Hybrid Electric Vehicle

presented by -

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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.
Why Hybrid Vehicles?

- Emission is causing global warming and human sickness.
Why Hybrid Vehicles?

- Oil reserves being in scarce
- Natural gas extraction for the world will peak within a decade or two.
Why Hybrid Vehicles?

- Hybrid vehicles produce much less emissions and use about 50% less fuel than the average new vehicle in the same class. (Partial-Zero emissions)
Why Hybrid Vehicles?

- Overcome short range travel in single charging unlike electric vehicles
- **Plug-in Hybrid vehicles** eventually will be charged at parking locations using renewable energy.
HEV Advantages

• Reduced fuel consumption
• Excellent mileage
• Fewer tailpipe emissions
• Mixed urban driving is modestly favorable
• HEV use smaller engines than conventional automobiles
• The engine can shut off when the car stops.
• Choose to operate the engine only at its highest efficiency.
• No problem of coldstart
• 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
Hybrid Powertrain Topology

- **Parallel**
  - Engine
  - Electric Motor
  - Battery
  - Fuel Cell

- **Series**
  - Engine
  - Electric Motor
  - Battery
  - Fuel Cell

- **Full Hybrid**

- **Micro Hybrid**

- **Mild Hybrid**

- **Electric Vehicle**

- **Range extender**

- **Series Hybrid**

- **Conventional**
Early Electric Cars

- Electric vehicles are clean and easy to use.
- Low maintenance, available infrastructure.
- Electric motors were easy to control.
- Motors have high power-to-weight ratio.
- 1914 Detroit Electric car.
- Limited range.
Early Hybrid Cars

- The advantages of electric drives are substantial, but range is a challenge.
- Hybrids can deliver energy for long intervals.
- Retain the reliability and ease-of-use advantages of electric cars.
- The 1900 Porsche hybrid.
Gasoline Car Culture

• Gasoline was a waste product of oil refining.
• Low-cost mass production, low fuel costs, and performance limits helped fuel-driven cars overtake electric cars by 1920.
• Reliability has been improving continuously for fuel vehicles.
• There was little change in electric car technology until the 1960s.
Revival

- Revival of hybrid cars about 1970.
- New electronics attempted in the 1980s (GM Sunraycer).
- Mature power electronics since early 1990s.
- NiMH batteries matured enough in the late 90s.
- Li-ion almost there now.
Revival

- Maturing power electronics overcame major performance barriers in the 1990s.
- 2000 General Motors EV1 high-performance electric car prototype.
- Limited range. Storage problems unresolved.
Parts of HEV

**Gasoline engine** - The hybrid car has a gasoline engine much like the one you will find on most cars. However, the engine on a hybrid is smaller and uses advanced technologies to reduce emissions and increase efficiency.

**Electric motor** - The electric motor on a hybrid car is very sophisticated. Advanced electronics allow it to act as a motor as well as a generator. For example, when it needs to, it can draw energy from the batteries to accelerate the car. But acting as a generator, it can slow the car down and return energy to the batteries.

**Generator** - The generator is similar to an electric motor, but it acts only to produce electrical power. It is used mostly on series hybrids.

**Batteries** - The batteries in a hybrid car are the energy storage device for the electric motor. Unlike the gasoline in the fuel tank, which can only power the gasoline engine, the electric motor on a hybrid car can put energy into the batteries as well as draw energy from them.

**Transmission** - The transmission on a hybrid car performs the same basic function as the transmission on a conventional car.
Hybrids Can Have Multiple Configurations

**Parallel hybrid**, both the gasoline engine and the electric motor can turn the transmission at the same time, and the transmission then turns the wheels.

**Series hybrid**, the gasoline engine turns a generator, and the generator can either charge the batteries or power an electric motor that drives the transmission. Gasoline engine never directly powers the vehicle.

**Power split**, acts both as series and parallel. Motor/Generator 1 and 2 alternately power each other via the power split planetary unit.
How a HEV work?

- At standstill motor can be switched off instantly
- During start, Battery drives the motor, which in turn drives the transmission
- Engine is disengaged by automatic clutch
- Emission is less
How a HEV work?

For Hard acceleration, both engine and motor provide power.

Clutch automatically engages with transmission to cater to high power requirement along with motor.
How a HEV work?

During cruising, battery disconnects as it cannot sustain long.

Engine now drives the vehicle thru’ auto clutch.

Simultaneously engine also charges battery via the generator.
How a HEV work?

- During braking, recaptures kinetic energy normally lost as heat.
- Electric motor acts as generator when brakes applied.
- Kinetic energy is converted to electrical energy which can be stored in batteries.
How a HEV work?

**Moving off**
- Automatic Clutch
- Electric motor/generator
- Small clean diesel engine
- Lithium-ion battery
- Inverter

**Hard acceleration**
- Automatic Clutch
- Electric motor/generator
- Small clean diesel engine
- Lithium-ion battery
- Inverter

**Cruising/Recharging**
- Automatic Clutch
- Electric motor/generator
- Small clean diesel engine
- Lithium-ion battery
- Inverter

**Slowing down**
- Automatic Clutch
- Electric motor/generator
- Small clean diesel engine
- Lithium-ion battery
- Inverter
Myth: Limited market

“No one wants to buy a second car suitable just for commuting.”

Fact: Most driving needs can be met with a car that has just 40 miles of range.
Fact: Most of my neighbors own multiple cars, with at least one used almost exclusively for commuting.
Myth: Inadequate infrastructure

“Houses and businesses will need much more electrical infrastructure to support plug-in hybrids and electrics.”

Fact: The best designs use about 150 W-h/mile. A 6 h charge from a 120 V outlet is more than enough for a 40 mile battery.
Myth: Stepping stones

- *Hybrid, electric, fuel cell* vehicle designs are a stepping stone toward longer term *hybrid, electric, fuel cell* vehicles.

- *Fact:* ALL vehicle designs are increments toward people’s aspirations for personal transportation.
Myth: Industry as a group is converging toward the best solutions

• “Existing design are proven and capable, and should be emulated.”

• **Fact:** Hybrids on the road have not achieved the performance levels and efficiencies of known electric car designs.
• In 2005, US President signed a bill allowing tax credits for the purchase of new electric hybrid vehicles, in addition to other tax discounts offered by states for the purchase of HEVs.
• Many cities in the USA waived parking fees, allow HEVs to use carpool lanes without restrictions, and try to initiate other benefits to encourage the use of hybrid electric vehicles.
• The use of the electric motor for propulsion in low speed environments and the technology that allows a HEV to turn off the combustion engine when idling greatly reduces the emissions from the vehicle. Hybrid electric vehicles use smaller engines than conventional automobiles and have less moving parts that are prone to wearing out and creating waste.
Hybrid electric vehicles are not a recent invention. Although there were earlier HEVs built, it wasn't until 1905 that the American Engineer, H. Piper, filed for a patent to add an additional electric engine to a gasoline combustion engine in order to speed the engine's acceleration capabilities. By the time this patent was approved, the gasoline combustion engine had evolved to achieve the desired acceleration rate without the additional electric support and interest in the idea waned. Henry Ford's development and implementation of the assembly line to produce gasoline powered engine further destroyed interest in developing a Hybrid Electric Engine.

In 1931, the German inventor, Erich Gaichen, built a Hybrid Electric Vehicle that introduced a recharging technology that is still in use today in Toyota's Prius design, Gaichen's HEV would recharge itself as it went down hill, foreshadowing the regenerative braking system (RESS) found in the Prius and other modern HEVs.

A resurgence of interest in hybrid vehicles occurred in the USA in the 1960's when Congress began to see bills introduced that suggested that producing HEVs would help cut air pollution. By 1970, General Motors had developed a hybrid electric vehicle prototype that used electric power up to 13 mpg and then switched to gasoline power. In 1993, the Department of Energy introduced the HEV program that created a partnership with the three largest U.S. automakers to develop Hybrid Electric Vehicles with a goal to have realistic models by the year 2000, and usable, low cost vehicles available to the public by 2003. Despite efforts by all three automakers, as well as other car manufacturers during the 80's and early 90's, the public remained unenthusiastic about the electric vehicles introduced into the market. Not until the late 1990's, with the introduction of the Honda Insight and Toyota Prius, did HEVs become viable products on the market.
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.
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
Thank you

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