Testimony of Alan Weverstad
Before the House Science Committee
Regarding GM Advanced Technology Vehicle Plans
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Good morning. My name is Alan Weverstad and I am Executive Director for Environment and Energy in the GM Public Policy Center. I am pleased to be able to speak to you today regarding GM's near and longer term plans for development and implementation of advanced technologies into our future vehicles.

GM has always been a leader in the development and use of technologies in vehicles. From the move away from hand-cranked starters -- to the highly successful catalytic control technology for vehicle emissions -- to efforts to produce an innovative electric vehicle in the 1990s, GM has been instrumental in the implementation of advanced technologies.

Today, we are continuing to focus on ways to advance vehicle fuel economy, safety and emissions. And GM is actively engaged in all of these activities. We have a plan to address both the needs of our customers and the critical public policy issues facing us. This plan includes near term steps, such as continuing to make improvements to today's internal combustion engines and transmissions and increased E85 flexfuel capability; mid-term steps, such as more affordable and flexible hybridization of vehicles; and long-term steps, such as fuel cells powered by hydrogen. The answer to today's energy issues is not simple, and we believe that all of these technologies will play an important role in America's energy future.

Today, I am here to speak about our work in these areas.

GM is leading the effort on flexfueled vehicles capable of running on gasoline or E85 ethanol. These vehicles offer a choice to consumers -- a choice that has significant energy and economic benefits. Ethanol is renewable and, in high concentration blends, helps reduce greenhouse gas emissions; as E85 it helps reduce U.S. dependence on petroleum, diversifies our sources of transportation fuel, and reduces smog-forming emissions.

Ethanol usage provides great opportunities for the domestic agriculture industry and should help spur new job growth in other areas.

Until last fall there was limited interest in the development of ethanol as an alternative fuel. But when gasoline prices spiked in the aftermath of the hurricanes that devastated the Gulf Coast, ethanol became more visible and GM recognized an opportunity to become part of the solution. Earlier this year, General Motors launched a national advertising campaign, beginning with the very visible 2006 Super Bowl, hosted in our own home city of Detroit. After the Super Bowl, we continued through the 2006 Winter Olympics, including launching our "Live Green, Go Yellow" website. Traffic to that website quickly rose to the millions -- as consumers wanted to know more about E85, GM flexfuel vehicles and station locations.

But that was just the beginning. With nearly two million E85 capable vehicles already on the road and a plan to offer 14 separate E85 capable models in 2007, we wanted to make sure our customers knew when they were getting this flexfuel capability. So, GM launched a labeling effort that included an external badge on the vehicle noting its flexfuel capability and a yellow gas cap to remind customers that their vehicle is capable of running on E85.

We have also embarked upon several significant partnerships to increase the availability of the ethanol fueling infrastructure. Most recently, GM partnered with Meijer, CleanFuelUSA, the State of Michigan and the State of Indiana to work toward approximately forty new retail outlets. We have previously announced similar partnerships in California, Illinois, Minnesota and Texas -- working with a variety of energy companies, state agencies, and distribution outlets.

For the U.S., the growth of the ethanol industry raises enormous potential for displacing gasoline consumption in the transportation sector. If all of the 5 million flexfueled vehicles on the road today were fueled using E85, the U.S. could offset the need for 3.6 billion gallons of gasoline annually. And for the individual

consumer, regularly filling a 2007 Chevrolet Tahoe with E85 would displace the use of over 600 gallons of gasoline each year. These are impressive numbers, so we need to find ways to increase availability of E85 in the marketplace.

Although E85 technology is generally well known, it is not costless to the manufacturers. Each E85 flexfuel capable vehicle requires fuel system materials with improved corrosion resistance. The fuel system parts involved include the fuel tank, fuel pump, the fuel level sender, the on-board diagnostic pressure sensor and the fuel injectors. Both the fuel pump and the injectors must be sized for significantly higher flow rates to compensate for E85's lower energy density. The cylinder heads and valve materials within the engine need to be able to withstand E85's different chemical properties. And finally, the fuel system software and calibrations must be tailored to recognize E85 or gasoline and adjust the fueling and spark timing accordingly. Effecting all of these changes across a range of vehicles will take time – especially for full-line automakers like GM, which have a variety of engines and fuel systems that will need to be modified. In some cases – for low volume products or new direct injection technologies – it may well not be cost effective to add this technology – especially since ethanol will not be displacing gasoline across the board, like unleaded gasoline did in replacing leaded gasoline.

On the hybrid technology front, later this year, we will introduce the 2007 Saturn Vue Green Line Hybrid, the first GM vehicle powered by a new, more affordable hybrid system. With a fuel economy improvement of approximately 20% over the Vue's conventional engine, the Saturn Vue Green Line is expected to deliver an estimate 27 mpg in the city and 32 mpg on the highway, the best highway mileage of any SUV. This new, more affordable hybrid system reduces fuel consumption in five ways. First, the system shuts off the engine when the vehicle is stopped, to minimize idling. Second, the system restarts the engine promptly when the brake pedal is released. Third, fuel is shut-off early while the vehicle is decelerating. Fourth, vehicle kinetic energy is captured during deceleration (regenerative braking) to charge an advanced nickel metal hydride battery. And finally, the

battery is charged when it is most efficient to do so. This new and more affordable hybrid technology is leading the way for GM to offer the all new two-mode full hybrid Chevy Tahoe and GMC Yukon in 2007.

In addition, GM is evaluating the potential for and cost effectiveness of plug-in hybrid electric vehicles (PIHEVs). Essential to make this technology a success are lower cost, lighter, faster charging batteries that can be used to propel the vehicle in most local commuting and other trips (up to 20 miles or more) without needing to use the internal combustion engine. While extensive battery research is being done, we are still not at the point where this technology is ready for widespread implementation From GM's prior work on pure electric vehicle technology (especially production of the EV1) and through the company's broad work in hybrid technology, GM sees several challenges automakers will need to overcome to get this technology into the market.

The first is the significant cost challenge that is already present with hybrid vehicles, but then is amplified with the addition of plug-in capability. The increase in battery size is the most significant contributor to this additional cost.

Secondly, the additional battery mass and volume present considerable technical challenges to the vehicle design. With the pressure today to reduce vehicle mass and packaging space already at a premium for hybrid vehicles, this is a challenge that requires significant advances in battery mass and volume to accommodate.

Thirdly, the PIHEV will require advances in battery technology, specifically the development of a battery that has long life with high charge/discharge capabilities needed to propel the vehicle during EV operation. Promising results have been seen with next generation lithium ion battery technology, but this still requires study to know that the full range of vehicle performance characteristics can still be met.

Looking to the long-term, General Motors has placed very high priority on fuel cells and hydrogen as the power source and energy carrier for automobiles. To accomplish this, GM's fuel cell program is focused on lowering cost and increasing reliability of the fuel cell stacks, demonstrating the promise of the technology

through validation programs and collaborating with other parties on the infrastructure issues that need to be addressed. We have made significant progress in several of these areas:

- In the last six years, we have improved fuel cell power density by a factor of seven, while enhancing the efficiency and reducing the size of our fuel cell stack.
- We have significantly increased fuel cell durability, reliability, and cold start capability.
- We have developed safe hydrogen storage systems that approach the range of today's vehicles.
- We have made significant progress on cost reduction through technology improvements and system simplification.

With respect to collaboration, we are working with key partners on virtually every aspect of fuel cell and infrastructure technology. The FreedomCAR and Fuel Partnership, managed through the U.S. Department of Energy, has proven to be an important forum for addressing these issues and challenges.

Clearly huge challenges remain. Reliability of the fuel cell stacks and storage of the hydrogen on board the vehicle must be resolved to draw American consumers to these vehicles. And the fueling infrastructure must be available so that owners of these vehicles have no concerns about where to get the hydrogen.

In conclusion, there is no one single solution to the challenges we face. We are concentrating our energies on a number of different fronts, and believe that many of these technologies will coexist in the marketplace. General Motors has a rational advanced technology plan that goes from near term, focused on alternative fuels like E85 ethanol, to the long term hydrogen-powered fuel cells. We are executing that plan. All of these will help to simultaneously reduce U.S. energy dependence, remove the automobile from the environmental debate, and stimulate economic and jobs growth.

ALAN R. WEVERSTAD, Executive Director Mobile Emissions and Fuel Efficiency, Public Policy Center, General Motors Corporation. Mr. Weverstad began his career in 1971 in the engineering area with Pontiac Motor Division where he worked as a design release & development engineer in the chassis and engine development sections. In 1985 he became a part of the Chevrolet-Pontiac-GM of Canada team where he was involved in the emission certification of 77 engine families. He then joined the Marine Engine Division and in 1991 moved to the Environmental Activities Staff and GM Research working on vehicle emissions issues. He is now the Executive Director of the Environment & Energy Staff of the Public Policy Center.

Mr. Weverstad is the immediate past chairman of the California Fuel Cell Partnership and vice president of the Engine Manufacturers Association. He is also on the board of directors for the Electric Drive Transportation Association and on the board of advisors for UC Riverside and California H_2 Highway.

Mr. Weverstad is a graduate of General Motors Institute and holds a Bachelor of Science degree in Engineering from Oakland University.