Hydrogen and nanomaterials may transform energy industry

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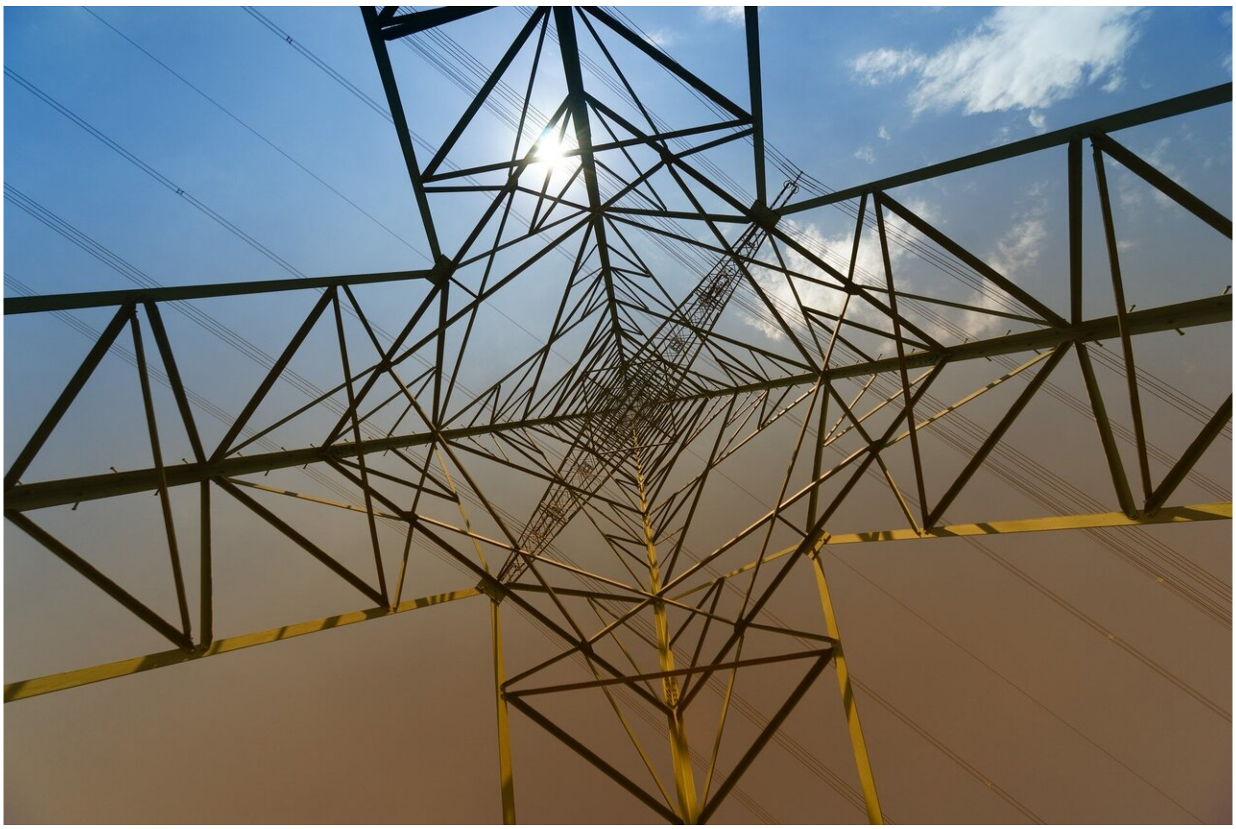

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Hydrogen as a zero-carbon energy carrier has the potential to fundamentally transform the global energy landscape—but the production must benefit the environment, according to experts at Rice

University's Baker Institute for Public Policy.

Rachel Meidl, the fellow in energy and environment at the institute's Center for Energy Studies, and Emily Yedinak, a doctoral candidate in materials science and nanoengineering at Rice, published a new brief, "Measuring the True Cost of Sustainability: A Case Study in a Green Energy Approach."

"We are transitioning to a new age of human development, one where the environmental and societal consequences must now be balanced with economic ambitions," they wrote. "If the fossil fuel industry wishes to remain relevant, it must adapt and explore paths towards zero-carbon or low-carbon energy and carbon utilization strategies."

According to the brief, the U.S. Energy Information Administration (EIA) projects a 28% increase in average world energy consumption between 2015-2040, and fossil fuels will continue to take up 50-80% of that consumption.

Meidl and Yedinak argue that hydrogen, used as a zero-carbon energy carrier, has the potential to significantly transform the global energy landscape.

"Unlike solar and wind energy, hydrogen is a more natural substitute for fossil fuels in sectors that are particularly difficult to decarbonize (i.e. transportation and industrial)," they wrote.

"Hydrogen can be produced from several diverse and geographically dispersed resources, and its utility cuts across multiple sectors including metals refining, fuels upgrading and ammonia production," the authors explained. "Furthermore, hydrogen fuel cells are two to three times more efficient than internal combustion engines, thereby offering additional energy efficiency gains."

The brief presents a case study that considers the technological merits of methane pyrolysis, the direct conversion of methane in natural gas to hydrogen and value-added carbon materials, while also addressing real-world implications including health and safety risks and commercial risks for introducing new carbon supply chains.

The value-added carbon materials that are produced through pyrolysis, alongside hydrogen, could theoretically be a substitute for hard-to-decarbonize industrial processes and materials such as steel, copper and aluminum. This is due to the light weight, strength and conductivity of carbon nanotubes.

However, "several challenges remain in assessing nanosafety risks," the authors argue. Risks include unintended chemical exposure throughout the supply chain that would need oversight.

Even beyond the technical hurdles of making the process efficient and scalable, the authors explain, expanding on or creating new carbon supply chains from large-scale methane pyrolysis will also require companies to overcome regulatory hurdles.

"Legislation has not kept pace with the rapid rate of innovation," the authors wrote.

As new supply chains for carbon and carbon dioxide are introduced, companies will need to weigh the economic benefits with the social costs—determining how the supply chain will affect the environment. The authors argue that companies as well as governments must guide investment decisions toward solutions that benefit society as well as the bottom line.

"Sustainable progress cannot be achieved when health, safety and environmental risks outweigh emissions reductions," they wrote.

More information: Measuring the True Cost of Sustainability: A Case Study in a Green Energy Approach. www.bakerinstitute.org/media/f … s-sustainability.pdf

Provided by Rice University