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CRS Report for Congress

Hydrogen and Fuel Cell Vehicle R&D: FreedomCAR and the President's Hydrogen Fuel Initiative

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Summary

FreedomCAR and the Hydrogen Fuel Initiative are two complementary government-industry research and development (R&D) policy initiatives that promote the development of hydrogen fuel and fuel cell vehicles. Coordinated by the Department of Energy (DOE), these initiatives aim to make mass-market fuel cell and hydrogen combustion vehicles available at an affordable cost within 10 to 15 years from the launch of the initiatives. However, questions have been raised about the design and goals of the initiatives. This report discusses the organization, funding, and goals of the FreedomCAR and Fuel partnerships, and issues for Congress.

Introduction

In his State of the Union Address on January 28, 2003, President George W. Bush announced a new $720 million research and development (R&D) initiative to promote hydrogen as a transportation fuel. The Hydrogen Fuel Initiative is intended to complement the FreedomCAR initiative,[1] which focuses on cooperative vehicle research between the federal government, universities, and private industry.

The FreedomCAR initiative replaced a related Clinton Administration initiative, the Partnership for a New Generation of Vehicles (PNGV), announced in 1993.[2] While both initiatives aimed to increase fuel efficiency of the automotive fleet, FreedomCAR extended the time frame by another 10 to 15 years and focused research on hydrogen fuel

[1] FreedomCAR (Cooperative Automotive Research) was announced on January 8, 2002 at the Detroit Auto Show by Energy Secretary Spencer Abraham.

[2] For a more detailed discussion of PNGV, see CRS Report RS20852, *The Partnership for a New Generation of Vehicles: Status and Issues*, by Brent D. Yacobucci.

cell vehicles; PNGV focused mainly on diesel-fueled hybrid vehicles.[3] Through FY2003, the overall level of funding for PNGV- and FreedomCAR-related research at the Department of Energy (DOE) remained relatively constant, with some of the funds for hybrid vehicles transferred to fuel cell research.[4] For FY2004, however, overall funding for research (within the Office of Energy Efficiency and Renewable Energy) into hydrogen fuel, fuel cells, and vehicle technologies increased by about 30%. Some of this increase was offset by funding reductions in other programs, but the major portion of the increase was new funding. For FY2005 through FY2008, funding for hydrogen and fuel cell R&D steadily increased. However, for FY2009, the Bush Administration has requested 30% below the FY2008 appropriation for hydrogen, fuel cell, and vehicle technologies programs. Much of that decrease would be offset by an almost doubling of related basic science research. Overall, the request is roughly 4% below FY2008 levels for all related research.

Organization and Funding

Most federal research on hydrogen fuel and fuel cell vehicles is overseen by two offices within the DOE Office of Energy Efficiency and Renewable Energy (EERE). The Office of FreedomCAR and Vehicle Technologies (FCVT) coordinates research on automotive fuel cells and other advanced vehicle technologies, including electric propulsion systems, vehicle systems, materials technology, and other areas. The Office of Hydrogen, Fuel Cells and Infrastructure Technologies (HFCIT) coordinates research on fuel cell technologies (for all applications, not solely transportation),[5] as well as research on hydrogen fuel production, delivery and storage systems. As part of its FY2006 budget request for the Hydrogen Fuel Initiative, DOE added ongoing research funded through three additional DOE offices, as well as a small amount of research funding at the Department of Transportation. The three DOE offices are the Office of Fossil Energy (FE), the Office of Nuclear Energy (NE), and the Office of Science (SC).

Members of the partnerships include the federal government and the national laboratories, as well as universities, state governments, vehicle manufacturers, energy companies, equipment manufacturers, and industry groups.

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[3] For more information on fuel cell and hybrid vehicle technology, see CRS Report RL30484, *Advanced Vehicle Technologies: Energy, Environment, and Development Issues*, Brent D. Yacobucci.

[4] It should be noted that PNGV research did not terminate *per se*. The majority of PNGV-related research is ongoing through FreedomCAR and other DOE programs.

[5] Key fuel-cell-related portions of the FreedomCAR partnership will actually be funded by the HFCIT program, through its Hydrogen Technology Budget.

Funding for FreedomCAR and Hydrogen Fuel Initiative research (including hydrogen-related research fossil energy research, nuclear hydrogen research and basic scientific research) is included in the Energy and Water Development appropriations bill.[6] Funding for these areas is shown in **Table 1**.

Table 1. FreedomCAR- and Hydrogen Fuel-Related R&D Funding

($ in millions)

DOE Office	Program	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY2009 Request
EERE-FCVT	FreedomCAR[a]	87.6	86.7	83.4	99	109.8	127.4	157.6
EERE-HFCIT	Fuel Cell Technologies[a]	57.0	63.8	0[d]	0[d]	0[d]	0[d]	0[d]
EERE-HFCIT	Hydrogen Technology[b]	40.0	80.4	166.8	155.6	189.5	211.1	146.2
Subtotal[b]		184.6	230.9	250.2	254.6	299.3	338.5	303.8
NE	Nuclear Hydrogen[b,c] Initiative	n.a.	6.2	8.9	24.8	18.8	9.9	16.6
FE	President's Coal Research Initiative — Fuels[a,c]	n.a.	21.3	16.5	21.6	21.5	24.8	11.4
SC	Basic Energy Research[b,c]	n.a.	7.7	29.2	32.5	36.4	36.4	60.4
	Department of Transportation[b]	n.a.	n.a.	0.5	1.4	1.4	1.4	1.4
Total		184.6	266.1	305.3	334.9	377.4	411.0	393.6

Notes: n.a. means funding levels not available.

a. Before FY2006, appropriations for Fuel Cell Technologies, FreedomCAR, and the President's Coal Research Initiative were contained in the Interior and Related Agencies appropriations bill.

b. Before FY2006, appropriations for Hydrogen Technology, the Nuclear Hydrogen Initiative, and Basic Energy Research were contained in the Energy and Water appropriations bill.

c. Before FY2006, only the FreedomCAR, Fuel Cell Technologies, and Hydrogen Technologies line items were considered part of the FreedomCAR and Hydrogen Fuel Initiative Budgets.

d. For the FY2007 budget request, DOE combined funding for the Fuel Cell Technology program within the funding for Hydrogen Technology. The comparable appropriations levels for previous years were similarly combined. DOE, *FY2007 Congressional Budget Request*. February 2006. Volume 3. p. 82.

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[6] Before FY2006, funding for several DOE programs, including vehicle technology and fuel cell research, was included in the Interior and Related Agencies appropriations bill. As of FY2006, all DOE funding is contained in the Energy and Water appropriations bill. U.S. Department of Energy (DOE), *FY2006 Congressional Budget Request*. February 2005. Volume 3. p. 61.

The mission of the Hydrogen Fuel Initiative is to "research, develop, and validate fuel cells and hydrogen production, delivery, and storage technologies for transportation and stationary applications."[7] Fuel cell R&D areas include transportation systems, stationary systems, fuel processing, fuel cell components, and technology validation. The focus of hydrogen fuel R&D includes hydrogen production and delivery, fuel storage, hydrogen infrastructure, safety, codes and standards, and training and education.

Partnership Goals

The FreedomCAR and the Hydrogen Fuel Initiatives have each set four goals for 2015, and share one additional goal between them. The shared goal is to produce hydrogen-fueled engine systems that achieve double to triple the efficiency of today's conventional engines at a cost competitive with conventional engines.

FreedomCAR's individual goals mainly focus on reducing system costs for various technologies. The FreedomCAR goals are to develop

- electric drive systems with a 15-year life and significantly reduced hardware costs;
- advanced internal combustion engine systems with double to triple the efficiency of current systems at no greater cost and no higher emissions than conventional engine systems;
- electrical energy storage with improved life and lower cost than current systems; and
- materials and manufacturing technologies that achieve a 50% weight reduction in vehicle structure, while maintaining affordability and increasing the use of recyclable/recycled materials.

The four goals for the Hydrogen Fuel Initiative focus on improvements in fuel cell technology and improvements in the storage and delivery of hydrogen fuel. The Initiative's goals are to develop

- hydrogen fuel cell power systems that are durable, and deliver higher efficiency at lower cost than today's systems;
- transportation fuel cell systems that deliver greater efficiency and lower cost, and meet or exceed emissions standards;
- hydrogen refueling systems that are highly efficient and deliver fuel at the market price of gasoline; and
- on-board hydrogen storage systems with improved energy density and cost over existing systems.

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[7] DOE, Hydrogen, Fuel Cells, and Infrastructure Technologies Program, *Mission, Vision, & Goals.* [http://www.eere.energy.gov/hydrogenandfuelcells/mission.html], updated January 29, 2003.

Debate Over the Initiatives

The creation of FreedomCAR and the President's Hydrogen Fuel Initiatives have raised debate over several issues. These issues include the proper role of the government in R&D, as well as the proper level of funding, and concerns over energy efficiency and fuel consumption.

Some environmental groups, including the Sierra Club, have criticized the initiatives. They argue that while funding has increased for efficient technologies, the initiatives do not require auto manufacturers to make fuel cell vehicles available to customers by any specific time.[8] Also, groups such as the Natural Resources Defense Council argued that the initiatives were put in place to forestall significant increases in national fuel economy standards.[9] However, in 2007 Congress enacted more stringent fuel economy standards for passenger cars and light trucks as part of the Energy Independence and Security Act of 2007 (P.L. 110-140).[10]

The Administration argues that the higher R&D funding will provide significant impetus for advancements in hydrogen and fuel cell technologies, and that without those advancements, the technology would be unaffordable for consumers.[11] Further, some engineers argue that FreedomCAR's efficiency and cost goals may be difficult to attain in the time frame of the program, and that any sort of sales goal would be unrealistic.[12] Moreover, industry groups argue that an explicit sales goal could force manufacturers to abandon R&D on other promising technologies like gasoline-electric hybrids.

Even among supporters of the program, there is criticism that FreedomCAR and the President's Hydrogen Fuel Initiative are under-funded and that additional government commitments to hydrogen and fuel cells must be made. According to some proponents, these commitments could take the form of increased R&D funding, expanded demonstration programs, vehicle and fuel sales or production incentives, and other incentives to make these vehicles attractive to customers.[13]

Finally, some critics argue there are too many technical and economic hurdles to the development of affordable, practical hydrogen and fuel cell technology, especially for automobiles, and that federal research should focus on more realistic goals.

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[8] J. L. Laws, "Budget II: Bush Ups Ante On Hydrogen-Powered Vehicles," *Greenwire.* January 29, 2003.

[9] Harry Stoffer, "Unmoved by Hydrogen, Critics Seek Higher CAFE," *Automotive News.* January 21, 2002. p. 3.

[10] For more information on fuel economy standards, see CRS Report RL33413, *Automobile and Light Truck Fuel Economy: The CAFE Standards*, by Brent D. Yacobucci and Robert Bamberger.

[11] Sheila Schimpf, "Abraham Says Hydrogen Plan to Focus On Lowering Costs, Developing Infrastructure," *Daily Environment Report.* February 10, 2003. p. A-11.

[12] Sheila Schimpf, "DOE Official Reaffirms Commitment to Developing Auto Fuel Cell Technology," *Daily Environment Report.* August 9, 2002. p. A-2.

[13] Carol Cole, "FreedomFuel Only 'First Step,' More Needed to Advance Hydrogen," *Octane Week.* February 10, 2003.

Research at Other Agencies

In addition to DOE, other government agencies are also involved in fuel cell vehicle R&D, although this funding is considerably lower. For example, the National Automotive Center (NAC), part of the Army's Tank-Automotive Research, Development, and Engineering Center (TARDEC), coordinates fuel cell vehicle research between the Department of Defense (DOD) and private contractors, and partners with DOE, the Department of Transportation (DOT), the Environmental Protection Agency (EPA), academia, and industry.

Current Legislation

The appropriations processes over the next few years will directly affect the future of FreedomCAR and the President's Hydrogen Fuel Initiative. Between FY2004 and FY2008, the Administration's stated goal was a funding increase for both initiatives of $720 million above FY2003 levels for FY2004 through FY2008. In total, Congress appropriated an additional $450 million in total between FY2004 and FY2008 for hydrogen, fuel cell, and advanced vehicle programs. Congress appropriated an additional $145 million for other programs, mainly basic sciences, for a total increase of roughly $600 million over that five-year period.

In addition to appropriations legislation, hydrogen and fuel cell vehicles are addressed by other recent legislation. On August 8, 2005, President Bush signed the Energy Policy Act of 2005 (P.L. 109-58). Among other provisions, P.L. 109-58 authorizes appropriations for hydrogen and fuel cell research at higher levels than requested by the President — $3.3 billion over five years. In addition to R&D funding, the bill provides tax incentives for the purchase of new fuel cell vehicles.

Issues for Congressional Consideration

FreedomCAR and the President's Hydrogen Fuel Initiative raise several key issues for Congressional consideration. Some of these issues are:

- Given rising federal deficits and the potential for increased defense costs, can the federal government afford the recent increase for hydrogen and fuel cell R&D?
- Should the federal government be picking hydrogen and fuel cell vehicle technologies over other technologies, such as hybrid vehicles and lean-burn engines?
- Would the designation of a target deadline for commercialization of fuel cell vehicles help focus the program and make better use of funding resources? Alternately, would such a deadline force manufacturers to abandon other promising technologies or create an unfair burden on the industry?
- Should the government focus on long-term research or should it focus on technologies closer to commercialization, or both?
- Is the widespread use of hydrogen and fuel cells technically and economically feasible, or is the government taking too large a risk on unproven technology?