# VEHICLES111 Ends the “Hydrogen Fuel Bottleneck”

hydrogen fuel bottleneck

# Technologies from Vehicles111 end the hydrogen re-fuel bottleneck by refueling any hydrogen car or device with seconds anywhere in the world.

# U.S. Companies Tackle Hydrogen Economy Bottleneck

by Tina Casey


The U.S Department of Energy tapped a group of high-tech companies for $35 million in funding to help the hydrogen economy get past a classic chicken-and-egg dilemma: Why build hydrogen fueling stations if nobody is buying hydrogen-fueled cars? And why buy a hydrogen car if there's nowhere to fuel up?

The goal of the program is to enable hydrogen to be transported and stored using the same infrastructure deployed by the petroleum industry. That sounds simple enough, but the devil is in the details.

# Hydrogen chicken, meet egg

When used in a fuel cell, hydrogen is a zero-emission fuel. It produces an electrical current by reacting with oxygen. The only byproduct is water.

Loosely speaking, hydrogen stores energy like a battery. The big difference from a consumer perspective is that batteries need to be charged before use, and that takes time. In contrast, hydrogen fuel cells create an electrical current on-the-go.

A hydrogen fuel cell electric vehicle can fuel up in a matter of minutes, just like a gasoline vehicle.

That's an attractive advantage, but the problem is that transporting, storing and distributing hydrogen gas is expensive.

The lack of fueling stations has put a check on demand for hydrogen-powered vehicles. With few vehicles on the road, investors are skittish about pumping money into the fueling infrastructure. For now, battery EVs are tops in the emerging zero-emission mobility market.

The cost factor is also inhibiting the introduction of stationary fuel cells for buildings.

The logjam is beginning to break in the logistics sector, because time and space are at a premium in warehouse operations. Hydrogen fuel cell fork lifts provide a significant savings over their battery-powered cousins, which require more time and space for recharging.

Another area to watch is long-distance hauling. Toyota recently announced a pilot project for a hydrogen fuel cell semi truck. And a startup company called Nikola has paired with trucking company Ryder and the manufacturer Fitzgerald to introduce the Nikola One hydrogen truck.

Nikola has an ambitious business plan that includes a vast network of fueling stations, and the hydrogen will be sourced using renewable energy. (Fossil natural gas is still the primary source for hydrogen.)

# An ammonia-fueled turbo boost for the hydrogen economy

Companies like Toyota and Nikola are the exceptions that prove the rule: The fact is that the need for zero-emission vehicles is urgent, and the pace of development is far too slow.

That's where the Department of Energy comes in. The new round of funding attacks the hydrogen bottleneck from a unique angle. Rather than focusing strictly on more efficient (and less costly) ways to compress hydrogen gas, the agency is looking for systems that use ammonia as a platform.

If that sounds somewhat odd, consider that ammonia is composed of hydrogen and nitrogen. The basic idea is that ammonia can pass along the existing storage and transportation infrastructure. Once it reaches a point of use, the hydrogen can be separated out.

One main obstacle is that existing separation methods are expensive and energy intensive. The new funding will help several tech companies work on that problem, including the Bettergy Corp. and SAFCell. Both companies are developing different ways to whittle the complex process down into one step or one device.

A team from the University of South Carolina is developing an energy-efficient reactor with a low-cost catalyst that will separate hydrogen from ammonia as it decomposes.

Teams from Materials and Systems Research, Inc. and the University of Delaware will take a different approach, by developing a fuel cell that can generate electricity directly from ammonia.

# Fuel from water and air

Another hurdle is to reduce the cost and impact of producing ammonia itself. The company FuelCell Energy, Inc. will work on that with a reversible, energy-efficient system that can generate electricity from ammonia, or produce ammonia from nitrogen and water.

Storagenergy Technologies, Inc. is also working on a cell-based system for producing ammonia from water and nitrogen.

And the University of Minnesota Twin Cities is working on a way to increase the efficiency of the conventional Haber-Bosch system for generating ammonia through a reaction between hydrogen gas and airborne nitrogen.

A company called Giner, Inc. is coming at the problem from a more specific angle. It is developing new, more efficient materials for catalysts that are needed to produce ammonia from nitrogen.

# The renewable energy factor

The funding is also focused on ammonia production systems that account for the intermittent nature of renewable energy. In effect, the goal is to use synthetic ammonia as a storage platform for wind or solar power.

RTI International is reworking a conventional ammonia production process, so that it can start up and gear down efficiently depending on the availability of renewable energy sources.

The West Virginia University Research Corp. is also working on a renewables-friendly method that increases the efficiency of the Haber-Bosch process.

Renewable energy also factors into a project of Wichita State University that involves producing ammonia with airborne nitrogen. The team will tweak the system to accommodate renewables, resulting in a more efficient and less costly ammonia production method.

# More and better sustainable fuels

Aside from accelerating the hydrogen economy, the $35 million will also be split among three other sustainable fuel projects.

Teams from the Gas Technology Institute and Sustainable Innovations, Inc. are working on different systems for producing dimethyl ether as a substitute for diesel fuel, using practically nothing but carbon dioxide, hydrogen and electricity. Potentially, both the hydrogen and electricity could be sustainably sourced.

Opus 12, Inc. is looking to re-configure a hydrogen production system and make it convert carbon dioxide directly into ethanol.

# The ARPA-E factor

All together, the new funding round packs a lot of power into 16 different projects. The funding comes under the umbrella of ARPA-E, the Energy Department’s high-tech funding division.

ARPA-E was established in the closing years of the George W. Bush administration to provide support for high-risk, high-payoff R&D in the energy field. The aim is to bring the research up to the point where it begins to attract private-sector investment.