February 5, 2002

FreedomCAR:
Energy Security for America's Transportation

[Agreement between Department of Energy and
United States Council for Automotive Research]

Vision:
Affordable full function cars and trucks are free of foreign oil and harmful emissions, without sacrificing safety, freedom of mobility and freedom of vehicle choice.

Message:
America's transportation freedoms:

- Freedom from petroleum dependence
- Freedom from pollutant emissions
- Freedom to choose the vehicle you want
- Freedom to drive where you want, when you want
- Freedom to obtain fuel affordably and conveniently

National Benefits:
Ensure the Nation's transportation energy and environmental future, by preserving and sustaining America's transportation freedoms. In other words, Freedom and Security made available through Technology.

> The government and industry research partners recognize that the steady growth of imported oil to meet our demand for petroleum products is problematic and not sustainable for the Nation in the long term. No single effort limited to one economic sector can successfully change this trend. Altering our petroleum consumption patterns will require a multi-tiered approach, including policy and research programs, across every end use sector of our economy. The transportation sector has a significant role to play in addressing this challenge, and success resulting from the FreedomCAR research initiatives will help accomplish the broader National Goals and Objectives that are being pursued.

Strategic Approach:

- Develop technologies to enable mass production of affordable hydrogen-powered fuel cell vehicles and assure the hydrogen infrastructure to support them.
- Continue support for other technologies to dramatically reduce oil consumption and environmental impacts.
- Instead of single vehicle goals, develop technologies applicable across a wide range of passenger vehicles.

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Technology Specific 2010 Goals [1]

- To ensure reliable systems for future fuel cell powertrains with costs comparable to conventional internal combustion engine/automatic transmission systems, the goals are:

  - Electric Propulsion System with a 15-year life capable of delivering at least 55kW for 18 seconds, and 30kW continuous at a system cost of $12/kW peak.

  - 60% peak energy-efficient, durable fuel cell power system (including hydrogen storage) that achieves a 325 W/kg power density and 220 W/L operating on hydrogen. Cost targets are at $45/kW by 2010 ($30/kW by 2015).[2]

- To enable clean, energy-efficient vehicles operating on clean, hydrocarbon-based fuels powered by either internal-combustion powertrains or fuel cells, the goals are:

  - Internal combustion engine powertrain systems costing $30/kW, having a peak brake engine efficiency of 45%, and that meet or exceed emissions standards.

  - Fuel cell systems, including a fuel reformer, having a peak brake engine efficiency of 45%, and that meet or exceed emissions standards with a cost target of $45/kW by 2010 and $30/kW in 2015.[2,3]

- To enable reliable hybrid electric vehicles that are durable and affordable, the goal is:

  - Electric drivetrain energy storage with 15-year life at 300 Wh with discharge power of 25 kW for 18 seconds and $20/kW.

- To enable the transition to a hydrogen economy, ensure widespread availability of hydrogen fuels, and retain the functional characteristics of current vehicles, the goals are:

  - Demonstrated hydrogen refueling with developed commercial codes and standards and diverse renewable and non-renewable energy sources. Targets: 70% energy efficiency well-to-pump; cost of energy from hydrogen equivalent to gasoline at market price, assumed to be $1.25 per gallon (2001 dollars).[4]

  - Hydrogen storage systems demonstrating an available capacity of 6 weight percent hydrogen, specific energy of 2000 W-h/kg, energy density of 1100 W-h/liter at a cost of $5/kWh.[5]

  - Internal combustion engine powertrain systems operating on hydrogen with a cost target of $45/kW by 2010 and $30/kW in 2015, having a peak brake engine efficiency of 45%, and that meet or exceed emissions standards.

- To improve the manufacturing base, the goal is:

- Material and manufacturing technologies for high volume production vehicles which enable/support the simultaneous attainment of:
  - 50% reduction in the weight of vehicle structure & subsystems,
  - affordability, and
  - increased use of recyclable/renewable materials.

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1. Cost references based on CY 2001 dollar values. Where power (kW) targets are specified, those targets are to ensure that technology challenges that would occur in a range of light-duty vehicle types would have to be addressed.
2. Does not include vehicle traction electronics.
3. Includes fuel cell stack subsystem, fuel processor subsystem and auxiliaries; does not include fuel tank.
4. Targets are for hydrogen dispensed to a vehicle assuming a reforming, compressing and dispensing system capable of dispensing 150 kilograms per day (assuming 60,000 SCF per day of NG is fed for reforming at the retail dispensing station) and servicing a fleet of 300 vehicles per day (assuming 0.5 kgs used in each vehicle per day). Targets are also based on several thousand stations, and possibly demonstrated on several hundred stations. Technologies may also include chemical hydrides such as sodium boro-hydride.
5. Based on lower heating value of hydrogen; allows over 300-mile range.