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A REVIEW ON EVOLUTION OF HYBRID AND ELECTRIC VEHICLE

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ABSTRACT

Vehicles have been around for more than 100 years. They have changed a lot in that time. Today's cars are faster and more reliable than those of long ago. They are also safer and more comfortable. One thing has not changed: the way most cars work. Most cars of the past ran on fuel made from oil. That's still true today. Usually the fuel is gasoline (often called "gas" for short). Sometimes it is diesel fuel. Both come from oil. The Trouble with Oil is a very good source of energy, but using it has problems. One problem is that oil is not a renewable resource. Once it's used, it's gone. If people keep on using it, eventually the world will run out of oil. Another problem is that using fuels made from oil releases certain gases into the air. Some of these gases can be bad for people's health. Many scientists say that some of the gases are changing Earth's climate. These are serious problems because the world has a huge number of vehicles, and every year more are produced. In year 2013more than 70 million cars were made. If you include trucks and buses, the number of new vehicles made that year gets even bigger. One way to deal with these problems is to use less oil. This is where "HYBRID Vehicle" comes in use. They get their power from electricity as well as from gasoline (or diesel).

KEYWORDS: Hybrid, HEV, gasoline, gearbox, engine.

INTRODUCTION

A hybrid vehicle is a vehicle that uses two or more distinct power sources to move the vehicle.[1]The term most commonly refers to hybrid electric vehicles (HEVs), which combine an internal combustion engine and one or more electric motors However, other mechanisms to capture and use energy are included.). A hybrid car gets power from both a gasoline engine and an electric motor. The engine and motor can work together in different ways. In some hybrids there are times when only one of them operates. In hybrid cars, the engine can automatically shut off when it is not needed—for example, at a red light or in stop-and-go traffic. This is one reason why hybrids usually use less gasoline than traditional cars. Another reason is that since the electric motor does some of the work of moving the car, the gasoline engine is usually smaller than in traditional cars. The motor—as in electric cars—get power from large batteries. Unlike ordinary electric cars, most of today's hybrids don't need to be plugged in to get recharged. Instead, their batteries can be recharged while the car is being used. The car may have a generator to make electricity. This generator is powered by the gasoline engine. In some hybrids the electric motor itself works as a generator at times.

History of hybrid— It i8s hard to say who made the first hybrid. Having two different power sources is actually an old idea. The first important hybrid that we know of today was made around 1900 by the famous Austrian car designer Ferdinand Porsche. The car had a gasoline engine, and there were electric motors in the wheel hubs. It was a series hybrid. The engine ran a generator that made electricity. Other people also made hybrids in the early 20th century. But the internal-combustion car became very popular. It was powerful, and fuel was cheap and easy to get. Also, hybrid cars cost more to make. For decades few people bothered to even experiment with them.

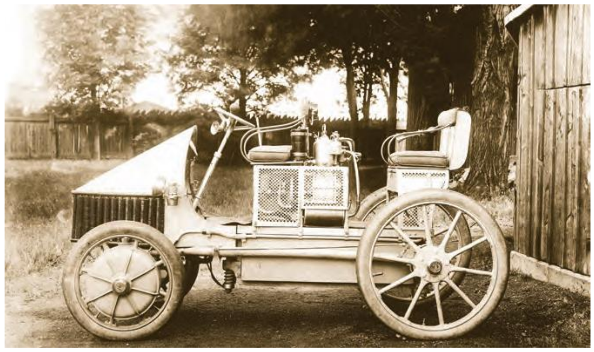

Fig. 1

Fig. 2

Troubles in oils— Oil is a very good source of energy, but using it has problems. One problem is that oil is not a renewable resource. Once it's used, it's gone. If people keep on using it, eventually the world will run out of oil. Meanwhile, as oil gets less plentiful, fuels made from it will probably get more and more costly over time. Another problem is that using fuels made from oil releases certain gases into the air. Some of these gases can be bad for people's health. Many scientists say that some of the gases are changing Earth's climate. These are serious problems because the world has a huge number of vehicles, and every year more are produced. In 2007, for example, more than 50 million cars were made. If you include trucks and buses, the number of new vehicles made that year gets even bigger. One way to deal with these problems is to use less oil. This is where hybrid cars come in. They get their power from electricity as well as from gasoline (or diesel). As a result, they use less gas.

Types of hybrid system— Generally there are two types of the hybrid technology are

- series hybrid
- parallel hybrid

In a parallel hybrid, both the engine and the electric motor make the wheels turn. In a series hybrid, the motor turns the wheels, while the engine runs a generator to make electric.

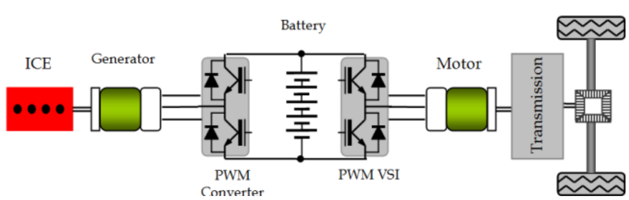

Fig. 3. Series hybrid system

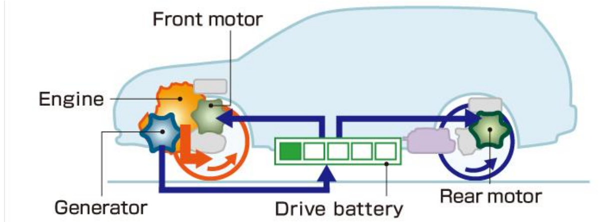

Fig. 4. Parallel hybrid system

Parallel hybrid— In parallel hybrids, both the OBPU and the electric motor(s) can drive the wheels, either separately (each takes one drive shaft), or through a transmission or gear set with two or more input shafts, or through use of an integrated motor/engine set where the motor can also serve as the starter. Figure 2-2 shows a simplified layout of a parallel hybrid with engine and battery/electric motor(s) powering separate drive shafts. A commonly discussed mode of operation for parallel hybrids has the vehicle operating like an EV at low speeds, with only the motor(s) engaged (this is called electric launch); the OBPU engages only at higher speeds. This operating strategy keeps engine operations away from low load operations that generally produce high hydrocarbon (HC) and carbon monoxide (CO) emissions and inefficient fuel use. Within this basic design, there are a number of choices of alternative operating strategies. For example, one operating strategy would limit motor usage to electric launch, regenerative braking, and power boosting when the OBPU could not handle the power demand by itself. In other words, once the OBPU is engaged after an electric launch, it would provide all of the power needed to run the vehicle, with the motor disengaged except during braking (to be used as a generator for regenerative braking) or under high load (e.g., during high acceleration) to provide boost power to the engine. When the vehicle is stopped, the engine can be turned off and the accessories run by the battery. Toyota's Prius HEV operates this way. Although Toyota calls the Prius a "parallel/series" hybrid, from the basis of energy flows it may be most appropriately called a parallel hybrid.

Parallel hybrid designs had generated less interest than series hybrid designs among automakers and researchers, perhaps because they are harder to design and analyse. A parallel hybrid operating in the city will have to turn its OBPU on and off frequently, and smoothly and efficiently combine the changing torques of OBPU and motor, decoupling and recoupling one or the other from the driveshaft when needed (Burke 1992) – not an easy task for either the control system or the transmission.

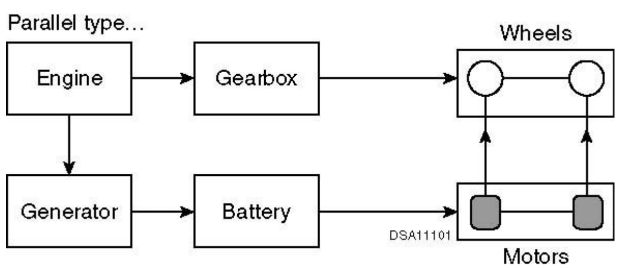

Fig. 5

Although series hybrids are mechanically simpler than parallel hybrids and would seem to be easier to design, an important advantage of the parallel hybrid is that it can obtain the efficiency advantages of the series hybrid (use of regenerative braking, engine downsizing, and maintenance of OBPU operations in the better parts of its operating map) with a more efficient connection of OBPU shaft power to the wheels. In other words, the combination of transmission, torque converter, and differential is more efficient than the series hybrid's shaft-to-wheel path of generator/alternator, (possibly) inverter, motor/controller, transmission or reduction gear and (unless direct drive wheel motors are used) differential. Another major advantage is that a parallel hybrid's electric motor will be significantly smaller than that required on a series hybrid, since in the series case the motor provides the sole motive power to the wheels. This yields a significant cost savings. Because most conceptions of the parallel hybrid have the engine doing more load-following than in a series layout, and the engine being frequently turned on and off, there had been concerns that attaining low emissions might be substantially more difficult than with a series layout (Burke 1992). As noted above, this concern now appears to have been misplaced.

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Weaknesses of parallel hybrid vehicles: Rather complicated system. The ICE doesn't operate in a narrow or constant RPM range, thus efficiency drops at low rotation speed. As the ICE is not decoupled from the wheels, the battery cannot be charged at standstill.

Advantages of parallel hybrid vehicles: Total efficiency is higher during cruising and long-distance highway driving. Large flexibility to switch between electric and ICE power Compared to series hybrids, the electromotor can be designed less powerful than the ICE, as it is assisting traction. Only one electrical motor/generator is required.

Series hybrid— In a series hybrid, the OBPU drives a generator, whose electrical output powers an electric motor driving the wheels and any accessories when needed, and charges a storage device when the device's state of charge (SOC) drops below a desired range. Figure 2-3 shows a simplified24 diagram of a series hybrid layout.

In a series configuration, all of the tractive power needs are met by the motor, which obtains electricity from either the engine/generator directly or from the battery. As with the parallel hybrid, the control system must decide how to trade off the operating advantages and disadvantages of the various energy paths available to the system – in this case, the "engine to generator to motor" path and the "battery to motor" path, with the battery being recharged from the engine, regenerative braking, and for grid-connected hybrids, the grid. For a grid-independent hybrid, frequent use of the battery to drive the motor may force the engine to recharge the battery, which adds the battery's in/out charging losses to the engine to motor path; the control system will generally avoid engine recharge unless battery charge is getting dangerously low or the engine would otherwise be forced to operate quite inefficiently. But in a grid-connected hybrid, the system will often favour the battery to motor path, to maximize the amount of grid recharging that can be obtained

Energy Use in Conventional Vehicles: To understand how a hybrid may save energy, it is necessary first to examine how conventional vehicles use energy:

In order to maintain movement, vehicles must produce power at the wheels to overcome aerodynamic drag (air friction on the body surfaces of the vehicle, coupled with pressure forces caused by the air flow), rolling resistance (the resistive forces between tires and the road surface), and any resistive gravity forces associated with climbing a grade. Further, to accelerate, the vehicle must overcome the natural resistance of its mass to acceleration, called inertia – most of the energy expended in acceleration is then lost as heat in the brakes when the vehicle is brought to a stop.16 And in addition, the vehicle must provide power for accessories such as heating fan, lights, power steering, and air conditioning.

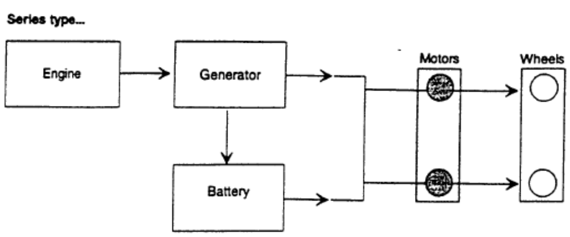

Fig. 6

WEAKNESSES OF SERIES HYBRID VEHICLES

The ICE, the generator and the electric motor are dimensioned to handle the full power of the vehicle. Therefore, the total weight, cost and size of the powertrain can be excessive.
The power from the combustion engine has to run through both the generator and electric motor. During long-distance highway driving, the total efficiency is inferior to a conventional transmission, due to the several energy conversions.

ADVANTAGES OF SERIES HYBRID VEHICLES

There is no mechanical link between the combustion engine and the wheels. The engine-generator group can be located everywhere.

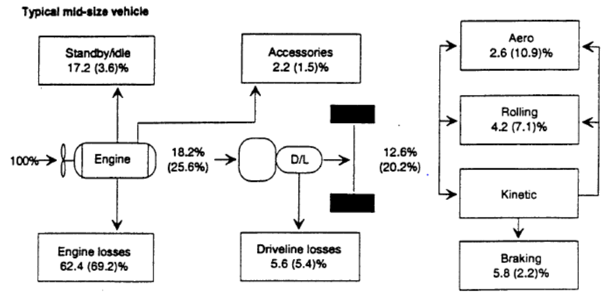

Fig. 7

There are no conventional mechanical transmission elements (gearbox, transmission shafts). Separate electric wheel motors can be implemented easily.

The combustion engine can operate in a narrow rpm range (its most efficient range), even as the car changes speed. Series hybrids are relatively the most efficient during stop-and-go city driving.

ENERGY SAVINGS POTENTIAL OF HYBRID DRIVETRAINS

In terms of overall energy efficiency, the conceptual advantages of a hybrid over a conventional vehicle are:

1. Regenerative braking— A hybrid can capture some of the energy normally lost as heat to the mechanical brakes by using its electric drive motor(s) in generator mode to brake the vehicle;
2. More efficient operation of the on board power unit (OBPU), including elimination (or sharp reduction) of idle— A hybrid can avoid some of the energy losses associated with engine operation at speed and load combinations where the engine is inefficient by using the energy storage device to either absorb part of the OBPU's output or augment it (or even substitute for it), allowing it to operate only at speeds and loads where it is most efficient. When an HEV is stopped, rather than running the engine at idle, where it is extremely inefficient, the control system may either shut off the engine, with the storage device providing auxiliary power (for heating or cooling the vehicle interior, powering headlights, etc.), or run the engine at a higher-than-idle (more efficient) power setting and use the excess power (over auxiliary loads) to recharge the storage device. When the vehicle control system can shut the engine off at idle, the drivetrain can be designed so that the drive motor also serves as the starter motor, allowing extremely rapid restart due to the motor's high starting torque.
3. Smaller, lighter OBPU— Because the storage device can take up part of the load, a hybrid's OBPU can be downsized. In some cases, the OBPU can be sized for the highest sustained loads, not for (higher) short-term acceleration loads. Consequently, the OBPU can have a significantly lower power rating than the engine in a conventional vehicle. This allows the engine to be run at a higher fraction of its rated power, generally at higher efficiency, during most driving. Also, the reduced engine weight is mildly beneficial to fuel economy.20
4. Potential for alternative OBPU technologies— Conventional drivetrains use piston engines because such engines do a fair job, when coupled with multispeed transmissions, of efficiently matching vehicle load requirements (static matching), and an excellent job of rapidly boosting or reducing power to match the vehicle's changing loads (dynamic matching). Most alternative power sources do not share these matching characteristics.

There are counterbalancing factors reducing hybrids' energy advantage, including:

1. Potential for higher weight— Although the fuel-driven energy source on a hybrid generally will be of lower power and weight than the engine in a conventional vehicle of similar performance, total hybrid weight is likely to be higher than the conventional vehicle it replaces because of the added weight of the storage device, electric motor(s), and other components. This depends, of course, on the storage mechanism chosen, the vehicle performance requirements, and so forth. The hybrid configurations examined in this report [conventional internal combustion engines (ICEs) and nickel metal hydride batteries] were consistently heavier than their conventional vehicle (CV) counterparts.
2. Electrical losses— Although individual electric drivetrain components tend to be quite efficient for one-way energy flows, in many hybrid configurations, electricity flow back and forth through components in a way that leads to cascading losses. Further, some of the components may be forced to operate under conditions

where they have reduced efficiency. For example, like ICEs, most electric motors have lower efficiency at the low-speed, low-load conditions often encountered in city driving. Without careful component selection and a control strategy that minimizes electric losses, much of the theoretical efficiency advantage often associated with an electric drivetrain can be lost

Batteries used in electric car— The following energy storage systems are used in hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and all-electric vehicles (EVs).

1. Lithium-Ion Batteries— Lithium-ion batteries are currently used in most portable consumer electronics such as cell phones and laptops because of their high energy per unit mass relative to other electrical energy storage systems. They also have a high power-to-weight ratio, high energy efficiency, good high- temperature performance, and low self-discharge. Most components of lithium-ion batteries can be recycled. Most of today's plug-in hybrid electric vehicles and all-electric vehicles use lithium-ion batteries, though the exact chemistry often varies from that of consumer electronics batteries. Research and development is ongoing to reduce cost and extend their useful life cycle.
2. Nickel-Metal Hydride Batteries— Nickel-metal hydride batteries, used routinely in computer and medical equipment, offer reasonable specific energy and specific power capabilities. Nickel-metal hydride batteries have a much longer life cycle than lead-acid batteries and are safe and abuse tolerant. These batteries have been used successfully in all-electric vehicles and are widely used in hybrid electric vehicles. The main challenges with nickel-metal hydride batteries are their high cost, high self-discharge and heat generation at high temperatures, and the need to control hydrogen loss.
3. Lead-Acid Batteries— Lead-acid batteries can be designed to be high power and are inexpensive, safe, and reliable. However, low specific energy, poor cold- temperature performance, and short calendar and cycle life impede their use. Advanced high-power lead-acid batteries are being developed, but these batteries are only used in commercially-available electric drive vehicles for ancillary loads.
4. Ultra capacitors— Ultra capacitors store energy in a polarized liquid between an electrode and an electrolyte. Energy storage capacity increases as the liquid's surface area increases. Ultra capacitors can provide vehicles additional power during acceleration and hill climbing and help recover braking energy. They may also be useful as secondary energy- storage devices in electric drive vehicles because they help electrochemical batteries level load power.

Fig. 8

5. Recycling Batteries— Electric drive vehicles are relatively new to the U.S. auto market, so only a small number of them have approached the end of their useful lives. As a result, few post-consumer batteries from electric drive vehicles are available, thus limiting the extent of battery-recycling infrastructure. As electric drive vehicles become increasingly common, the battery-recycling market will likely expand. Widespread battery recycling would keep hazardous materials from entering the waste stream, both at the end of a battery's useful life, as well as during its production. Work is now under way to develop battery-recycling processes that minimize the life-cycle impacts of using lithium- ion and other kinds of batteries in vehicles. But not all recycling processes are the same:

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1. Smelting— Smelting processes recover basic elements or salts. These processes are operational now on a large scale and can accept multiple kinds of batteries, including lithium-ion and nickel-metal hydride batteries. Smelting takes place at high temperatures, and organic materials, including the electrolyte and carbon anodes, are burned as fuel or reductant. The valuable metals are recovered and sent to refining so that the product is suitable for any use. The other materials, including lithium, are contained in the slag, which is now used as an additive in concrete.
2. Direct recovery— At the other extreme, some recycling processes directly recover battery- grade materials. Components are separated by a variety of physical and chemical processes, and all active materials and metals can be recovered. Direct recovery is a low-temperature process with minimal energy requirement.
3. Intermediate processes— The third type of process is between the two extremes. Such processes may accept multiple kinds of batteries, unlike direct recovery, but recover materials further along the production chain than smelting does. Separation of different kinds of battery materials is often a stumbling block for the recovery of high- value materials. Therefore, battery design that takes disassembly and recycling in mind is important to the success of PEV sustainability. Standardization of batteries, materials, and cell design would also make recycling easier and more cost-effective.

ADVANTAGE OF HYBRID SYSTEM

1. High efficiency
2. Low pollution
3. Environmental friendly
4. Light weights
5. produce 27% less Co2

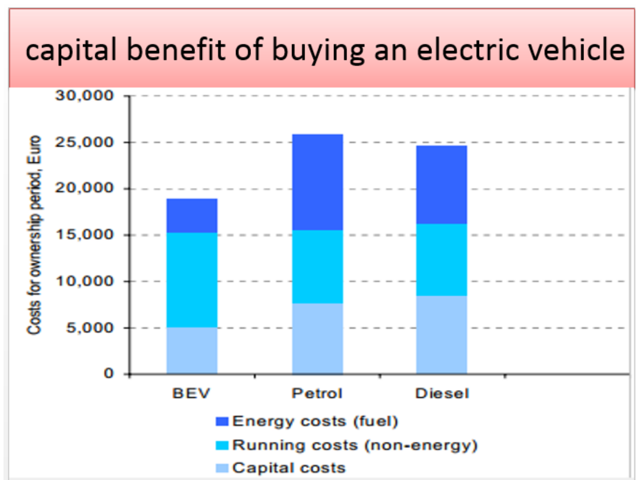

Fig. 9

Overall cost of HEV and fuel vehicle

Hev vehicle

Assumption:	Average ownership	Short-term ownership/ high use	Average use/ Long-term ownership
Ownership period (years)	10	5	21
Annual distance driven (km)	25,500	38,000	17,000
% of driving in city areas	25%	25%	25%
Financial costs:			
Capital cost (after discount and including resale)	€25,500	€23,600	€27,100
Running costs (non-energy i.e. tax + maintenance)	€7,800	€4,800	€12,200
Running costs (energy)	€12,300	€11,200	€12,900
Total cost (over ownership period)	€45,500	€39,600	€52,200

Diesel vehicle

Assumption:	Average ownership	Short-term ownership/ high use
Ownership period (years)	10	5
Annual distance driven (km)	34,500	53,500
% of driving in city areas	25%	25%
Financial costs:		
Capital cost (after discount and including resale)	€28,800	€27,300
Running costs (non-energy i.e. tax + maintenance)	€7,800	€4,800
Running costs (energy)	€13,400	€12,800
Total cost (over ownership period)	€50,000	€44,900

Fig. 10

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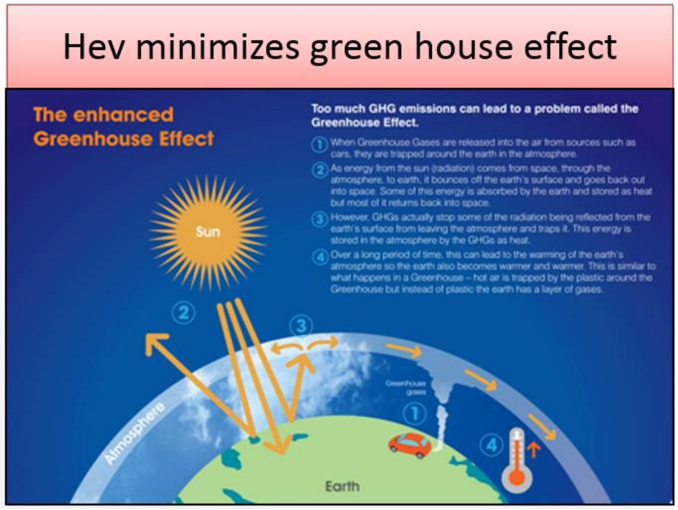

Fig. 11

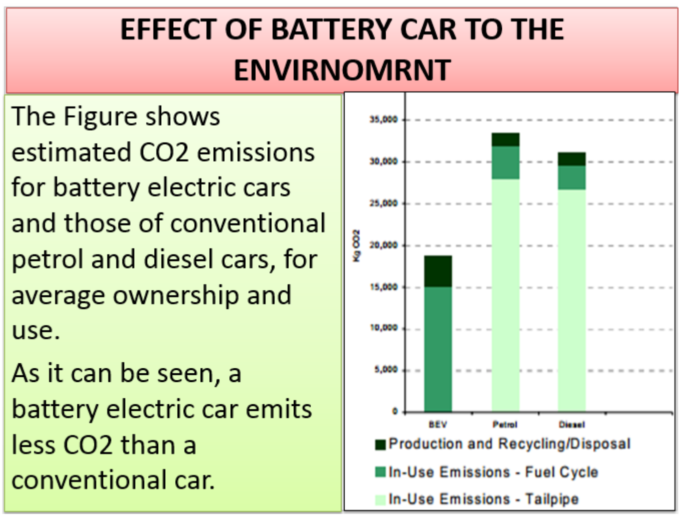

Fig. 12

EVs compared to normal cars

	Electric vehicles	Normal cars
Energy comes from	electricity	fossil fuels
Where Energy is stored	rechargeable batteries	petrol tank
Engine type	electric motor	internal combustion engine
Where the energy is put in	power outlet and charging cord	petrol cap
Are there any 'tail-pipe' emissions?	no	yes

Fig. 13

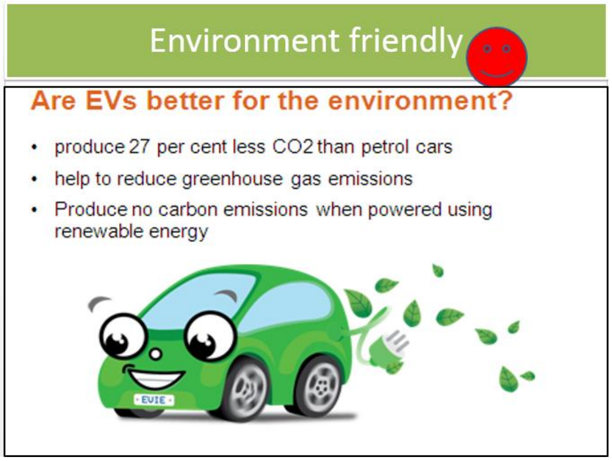

Fig. 14

DRAWBACKS OF HYBRID SYSTEM

Hybrids have some disadvantages. For one thing, they tend to cost more to buy than similar traditional cars. Of course, they do save money for their owners by using less gasoline. Hybrids are often smaller and less powerful than similar non-hybrid cars. This can be a drawback for people who like big, powerful cars. Some hybrids do have big engines. These "muscle" hybrids can deliver a lot of power, but they don't save much on gasoline. The hybrid version of Toyota's 2009 Highlander SUV got just 25 miles per gallon (10.6 kilometres per litter) on the highway, according to the EPA. The non-hybrid version was almost as good, averaging 23 to 24 miles per gallon (9. 8 to 10.2 kilometres per litter).

EXPENSIVE BATTERIES AND SERVICE

The batteries in a hybrid are heavy. Their weight increases the amount of energy needed to make the car go. Also, they take up a lot of space. They make the car less roomy. In addition, they are very expensive. They are very reliable and should last a long time, but if hybrid batteries ever need to be replaced, the cost will be high. Hybrids are complicated cars. Fewer service people know how to fix x them. Repairs may sometimes cost more than for traditional cars. But this situation may change as more and more hybrids appear on the road.

CONCLUSION

- Due to the proliferation of hybrid vehicles on the road today, responders must be familiar with how these vehicles operate, and how to handle an emergency which involves one of these vehicles.
- Additionally, responders must stay up-to-date with current vehicle technology, as it is continuously changing.
- And my personal view is we must should use hev as at least personal transport, for day to day life, short distances and should save something for tomorrow.
- Let us make a beautiful world!
- In future we can have hev with pneumatic and hydraulic sources as well and I am sure there is a much more chances towards better.

REFERENCES

[1] http://en.wikipedia.org/wiki/Hybrid_vehicle
[2] http://en.wikipedia.org/wiki/Hybrid_electric_vehicle
[3] http://www.sonnycovic.com/files/ Hybrid_Vehicles.ppt
[4] http://www.physics.rutgers.edu/~kotliar/honors/honsem02/somalwar/HonSem02/hybrid%20presentation.ppt
[5] http://www.transport.vic.gov.au/__data/assets/ powerpoint_doc/0017/60623/DOT-EV-powerpoint.ppt