

Scientists using sunlight, water to produce renewable hydrogen power

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UI researchers have developed a small solar-powered electrochemical device that can help make energy using sunlight and water. Credit: Syed Mubeen.

University of Iowa researchers are working with a California-based startup company to make clean energy from sunlight and any source of water.

The university recently renewed a one-year research agreement to further develop the technology with HyperSolar, a company that aims to commercialize low-cost renewable [hydrogen](#).

Hydrogen power is arguably one of the cleanest and greenest [energy](#) sources because when it produces energy, the final byproduct is [water](#) instead of carbon emissions. Hydrogen power also can be stored in a fuel cell, making it more reliable than traditional solar cells or solar panels, which need regular sunlight to remain "on."

HyperSolar's lead scientist, Syed Mubeen, a chemical engineering professor at the UI, says although hydrogen is the most abundant element in the universe, the amount of pure hydrogen in the Earth's atmosphere is very low (about 0.00005 percent), so it must be produced artificially.

Currently, most hydrogen power is made from fossil fuels in a chemical process called steam reforming, which emits carbon dioxide. Even though the end product is hydrogen, its inputs make it much less environmentally friendly and sustainable.

Hydrogen also can be made using electrolysis, which requires electricity and highly purified water to split water molecules into hydrogen and oxygen. Although this is a sustainable process (assuming the electricity is produced from a [renewable energy source](#)), the cost of materials associated with the system are expensive—a major barrier to the affordable production of renewable hydrogen.

"Developing [clean energy](#) systems is a goal worldwide," Mubeen says.

"Currently, we understand how clean energy systems such as solar cells,

wind turbines, et cetera, work at a high level of sophistication. The real challenge going forward is to develop inexpensive clean [energy systems](#) that can be cost competitive to fossil fuel systems and be adopted globally and not just in the developed countries."

With HyperSolar, Mubeen and his team at the UI's Optical Science and Technology Center are developing a more cost-effective and environmentally friendly way to manufacture hydrogen by drawing inspiration from plants. So far, the researchers have created a small solar-powered electrochemical device that can be placed in any type of water, including seawater and wastewater. When sunlight shines through the water and hits the solar device, the photon energy in sunlight takes the water (a lower [energy state](#)) and converts it to hydrogen (a higher energy state), where it can be stored like a battery. The energy is harvested when the hydrogen is converted back into its lower energy state: water. This is similar to what plants do using photosynthesis, during which plants use photons from the sun to convert water and [carbon dioxide](#) into carbohydrates—some of which are stored in fruits and roots for later use.

Mubeen says his team is currently working to lower costs even further and to make their process more robust so it can be produced on a mass scale. That way, it eventually could be used as renewable electricity or to power hydrogen fuel cell vehicles.

"Although H₂ can be used in many forms, the immediate possibility of this renewable H₂ would be for use in fuel cells to generate electricity or react with CO₂ to form liquid fuels like methanol for the transportation sector," he says. "If one could develop these systems at costs competitive to fossil fuel systems, then it would be a home run."

Provided by University of Iowa

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