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RESEARCH REPORT

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Bartlomiej Kolodziejczyk, PhD

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About the Series Editor

Bart Kolodziejczyk, PhD, is Chief Technology Officer of the Singapore-based H2SG Energy Pte Ltd. In his role, Kolodziejczyk develops hydrogen generation technologies and works with a number of customers throughout the Asia-Pacific region to implement hydrogen solutions in transportation, energy storage, and other industrial applications. Kolodziejczyk became interested in hydrogen power in 2009 while developing and testing fuel cell inverters for Danfoss Solar Inverters A/S. Kolodziejczyk holds a master's degree in Renewable Energy Science with focus on Fuel Cell Systems and Hydrogen awarded jointly by the University of Iceland and the University of Akureyri, as well as two PhDs in Materials Engineering from Monash University in Australia and Microelectronics from Ecole des Mines de Saint-Etienne in France. Kolodziejczyk has extensive research experience in electrochemistry, catalysis, fuel cell development, and hydrogen generation. He was a Research Fellow at Carnegie Mellon University, where he explored materials for biosensing and energy applications. Kolodziejczyk has advised the United Nations, Organisation for Economic Co-operation and Development (OECD), G20, and European Commission Council of Science, Technology, and Innovation Policy and was named one of MIT Technology Review's Innovators Under 35 for developments of new energy materials and catalysts. Kolodziejczyk has published extensively, covering electrocatalysis and hydrogen generation and its application, among other energy fields. Kolodziejczyk is a Fellow of the Royal Society of Arts, Member of the Royal Society of Chemistry, and Chartered Environmentalist.

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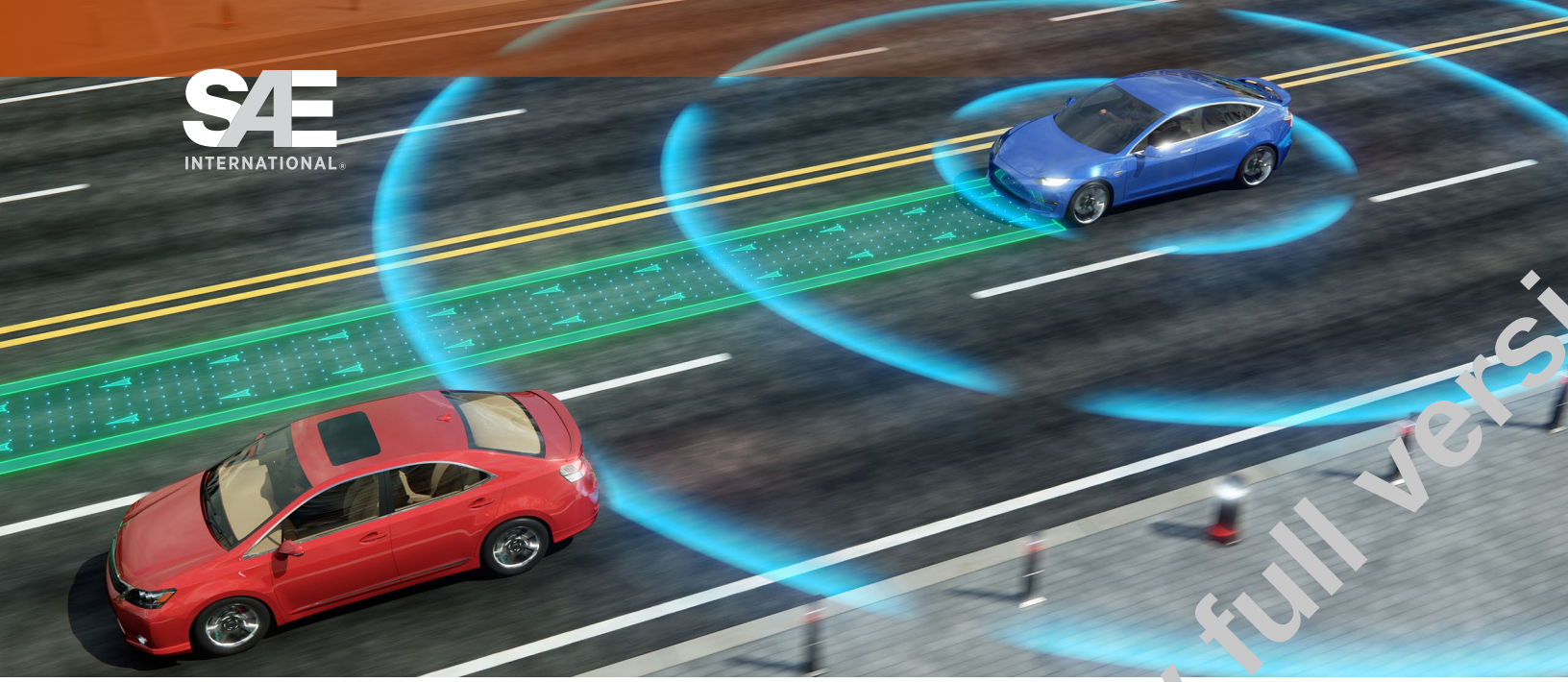

Unsettled Issues Concerning the Use of Fuel Cells in Electric Ground Vehicles

Abstract

Hydrogen fuel is rapidly emerging as a clean energy carrier solution that has the potential to decarbonize a variety of industries, including, or predominantly, the transportation industry. Fuel cell electric vehicles (FCEVs), which electrochemically combine stored hydrogen with atmospheric oxygen to efficiently generate electricity while producing only water vapor and small amounts of heat, are heralded to be a game-changing technology. The so-called hydrogen economy has the potential to displace traditional fossil fuel-based economy, with the transportation industry being the first mover in the hydrogen space.

Technological advances made in the last decade in the areas of hydrogen generation and fuel cell technology have enabled the current uptake of hydrogen-based solutions for vehicle applications. Reduced costs, climate change, and carbon tax mechanisms are driving many governments, manufacturers, and consumers toward hydrogen-powered vehicles. The major drawbacks of hydrogen compared to the other competing clean-energy technologies (e.g., battery power), is the high cost of hydrogen refueling and FCEVs. However, application of the economy of scale will enable further cost reduction and broad international uptake of hydrogen in automotive applications.

This Society of Automotive Engineers (SAE) EDGE™ Research Report explores the opportunities and challenges of hydrogen and fuel cell systems in the automotive industry. With the help of experts from various sectors, several different technological, economic, and safety aspects are considered to develop a better understanding of this emerging hydrogen-based automotive industry. While debates between proponents of battery electric vehicles (BEVs) and FCEVs continue, the current report discusses the unsettled issues in the latter technology and presents a critical overview of the hydrogen and fuel cell systems in the automotive industry. Finally, the report concludes with a series of recommendations aimed at the industry and government stakeholders for implementing and advancing hydrogen transportation projects.

NOTE: SAE EDGE™ Research Reports are intended to identify and illuminate critical issues in emerging, but still unsettled, technologies of interest to the mobility industry. The goal of SAE EDGE™ Research Reports is to stimulate discussion and work in the hope of promoting and speeding resolution of identified issues. SAE EDGE™ Research Reports are not intended to resolve the issues they identify or close any topic to further scrutiny.

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