Analysis and Environment

How geologic hydrogen went from fringe science to potential green fuel

Just a year ago, few people took seriously the idea that we could extract hydrogen from the ground as a clean energy source – but now the US Department of Energy is injecting $20 million into the concept

By James Dinneen

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Olivine minerals like forsterite can produce hydrogen when interacting with groundwater
Smithsonian National Museum of Natural History/USGS

Efforts to extract underground hydrogen for use as a clean fuel have received a huge boost from the US Department of Energy (DoE), which earlier this month announced $20 million in funding to explore the concept. What is behind the rapid rise in interest in this "geologic hydrogen", which was on the fringes of science less than a year ago?

"We're on an exponential curve," says Geoffrey Ellis at the US Geological Survey, whose research has played a role in

more hydrogen than thought. Enthusiasm for geologic hydrogen has also grown with the wider move to use the gas for clean energy.

Now, ARPA-E, the hi-tech R&D wing of the DoE, wants to fund methods of stimulating minerals underground to produce geologic hydrogen. It is also backing research into the extraction of the gas, which emits only water vapour and heat when burned. Ellis says the $20m is the largest funding opportunity for natural hydrogen research he knows of. "It's major."

Huge questions remain about whether geologic hydrogen could be a viable source of clean energy, and using lots of hydrogen from any source may have its own climate-warming effects. But getting the gas from underground could be a much less energy and emissions-intensive way to obtain it than making it from methane or using clean electricity to split water molecules.

The fact that the DoE, one of the world's most sophisticated scientific organisations, is taking geologic hydrogen seriously is significant. "It lends a lot of credibility," says Ellis, who spoke to *New Scientist* just before departing for a trip to consult with the government of Oman on the potential for geologic hydrogen there.

A gaggle of companies are already exploring for natural reserves, from numerous start-ups in Australia to a US-based company that has raised almost $100 million from Bill Gates and other well-known clean energy investors. Earlier this summer, a reserve of natural hydrogen was discovered in France that may contain the equivalent of half the world's current production of the gas.

ARPA-E's focus, however, is less on naturally occurring deposits of the gas — often referred to as "white" or "gold"

comes to geologic hydrogen, we're asking 'are there disruptive ways to access this hydrogen source and explore the potential?'" said the agency's director Evelyn Wang in a press release.

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One approach would involve pumping water underground where it would interact with iron-rich minerals to produce hydrogen — sometimes called "orange hydrogen".

At a workshop on geologic hydrogen hosted by ARPA-E in April, ahead of the funding decision, researchers and industry representatives discussed what was needed to make this process more efficient and productive, what new technologies would be required to store, purify and extract the gas, as well as identifying areas with the right geology.

The agency hasn't yet announced how it will award the new funds, and it isn't clear whether companies have already tried stimulating the production of geologic hydrogen. But researchers are working on this. For instance, Toti Larson at the University of Texas at Austin says his group is searching for catalysts that could reduce the temperatures required to make hydrogen by mixing water and iron-rich rock. "We know how much potential there is if we can stimulate the subsurface," he says.

"Stimulating hydrogen represents many more challenges [than extracting natural hydrogen], but also much more potential," says Viacheslav Zgonnik at Natural Hydrogen Energy, the Colorado-based company behind an exploratory hydrogen well in Nebraska. "This will have an impact not only on the US, but I believe the entire world," he says.

Adam Brandt at Stanford University in California cautions that despite all the buzz, it is unknown how much geologic hydrogen might be available for use. But he is glad to see the attention: "I think this is the perfect time for DoE to support early-stage 'blue sky' work to see if geologic hydrogen will be a material solution."

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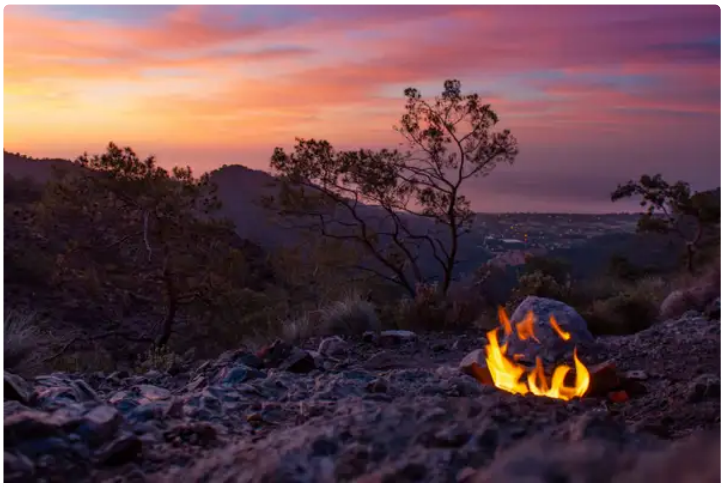

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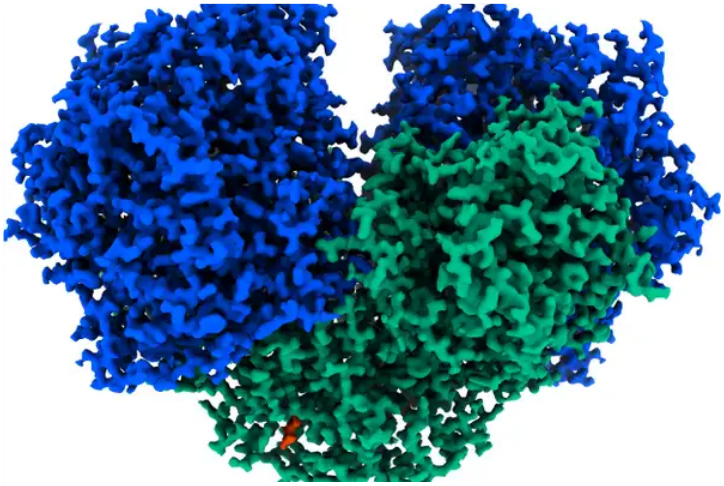

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