How long until efficient fuel cells? Ask the experts

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If proton exchange membrane fuel cells hold great promise for future vehicle electrification, why do they lack market acceptance? Credit: Pixabay

In the quest for the perfect alternative for gas-powered vehicles, there have been a lot of contenders over the years. When it comes to public perception, battery electric vehicles (BEVs) are some of the most widely known. But among experts in the field, there is another alternative that shows even greater promise for future vehicle electrification: fuel cells. In particular, proton exchange membrane fuel cells (PEMFCs). However, despite decades of development, PEMFCs still lack wide market acceptance in vehicles.

To understand what is affecting this acceptance, and where the market is expected to go in the future, researchers from Carnegie Mellon University conducted an expert elicitation assessment of the current and expected future cost and performance of automotive PEMFCs. The findings were published in *Proceedings of the National Academy of Sciences*.

Michael Whiston, a postdoctoral research associate in engineering and public policy, and College of Engineering professors Ines Azevedo, Shawn Litster, Kate Whitefoot, Constantine Samaras, and Jay Whitacre spoke with 39 experts in the field of fuel cells to understand their assessments of PEMFC costs, stack durability, and stack power density under a hypothetical, large-scale production scenario.

"Expert elicitation draws on the knowledge and experience of individuals who have worked extensively with the technology," says Whiston, "and thus can inform the technology's status and future trajectory. In the absence of published data or conclusive evidence, assessments from expert elicitation could be used to develop technology roadmaps, inform policy-making, guide business decisions, and develop analytical models."

In the study, the researchers asked the experts to assess the system costs, stack durability, and stack power density of PEMFCs, then to quantitatively assess what it will take to meet cost and performance goals. Most respondents anticipate that the Department of Energy's cost goal would be met by 2050. This goal of $30/kW would greatly increase the likelihood of widespread adoption by the general public.

Additionally, more than 45% of respondents expect the DOE's targets for stack durability to be met by 2050, and many anticipate that the target median stack power density could be achieved by 2035. Once these targets are hit, and PEMFCs reach more mainstream adoption, this could spell big things for the auto industry—bigger than BEVs, and even other types of fuel cells.

"The benefits of PEMFCs over batteries include faster refueling times and longer ranges," Whiston says. "Fuel cell electric vehicles (FCEVs) refuel within five minutes and operate at ranges exceeding 300 miles. BEVs tend to be more limited in range, depending on the battery size and cost, and can take hours to recharge."

Because FCEVs operate efficiently on carbon-free hydrogen, they could significantly reduce fossil fuel consumption and tailpipe carbon emissions in vehicles. Hydrogen fuel can be produced by a range of low-carbon electricity sources, including natural gas, so FCEVs could substantially reduce the net amount of greenhouse gas emissions from passenger cars. Additionally, these fuel cells emit none of the harmful tailpipe criteria pollutants, such as nitrogen oxides, particulate matter, and carbon monoxide, making them much safer for human health.

More information: Expert assessments of the cost and expected future performance of proton exchange membrane fuel cells for vehicles, *Proceedings of the National Academy of Sciences*, DOI: 10.1073/pnas.1804221116

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