



General Motors

Fuel Economy and Energy Diversity





2020

1.1 billion vehicles

Circle the earth 125 times



Our Mission

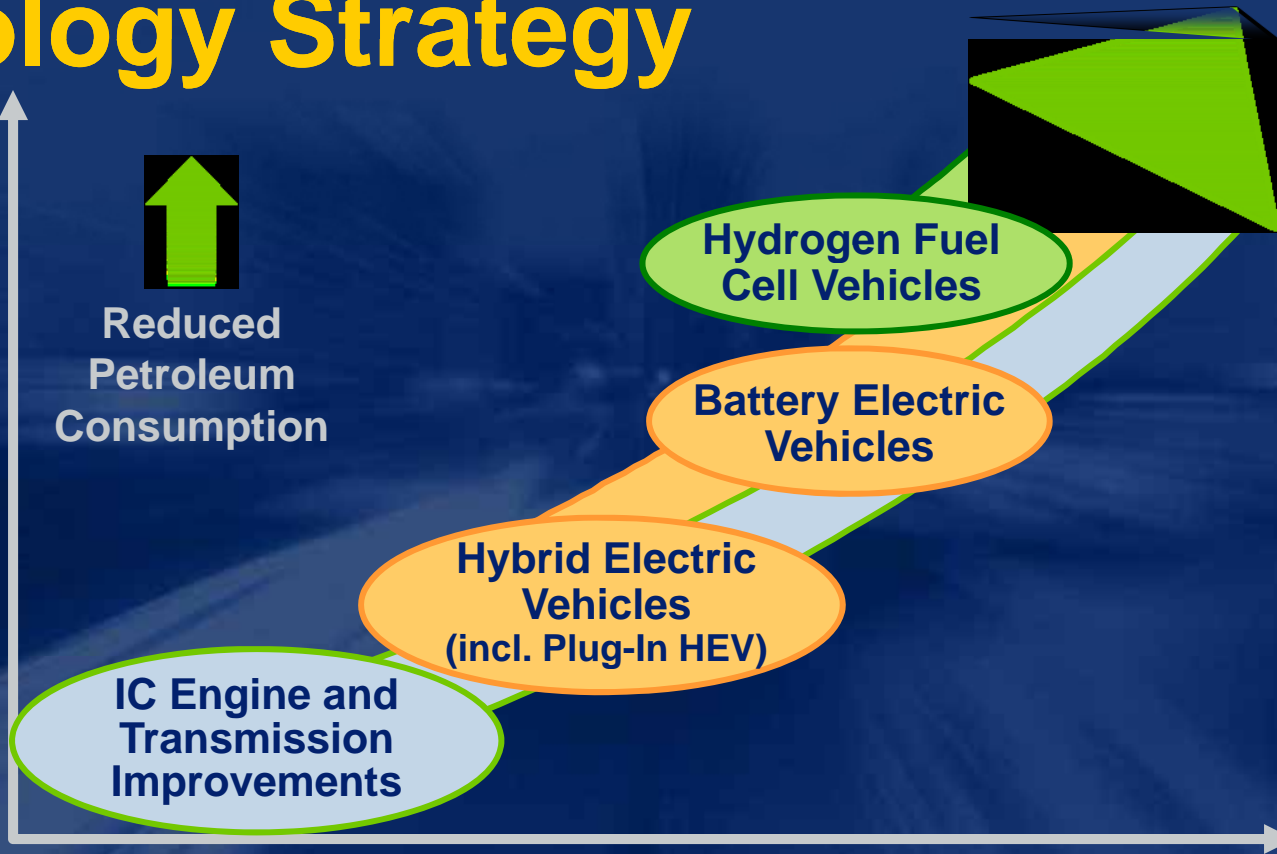
- **Improve Fuel Economy and Reduce Vehicle Emissions**
- **Energy Diversity**
- **Reduce dependence on petroleum**



Advanced Propulsion Technology Strategy


Improved
Vehicle Fuel
Economy &
Emissions


Reduced
Petroleum
Consumption



**Fuel
Infrastructure**

Petroleum *(Conventional & Alternative Sources)*

Bio Fuels *(Ethanol E85, Bio-diesel)*

Electricity *(Conventional & Alternative Sources)*

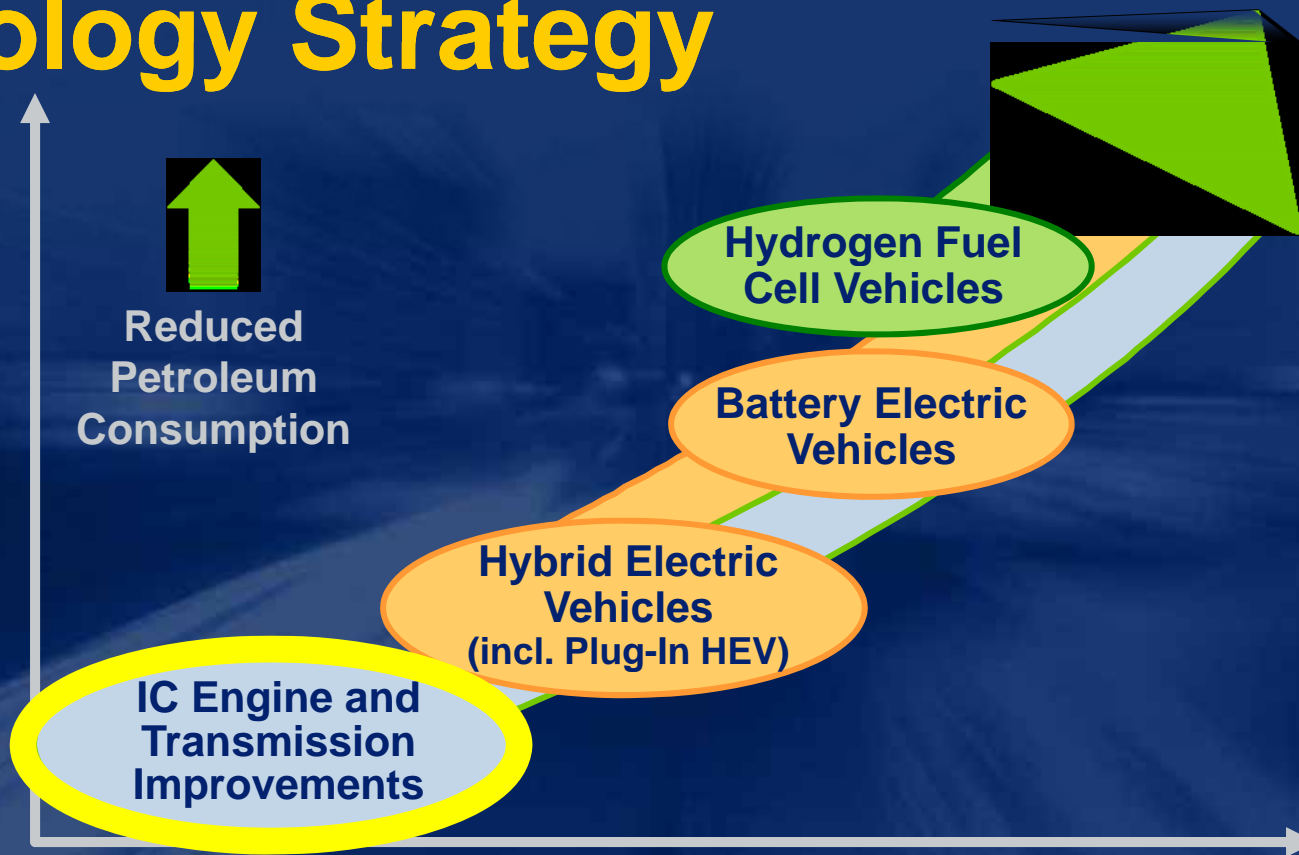
Hydrogen



Advanced Propulsion Technology Strategy

↑
Improved Vehicle Fuel Economy & Emissions

↑
Reduced Petroleum Consumption



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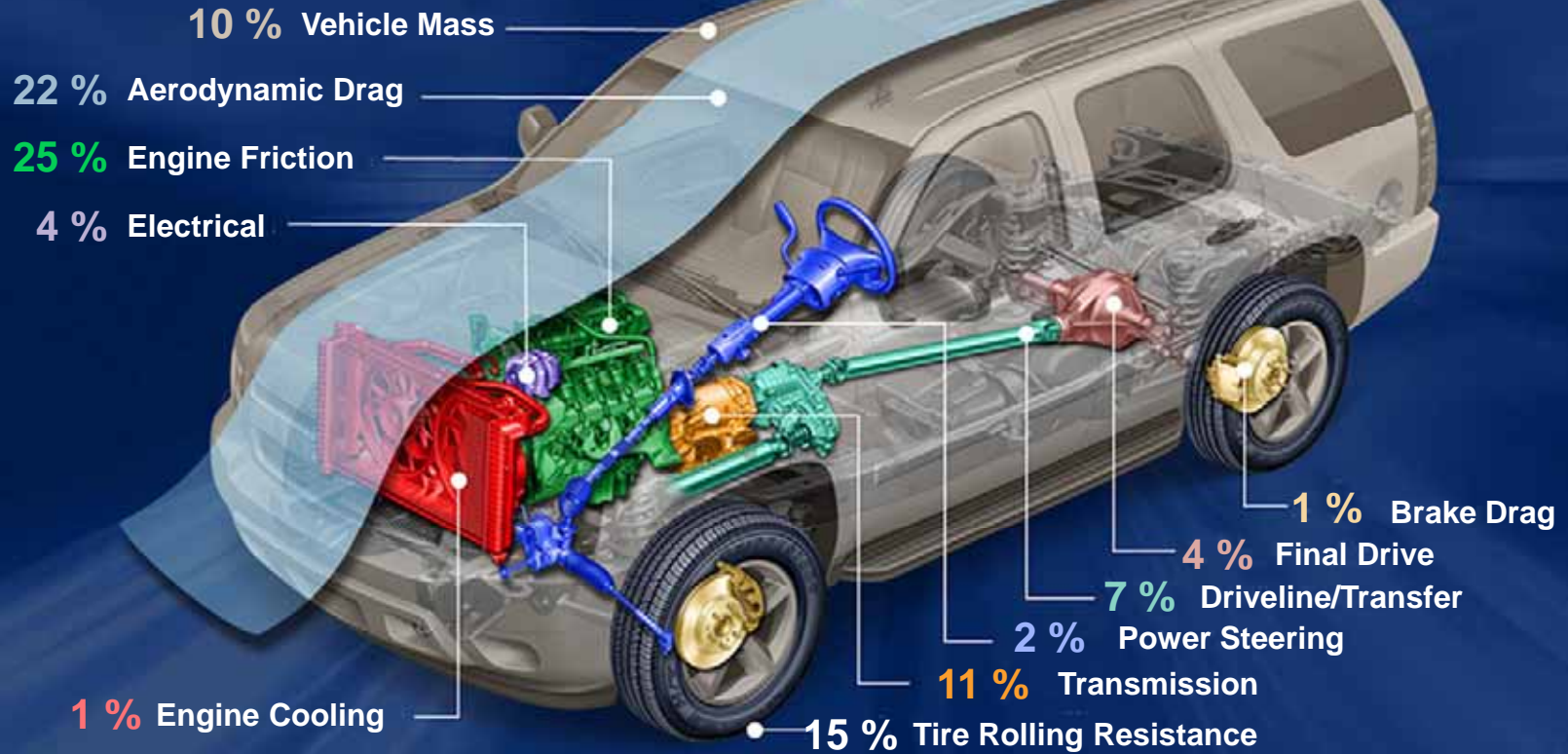
Hydrogen



How We Engineer Fuel Economy

Typical Truck Mechanical Energy Losses

Mechanical Energy = 37% of fuel energy for a typical gasoline engine



GM's Total Vehicle Approach To Fuel Economy

VEHICLE TECHNOLOGIES



Aerodynamic Drag Reduction 1–5%

Regulated Voltage Control 1%



Electric Cooling Fans 1%

Mass Reduction 2%



Low Chassis Losses 1%

Variable Displacement A/C Compressor
3–5% off-cycle



Electric Power Steering 1–2%



GM's Total Vehicle Approach To Fuel Economy

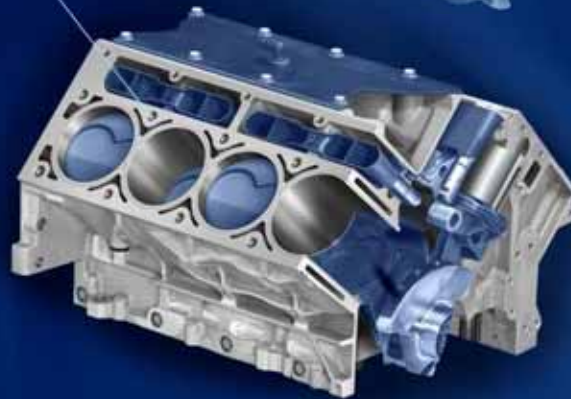
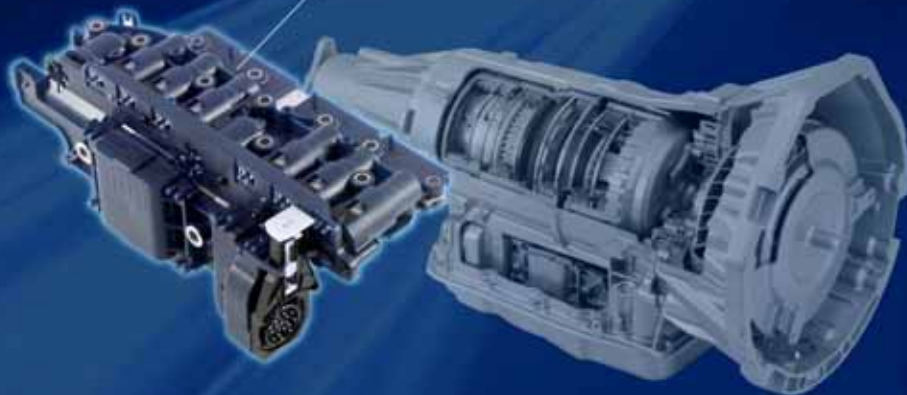
POWERTRAIN TECHNOLOGIES

Active Fuel Management 7–12%

Variable Valve Timing 1–3%

6-Speed Automatic 2–7%

Mass Reduction 1%



GM

COLLECTION

THE GM "OVER 30 MPG CLUB"



Chevrolet Cobalt
32 MPG



Chevrolet Aveo
34 MPG



Pontiac G6
34 MPG



Pontiac Vibe
34 MPG



Chevrolet Malibu
32 MPG



Saab 9-3 Sport Combi
30 MPG



Chevrolet Monte Carlo
31 MPG



Saab 9-3 Sport Sedan
30 MPG



Pontiac Grand Prix
30 MPG



Buick LaCrosse
30 MPG



Chevrolet Impala
31 MPG



Saturn Ion
32 MPG



Chevrolet Aveo 5
34 MPG



Saab 9-3 Convertible
30 MPG



Saturn Vue Hybrid
32 MPG



Chevrolet HHR
30 MPG



Saturn Sky
31 MPG



Pontiac G5
32 MPG



Saab 9-5 Sport Sedan
30 MPG



Pontiac Solstice
31 MPG



Saab 9-5 SportCombi
30 MPG



Chevrolet Malibu Maxx
30 MPG



Saturn Aura
30 MPG

(EPA Highway Labels)

*EPA ratings for 2007 MY vehicles

GM



E85

- Alternative fuel consisting of 85 percent ethanol and 15 percent gasoline
- Typically produced today in the U.S. from corn and other grain products
- In the future -- may be economically produced from other biomass resources
- Lower fuel economy (-25%) offset by emissions benefits and decrease in petroleum consumption

Benefits

- Ethanol is a renewable fuel
- Helps to reduce greenhouse gas emissions
- Reduces dependence on petroleum
- Better vehicle performance
 - Higher octane rating gives more horsepower and torque
- Aids in reducing smog forming emissions
- Supports U. S. domestic agriculture industry.



The GM U.S. "FlexFuel Club"

16 models for 2007 MY!

Over 2 Million on the Road



Chevrolet Silverado



Chevrolet Impala



Chevrolet Monte Carlo



GMC Sierra



GMC Yukon & Yukon XL



Chevrolet Avalanche, Suburban & Tahoe



GMC Savana



Chevrolet Uplander



GM Global Portfolio

Renewable Fuels Capability

GM has sold 2 million FlexFuel E85-capable vehicles in the U.S. and is building more than 400,000 every year.

50-percent of annual production will be Flex Fuel capable by 2012.

In Brazil, FlexPower is now available in every GM passenger car model. FlexPower models account for 90% of sales.

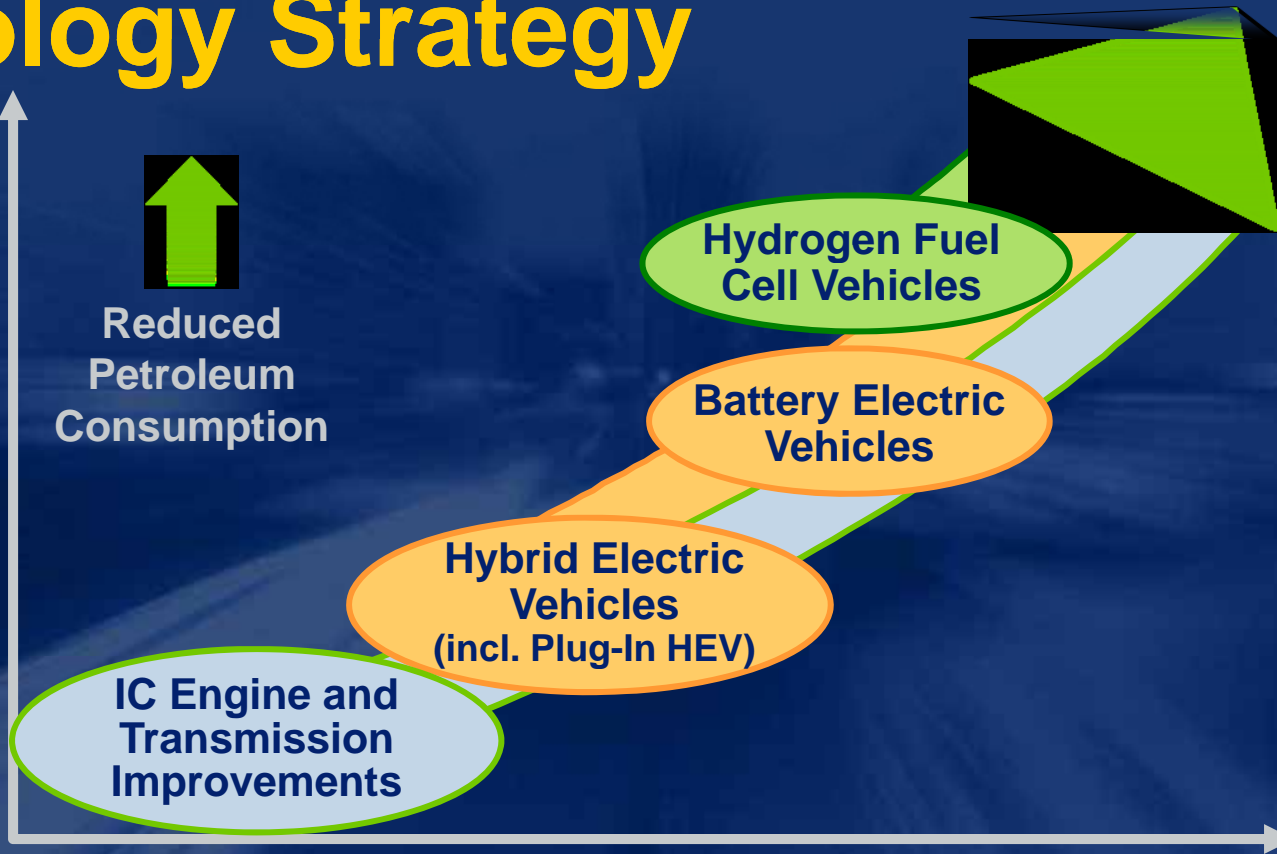
In Sweden, Saab leads the environment-friendly car segment with 9-5 BioPower, accounting for 85% of Saab 9-5 sales.



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IC Engine and
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Improvements

Hybrid Electric
Vehicles
(incl. Plug-In HEV)

Battery Electric
Vehicles

Hydrogen Fuel
Cell Vehicles

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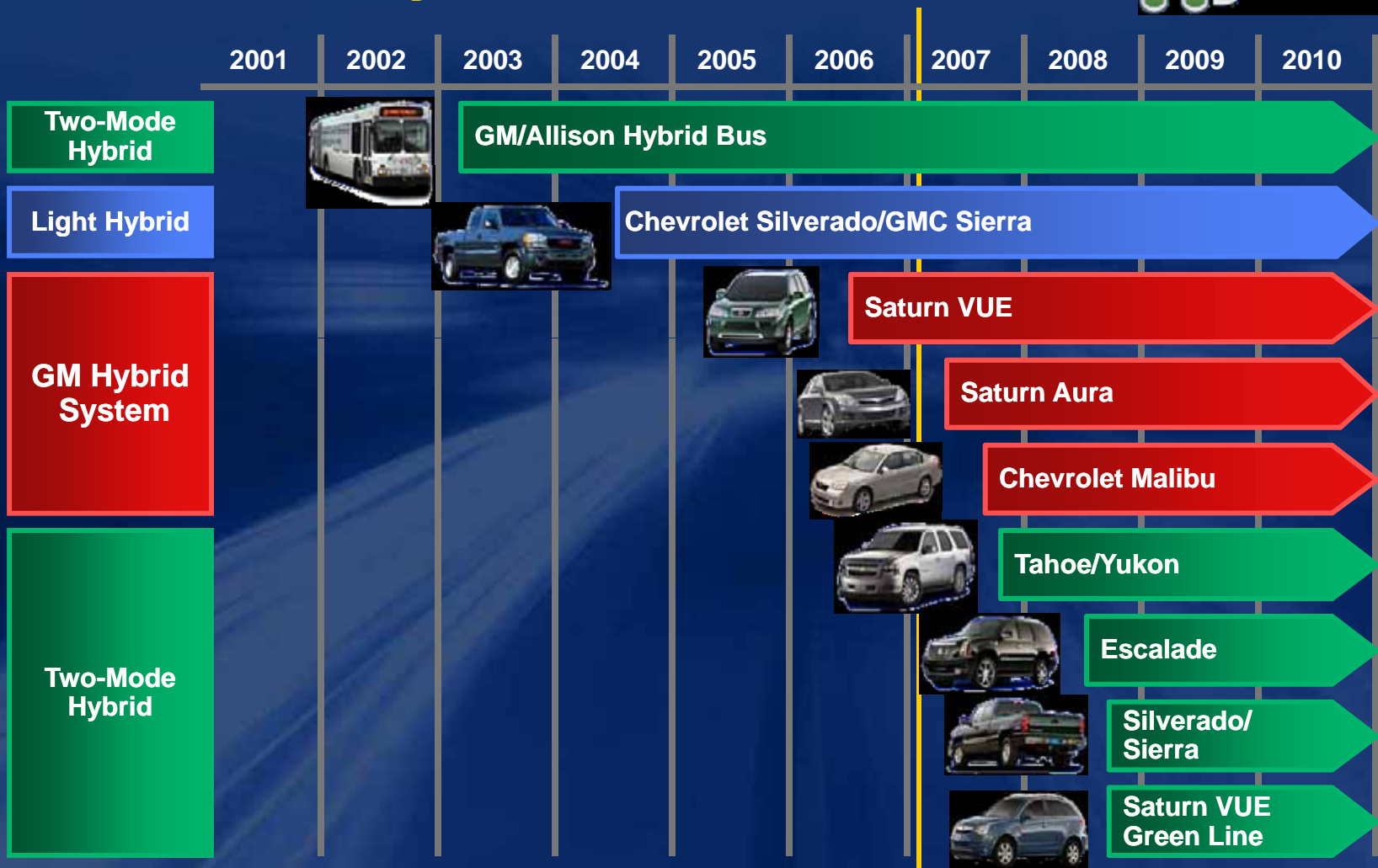
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GM's Hybrid Portfolio



Revised December 08, 2006

Today

GM Hybrid System

Saturn Vue Green Line

Available since September 2006

Operation

- Engine off when vehicle is stopped
- Fuel cutoff during coasting
- Regenerative braking
- Intelligent charging of advanced hybrid battery
- Electrical power boost for acceleration

Benefits

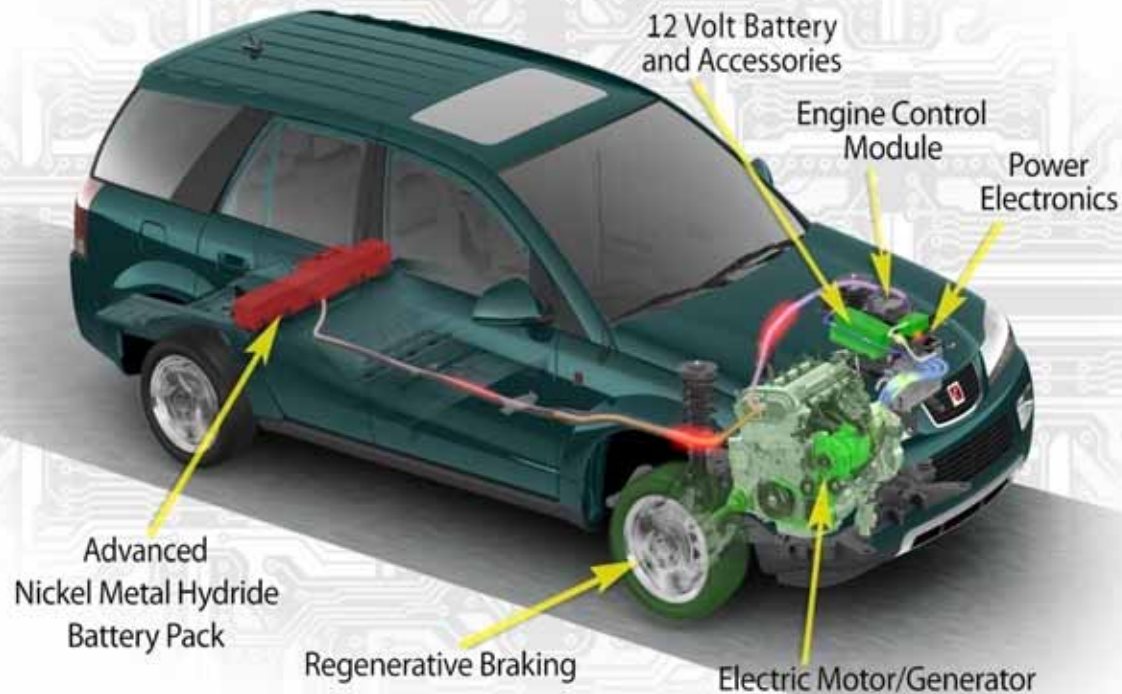
- 20% improvement in fuel economy
 - 5 mpg for both hwy (32mpg) and city (27mpg)
- No sacrifice in room, power or utility
- Combination of price and improved fuel economy make this the best value hybrid system on the market



The GM Hybrid system is one of the most affordable hybrid choices in the world
Base price under \$23,000



GM Hybrid System for Saturn VUE Green Line



GM Full-Size Truck

2-Mode Hybrid

Operation

- 2-Mode Hybrid provides both city & highway fuel consumption improvements
- Engine off at idle
- Fuel cutoff during coasting
- Strong regenerative braking
- Low-speed electric-only propulsion
- Advanced Miller cycle engine with Active Fuel Management



2008 MY
Tahoe-Yukon

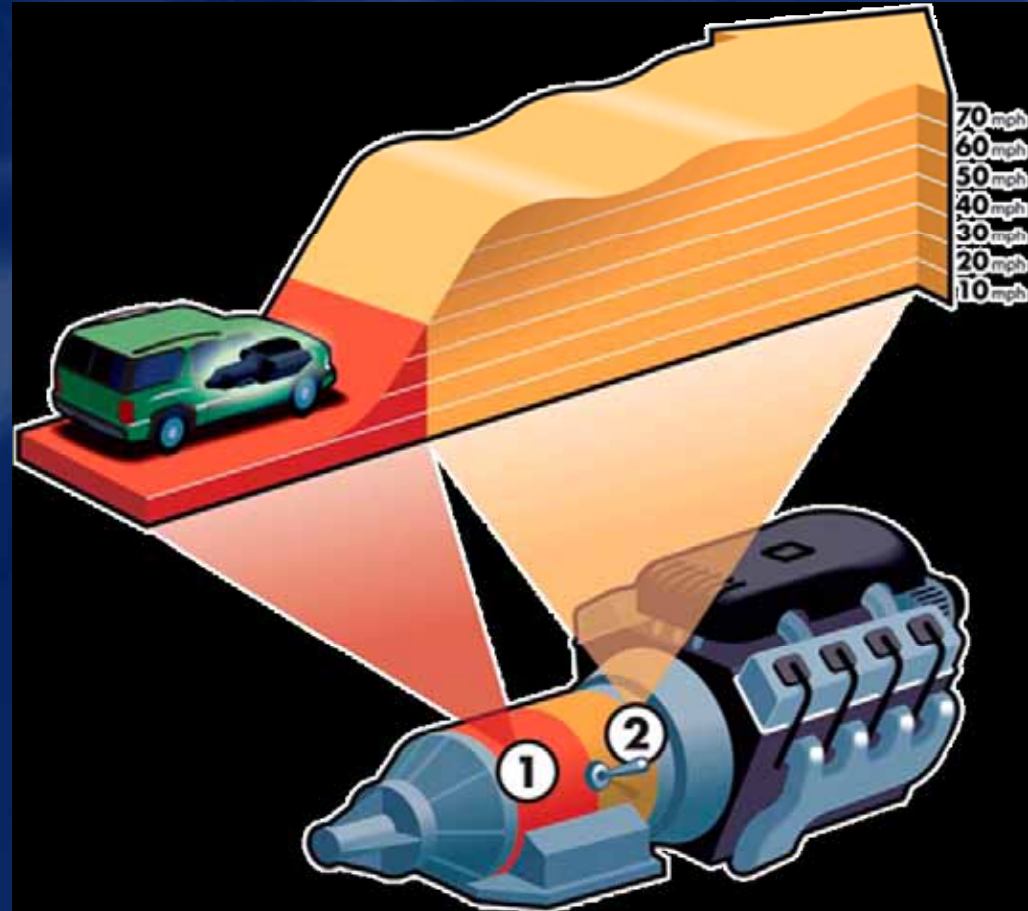
Benefits

- +25% overall fuel economy improvement
- Maintains SUV performance, towing and utility



Two-Mode Hybrid System

- Provides full hybrid capability and efficiency as well as superior acceleration and continuous power
- Two ECVT modes optimize engine speed for efficiency
- Fixed-gear operation maximizes efficiency at high speeds and heavy loads
- Leverages GM's two-mode hybrid electric bus system
- GM-DCX-BMW collaboration



Chevrolet VOLT Concept Vehicle

- Revealed at the 2007 NAIAS in Detroit
- Represents first application of GM's E-Flex System
- Fusion of design and technology



VOLT



E-FLEX



E-Flex System

Family of Electric Vehicle Propulsion Systems

Pure electric drive... not a typical hybrid

Adaptable to a range of energy sources

- Short range EV with energy supplied by grid charging or an on-board ICE (range extender)
- Fuel Cell with electricity supplied by Hydrogen
- Full battery-electric using grid charging (technology dependent)

Sets the stage for a more diverse range of energy resources

Engineering development has been initiated



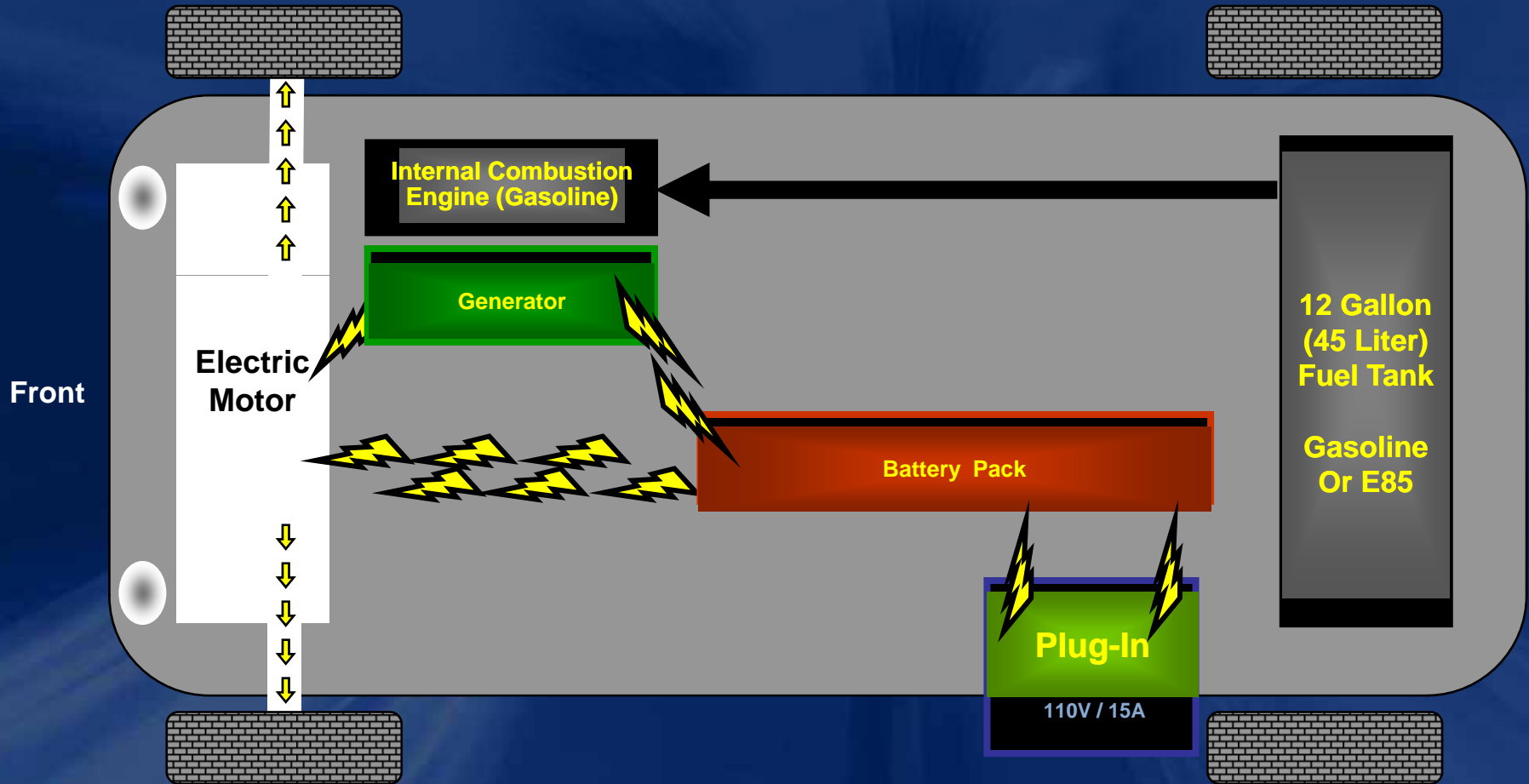
**The Chevrolet Volt Concept Vehicle is capable of 40 miles (64 km) of pure electrical vehicle driving.
(based on EPA city cycle)**



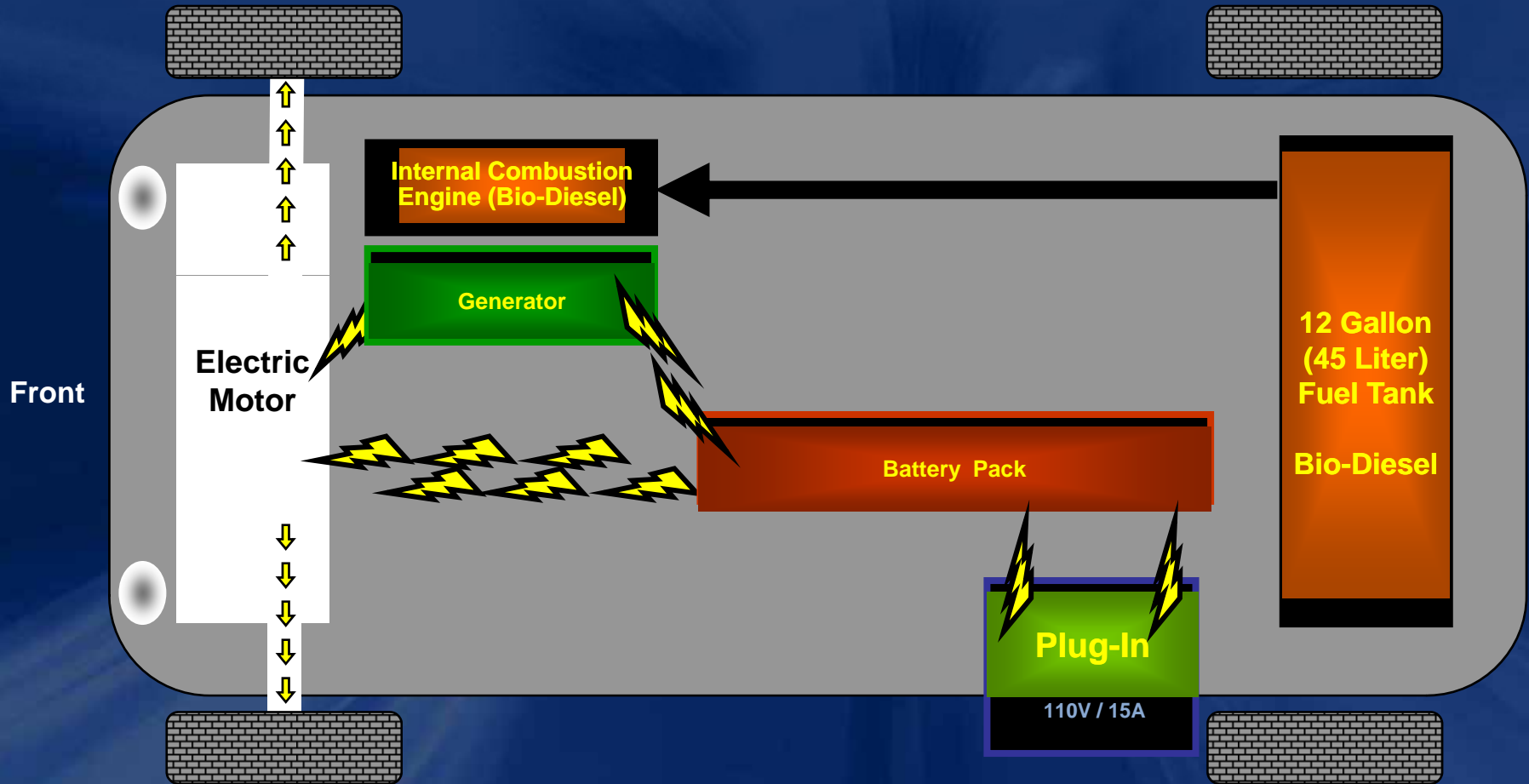
For many drivers, the Chevrolet Volt will use little or no gasoline.



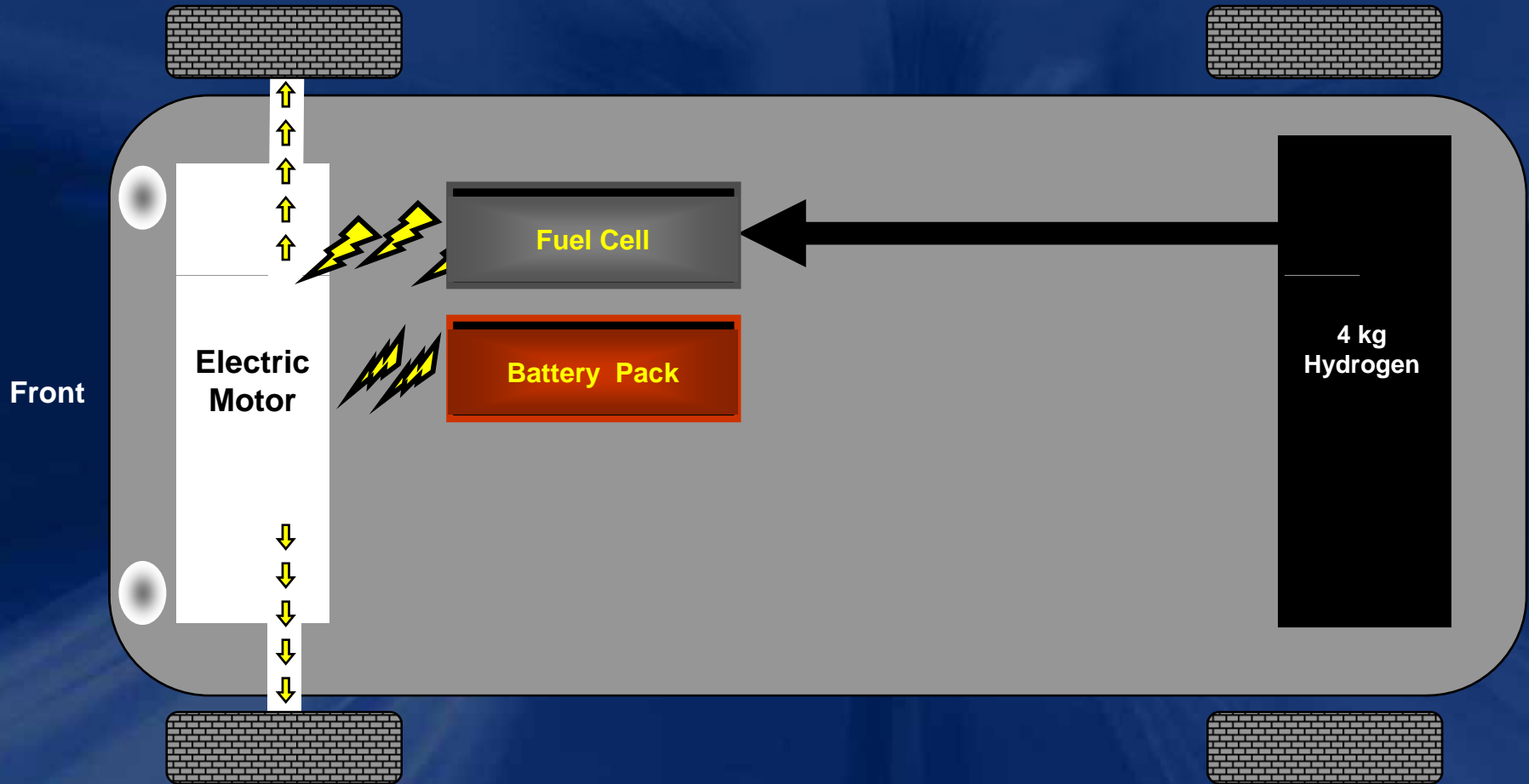
E-Flex System Flexible Propulsion System Schematic



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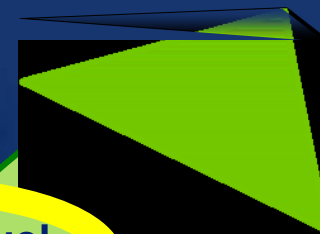

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GM's Fuel Cell Development

- Since 2001, GM has developed a range of fuel cell vehicles to demonstrate its commitment to fuel cell technology
 - HydroGen3 demonstrated how a fuel cell system could be packaged into a conventional vehicle design
 - Autonomy demonstrated how we could totally reinvent the automobile by combining fuel cells and by-wire technology
 - The Hy-wire was the world's first drivable fuel cell and by-wire vehicle



GM's Fuel Cell Development

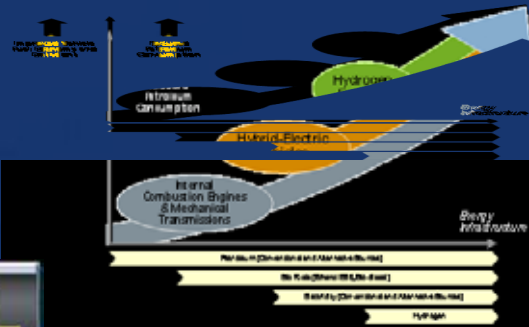
- September 2006: Journalists were given a test-drive of the GM Sequel, the first fuel cell vehicle capable of driving 300 miles between fill ups and the first vehicle designed from the ground up around a fuel cell propulsion system.



GM's Fuel Cell Development

- Also in September 2006, GM committed to building the world's largest fuel cell vehicle fleet – more than 100 Chevrolet Equinox Fuel Cell vehicles.
- GM will begin placing them with customers in the fall of 2007.
- The Equinox Fuel Cell vehicle, features GM's fourth-generation fuel cell propulsion system. It is engineered for 50,000 miles of life and is able to start and operate in sub-freezing temperatures.





FLEXFUEL
E85 ETHANOL



Questions?



Fuel Economy Tips

Topic list

1. Plan your trips and driving routes to avoid traffic congestion
2. Observe speed limits
3. Accelerate moderately and smoothly
4. Maintain steady speeds
5. Limit the use of accessories
6. Don't carry more than you need
7. Make sure your vehicle is properly maintained
8. Avoid extended engine idle time
9. Get the most from Active Fuel Management™
10. Towing and heavy-duty usage



Fuel Economy Tips

Topic details

1. Plan your trips and driving routes to avoid traffic congestion and minimize stop lights

Significantly more fuel is consumed to accelerate your vehicle than to maintain a constant speed. By limiting the number of times you stop your vehicle and re-accelerate, you will observe higher average fuel economy. Pacing your speed between traffic lights can help.

2. Observe speed limits

Wind drag accounts for almost 25% of the fuel consumed to drive your vehicle. Each additional 10 mph of highway speed can reduce fuel economy by about 4 mpg.

3. Accelerate moderately and smoothly

As a general rule, your engine consumes more fuel the faster it spins. By gently applying the accelerator pedal and not accelerating too briskly, your vehicle will maintain lower engine speeds during vehicle acceleration and cruising, and thereby improve fuel economy.



Fuel Economy Tips

Topic details

4. Maintain steady speeds

Your vehicle's cruise control can help you maintain a steady speed. This could improve fuel economy by as much as 2 percent for some drivers, as it minimizes engine speed changes (see Tip #3).

5. Limit the use of accessories

Accessories such as air conditioning, heated seats, rear window defoggers all consume energy that ultimately comes from the fuel in your vehicle. Limiting their use to when it is most needed can save fuel. When entering a hot vehicle, open windows to vent the hot air as you turn your air conditioning on.

6. Don't carry more than you need

Avoid carrying unnecessary items in your vehicle on a regular basis. An extra 100 pounds in a vehicle could reduce fuel economy by up to two percent. Items mounted to the exterior of your vehicle (such as bike racks and roof-top carriers) will also increase wind drag, which costs you fuel. Remember to remove items not in use. While a pickup truck bed cover can help reduce drag, leaving the gate down or installing a "net" in its place increases it.



Fuel Economy Tips

Topic details

7. Make sure your vehicle is properly maintained

Following the manufacturer's regular maintenance schedule can improve your mileage as much as 10 percent. This includes replacing a dirty air filter, regularly checking tires to maintain the recommended pressure. This not only saves fuel, but greatly extends tire life.

8. Avoid extended engine idle time

Extended idle time directly impacts your fuel economy, since your vehicle is getting 0 mpg while stationary. Turn your vehicle off if you are going to be idling for more than a minute or two. For example, a 20 mile journey that includes a 10-minute idle can reduce the average fuel economy of the trip from 20 mpg to 17.5 mpg. While GM's new remote start feature provides great convenience by pre-warming the interior and defrosting your vehicle in inclement weather, limit use of this feature to situations where you need it.



Fuel Economy Tips

Topic details

9. Get the most from Active Fuel Management™

Fuel economy can be maximized by driving your vehicle smoothly. This is especially true for vehicles equipped with Active Fuel Management™. To get the most fuel economy from your vehicle, you should strive to maximize your operation in V4 mode (V3 mode for V6 engines). Smooth, steady application of the accelerator pedal up to the desired speed is best. Note that Tips #1 thru #6 will also help you maximize V4 operation, and thus fuel economy.

10. Towing and heavy-duty usage

Fuel economy during trailer towing can be maximized if the front profile of the trailer is hidden by the tow vehicle. Closed-body trailers with rounded corners will minimize trailer wind drag. When pulling a trailer, it is even more beneficial to drive within posted speed limits (see Tip #2). Proper trailer maintenance (tire pressure, properly adjusted brakes, wheel lubrication) is also very important for maximizing fuel economy. Consult your dealer for the optimal vehicle configuration for trailering.

