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Hybrid Electric Vehicle Design

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Abstract

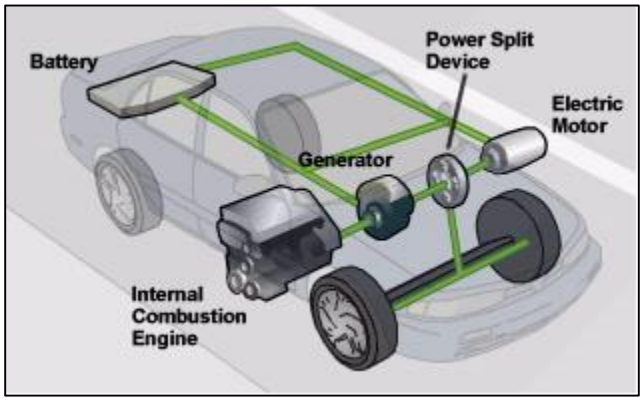
A hybrid electric vehicle (HEV) is a hybrid vehicle which combines a conventional propulsion system with a rechargeable energy storage system (RESS) to achieve better fuel economy than a conventional vehicle. Modern mass-produced HEVs prolong the charge on their batteries by capturing kinetic energy via regenerative braking, and some HEVs can use the internal combustion engine to generate electricity by spinning an electrical generator (often a motor-generator) to either recharge the battery or directly feed power to an electric motor that drives the vehicle.

Keyword- Hybrid Electric Vehicle (HEV), Rechargeable Energy Storage System (RESS), Internal Combustion Engine (ICE)

I. HYBRID ELECTRIC VEHICLE

Regular HEVs most commonly use an internal combustion engine (ICE) in tandem with [[electric motor]]s to power their propulsion system. Modern mass-produced HEVs prolong the charge on their batteries by capturing "kinetic energy" via [[regenerative braking]], and some HEVs can use the combustion engine to generate electricity by spinning an [[electrical generator]] (often a [[motor-generator]]) to the fraction of the cause results to the abdomile reswult the vehicle.An HEV's engine is smaller and may be run at various speeds, providing more efficiency.

Hybrid-electric vehicles (HEVs) combine the benefits of gasoline engines and electric motors and can be configured to obtain different objectives, such as improved fuel economy, increased power, or additional auxiliary power for electronic devices and power tools.



A. Regenerative Braking

The electric motor applies resistance to the drivetrain causing the wheels to slow down. In return, the energy from the wheels turns the motor, which functions as a generator, converting energy normally wasted during coasting and braking into electricity, which is stored in a battery until needed by the electric motor.

B. Electric Motor Drive/Assist

The electric motor provides additional power to assist the engine in accelerating, passing, or hill climbing. This allows a smaller, more efficient engine to be used. In some vehicles, the motor alone provides power for low-speed driving conditions where internal combustion engines are least efficient.

C. Automatic Start/Shutoff

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.

II. THE CHOICE

Generally speaking, hybrid cars run on rechargeable batteries and gasoline.
The type of hybrid depends on how the two sources of power connect, when each one is in operation and for how long, and finally, what portion of power is supplied by which hybrid component.
There are four types of hybrid systems:

- Stop-start: shuts engine off when the car comes to a full stop and would otherwise idle.
- Integrated Starter Alternator with Damping (ISAD): has the stop-start feature and an electric motor.
- Integrated Motor Assist: The functions are identical to the ISAD but it has a larger electric motor for better performance.
- Full hybrid system: cars generally run on electric power at low speeds with the gas engine kicking in at higher speeds.

A. Engines and Fuel Sources

1) Gasoline

Gasoline engines are used in most hybrid electric designs, and will likely remain dominant for the foreseeable future. While petroleum-derived gasoline is the primary fuel, it is possible to mix in varying levels of ethanol created from renewable energy sources. Like most modern ICE-powered vehicles, HEVs can typically use up to about 15% bioethanol. Manufacturers may move to flexible fuel engines, which would increase allowable ratios, but no plans are in place at present.

2) Diesel

Diesel-electric HEVs use a diesel engine for power generation. Diesels have advantages when delivering constant power for long periods of time, suffering less wear while operating at higher efficiency. The diesel engine's high torque, combined with hybrid technology, may offer substantially improved mileage. Most diesel vehicles can use 100% pure biofuels (biodiesel), so they can use but do not need petroleum at all for fuel (although mixes of biofuel and petroleum are more common, and petroleum may be needed for lubrication). If diesel-electric HEVs were in use, this benefit would likely also apply. Diesel-electric hybrid drivetrains have begun to appear in commercial vehicles (particularly buses); as of 2007, no light duty diesel-electric hybrid passenger cars are currently available, although prototypes exist. Peugeot is expected to produce a diesel-electric hybrid version of its 308 in late 2008 for the European market.[2]

B. Gasoline-Electric Hybrid Structure

Gasoline-electric hybrid cars contain the following parts:

1) 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.

2) Fuel Tank

The fuel tank in a hybrid is the energy storage device for the gasoline engine. Gasoline has a much higher energy density than batteries do. For example, it takes about 1,000 pounds of batteries to store as much energy as 1 gallon (7 pounds) of gasoline.

3) 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.

4) Generator

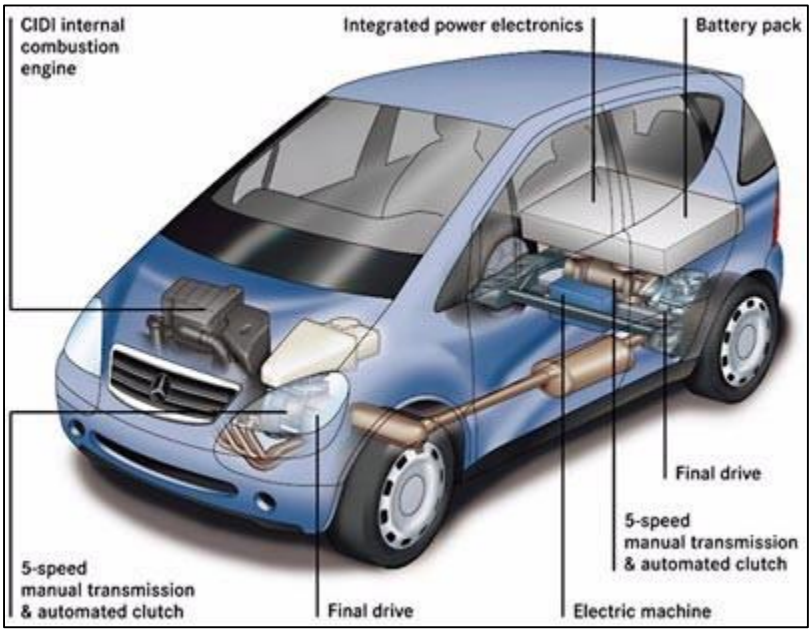
The generator is similar to an electric motor, but it acts only to produce electrical power. It is used mostly on series hybrids (see below).

5) 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.

6) Transmission

The transmission on a hybrid car performs the same basic function as the transmission on a conventional car. Some hybrids, like the Honda Insight, have conventional transmissions. Others, like the Toyota Prius, have radically different ones, which we'll talk about later.



You can combine the two power sources found in a hybrid car in different ways. One way, known as a parallel hybrid, has a fuel tank that supplies gasoline to the engine and a set of batteries that supplies power to the electric motor. Both the engine and the electric motor can turn the transmission at the same time, and the transmission then turns the wheels.

The animation below shows a typical parallel hybrid. You'll notice that the fuel tank and gas engine connect to the transmission. The batteries and electric motor also connect to the transmission independently. As a result, in a parallel hybrid, both the electric motor and the gas engine can provide propulsion power.

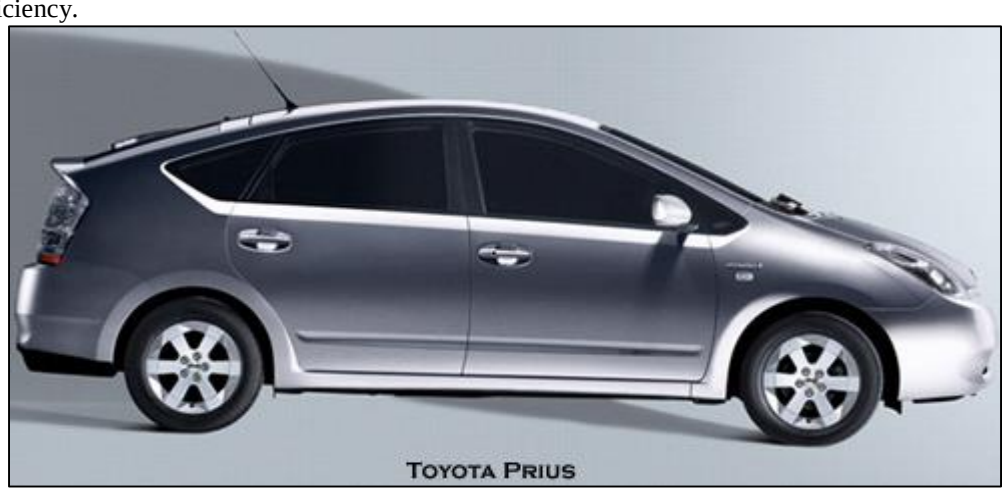
"Hybrid electric vehicles (HEVs) use both electricity and hydrocarbon fuels to provide motive power, but the vehicle's sole energy source is the hydrocarbon fuel. Relative to conventional vehicles in heavy urban traffic, HEVs can achieve around 50% better fuel economy, achieved by the regenerative braking and turning off their internal combustion engine when the vehicle is stopped or moving slowly. In open highway driving these benefits matter little, so a HEV will gave fuel consumption similar to an otherwise comparable conventional vehicle.

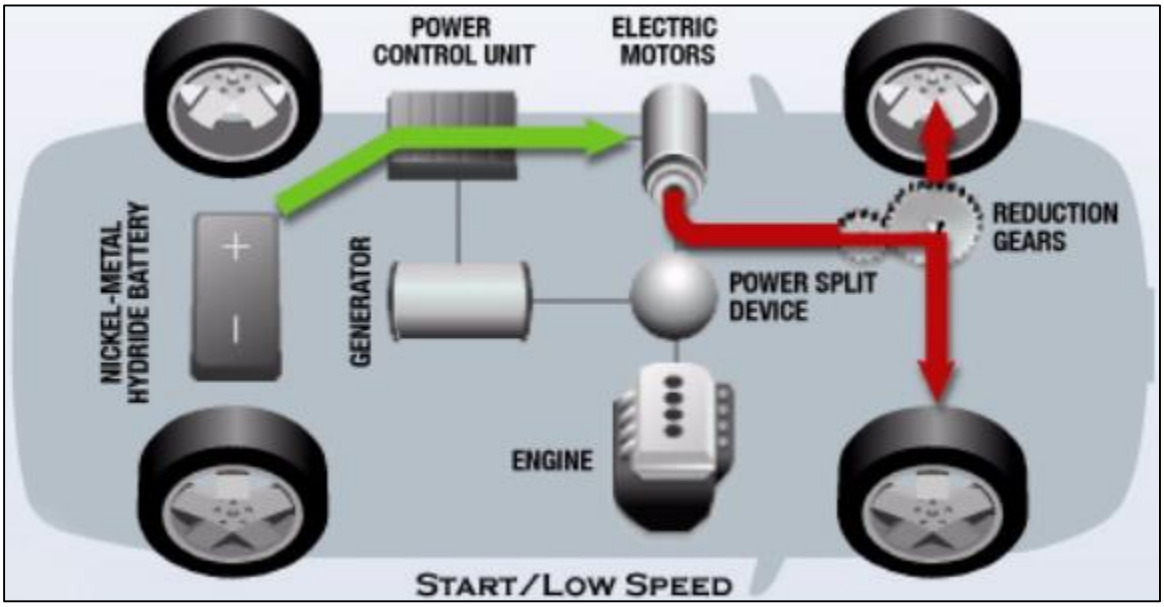
Hybrid-electric vehicles come in two flavours: parallel and series. In parallel HEVs, both the internal combustion engine and electric motors drive the wheels; usually the electric motor and internal combustion engine drive the same transaxle. The Toyota Prius is the familiar example.

In series HEVs, the internal combustion engine only drives a generator, which supplies power to batteries. The wheel drive motors are supplied only from the batteries or other onboard storage. The GM Volt will be a series PHEV [Plug-in Hybrid Electric Vehicle]

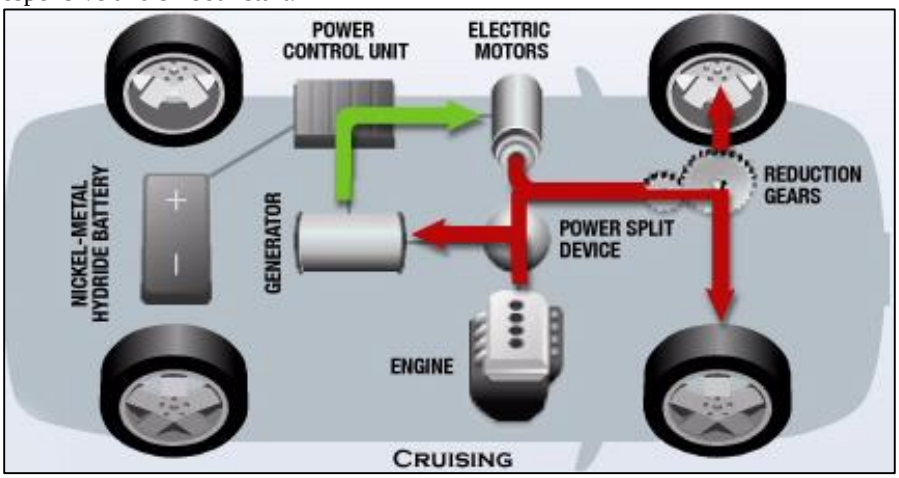
III. WORKING

At the centre of Toyota's hybrid technology is the Hybrid Synergy Drive. This system makes intelligent use of a vehicle's electric motors and gas/petrol engine to take advantage of the key attributes of the two power sources to ensure that the car operates at optimum fuel efficiency.

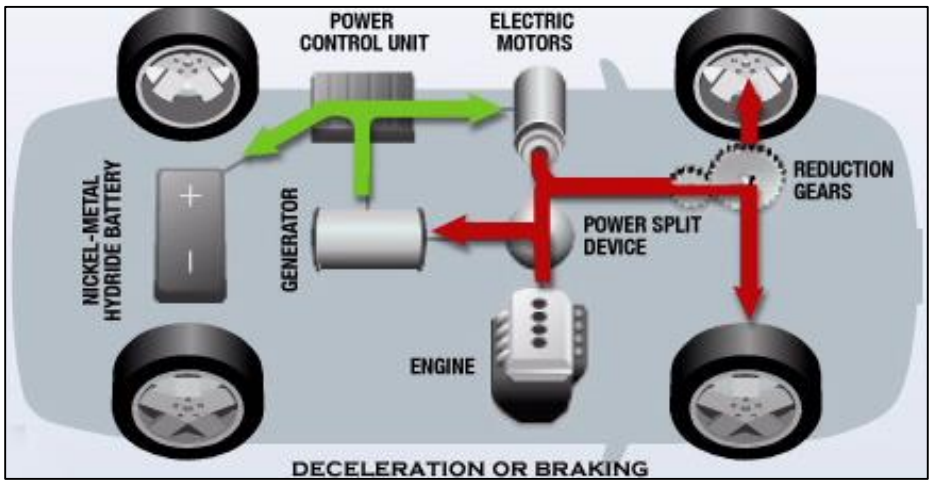




1) At start-off/low-speeds, Hybrid Synergy Drive runs the car on the electric motors only, since the gas/petrol engine does not perform efficiently. A gas/petrol engine cannot produce high torque in the low r.p.m. range, whereas electric motors can - delivering a very responsive and smooth start.



2) However, the gas/petrol engine is quite energy efficient for cruising. Power produced by the gas/petrol engine is used to drive the wheels and also the generator to provide power to the electric motors or to charge the battery. By making use of the engine/motor dual powertrain, the energy produced by the gas/petrol engine is transferred to the road surface with minimal loss.



3) Under deceleration or braking, Hybrid Synergy Drive uses the car's kinetic energy to let the wheels turn the electric motors and recover regenerative energy to recharge the battery. Energy that is normally lost as friction heat under deceleration is converted into electrical energy, which is recovered in the battery to be reused later.

A. Hybrid-Car Performance

The key to a hybrid car is that the gasoline engine can be much smaller than the one in a conventional car and therefore more efficient. Most cars require a relatively big engine to produce enough power to accelerate the car quickly. In a small engine, however, the efficiency can be improved by using smaller, lighter parts, by reducing the number of cylinders and by operating the engine closer to its maximum load.

There are several reasons why smaller engines are more efficient than bigger ones:

- The big engine is heavier than the small engine, so the car uses extra energy every time it accelerates or drives up a hill.
- The pistons and other internal components are heavier, requiring more energy each time they go up and down in the cylinder.
- The displacement of the cylinders is larger, so more fuel is required by each cylinder.
- Bigger engines usually have more cylinders, and each cylinder uses fuel every time the engine fires, even if the car isn't moving.

This explains why two of the same model cars with different engines can get different mileage. If both cars are driving along the freeway at the same speed, the one with the smaller engine uses less energy. Both engines have to output the same amount of power to drive the car, but the small engine uses less power to drive itself. But how can this smaller engine provide the power your car needs to keep up with the more powerful cars on the road?

Let's compare a car like the Chevy Camaro, with its big V-8 engine, to our hybrid car with its small gas engine and electric motor. The engine in the Camaro has more than enough power to handle any driving situation. The engine in the hybrid car is powerful enough to move the car along on the freeway, but when it needs to get the car moving in a hurry, or go up a steep hill, it needs help. That "help" comes from the electric motor and battery -- this system steps in to provide the necessary extra power.

The gas engine on a conventional car is sized for the peak power requirement (those few times when you floor the accelerator pedal). In fact, most drivers use the peak power of their engines less than one percent of the time. The hybrid car uses a much smaller engine, one that is sized closer to the average power requirement than to the peak power.

B. Improving Fuel Economy

Besides a smaller, more efficient engine, today's hybrids use many other tricks to increase fuel efficiency. Some of those tricks will help any type of car get better mileage, and some only apply to a hybrid. To squeeze every last mile out of a gallon of gasoline, a hybrid car can:

1) Recover energy and store it in the battery

Whenever you step on the brake pedal in your car, you are removing energy from the car. The faster a car is going, the more kinetic energy it has. The brakes of a car remove this energy and dissipate it in the form of heat. A hybrid car can capture some of this energy and store it in the battery to use later. It does this by using "regenerative braking." That is, instead of just using the brakes to stop the car, the electric motor that drives the hybrid can also slow the car. In this mode, the electric motor acts as a generator and charges the batteries while the car is slowing down.

2) Sometimes shut off the engine

A hybrid car does not need to rely on the gasoline engine all of the time because it has an alternate power source -- the electric motor and batteries. So the hybrid car can sometimes turn off the gasoline engine, for example when the vehicle is stopped at a red light.

3) Use advanced aerodynamics to reduce drag

When you are driving on the freeway, most of the work your engine does goes into pushing the car through the air. This force is known as aerodynamic drag. This drag force can be reduced in a variety of ways. One sure way is to reduce the frontal area of the car. Think of how a big SUV has to push a much greater area through the air than a tiny sports car.

Reducing disturbances around objects that stick out from the car or eliminating them altogether can also help to improve the aerodynamics. For example, covers over the wheel housings smooth the airflow and reduce drag. And sometimes, mirrors are replaced with small cameras.

4) Use low-rolling resistance tires

The tires on most cars are optimized to give a smooth ride, minimize noise, and provide good traction in a variety of weather conditions. But they are rarely optimized for efficiency. In fact, the tires cause a surprising amount of drag while you are driving. Hybrid cars use special tires that are both stiffer and inflated to a higher pressure than conventional tires. The result is that they cause about half the drag of regular tires.

5) Use lightweight materials

Reducing the overall weight of a car is one easy way to increase the mileage. A lighter vehicle uses less energy each time you accelerate or drive up a hill. Composite materials like carbon fiber or lightweight metals like aluminum and magnesium can be used to reduce weight.

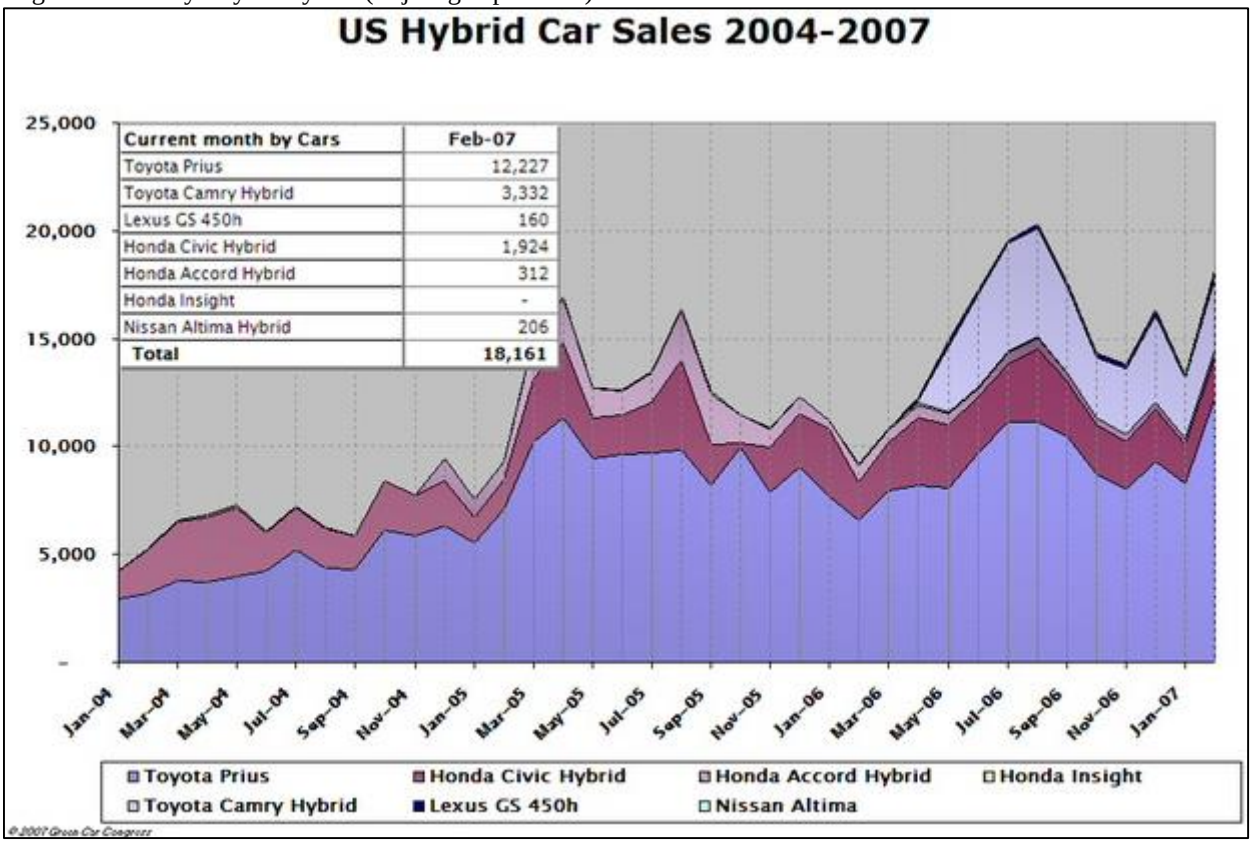
C. The Benefits of a Hybrid Car

You might wonder why anyone would build such a complicated machine when most people are perfectly happy with their gasoline-powered cars. The reason is twofold: to reduce tailpipe emissions and to improve mileage. These goals are actually tightly interwoven.

Let's take the example of the California emissions standards, which dictate how much of each type of pollution a car is allowed to emit in California. The amount is usually specified in grams per mile (g/mi). For example, the low emissions vehicle (LEV) standard allows 3.4 g/mi of carbon monoxide. The key thing here is that the amount of pollution allowed does not depend on the mileage your car gets. But a car that burns twice as much gas to go a mile will generate approximately twice as much pollution. That pollution will have to be removed by the emissions control equipment on the car. So decreasing the fuel consumption of the car is one of the surest ways to decrease emissions.

Carbon dioxide (CO_2) is another type of pollution a car produces. The U.S. government does not regulate it, but scientists suspect that it contributes to global warming. Since it is not regulated, a car has no devices for removing CO_2 from the exhaust. A car that burns twice as much gas adds twice as much CO_2 to the atmosphere.

Auto makers in the United States have another strong incentive to improve mileage. They are required by law to meet Corporate Average Fuel Economy (CAFE) standards. The current standards require that the average mileage of all the new cars sold by an auto maker should be 27.5 mpg (8.55 liters per 100 km). This means that if an auto maker sells one hybrid car that gets 60 mpg (3.92 liters per 100 km), it can then sell four big, expensive luxury cars that only get 20 mpg (11.76 liters per 100 km).
You can actually take steps to drive your car in ways that increase its gas mileage. In the next section, we'll look at some tips for increasing the efficiency of your hybrid (or just gas-powered) car.



IV. CONCLUSION

Thus by using hybrid electric vehicle we can save our earth from the hazards like greenhouse effects global warming ,ozone deplication and pollution can be controlled hence hybrid electric vehicles are ecofriendly.

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