United States General Accounting Office

GAO

Testimony

Before the Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, House of Representatives

For Release on Delivery
Expected at 9:30 a.m., EDT
Thursday, June 6, 2002

RESEARCH AND DEVELOPMENT

Lessons Learned from Previous Research Could Benefit FreedomCAR Initiative

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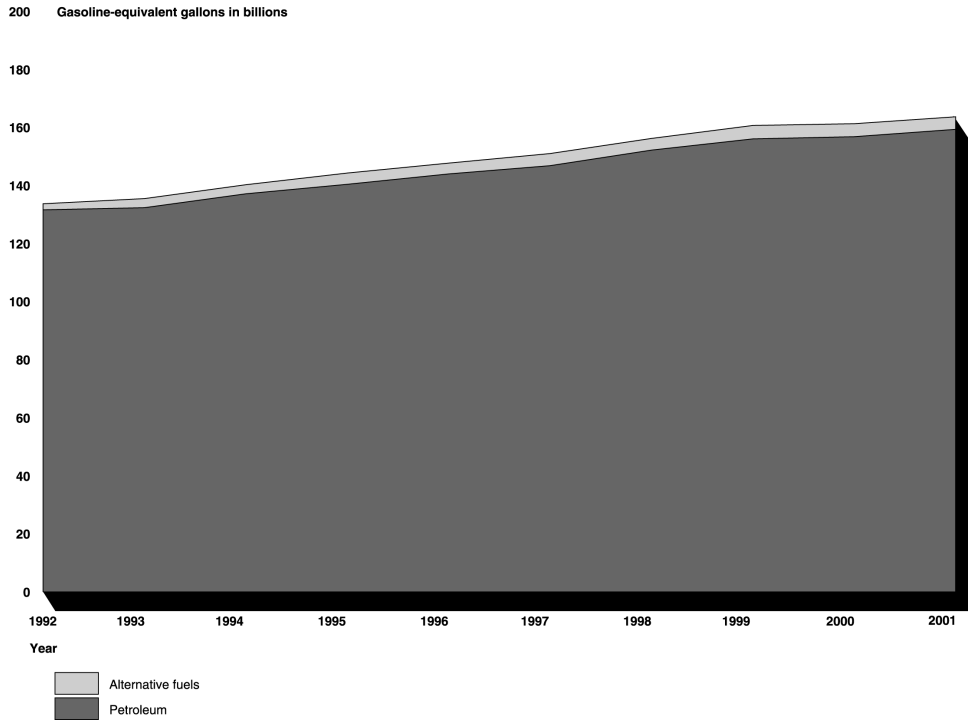
Mr. Chairman and Members of the Subcommittee

We are pleased to be here to discuss our previous work on federal research and development (R&D) initiatives that provide some useful insight as Congress considers the FreedomCAR initiative. [1] As you know, one of the major challenges facing the nation is to reduce the consumption of petroleum in the transportation sector. Transportation represented about two-thirds of total U.S. petroleum consumption and roughly one-quarter of total national energy consumption. Furthermore, the United States consumes about 45 percent of the gasoline consumed in the world. The nation's continued reliance on petroleum makes the sector highly vulnerable to the uncertainties of the world oil market and greatly increases the difficulty of achieving clean air objectives.

Over the past 25 years, the federal government has spent billions of dollars attempting to reduce the consumption of petroleum in the transportation sector. Throughout the period, we have tried a variety of means, such as tax incentives, mandates to use vehicles that run on alternative fuels, and laws designed to enhance fuel efficiency. More recently, the federal government conducted a $1.2 billion partnership between industry and government, the Partnership for a New Generation of Vehicle (PNGV), which focused on developing a highly fuel-efficient car. Clearly, some of these efforts, along with industry advances, have made many vehicles more fuel-efficient and less polluting than vehicles were a generation ago. However, any gains in fuel efficiency have been outpaced by increases in the total miles driven and the growing popularity of less fuel-efficient sport utility vehicles and light trucks. As a result, as shown in figure 1, the total amount of petroleum our vehicles consume continues to rise.

[1] See Related GAO Products.

Figure 1: Trends in Motor Vehicle Consumption of Petroleum and Alternative Fuels, 1992 through 2001



Note 1: Alternative fuels include ethanol and MTBE used as oxygenates in gasoline.

Note 2: Year 2002 data are forecasts.

Source: Energy Information Administration.

Further, about 97 percent of the total motor vehicle fuel consumption comes from petroleum. This is because consumers have not widely embraced vehicles that run on alternative fuels, such as natural gas, ethanol, or liquefied petroleum gas. As we have reported, these vehicles are often more expensive than traditional vehicles, few refueling stations are available, and the price of gasoline is lower today in real terms than the 30-cents-per-gallon gasoline sold in 1960.[2]

[2] U.S. General Accounting Office, GAO/RCED-00-59, *Energy Policy Act of 1992: Limited Progress in Acquiring Alternative Fuel Vehicles and Reaching Fuel Goals* (Washington, D.C.: Feb. 11, 2000).

In this context, the Administration has proposed a new initiative, known as FreedomCAR. Although the initiative is still in its early stages, it appears to be focused on developing hydrogen fuel cells that will provide the technology necessary to create cars and trucks that are free from petroleum and have no polluting emissions—without sacrificing safety or convenience. FreedomCAR will operate as a cooperative research effort between the Department of Energy and the automakers General Motors, Daimler-Chrysler, and the Ford Motor Company. The department has requested $150 million for FreedomCAR in fiscal year 2003 and will require additional funding for the initiative over the next 10 to 15 years.

As Congress considers the FreedomCAR initiative or any comparable federally sponsored research program, we would like to suggest four themes for congressional oversight, based on the lessons learned from 20 years of our work on R&D in many areas. Specifically, as you oversee the initiative, you may want to make sure that it

1. performs research that private industry would not do on its own,
2. specifies a clear and measurable goal,
3. devises a strategy to directly address that goal, and
4. considers whether consumers will buy the products resulting from the R&D.

While these lessons seem like common sense, let me elaborate a bit on each, using examples from previous GAO work to show how each is crucial to an R&D project's success.

Perform Research That Private Industry Would Not Do on Its Own

To ensure federal funds are being spent wisely, it is important to ask, "Would the private sector do the research without government funding?" Federal R&D programs have not always considered whether the federal funding is merely displacing private research rather than spawning new work. For example, when we spoke a few years ago to participants in the Department of Commerce's Advanced Technology Program (ATP), about 40 percent of program participants told us they would have performed the research done as part of the program even without federal funding.[3] Before

[3] U.S. General Accounting Office, GAO/RCED-96-47, *Measuring Performance: The Advanced Technology Program and Private-Sector Funding* (Washington, D.C.: Jan 11, 1996).

funding particular ATP projects, the Department of Commerce now considers whether industry would perform the R&D even without federal funding.

Specify a Clear, Measurable Goal

To be effective, any R&D program must be directed towards a clear goal and be reassessed periodically to see if the goal is still worth pursuing. For example, we noted that SEMATECH, the federal and industry consortium formed in 1987, succeeded in part because it clearly articulated both a goal—improve the competitiveness of U.S. manufacturing in semiconductors—and a method to achieve this goal—by building a state-of-the-art semiconductor using only equipment built in the United States.[4] In contrast, in 2000, we said a significant problem with the Department of Energy's performance plans for its "Science and Technology" business line was that the department did not clearly articulate its goals.[5] For example, the department sought as a goal to "pursue technology research partnerships with industry, academia, and other government agencies" without stating why it wanted to do so or how the goal helped to achieve the department's overall missions. We also reported that, although the PNGV began with a clear goal of developing a highly fuel efficient family sedan, the partnership did not later reassess the goal as consumer tastes shifted away from family sedans and towards light trucks and sport utility vehicles.[6]

Devise a Strategy That Directly Addresses the Goal

Although it may sound surprising, government-sponsored R&D programs have sometimes articulated a goal but then devised a strategy that did not directly address the goal. For example, in 2000, we noted that the Department of Energy sought to achieve one of its performance goals, "diversify the international supply of oil and gas," in part by continuing "leadership in international energy initiatives"—a strategy that seems

[4] U.S. General Accounting Office, GAO/RCED-92-223BR, *Federal Research: SEMATECH's Technological Progress and Proposed R&D Program* (Washington, D.C.: Jul. 16, 1992).

[5] U.S. General Accounting Office, GAO/RCED-00-268R, *Government Performance and Results Act: Information on Science Issues in the Department of Energy's Accountability Report for Fiscal Year 1999 and Performance Plans for Fiscal Years 2000 and 2001* (Washington, D.C.: Aug. 25, 2000).

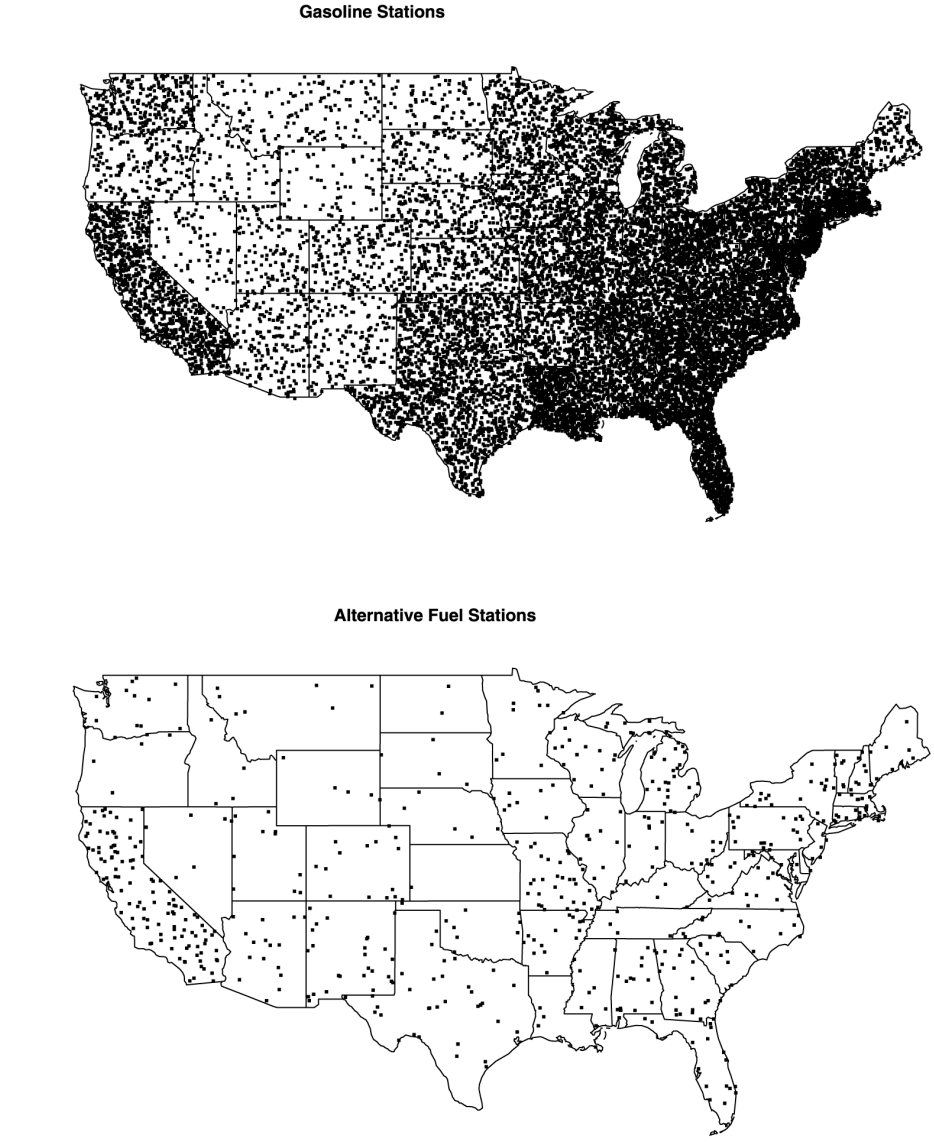
[6] U.S. General Accounting Office, GAO/RCED-00-81, *Cooperative Research: Results of U.S.--Industry Partnership to Develop a New Generation of Vehicles* (Washington, D.C.: Mar. 30, 2000).

somewhat vague and only tangentially related to the goal.[7] Similarly, the Energy Policy Act of 1992 established goals that alternative fuels replace at least 10 percent of petroleum fuels used in transportation by 2000 and at least 30 percent of petroleum fuels projected to be consumed in 2010. However, as we discussed in a 2000 report, the act's strategy mandated purchasing of alternative fuel vehicles rather than targeting the use of alternative fuels.[8] We noted that since some of these vehicles also run on gasoline, drivers often used gasoline in these vehicles, either because they were unaware the car could run on an alternative fuel, or because not many refueling stations are available for alternative fuels. As you consider the FreedomCAR initiative, it is important to recognize, as was the case with the alternative fuel efforts, that there is a lack of infrastructure for fuels other than gasoline, as shown in figure 2. This lack of infrastructure could pose a significant challenge to the implementation of FreedomCAR if the vehicles it develops run on fuels other than gasoline.

[7] U.S. General Accounting Office, GAO/RCED-00-209R, *Observations on the Department of Energy's Fiscal Year 1999 Accountability Report and Fiscal Year 2000/2001 Performance Plans* (Washington, D.C.: Jun. 30, 2000).

[8] U.S. General Accounting Office, GAO/RCED-00-59, *Energy Policy Act of 1992: Limited Progress in Acquiring Alternative Fuel Vehicles and Reaching Fuel Goals* (Washington, D.C.: Feb. 11, 2000).

Figure 2: Density of Refueling Stations for Gasoline and Alternative Fuels, 1999



Note: Each dot represents 10 refueling stations in the state, rounded up to the next highest 10 (e.g., a geographic location of stations in the state.

Source: Energy Information Administration.

Even when an R&D program at the outset clearly defines where it wants to go and creates a logical strategy to get there, things often change along the way—new technologies develop, better approaches are found, and

consumer tastes or needs change. As a result, those who manage R&D programs should consistently build in "reality checks" to ensure the strategy still helps to achieve the goals. Planners need to establish interim milestones that are meaningful, achievable, and can be reconsidered as the project progresses. For example, although the PNGV did not achieve its ultimate goal, the partnership did incorporate interim milestones that allowed it to reevaluate the progress of research efforts and reallocate spending towards the most promising technologies.[9]

Consider Whether Consumers Will Buy the Product

Research for its own sake can deliver basic scientific discovery and expand general human understanding, but to increase energy efficiency and reduce the reliance on oil, the FreedomCAR program must remain focused on developing technologies that are competitive in the marketplace. Unfortunately, in some of our work, we have seen that federal research sometimes produces compelling technical accomplishments, but few marketable products. In 1995, we reported that, although the U.S. Advanced Battery Consortium could potentially achieve its intermediate technical goals, the resulting batteries would be too expensive and would perform too poorly to enable electric cars equipped with them to be competitive with traditional automobiles.[10] In our report on the PNGV, we noted that the partnership developed some products that car manufacturers adopted into their existing vehicles. However, industry officials told us that consumers would probably not buy the vehicle the Partnership sought to create because the costs would be too high.[11]

In conclusion, Mr. Chairman, the FreedomCAR initiative's plan to develop fuel cell technologies represents an exciting area of research. Yet, based on our reviews of previous federal R&D initiatives, it will be critical for the initiative to keep one eye on achieving technical goals and one eye on the marketplace. Moreover, the ultimate success of the new FreedomCAR initiative should be judged by its contribution towards reducing the

[9] See GAO/RCED-00-81.

[10] U.S. General Accounting Office, GAO/RCED-95-234, *Electric Vehicles: Efforts to Complete Advanced Battery Development Will Require More Time and Funding* (Washington, D.C.: Aug. 17, 1995).

[11] See GAO/RCED-00-81.

nation's use of petroleum in transportation, rather than by reaching specific technical R&D goals.

Mr. Chairman this concludes my prepared remarks. We would be pleased to answer any questions you or any Members of the Subcommittee may have.

Contacts and Acknowledgements

For further information, please contact Jim Wells at (202) 512-3841. Key contributors to this testimony included Jim Wells, Dan Haas, Vondalee Hunt, Jon Ludwigson, Ilene Pollack, and Daren Sweeney.

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