gas from land fills and waste water treatment plants. More advanced options involve the use of concentrated sunlight in solar-driven thermochemical cycles, costing $4-5.50/kg. Hydrogen can be used to store inexpensive energy such as from rice straw or off-peak electricity. The US Department of Energy (DOE) has a goal of $1/kg to pay for the delivery of hydrogen with centralized production.

For transportation, the cost of hydrogen could be well within range of what we pay for gasoline today. One gallon of gasoline has about as much energy as 1 kg of hydrogen and a fuel cell vehicle is about twice as efficient as a conventional combustion engine.

The average US household used approximately 565,000 BTUs per day in 2005 . This is equivalent to approximately 5 kg of hydrogen. Depending on how the hydrogen is converted to electricity, one would need as much as 10 kg/day to operate the average household.

Institutional barriers form the biggest obstacle in bringing about the mainstream use of hydrogen. Codes and standards have to change and some level of infrastructure will have to develop (even for purely distributed generation systems). The high cost of fossil fuels, awareness of climate change, environmental consequences, and the opportunity for a broad shift in political will all point to the potential for hydrogen and alternative energies to play a far larger role in our energy future.

Our energy needs will not be dealt with by a simple transplant of fossils fuels with renewable energy. At the community, level a holistic approach is needed involving smart growth initiatives, urban policies which promote mass transit/walkable communities, and sustainable agriculture. Germany is a good example of intelligent public policy that has been conducive to renewable energy growth. As of 2007, 14% of Germany's energy needs were provided by renewable energy. In order for a large growth of renewable energy to happen, several policies should be implemented including:

- national renewable energy goals,
- power generation promotion policies,
- feed in law/tariffs,
- capital subsidies, grants or rebates,
- sales, excise and energy tax reductions.

What do we do in the meantime? Using hydrogen in the near term will be expensive until economies of scale occur and large-scale manufacturing brings costs down. We need to encourage a national discussion to achieve consensus on a long-term energy plan, and then make sure politicians follow through on that plan. Hydrogen will be part of this solution. We need to encourage local fire marshals or "authorities having jurisdiction" to become educated about hydrogen to facilitate infrastructure development, and to encourage widespread hydrogen use in the US. Our energy needs can be intelligently reduced, and a transition to clean energy is not only possible, but inevitable. The actions and efforts put forth today will determine how fast and orderly that transition is.

Article references available on request.

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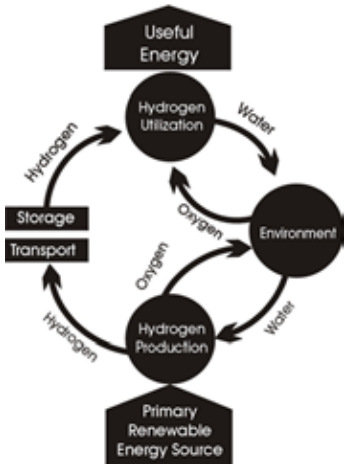
Hydrogen Life Cycle



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Feed in Tariffs

Germany has become a leader in small, distributed, renewable energy because they are using feed in tariffs (FITS). These mandate that utilities have to buy power from any producer and pay a specified rate depending on the source of the power. The rates are established to pay back the upfront costs of the solar panel, wind generator, or other generating device

In Germany, and now most of the EU, feed-in-tariffs are generating more investment in renewables and a larger percentage of all energy coming from renewables. Washington and Wisconsin have established FITS and several other states are in the process of implementing them. We should make sure that all states make these rates available to energy producers