HYBRID ELECTRIC VEHICLES

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History of HEVs

- 1997 – First modern HEV introduced in Japan: Toyota *Prius* (on left below)
- 1999 – First modern HEV sold in U.S.: Honda *Insight* (on right below)
What Is a Hybrid Electric Vehicle (HEV)?

- The combination of an internal combustion engine (ICE) with one or more electric motor/generators and a battery pack.

- Combines Propulsion System With **RESS** and gets Better Fuel economy.

- An HEV uses less gasoline because the electric motor does some of the work.
HEV MODEL
Components of HEVs

Hybrid engine, electric motor and transmission (Honda).

Hybrid battery pack (Ford).

300 VOLTS
Basic Components of HEVs

- Internal Combustion Engine/APU
- Electric Motor/Generator
- Controller
- Batteries
How HEVs Work

- MMP HEV’s prolong charge on batteries capturing KE via Regenerative Braking.

- HEV’s use ICE to generate Electricity by spinning Electric Generator either to Recharge or to feed power.
HOW HYBRIDS WORK?
OVERVIEW

Full hybrids use a gasoline engine as the primary source of power, and an electric motor provides additional power when needed.

In addition, full hybrids can use the electric motor as the sole source of propulsion for low-speed, low-acceleration driving, such as in stop-and-go traffic or for backing up.

This electric-only driving mode can further increase fuel efficiency under some driving conditions.

Rollover the hybrid components to get more information.
STARTING

When a full hybrid vehicle is initially started, the battery typically powers all accessories.

The gasoline engine only starts if the battery needs to be charged or the accessories require more power than available from the battery.

The battery stores energy generated from the gasoline engine or, during regenerative braking, from the electric motor. Since the battery powers the vehicle at low speeds, it is larger and holds much more energy than batteries used to start conventional vehicles.
LOW SPEED

For initial acceleration and slow-speed driving, as well as reverse, the electric motor uses electricity from the battery to power the vehicle.

If the battery needs to be recharged, the generator starts the engine and converts energy from the engine into electricity, which is stored in the battery.

Rollover the hybrid components to get more information.
CRUISING PART 1

At speeds above mid-range, both the engine and electric motor are used to propel the vehicle.

The gasoline engine provides power to the drivetrain directly and to the electric motor via the generator.

Go to next...
PASSING PART 1

During heavy accelerating or when additional power is needed, the gasoline engine and electric motor are both used to propel the vehicle.

Go to next...
BRAKING PART 1

Regenerative braking converts otherwise wasted energy from braking into electricity and stores it in the battery.

In regenerative braking, the electric motor is reversed so that, instead of using electricity to turn the wheels, the rotating wheels turn the motor and create electricity. Using energy from the wheels to turn the motor slows the vehicle down.

Go to next...
STOPPED

When the vehicle is stopped, such as at a red light, the gasoline engine and electric motor shut off automatically so that energy is not wasted in idling.

All other systems, including the electric air conditioning, continue to run.

Rollover area: Battery: The battery stores energy generated from the gasoline engine or, during regenerative braking, from the electric motor. Since the battery powers the vehicle at low speeds, it is larger and holds much more energy than batteries used to start conventional vehicles.
About HEVs

- HEVs offer the efficiency of electric-powered vehicles without having to recharge by using conventional engines and fuels.
- Efficiencies are gained from motor downsizing and regenerative braking.
- Inherent flexibility allows use for numerous applications.
HEV Efficiency

Three key factors:

- Regenerative braking
- Engine size
- Vehicle weight & aerodynamic design
HEV Efficiency (contd…)

- Engine size = may be smaller than in a conventional vehicle
  - Engine is sized to accommodate *average load* – not *peak load*

- Vehicle weight/aerodynamic design:
  - Built using special lightweight materials
  - Uses advanced aerodynamics to reduce drag
Advanced Technologies

- Regenerative Braking
- Electric Motor Drive/Assist
- Automatic Start/ ShutOff
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Regenerative Braking

- Recaptures *kinetic energy* normally lost as heat during braking.
  - Kinetic energy = energy of motion
- Electric motor acts as a generator when brakes applied.
- Converts kinetic energy to electrical energy, stored in batteries.
  - It becomes *potential energy* – available for use.
  - No system is 100% efficient.
Electric Motor Drive/Assist

- Additional Power to assist engine
  Accelerating, Passing and Hill Climbing.

- So, allows Smaller and More Efficient Engine to be Used.
Automatic Start/Shutdown

- Automatically shuts off the engine when the vehicle comes to a stop and restarts it when the accelerator is pressed. This prevents wasted energy from idling.
HEVs and Air Pollution

- Decreased fuel consumption results in reduced vehicle emissions

- Ability to operate with smaller, more efficient motor maximizes emission management Strategies

- Result is reduction of harmful pollutants in atmosphere

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HEVs in Transportation

- Increasing gasoline prices are making HEVs very attractive to consumers.

- HEVs are already available today, and their use will become more widespread as production picks up.
Hybrid Reliability

- Hybrids have some of the highest safety ratings of all vehicles
- High-voltage system contains many safety features
- Battery charge is computer controlled – extends battery life
- Batteries under warranty for 100,000 miles, is your engine???

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Hybrid Reliability (contd...) 

- The cost of maintenance is reduced due to operation of hybrid technology.
- Regenerative braking reduces wear on brakes.
- Idle stop extends engine life.
- Electric accessories reduce load on Engine.

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HEV Advantages

- Reduced fuel consumption
- Excellent gas mileage
- Fewer tailpipe emissions
- Lighter batteries than electric vehicles
- Regenerative braking system stores electrical energy in Batteries
- Uses less fuel to recharge batteries
HEV Disadvantages

- Reduced, but not emission-free
- HEVs are partial zero-emission vehicles (PZEVs) – they produce zero emissions only when engine is not running
- More expensive than conventional Vehicles
- Has a payback period in average use

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Current Models of HEVs

• Chevrolet Tahoe Hybrid
• Honda Accord Hybrid
• Honda Civic Hybrid
• Ford Escape Hybrid
• GMC Silverado Hybrid
• GMC Sierra Hybrid
• Toyota Prius
• Toyota Highlander Hybrid
• Lexus 400h

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In India

- According to the Business News on 19th January, 2009, M&M is planning to Launch Hybrid Electric Vehicles in India in a couple of Years.

- Soon can be seen on Indian Roads

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CONCLUSION

- So, the HEVs have more efficiency, Low Fuel Economy, High Reliability and Less Air Pollution.

- Optimum Utilisation of these Vehicles will yield in good Results, especially Reduction of pollution.

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