General Motors
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General Motors Technology Update

STRATEGY

For GM, energy diversity and alternative propulsion technologies that improve fuel economy and reduce emissions are the keys to developing sustainable transportation. GM's strategy to do this includes the following elements:

- GM is improving the traditional internal combustion engine with advanced technologies that save fuel such as Active Fuel Management, Six Speed Transmissions, and Variable Valve Timing; and with the use of alternative fuels like E85 ethanol.
- GM has pledged a broad commitment to producing electrically-driven vehicles that help diversify energy sources, reduce emissions and improve fuel efficiency. Vehicles include hybrids, plug-in hybrids, extended range electric vehicles and hydrogen fuel cell vehicles.

FUEL ECONOMY

- GM is committed to continually improving the fuel economy of its vehicles with various advanced technologies.
- For the 2007 model year, GM offers 24 vehicle models that achieve 30 miles per gallon or more on the highway, as estimated by the Environmental Protection Agency (EPA), this is more than any other automaker.
- GM is focused on applying advanced fuel-saving technologies to the highest consuming vehicles first, so as to realize the greatest amount of fuel savings.
- In the past three decades, new vehicle fleet fuel economy has more than doubled for passenger cars and increased 60 percent for light trucks.

E85 ETHANOL

- Producing E85 flexible fuel vehicles is part of GM's strategy to reduce vehicle emissions and dependency on petroleum.

- GM is increasing its E85 vehicle production by 25 percent. Today, GM has more than 2 million E85 flexible fuel vehicles on the road in all 50 states, and by the end of the decade GM will more than double that amount.

- In late 2006, GM, along with Ford and Chrysler, announced that America's domestic auto companies were prepared to make fully half of their annual vehicle production bio-fuel capable by 2012, provided there is ample availability and distribution of E85 ethanol.
- To help expand the availability of E85 ethanol in the U.S., GM has announced partnerships in 13 states to locate more than 235 new E85 ethanol fueling pumps at stations in these areas. GM will continue to work on establishing more partnerships to do the same.
- For the 2007 model year, GM offers the following E85 FlexFuel vehicles:

Chevrolet Tahoe	GMC Yukon
Chevrolet Suburban	GMC Yukon XL
Chevrolet Avalanche	GMC Sierra
Chevrolet Silverado	GMC Savana
Chevrolet Impala	Buick Terraza
Chevrolet Monte Carlo	Pontiac Montana SV6 (Canada only)
Chevrolet Uplander	
Chevrolet Express	

HYBRIDS

- In the U.S., GM's strategy is to save as many gallons of fuel as possible by first applying hybrid technology to high-volume and high fuel consuming vehicles like mass transit buses, full-size trucks and SUVs.
- GM will build 12 different hybrid models on its highest volume car and truck platforms, and deliver those vehicles with no compromises in performance.
- Current hybrid portfolio:
  - GM Allison two-mode hybrid system for transit buses debuted in 2003. The diesel-electric drive system uses the most efficient parallel hybrid architecture available in the world today which improves fuel economy and lowers emissions.
  - Introduced the world's first full-size hybrid pickup truck in 2004 with the Chevrolet Silverado Hybrid Truck and the GMC Sierra Hybrid Truck. Provides a 10 percent fuel economy savings – and the highest estimated city fuel economy of any full-size or mid-size truck.
  - 2007 Saturn Vue Green Line Hybrid debuted fall 2006. Achieves an EPA-estimated 27 mpg in the city and 32 mpg highway – the best highway mileage of any SUV.
  - 2007 Saturn Aura Green Line is on sale now (March 2007). This is GM's first hybrid passenger car, providing an estimated 30 percent improvement in unadjusted, combined EPA fuel economy ratings (28 city / 35 highway) compared to the base 2007 Saturn Aura XE (20 city / 30 highway). It also has the lowest MSRP of any hybrid available, at$22,695.

- Upcoming hybrid vehicles:
  - Will introduce the world's first 2-mode hybrid system in 2007 with the 2008 Chevrolet Tahoe and 2008 GMC Yukon. The hybrid system

will be mated with Active Fuel Management to provide at least 25 percent improved fuel economy (based on unadjusted composite fuel economy).
- In 2008(CY), the Saturn Vue Green Line will be the industry's first front-wheel-drive vehicle to utilize GM's new, 2-mode hybrid system. It is expected to achieve up to a 45 percent improvement in combined city and highway fuel economy compared with the non-hybrid Vue.
- Saturn Vue Green Line plug-in hybrid - GM has plans to produce this, but a production date is dependent upon the availability of appropriate battery technology. The vehicle will have the potential to achieve double the fuel efficiency of any current SUV.

HYDROGEN FUEL CELL VEHICLES

- GM continues to see hydrogen fuel cells as the best long-term solution for reducing dependency on oil.
- GM is a leader in fuel cell technology and we have demonstrated our fuel cell vehicles around the world in places like Washington, D.C., Tokyo, Berlin, Shanghai and Korea. In fact, in September 2006, GM announced plans for the largest market test of fuel cell vehicles in the world. "Project Driveway" will entail the loan of 100 Chevrolet Equinox Fuel Cell vehicles to every day drivers, celebrities, and other dignitaries to gauge interest, consumer reaction, and vehicle performance.
- GM's goal is to design and validate a fuel cell propulsion system by 2010 that is competitive with current combustion systems on durability and performance, and that ultimately can be built at scale affordably.

EXTENDED RANGE ELECTRIC VEHICLES - CHEVROLET VOLT (CONCEPT)

- The Chevrolet Volt concept electric vehicle is the first variant off GM's E-Flex system. The E-Flex System is a family of electric vehicle propulsion systems built into a common chassis. An on-board engine or fuel cell creates electricity and extends the range of the vehicle.
- The Chevrolet Volt, for most daily commutes, could nearly eliminate going to the gas station altogether and greatly reduce tailpipe emissions.
- The Chevrolet Volt has a long driving range:
    - **40 Mile Daily Driving Pattern** - The Chevy Volt will use zero gasoline and produce zero emissions and could nearly eliminate going to the gas station altogether.
    - **60 Mile Daily Driving Pattern** - Drivers who travel 60 miles a day (over 21,000 miles per year) would save nearly 570 gallons of gasoline annually (compared to a similar size vehicle that averages 30 mpg) averaging about 150 mpg.
    - **Extended Road Trips**: The Chevrolet Volt has an impressive range of 640 miles averaging nearly 50 mpg. The range extending power source will continuously recharge the Volt's battery for the duration of the trip.

- The E-Flex System is a flexible propulsion system that produces electricity and fits into a common chassis. Its on-board generator is capable of converting and storing electricity from energy carriers such as hydrogen, gasoline, E85 ethanol, bio-diesel and diesel.
- Configured as a pure fuel cell, the E-Flex system reduces the size of the lithium-ion energy batteries and eliminates the internal combustion engine.

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