

Researchers are on a quest to make hydrogen from solar rays and heat

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Spain hosts the largest test center in Europe for concentrated solar technologies.
Credit: © PLATAFORMA SOLAR DE ALMERÍA / CIEMAT

As Europe turns increasingly to clean sources of energy, EU researchers are on a quest to make hydrogen from solar rays and heat.

In July 2023, when southern Europe endured an unprecedented heat wave with temperatures soaring to around 45°C, a [particular place](#) in Spain got much hotter without becoming headline news.

The place was a test site in Almería province and the temperatures reached 1,400°C.

High hopes

The eye-popping heat levels were created at the Plataforma Solar de Almería, where mirrors direct the region's abundant sunlight onto a tiny spot on a 43-meter tower. The structure uses [solar energy](#) to generate those enormously high temperatures.

EU researchers think the platform—the largest test center in Europe for concentrated [solar technologies](#)—might also be key to generating renewable hydrogen. This form of power, like [solar panels](#) and [wind turbines](#), could help Europe and other parts of the world ditch fossil fuels, which emit greenhouse gases including CO₂ that are accelerating global warming.

"We need real clean energy, which would benefit everyone," said Souzana Lorentzou, a [chemical engineer](#) at the Center for Research & Technology Hellas in Thessaloniki, Greece.

Hydrogen could help green economies worldwide because it generates almost no [greenhouse gases](#) when burned and can power hard-to-decarbonize industries ranging from steel to aviation.

Renewable energy including clean hydrogen is a pillar of the

REPowerEU strategy to abandon Russian fossil fuels this decade and of the "Green Deal" to make the EU climate-neutral by 2050.

The hitch is that the process of coming up with hydrogen itself often involves energy sources such as natural gas and coal that emit CO₂. In Europe in 2022, 96% of all [hydrogen production](#) came from natural gas.

In fact, a relatively easy way to create clean hydrogen already exists.

It's a method using an electrical current from a renewable energy source to separate water into hydrogen and oxygen. The process, called electrolysis, can even be performed in high-school science experiments.

But it has yet to catch on widely amid cost barriers.

Only 4% of global hydrogen production at the end of 2021 came from electrolysis, according to the International Renewable Energy Agency. And just 1% was produced through electrolysis powered by renewable energy.

Here comes the sun

Researchers in Europe say that looking to the sun to come up with more ways to create [renewable hydrogen](#) makes sense.

Solar rays and the heat they create might just turn out to be an ideal way of producing clean hydrogen. No electricity would be required, just sunshine.

"Our technology is built on top of an existing system—a concentrated solar plant," Lorentzou said. "What if, on top of electricity, these plants could also produce green hydrogen almost as a bonus?"

Hydrogen production currently causes more than 800,000 million tons of CO₂ emissions, or around 2% of the global total of such discharges, according to Marcel Boerrigter, principal researcher at Leitat Technological Center in Barcelona, Spain.

"If we can green that, we can prevent an enormous amount of emissions," Boerrigter said.

Research allies

He and Lorentzou in Thessaloniki share the aim of finding ways to generate zero-emissions hydrogen and each leads a research project that has received EU funding to bring the goal closer.

That's where the solar tower in Almería—an area that is home to Europe's only inland desert, the Tabernas with more than 3,000 hours of sunshine a year—comes in.

Lorentzou's project uses the tower's extreme heat to initiate chemical processes in a reactor that transform water into clean hydrogen—without the use of electricity.

Called [HYDROSOL-beyond](#), the initiative is the latest in a series of projects on the production of solar hydrogen from the splitting of water. It started in January 2019 and is scheduled to wrap up at the end of 2023.

Boerrigter's project uses the light of the sun, in addition to its heat, to set in motion a process for creating clean hydrogen.

The initiative, named [GH2](#), runs for three years until end-September 2025.

Risk reduction

"Electricity is a major cost factor in the production of green hydrogen at the moment," said Boerrigter. "Our method eliminates the need for it."

While promising, the idea of creating hydrogen from just solar heat or rays will take more time to fulfill as a result of lingering technological challenges.

These hurdles highlight the role of research including publicly funded projects that take on risks often avoided by commercially minded businesses.

The HYDROSOL-beyond technology has been under development for about 20 years. Although many advances have been made over that period, Lorentzou remains unsure when large-scale deployment will start.

"This is the fifth project in the series," she said. "I have seen the technology evolve from something we would build in a laboratory, to small-scale installations, to the current very large-scale system we have now."

Work in progress

Lorentzou said another five years of technological fine-tuning, including of the reactor at Almería, might be needed.

"We have identified several challenges by building an installation at such a large scale," she said. "We, for example, need to change the design of the reactor to make it more durable. That's our priority right now."

For its part, the technology behind GH2 is still in the laboratory and relatively far from any commercial applications.

There, the researchers need to streamline the [chemical processes](#) before they can be scaled up and used in the real world.

"It will probably take around 10 to 20 years before this technology will reach a commercial stage," said Boerrigter. "That sounds slow, but we're going very fast seeing the early stage we're in."

He, Lorentzou and other researchers say the goal of generating clean hydrogen using the sun can help prevent catastrophic climate change in the coming decades.

"With this technology we're taking down CO₂ emissions, creating green hydrogen and not using up more electricity," said Boerrigter. "We're moving several stones at the same time."

More information:

- [HYDROSOL-beyond](#)
- [GH2](#)
- [Mission Innovation: Converting sunlight into solar fuels and chemicals](#)

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