

# Clean-vehicle research initiative making progress

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A public-private effort to develop technologies for more fuel-efficient automobiles and to investigate the feasibility of hydrogen-based vehicles has made significant progress in most research areas, says a new report from the National Research Council.

While several barriers hinder the program from achieving its full objectives, the potential benefits -- reducing dependence on imported oil and minimizing harmful environmental effects -- justify the cost of the research. A strategic reassessment of the overall program plan that accounts for new national and changed research priorities also should be developed, said the committee that wrote the report.

The FreedomCAR (Cooperative Automotive Research) and Fuel Partnership -- a research collaboration among the U.S. Department of Energy, the Detroit Three automakers, and five major energy companies -- seeks to develop technology that will allow U.S. automakers to decide by 2015 whether hydrogen-powered vehicles could be manufactured on a large scale. To achieve this goal, the program's partners are seeking safe, cost-efficient methods to produce hydrogen from traditional and renewable energy sources, as well as ways to deliver, dispense, and store hydrogen for vehicles. The program also sponsors research to reduce the size, weight, and cost of vehicle components to increase fuel efficiency. While pursuing these goals, the program is exploring technology that, in the short term, will provide more efficient and less polluting combustion engines, as well as electric batteries that could be used in hybrid-electric or all-electric vehicles.

"Since the Research Council's first review two years ago, the program has made great strides, and its managers have been generally thorough and receptive to the previous report's recommendations," said Craig Marks, committee chair and retired vice president for technology and productivity, AlliedSignal Inc., Bloomfield Hills, Mich. "The barriers the program faces are challenging, and require inventive solutions that are technically feasible and economically viable in the automotive and fuel supply markets. For the industry to transition to a hydrogen-based vehicle used on a broad scale, the program will have to continue to be well-planned and managed with foresight."

In light of progress and shifts in the automotive market, such as the successful introduction of biofuels, the committee recommended the partnership review its activities strategically to ensure their continuing relevancy. A reassessment of the goals in each technical area will also provide a better basis for judging future funding levels for each part of the program.

The development of fuel cells and a supporting hydrogen infrastructure would provide the most efficient and least polluting means to power personal transportation vehicles, the committee concluded. However, the early systems now being tested still need significant improvements in durability and cost to enable the mass production and sale of vehicles. Such improvements are being pursued through promising new materials and designs for fuel-cell membranes and membrane electrode assemblies. The committee recommended the partnership reassess the current allocation of funding within the fuel-cell program and reallocate as appropriate, in order to prioritize and emphasize research and development that addresses the most critical barriers.

In addition, advances over the last two years have been made toward meeting FreedomCAR's battery goals, which are critical to achieving widespread support for hybrid, plug-in hybrid, and all-electric vehicles.

Lithium-ion batteries can satisfy the program's goals; however, the cost to produce batteries remains high, approximately two times the target. While lower cost materials and manufacturing methods are being researched, the partnership should conduct an in-depth review of production and market forces behind lithium-ion batteries and intensify its efforts to develop other high-energy batteries, the report recommends. The success of this battery research will largely determine the viability of batteries in mass-produced vehicles.

During the first review of the program, the Research Council determined that the most difficult, long-term challenge was solving the problem of hydrogen storage in vehicles. Hydrogen, whether in the form of a gas or liquid, takes up more space than gasoline, requiring large, heavy tanks and frequent refueling.

In the latest report, the committee found that storing enough hydrogen in the vehicle to provide a 300-mile driving range while simultaneously meeting weight, volume, and cost targets continues to be challenging, and it is still too early to have confidence in ultimate success. Both domestic and foreign automakers are putting demo fuel-cell vehicles on the road with high-pressure hydrogen storage tanks. However, meeting the program's goals will probably rely on a storage technology that is yet undiscovered. Nevertheless, progress has been made with the establishment of three centers of excellence, each with different approaches to finding ways to reduce the size and mass of hydrogen storage devices. The report recommends that the program continue to support and conduct basic research in this field to help foster possible breakthroughs.

Besides technical barriers, economic and societal restrictions will impede the completion of FreedomCAR's goal of a gradual transition from petroleum-based fuel to hydrogen. The committee acknowledged that the partnership's Technology Validation Program is a well-conceived

path to addressing some of these broader issues, and DOE is currently studying scenarios of the likely transition, including the economics involved. The report suggests extending these studies until 2030-2035 to account for the probable emergence of more mature hydrogen fuel systems and to ensure the most critical factors in production and delivery are understood.

Source: The National Academies

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