

# Making Fuel Cells Cleaner, Better, and Cheaper

Highlights in  
Research and Development

NREL helps reduce contaminants in fuel cells, enabling the industry to cut costs and commercialize state-of-the-art technologies.

As fuel cell systems become more commercially competitive, and as automotive fuel cell research and development trend toward decreased catalyst loadings and thinner membranes, fuel cell operation becomes even more susceptible to contaminants. Therefore, the National Renewable Energy Laboratory (NREL) and its partners have performed research on contaminants derived from fuel cell system component materials. Such materials include structural plastics, lubricants, greases, adhesives, sealants, and hoses. Contaminants from all of these components affect the performance and durability of fuel cell systems.

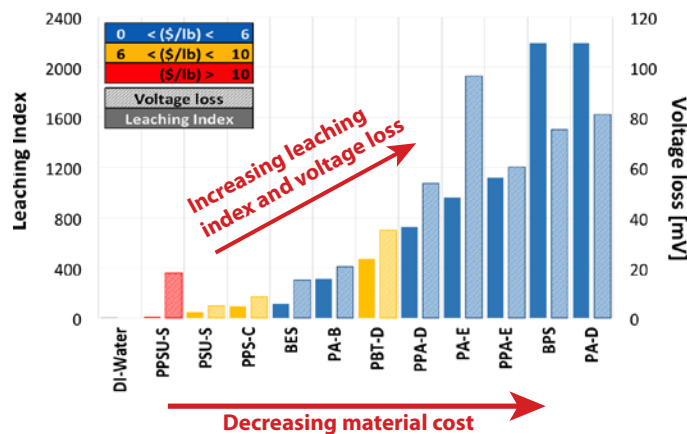
Between July 2009 and September 2013, NREL led a team to study the effect of system contaminants on the performance of polymer electrolyte member fuel cells. NREL collaborated with General Motors, the University of South Carolina, and others to screen about 60 balance of plant materials. The materials are from different manufacturers, comprise different chemistries, and are used for different functions.

The team assembled the contaminant database by first identifying classes of contaminants, then testing them to assess the impact of each class on fuel cell performance and the reversibility of the contaminant's impact. Contamination models were then developed from the knowledge gained about the contamination mechanisms. The team determined that the fundamental classes of contaminants included epoxy, silicone, urethane, and numerous polymers, especially fluoropolymers, polybutylene terephthalate (PBT), polyphthalamide (PPA), and polyamide (PA), among others.

The fuel cell community can now easily benefit from the study because NREL designed an interactive online tool that both archived the study results and allows users to screen materials according to contaminant characteristics. (The tool is also available to the public.) By knowing the contamination potential of various system components, fuel cell developers can select appropriate fuel cell materials during the design phase, and perform more accurate cost-benefit analyses. Thus, the industry can continue to reduce overall costs, which will enable commercialization of fuel cell technologies.

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**References:** "Hydrogen and Fuel Cell Research: Contaminants" (2014). National Renewable Energy Laboratory. <http://www.nrel.gov/hydrogen/contaminants.html> (See "System-Derived Contaminants," Data Tool tab)



NREL research has shown that less expensive fuel cell materials leach more contaminants and cause more voltage loss. Graph by Huyen Dinh, NREL

## Key Research Results

### Achievement

NREL and its partners have completed an extensive study of plastic materials that may be used in fuel cell systems, and published a comprehensive database about possible contamination effects from those materials.

### Key Result

NREL designed an interactive online tool to help fuel cell developers and materials suppliers explore the results of the contaminants study.

### Potential Impact

By having a better understanding of 1) the degree of contamination caused by different materials and 2) the contaminating species, fuel cell developers will be able to specify materials for their fuel cell systems that minimize contamination. Material suppliers will be better prepared to provide highly desirable (i.e. low-contaminating) materials to their customers. By reducing contamination in fuel cells, overall performance and durability will likely improve and overall costs will likely decrease. Such cost savings could enable and quicken commercialization of fuel cell technologies.

**NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.**

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