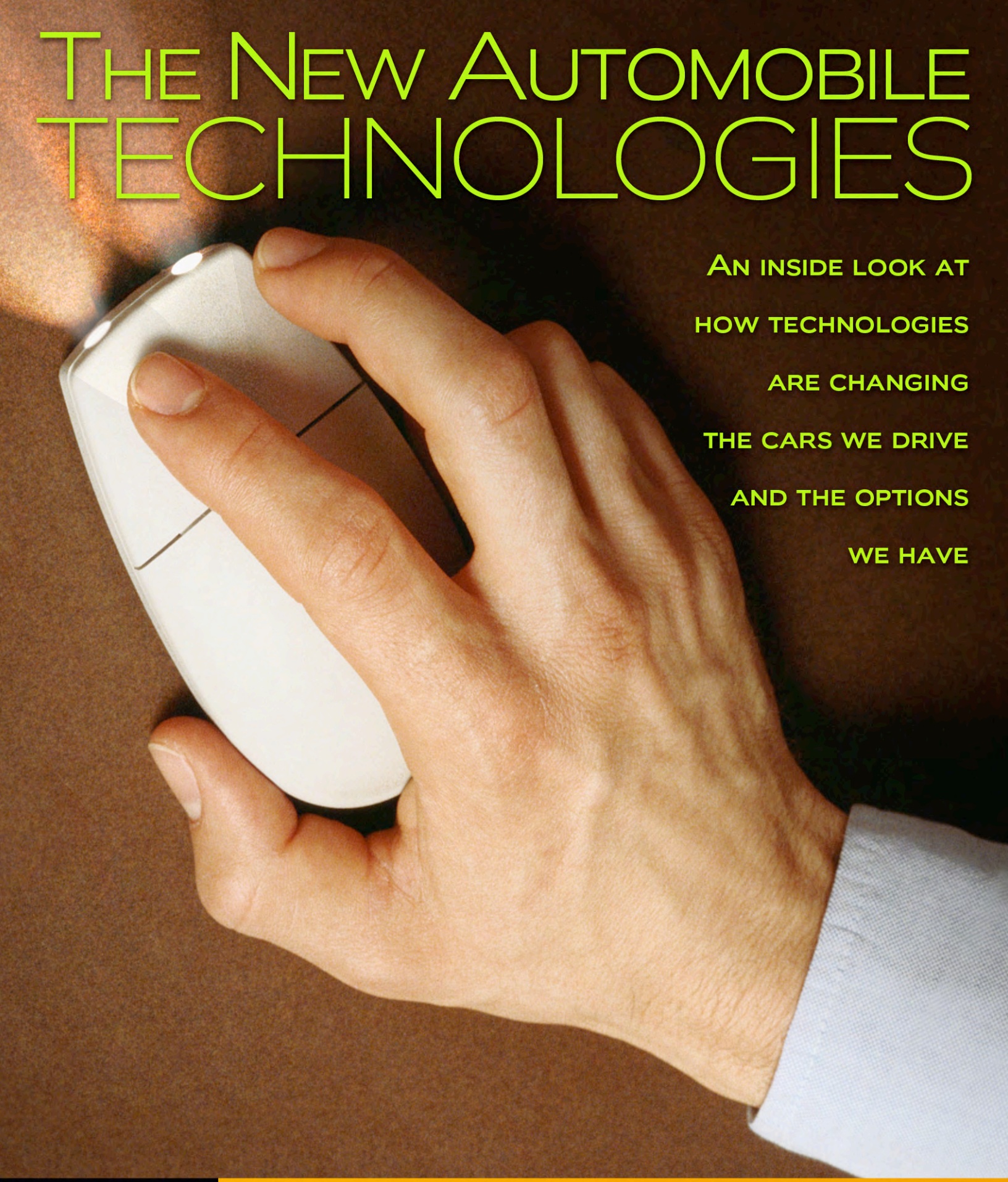
# The New Automobile Technologies



An inside look at how technologies are changing the cars we drive and the options we have

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# The New Automobile Technologies Contents



# The New Automobile Technologies
# Introduction

**What this eBook is all about** There is no doubt about it: the automobile is an essential to the lives of most of us today. A wonderful invention that seems as much a part of daily modern life as eating, breathing and sleeping. It comes in many forms and fills a huge variety of needs.


## What is the best car for you?

Large SUV or truck? Mini? All-wheel drive sports car? 130 mpg plug-in hybrid electric? Pure electric neighborhood vehicle?

There is no typical car or driver today. Car manufacturers are working to cater to all needs and tastes as well as coping with the rising cost of gasoline and diesel while addressing the increasing concern about the quality of the air we breathe.

This eBook is designed to help you find out what's available today (or will be available tomorrow) so you can make the most informed decision and best choice.

## Something we can all agree on

We may not see eye to eye about what the perfect car is, but there is one point that just about everyone who is driving today can agree on:

Whatever car they drive, just about everyone would love to drive it further for less money!

Gone are the days of $1 per gallon of gas. Americans were not used to having to pay over $3 a gallon of gasoline or diesel. In Europe, Latin America and other parts of the world, $3 per gallon is considerably less than they have been used to paying for years and years. There's no doubt about it—it's not cheap to get from here to there.

# The New Automobile
# TECHNOLOGIES
# NEW TECHNOLOGY

**Why new technologies?** The car had already advanced to great levels by the 1960s or 1970s, so why the endless search? And how will these impact our world?

## These new technologies include:

- ingenious improvements to the venerable internal combustion engine and the fuel that it burns
- diesel, once thought of as smelly, noisy and noxious, has cleaned up its act
- alternative fuels such as ethanol, natural gas, hydrogen, and many others
- electricity, either from batteries or from a smaller fuel-driven on-board engine or from a combination of both, is a popular alternative to the traditional gasoline engine
- the hydrogen fuel cell is another way of generating electricity which then drives the car
- and the list goes on.

## Economy

The rising cost of petroleum oil (gasoline, diesel) is a major motivation for car manufacturers to adopt new technology, either with a view to getting more mileage out of a gallon of fuel, or to use an altogether different source of power.

## Environment

There are other factors driving the development of new automobile propulsion technology. One of these is the environment. Since the 1960s when smog began to raise its ugly head in cities, the automotive industry started to work out ways to reduce those noxious tailpipe emissions. Then more recently there has been great pressure to reduce "greenhouse gases" from all emission sources, including the cars on the road.

## Natural resources

There was also the realization that petroleum, from which we get our gasoline and diesel, is not going to last forever. It takes so very long for oil to be made by natural processes, that the supply is considered to be finite. It's only natural to think ahead, even if it's a long way ahead, to the day when the oil is no longer there in plentiful supply, and to develop alternative fuels now from renewable sources.

Many countries do not have an oil supply of their own and they would feel more independent and secure if they had their own source of energy for such a major requirement as personal transportation, rather than having to depend on other nations.

All these issues, and probably some more, have for some time intensified the development of new technologies to propel that basic requirement: the car.

So, what's driving new technologies in automobile propulsion? All of the above. And the inventors and manufacturers have been busy and have poured out a torrent of new developments.

The result is a huge range of choices. We're going to look at the main ones in this book and try to simplify them.

Whoever you are and whatever your needs, the perfect automobile is waiting for you.

### Did you know?

***1901 Porsche's second car was the Mixte Hybrid, with a gasoline engine and an electric motor. A gasoline engine powered a generator which provided power to the electric motors in the wheel hubs. The car could travel close to 40 miles on battery alone.***

**Commonly thought that it's been a choice between aesthetics and environmental responsibility, the auto industry has changed that standard, consistently raising the bar.**

# The New Automobile Technologies
# A Historical Perspective

**Did you know** that in the early 1900s there were more electric cars on the road than gasoline-powered automobiles, including whole fleets of battery driven taxi cabs in New York and London?

And that it was steam, not petroleum oil that began to put the horse and carriage out of business (along with the hordes of "dirt boys" employed to clean up the average 45 lb. per horse of dung every day)?

Then came major breakthroughs: an electric starter so that elegant young (or old) ladies didn't have to risk breaking an arm or dislocating a shoulder cranking the car to get it started; and the muffler to cut down the noise. The then popular steam and electric automobiles faded out of use, replaced by those that ran on gasoline.

The rest, as they say, is history.

# MILESTONES IN AUTOMOBILE HISTORY

| | |
|---|---|
| 1769 | Nicholas Cugnot began work on a steam-powered motor wagon, the first “horseless carriage.” |
| 1801 | Richard Trevithick developed a steam car that achieved nine miles per hour. |
| 1807 | François Isaac de Rivas invented hydrogen-oxygen, electric ignition internal combustion engine. In 1808 he powered a vehicle with this engine, making it the first internal combustion engine powered vehicle in the world. |
| 1839 | First electric cars built by Scotsman Robert Anderson. They ran on non-rechargeable batteries. |
| 1859 | Practical storage battery invented, making electric cars a viable possibility. |
| 1870 | Sir David Salomon invented a car with an electric motor and large, heavy storage batteries – too heavy to drive far or fast. |
| 1870 | First gasoline run vehicle, a hand cart with a petroleum-fueled internal combustion engine invented by Siegfried Marcus. |
| 1885 | First really practical gasoline internal combustion engine powered vehicles developed by Karl Benz. |
| 1893 | German inventor Rudolf Diesel invented the engine that bears his name, originally designed to run on peanut oil or vegetable oil. |
| 1897 | Hiram Percy Maxim invented the muffler which made the gasoline cars much quieter. |
| 1898 | Ferdinand Porsche built his first car – electric, front-wheel drive. |
| 1898 | The Electric Carriage and Wagon Company of Philadelphia had a fleet of twelve elegant electric cabs. |
| 1900 | In the US, 1,681 steam cars, 1,575 electric cars and 936 gasoline cars were made. |
| 1901 | Porsche’s second car is the Mixte Hybrid, with a gasoline engine and an electric motor. The gasoline engine drove a generator which provided power to the electric motors in the wheel hubs. The car could travel close to 40 miles on battery alone. |
| 1906 | Stanley rocket steam car sets the world land speed record of 205.5 km/h (128 mph) at Daytona Beach. |
| 1906 | Krieger electric landaulet incorporates regenerative braking where the kinetic energy of the car, as it slows down, is converted back into electric energy and usually used to recharge the battery. |
| 1911 | Charles Kettering invented the first workable electric starter, making cranking unnecessary. (The muffler and the electric starter were two main inventions that pushed the gasoline internal combustion engine-driven car into the lead. They overcame the two main objections: noise, and the dangers and difficulties of cranking to start the car. By the next year, the gasoline automobile became the most popular vehicle. Henry Ford sold 182,809 gasoline cars. 6,000 electric cars were sold.) |
| 1920s-1960s | Gasoline engines were king all over the world. No serious production of electric or alternative fuel cars. |

| | |
|---|---|
| 1924 | Herman Rieseler of Vulcan Motor invented the first automatic transmission though it did not go into use as an option until 1940. |
| 1960s | Smog caused by vehicle exhaust emissions started to become a problem. Scientists became aware of automobile caused pollution. |
| 1980s | Early versions of the start-stop or stop-start system were introduced in the VW Polo and Fiat Regata. In the start-stop or stop-start or start and stop system, the engine stops instead of idling and starts again when needed. Electrical components run on battery. Not a great success to begin with, the system was much more successful in the Audi A2 "3L" and Volkswagen Lupo "3L" of 1999 which still hold the record for the most fuel efficient production cars to date. |
| 1981 | General Motors introduces the Cadillac L62 V8-6-4 engine, the first general production version of variable displacement technology. An engine control unit switched the engine from 8 to 6 or 4 cylinders depending on how much power was needed. It was fraught with problems and was rapidly retired from use. |
| 1982 | Mitsubishi developed its own version of variable displacement which worked well. It reduced the engine from 4 to 2 cylinders when appropriate, for fuel economy purposes. |
| 1997 | Toyota Prius, gasoline-electric hybrid introduced in Japan. 18,000 sold in first year. |
| 1987-1992 | Major American car manufacturers introduce a number of all-electric cars, including the renowned GM EV-1, but production and sales ceased in 1999. The GM EV-1 was the first modern car to incorporate regenerative braking. |
| 1999 | Honda Insight, the first modern electric-gasoline hybrid from a major car manufacturer sold in the USA, boasting 61 mpg city and 70 mpg highway. |
| 2000 | Toyota Prius introduced into the USA. The most popular gasoline-electric hybrid car to date. |
| 2003 | Honda introduced variable cylinder displacement in the Inspire. This uses a system to shut down 4 of the 8 cylinders during highway driving and other times when less power is needed, so as to reduce fuel consumption. Similar systems became common and generally successful after 2005: GM (Active Fuel Management), Chrysler (Multi-displacement System) Daimler AG (Active Cylinder Control). Advances in computer technology were the main reason for more recent success. |
| 2006 | Tesla Roadster, all-electric car that can go from 0-60 in under 4 seconds, with a range of about 220 miles. |
| 2007 | Hybrid cars introduced by Lexus, Ford, Nissan, Chevrolet, Mazda, Dodge and others. |
| 2008-2009 | Stop-start technology, where the engine stops instead of idling, gains ground in many European and Japanese mainstream cars. |
| 2010 | Chevrolet Volt plug-in hybrid on sale. This car can run on battery alone for about 45-50 miles in the city. Rated at 60 mpg (US) average. |
| 2011 | Nissan Leaf, first all-electric car from a major auto maker since the early 1990s, available for sale in select markets. |
| 2012 | Toyota plans to release a plug-in hybrid version of its highly successful Prius. |
| 2012 | Tesla Motors plans to start delivering the Model S, premium battery electric sedan. The company claims a 300 mile range per charge, acceleration of 0-60 mph in 5.6 seconds and, of course, zero tailpipe emissions since it is all-electric. It will sell for $49,000 after federal tax credits. |
| 2012 | Volvo Plug-in Hybrid diesel V60 will reach the market, the world's first diesel-electric plug-in hybrid. All-wheel drive (electric rear wheel, diesel front wheel), 0-60 mph in under 7 seconds, 124 mpg , an all-electric range of 30 miles. |
| 2013 | Volkswagen have announced the L1 which will combine a 39-hp turbo diesel along with a 14-hp electric motor. Claims 240 mpg at normal speeds and 170 mpg at 100 mph. |

# The New Automobile Technologies
# What are your choices?

**From zero to sixty** Let's start off by differentiating between workable, practical technologies which you can buy and use today vs. experimental, hopeful, potential solutions which are still far from being ready for widespread implementation.

For example, you may have heard about hydrogen fuel cell automobiles, touted as the solution to oil. However, those who are working on this technology, which turns hydrogen and oxygen into electric power to drive an automobile and has the sole byproduct of plain water, will tell you that there won't be production hydrogen cell fuel vehicles until 2020 or 2030.

On the other hand, the Nissan Leaf is a fully functional, electric car you can buy today. No gasoline at all, no emissions, not even a tailpipe! Just a battery which you can charge overnight or when the car is not in use. Perfect for some people's needs, very cheap to run and as green and clean as you can get.

The Chevrolet Volt is a production plug-in hybrid car available today. You can run it on the battery alone for about 30 miles on the highway and up to 50 miles in town and reach speeds of 100mph. When you want to increase the range, the gasoline engine fires up and provides additional power in combination with the electric motors, with excess electricity being diverted to charge the battery. The battery is charged from the grid when the car is not in use, such as over night.

### Did you know?

***If you have the idea that an EV is slow and sluggish, think again. The Tesla Roadster sports car goes from 0-60 in 3.7 seconds! And it does so quietly and smoothly, like a spaceship. It has a range of 245 miles between charges. The top speed is electrically limited to 125 mph. The EV is almost silent in its operation. Drivers find their EVs a pleasure to drive.***

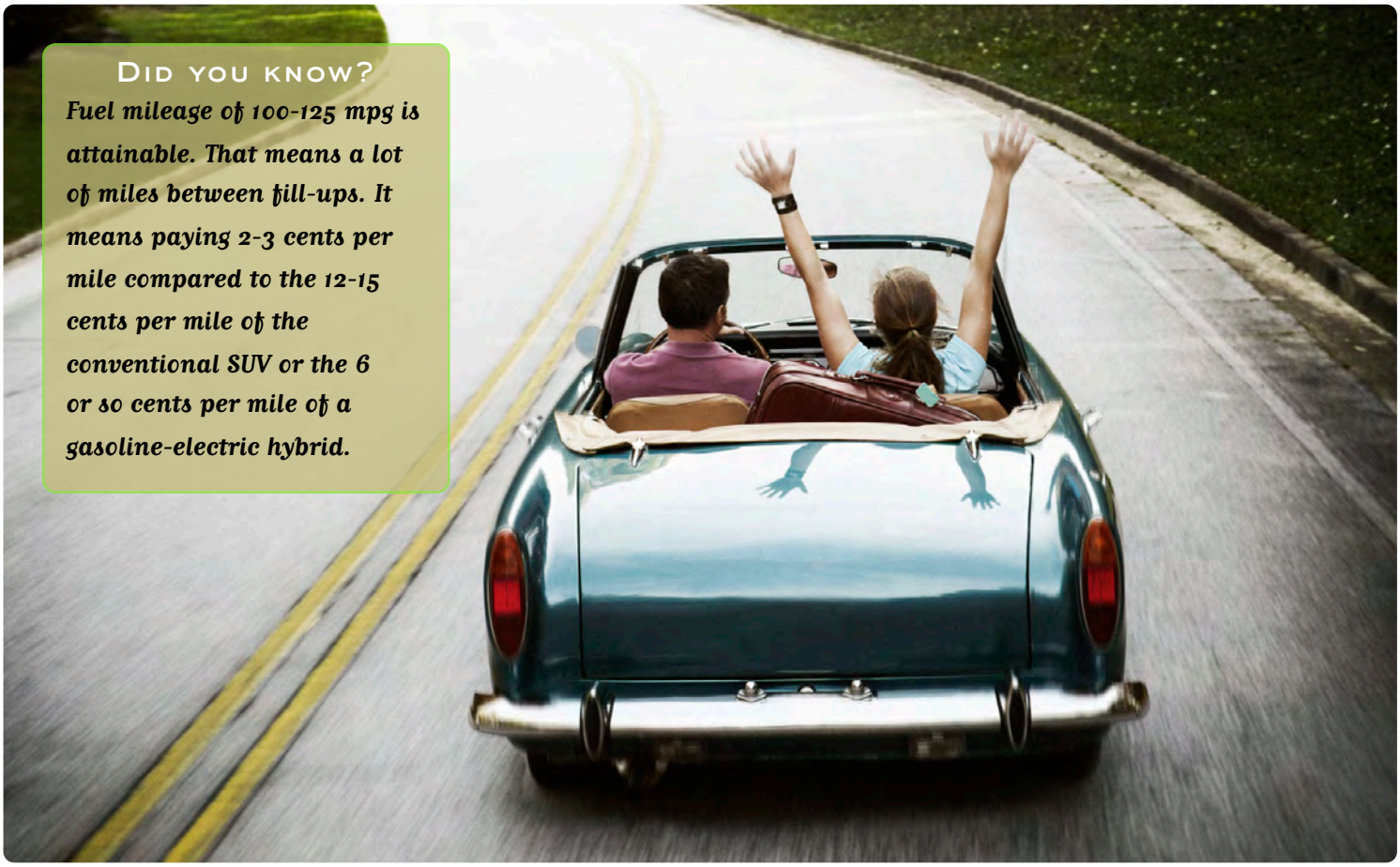
In this eBook, we're going to concentrate on technology available now and in the near future. We'll touch on the alternatives, but this information here is for you who are looking for your perfect car now or at least soon.

| Technology | Description | Pros | Cons |
|---|---|---|---|
| **Battery Electric Vehicle (BEV)**<br>Nissan Leaf, Tesla Roadster and the Think City | Runs on battery alone. Charged by plugging in to the grid. No tailpipe so no emissions at all. Costs pennies on the dollar compared to a traditional gasoline car. BEVs range from basic Neighborhood Electric Vehicles (NEV) all the way up to powerful, high end sports cars. Maximum range is about 245 miles before the batteries need to be recharged. | Very economical to run. Maintenance consists of rotating the tires every now and then.<br>No tailpipe emissions whatsoever; very kind to the environment.<br>Smooth, quiet, clean and can be fast and powerful. | The biggest "con" is range: once the battery has run down you have to charge it which is usually a matter of several hours (overnight or while you are at work before the commute home).<br>BEVs tend to be more expensive than their internal combustion engine equivalents. |
| **Hybrid Electric Vehicles (HEV)**<br>Toyota Prius, Honda Civic Hybrid, Ford Escape SUV, Lexus HS 250h, Honda Insight, Toyota Highlander SUV and the Chevrolet Silverado hybrid truck | HEVs have two sources of power, usually an electric motor, and an internal combustion engine driven by gasoline or diesel or an alternative fuel. Some HEVs can run on the electric motor or the internal combustion engine or both. Others run on the internal combustion engine supplemented by the electric motor.<br>The result is far better fuel mileage than a conventional internal combustion engine vehicle. | Fuel efficient: tend to be more economical than internal combustion only vehicles.<br>Extended range. The combination of a gasoline or diesel engine with a battery can mean longer trips between fill-ups.<br>Greatly reduced tailpipe emissions so HEVs are generally more environmentally benign than traditional internal combustion engine vehicles. | Currently, this option tends to be pricey. |
| **Plug-in Hybrid Electric Vehicle (PHEV)**<br>Chevy Volt, Dodge Sprinter PHEV van and the Renault Kangoo | The PHEV takes the hybrid concept one step further by providing a battery bank that can be recharged from the grid as well as by the on-board internal combustion engine. This means that a commute of 30-50 miles or runs around town can be made without ever using a drop of gasoline or diesel, running on the electric motor alone. | A spectacular fuel mileage of 100-125 mpg in a car that is otherwise "normal" in terms of performance and range.<br>This is an ingenious combination of a BEV and an HEV rolled into one. | Higher priced. (This will probably change as the market for HEVs and PHEVs ramps up.) |

| Technology | Description | Pros | Cons |
|---|---|---|---|
| **Clean Diesel and Biodiesel**<br>Audi A3 and Q7, BMW Advanced Diesel 335d and X5xDrive35d, Mercedes Benz ML350 SUV, R350 crossover, GL350 SUV and the VW Golf, Jetta and Touareg SUV | Diesel cars gained a reputation, particularly in the USA, for being noisy, sooty, smelly and underpowered. That was your father's diesel car. Not so today.<br>In Europe, of the 25 top fuel-efficient cars sold, all but one are diesel and that one is a gasoline-electric hybrid.<br>Diesel engines are comparable in every way to gasoline engines and a gallon of diesel costs roughly the same as a gallon of gasoline. But diesel engines are typically 20-25% more fuel efficient than their gasoline equivalents.<br>Biodiesel is fuel that a diesel engine can run on which is not derived from petroleum, such as vegetable oil, peanut oil, even the discarded oil from deep fry vats. | Better fuel economy than gasoline equivalents.<br>The diesel engine has a reputation for durability and running forever. | Tend to be slightly more expensive than their gasoline equivalents. |
| **Advanced Internal Combustion Engine Technology and Flex-fuel**<br>GM Monte Carlo SS, Chevrolet Camaro SS, Chevrolet Impala, Chevrolet Aveo, Honda Accord, Honda Pilot, Chrysler's Dodge Challenger and the Nissan Versa | There have been many advances in Internal Combustion Engine (ICE) technology which have resulted in more fuel-efficient gasoline engines. Innovations such as start-stop technology (the engine shuts down instead of idling), variable displacement (some of the cylinders are shut down when not needed), continuously variable transmission (just what it sounds like) and other improvements are all geared to increased fuel efficiency without compromise or sacrifice. | Use less imported petroleum products than gasoline or diesel equivalents.<br>Reduced emissions. | Alternative fuels are not easy to obtain with the current infrastructure so Flex-fuel vehicles often run on regular gasoline most of the time which takes away any advantage.<br>More expensive than their regular gasoline or diesel equivalents. |

# The New Automobile Technologies
# What's Right For Me?

**How to decide?** Looking for a new car? What, from this myriad of cars and new technology is best to suit your needs?

**Did you know?**

***Fuel mileage of 100-125 mpg is attainable. That means a lot of miles between fill-ups. It means paying 2-3 cents per mile compared to the 12-15 cents per mile of the conventional SUV or the 6 or so cents per mile of a gasoline-electric hybrid.***

There are a number of factors that you need to take into consideration. What do you plan to use your car for? Daily 30-mile commute? Taking the whole family camping at weekends? Hauling heavy loads over rough country roads? These are practical questions which you have to answer.

There is also a matter of personal preference which usually overrides all other factors (when you can afford it).

Cost is a major factor but this is not as simple as it looks:

- Cost of purchase.
- Cost to run (fuel consumption).
- Cost to repair and maintain. Generally the more complicated the car, the more maintenance is required. Modern BEVs tend to need almost no maintenance. No oil changes. No tune-ups. All you really have to do is rotate the tires.

Even here there are factors to take into account:

- Cost of fuel and a prediction of fuel costs for the time you expect to keep the vehicle.
- How many miles you expect to travel per year.
- What sort of tax credits and government financial support is available in your state or country.

If you simply take the cost of purchase, you may immediately decide that a hybrid, plug-in hybrid or electric car is more expensive than a traditional gasoline version and look no further. Or you may see that the diesel version of the car you like is more expensive to buy than its gasoline equivalent and leave it at that.

### Looking under the hood

But it's worth looking a little deeper. In the case of the hybrid or plug-in hybrid, for example, you may find that over a period of five years that your fuel savings more than make up for the higher purchase price.

### Economy

In the case of the diesel car, you may find that the fuel economy results in considerable savings which compensate for the higher purchase price.

### Environment

Then there are environmental factors to take into consideration. Is it important to you to buy a car that has a reduced carbon footprint? That uses some other fuel than petroleum? That has zero emissions through the tailpipe (a BEV for example)? This alone may make it worthwhile to you to pay a higher price for your car.

### Tax credits

Then there is the subject of tax credits and government incentives for purchasing greener cars. If you go to http://www.fueleconomy.gov/feg/taxcenter.shtml you can find relevant information for different types of car.

Every person and situation is different of course. But a few scenarios will help you make some initial decisions and show you how to work your way through the choices available.

## FUEL FOR THOUGHT

### Scenario 1

You travel 30 miles to work each day. At your office there are stations for recharging BEVs or PHEVs. You have a family of four including yourself and your spouse and often make fairly long trips to see grandparents or go on family outings. Your spouse needs a vehicle to take kids to school and get around while you are at work.

A small BEV (perhaps the new Nissan Leaf) or another BEV would work for your daily commute and cost you very little money to run. You may find that you can travel in the HOV (High Occupancy Vehicle) lane on the freeway, even though you are on your own.

Your spouse would do well with a PHEV such as the Chevrolet Volt of the new Toyota Prius when it is available or some other PHEV. This will give you fuel mileage of over 100 mpg perhaps.

This would be a workable combination if you are happy with the cars when you test drive them.

You will pay a higher price for each of the vehicles compared to their gasoline equivalents, but with the price of fuel at its current levels and especially if it rises, there will be a payback period.

### Scenario 2

You need a truck for work, often needing to carry heavy loads and use full power for hauling a trailer. However, much of your driving time is spent sitting in traffic on the freeway in an empty truck.

Look into trucks which have variable engine displacement technology so that you can use the full 8 cylinders when you need the power but which will only use 4 cylinders for your freeway commute. Add start-and-stop technology for the bumper-to-bumper starting and stopping and you will reduce fuel consumption and emissions further.

If your partner just needs a small vehicle for errands, shopping and so on around town, he or she would be a candidate for a BEV that you can charge at home overnight. Or perhaps a high mpg clean diesel or gasoline car.

### Scenario 3

You own a company which employs salespeople who are on the road most of the time, traveling high miles in a mixture of city and freeway driving.

You find out that there is a government incentive which adds up to a deduction of $7,000 from the full purchase price of a plug-in hybrid or hybrid.

A fleet of plug-in hybrids which are charged every night and achieve 125 mpg regularly might end up saving you a great deal of money while contributing to cleaner air in your area. The PHEVs are great to drive and your sales force will be contributing to reduced environmental impact while you save money.

There are obviously many other scenarios not mentioned here, but perhaps these will give you a good idea of where to start and what to look for.

## REALITY CHECK

Here are the questions to ask and answer. Do any needed research on www.myperfectautomobile.com or other websites (we've listed some useful ones in the Resources section). The questions and your answers should lead you towards a choice. Then some test drives and you should be able to come up with your perfect automobile!

1. How many cars or vehicles do you need for your family or business?
2. What are you driving now?
    a. What's good about it/them?
    b. What is not so good about it/them?
    c. What features are you missing?
    d. Why are you looking for a new car?
3. How long do you expect to keep the vehicle if you are buying a new one?
4. What will you use the vehicle for (answer for each vehicle if you're looking for more than one)?
    a. Commuting, single passenger?
    b. Car pool?
    c. Shopping, errands, etc.?
    d. Transporting people? How many? How far?
    e. Transporting goods, equipment and so on? How much?
5. How many miles do you expect to travel in a year (per vehicle)?
6. What sort of travel do you expect to do in the vehicle?
    a. Regular commute, same every day?
    b. Running around town?
    c. Longer trips? How long? How often?
    d. Hauling loads/rough roads/farm, etc.?
    e. A mixture of two or more of these?
7. Does your state permit travel in the HOV lane for single drivers in BEVs, HEVs, PHEVs?
8. Does your geographical area provide adequate access to Ethanol? Natural gas?
9. What is the current cost of gasoline? Diesel?
10. Try to get an idea of the trend of petroleum prices and any predictions.
11. Look into local tax breaks and government incentives for different types of cars and models.

# The New Automobile TECHNOLOGIES RESOURCES

**Need directions?** In the ever evolving auto industry, there are new technologies all the time. Here are some resources to keep yourself up-to-date.


For up-to-date information on the latest automobile technology and models, we invite you to get the latest updates, technology breakthroughs and market opportunities:

www.MyPerfectAutomobile.com

For the latest information on tax credits and incentives, fuel efficiency and environmental impact:

www.fueleconomy.gov

www.energy.gov/taxbreaks.htm

Some other useful sites:

www.greencar.com

www.future-car.net/future-car-technology.html

http://ec.europa.eu/research/transport/info/green_cars_initiative_en.html

http://www.green-cars-initiative.eu/public/

# The New Automobile TECHNOLOGIES GLOSSARY

**Huh?** With any subject, there are terms that need clarification. The team at MyPerfectAutomobile.com has worked tirelessly to compile this glossary for you.


What the words and acronyms all mean.

**Alternative Fuel Vehicle:** An alternative fuel vehicle is a vehicle that runs on a fuel other than "traditional" petroleum fuels (gasoline and diesel) and includes any technology of powering an engine that does not involve solely petroleum, such as EVs, HEVs, solar powered vehicles, compressed air vehicles.

**Alternative Fuels:** Alternative fuels, also known as non-conventional or advanced fuels, are any materials or substances that can be used as fuel other than conventional fuels. Conventional fuels include: petroleum, coal, propane and natural gas, and nuclear materials such as uranium. Some well known alternative fuels include biodiesel, bioalcohol (methanol, ethanol, butanol), chemically stored electricity (batteries and fuel cells), hydrogen, non-petroleum methane, non-petroleum natural gas, vegetable oil.

**BEV: Battery Electric Vehicle:** (also known as a pure electric vehicle), a type of electric vehicle (EV) that uses chemical energy stored in rechargeable battery packs. As with other electric vehicles, BEVs use electrical motors and motor controllers instead of internal combustion engines (ICEs) for propulsion. A pure electric vehicle uses on-board sources of electricity stored in a battery or battery bank as power, and it must be plugged into a source of electricity to recharge its batteries.

**Biodiesel:** Biodiesel is a catchall term that refers to diesel fuels that are derived from biological sources such as plants (waste

vegetable oil, soybeans, etc.) and animals (animal fats, etc.) instead of petroleum. Biodiesel is made from non-conventional products and is renewable. Biodiesel is non-toxic and biodegradable. It can often be used in diesel engines of all kinds. Biodiesel is a cleaner fuel than standard petroleum diesel. Since it can often be produced locally, biodiesel has the potential to decrease a country's dependence on foreign nations for oil, and enhance local economies where biodiesel production is taking place.

**CAV: Compressed-Air Vehicle:** a compressed-air vehicle is powered by an air engine, using compressed air, which is stored in a tank. Instead of mixing fuel with air and burning it in the engine to drive pistons with hot expanding gases, compressed-air vehicles use the expansion of compressed air to drive their pistons. Air powered cars are relatively new to the green car scene. Compressed air is currently being explored as a viable "alternative fuel" to efficiently power car engines with little or no environmental impact.

**CNG: Compressed Natural Gas:** a substitute for gasoline, diesel, or propane. Although its combustion does produce greenhouse gases, it is a more environmentally clean alternative to those fuels, and it is much safer than other fuels in the event of a spill (natural gas is lighter than air, and disperses quickly when released). CNG may also be mixed with biogas, produced from landfills or wastewater, which doesn't increase the concentration of carbon in the atmosphere. CNG is made by compressing natural gas (which is mainly composed of methane), to less than 1% of the volume it occupies at standard atmospheric pressure. It is stored and distributed in hard containers. CNG is used in traditional gasoline internal combustion engine cars that have been converted into bio-fuel vehicles (gasoline/CNG). Natural gas vehicles are increasingly used in the Asia-Pacific region, Latin America, Europe, and America due to rising gasoline prices.

**Diesel:** A method of combusting fuel to provide power. A diesel engine can burn a variety of fuels including crude oil, vegetable oils, animal fats, and even coal dust.

**ECVT: Electric Continuously Variable Transmission:** A continuously variable transmission (CVT) is a transmission that can change steplessly through an infinite number of effective gear ratios. This contrasts with other mechanical transmissions that offer a fixed number of gear ratios. This can provide better fuel economy than other transmissions by enabling the engine to run at its most efficient revolutions per minute (RPM) for a range of vehicle speeds. Alternatively it can be used to maximize the performance of a vehicle by allowing the engine to turn at the RPM at which it produces peak power. This is typically higher than the RPM that achieves peak efficiency.

**Ethanol:** Ethanol (ethyl alcohol) is the same type of alcohol as is found in alcoholic beverages. As a fuel, ethanol can be used in more than 30 flex-fuel vehicle models that have been designed to run on alcohol, gasoline, or any combination of the two fuels from the same tank. Most ethanol today is produced from corn or sugar cane, although this will change as cheaper ethanol made from fast growing woody grasses and other sources becomes a reality. As a popular alternative fuel, ethanol is typically used in the form of E85 to power flex-fuel cars outfitted specifically to run on this blend of 85% ethanol and 15% gasoline.

**EV: Electric Vehicle:** this covers many different types of electric vehicles and is often preceded by another letter or letters to define exactly which type of electric vehicle is referred to. A pure electric vehicle (EV), also known as an electric drive vehicle, uses one or more electric motors for propulsion. Electric vehicles first came into existence in the mid-19th century, when electricity was among the preferred methods for motor vehicle propulsion, providing a level of comfort and ease of operation that could not be achieved by the gasoline or steam cars of the time. Electric cars produce zero localized emissions since they're propelled by electric motors that run on batteries charged at home or at special electric vehicle charging stations. Electric cars are extremely efficient and run for pennies per mile, much cheaper than any other alternative fuel available today.

**FFV: Flexible-Fuel Vehicles:** a flexible-fuel vehicle or dual-fuel vehicle or flex-fuel vehicle is an alternative fuel vehicle with an

internal combustion engine designed to run on more than one fuel, usually gasoline blended with either ethanol or methanol, and both fuels are stored in the same common tank. Flex-fuel engines are capable of burning any proportion of the resulting blend in the combustion chamber as fuel injection and spark timing are adjusted automatically according to the actual blend detected by electronic sensors. The most common commercially available FFV in the world market is the ethanol flexible-fuel vehicle.

**Hydrogen Fuel Cell:** A hydrogen fuel cell uses hydrogen as its fuel and oxygen (usually from air) as its oxidant. A hydrogen fuel cell converts the chemicals hydrogen and oxygen into water, and in the process it produces electricity. The other electrochemical device that we are all familiar with is the battery. A battery has all of its chemicals stored inside, and it converts those chemicals into electricity too. This means that a battery eventually "goes dead" and you either throw it away or recharge it. With a fuel cell, chemicals constantly flow into the cell so it never goes dead — as long as there is a flow of chemicals into the cell, the electricity flows out of the cell. Most fuel cells in use today use hydrogen and oxygen as the chemicals.

**GHG: Greenhouse Gas:** a greenhouse gas is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases in the Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide and ozone. Greenhouse gases greatly affect the temperature of the Earth; without them, Earth's surface would be on average about 33° C (59° F) colder than at present.

**Green Vehicle or Environmentally Friendly Vehicle:** A green vehicle or environmentally friendly vehicle is a road motor vehicle that produces less harmful impact on the environment than comparable conventional internal combustion engine vehicles running on gasoline or diesel. Green vehicles are powered by alternative fuels and advanced vehicle technologies and include hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), battery electric vehicles (BEVs), compressed-air vehicles, hydrogen and fuel-cell vehicles, neat ethanol vehicles, flexible-fuel vehicles, natural gas vehicles, clean diesel vehicles, and some sources also include vehicles using blends of biodiesel and ethanol fuel, and other conventional motor vehicles with high fuel economy. Environmentally friendly vehicles reduce air pollution and greenhouse gas emissions.

**HEV: Hybrid Electric Vehicle:** a vehicle which combines a conventional internal combustion engine (ICE) propulsion system with an electric propulsion system. The electric power train is intended to achieve either better fuel economy than a conventional vehicle, or better performance. A variety of types of HEV exist, and the degree to which they function as EVs varies as well. Modern HEVs make use of efficiency-improving technologies such as regenerative braking, which converts the vehicle's kinetic energy into battery-replenishing electric energy, rather than wasting it as heat energy as conventional brakes do. Some varieties of HEVs use their internal combustion engine to generate electricity by spinning an electric generator (this combination is known as a motor-generator), to either recharge their batteries or to directly power the electric drive motors. Many HEVs reduce idle emissions by shutting down the ICE at idle and restarting it when needed; this is known as a start-stop system. A hybrid-electric produces less emissions from its ICE than a comparably-sized gasoline car, since an HEV's gasoline engine is usually smaller than a comparably-sized pure gasoline-burning vehicle (natural gas and propane fuels produce lower emissions) and if not used to directly drive the car, can be geared to run at maximum efficiency, further improving fuel economy.

**Hybrid Vehicle:** a hybrid vehicle is a vehicle that uses two or more distinct power sources to move the vehicle. The term most commonly refers to hybrid electric vehicles (HEVs), which combine an internal combustion engine and one or more electric motors. Hybrids combine two or more different propulsion systems, typically a gasoline engine and one or more electric drive motors. Most hybrids on the road today complement their gas engines by charging a battery when breaking. Engines running on diesel or other alternative fuels can also be used in hybrids.

**ICE: Internal Combustion Engine:** an engine in which the combustion of a fuel (traditionally petroleum-based) occurs in a combustion chamber. In an internal combustion engine the expansion of the high-temperature and -pressure gases produced by combustion applies direct force to some component of the engine, such as pistons or turbine blades. This force moves the component over a distance, generating useful mechanical energy.

**LEV: Low Emission Vehicle:** a low emission vehicle is a vehicle that emits relatively low levels of air pollutants. The term may be used in a general sense, but in some countries it is defined in law: low emission vehicles may be given tax or other advantages, while high emission vehicles may suffer restrictions or additional taxation.

**LNG: Liquified Natural Gas:** natural gas in liquified form so that it occupies about 1/600th of the volume of the gas in its normal state. It can be used in natural gas vehicles.

**Natural Gas:** Natural gas, the cleanest-burning conventional fuel, is being used by an increasing number of medium- and heavy-duty commercial vehicles like refuse trucks and delivery vans. Natural gas is stored and used in its liquefied or compressed states. It is most commonly abbreviated as **LNG for Liquefied Natural Gas, and CNG for Compressed Natural Gas.** While a variety of light-duty natural gas cars were once available, the only factory-produced natural gas car made today in the U.S. is Honda's Civic GX. Other car models may be developed and sold in the United States as additional focus is placed on natural gas as a fuel source for alternative fuel vehicles.

**NEV: Neighborhood Electric Vehicle:** Battery electric vehicles that are legally limited to roads with posted speed limits of 25 miles per hour (40 km/h) or less, usually are built to have a top speed of 30 miles per hour (48 km/h), and have a maximum loaded weight of 3,000 lb. NEVs fall under the United States Department of Transportation classification for low-speed vehicles. The NEV's battery pack recharges by plugging into a standard outlet and because it is an all-electric vehicle it does not produce tailpipe emissions. If recharged from clean energy sources such as solar or wind power, NEVs do not emit greenhouse gases. In the state of California, NEVs are classified by the California Air Resources (CARB) as zero emissions vehicles (ZEV) and are eligible for a purchase rebate of up to $1,500 if purchased or leased on or after March 15, 2010.

**NGV: Natural Gas Vehicle:** a natural gas vehicle is powered by an internal combustion engine that uses natural gas for fuel.

**NOx: Nitrous Oxides:** Above a certain concentration nitrous oxides can irritate the human respiratory system. They also damage plant life by causing acid rain, and they contribute to the accumulation of ozone. In the presence of sunlight this results in smog.

**PHEV or PHV: Plug-in Hybrid Electric Vehicle, also known as a Plug-in Hybrid Vehicle:** a hybrid vehicle with rechargeable batteries that can be restored to full charge by connecting a plug to an external electrical power source source (usually simply a normal electric wall socket). A PHEV shares the characteristics of both a conventional hybrid electric vehicle, having an electrical motor and an internal combustion engine, and of an all-electrical vehicle, also having a plug to connect to the electrical grid. Most PHEVs on the road today are passenger cars, but there are also PHEV versions of commercial vehicles and vans, utility trucks, buses, trains, motorcycles, scooters, and military vehicles. The cost of electricity to power plug-in hybrids for all-electric operation has been estimated at less than one quarter of the cost of gasoline. Compared to conventional vehicles, PHEVs reduce air pollution locally and dependence on petroleum. They may reduce greenhouse gas emissions compared with conventional vehicles. PHEVs also eliminate the problem of "range anxiety" associated to all-electric vehicles, because the combustion engine works as a backup when the batteries are depleted. Plug-in hybrids do not use their ICE during their all-electric range and produce lower greenhouse gas emissions if their batteries are charged from renewable electricity. Other benefits include fewer fill-ups at the filling station, the convenience of home recharging, opportunities to provide emergency backup power in the home and vehicle to

grid (V2G) applications. The "PHEV" may be followed by a number indicating how far the car can travel on electricity alone: PHEV-60 (miles) or PHEV-100 (km) for example. Plug in hybrids may never need to run on anything but electricity for shorter commutes. The combination of gas and electric driving technologies can already achieve up to 150 mpg.

**PZEV: Partial Zero Emission Vehicle:** PZEVs meet SULEV tailpipe emission standards, have zero evaporative emissions and a 15 year/150,000 mile warranty on its emission control components. No evaporative emissions means no unburned fuel escapes from the fueling system.

**SULEV: Super Ultra Low Emission Vehicle:** SULEVs are 90% cleaner than the average new model year car.

**ULEV: Ultra Low Emission Vehicle:** a vehicle that emits extremely low levels of air pollutants compared to other vehicles. Can be used in a general sense or have a precise definition in law. ULEVs are given tax advantages in some jurisdictions.

**Ultra-Low Sulfur Diesel:** Diesel fuel that contains far less of the potentially hazardous substance sulfur than do typical American diesel fuels. Sulfur is not only a pollutant but it can foul and clog catalytic converters and particulate filters meant to deal with other pollution.

**V2G: Vehicle-to-Grid:** a system in which plug-in electric vehicles communicate with the power grid to sell demand response services by either delivering electricity into the grid or by throttling their charging rate. Vehicle-to-grid can be used with such gridable vehicles as plug-in electric vehicles (BEVs and PHEVs), with grid capacity. Since most vehicles are parked an average of 95 percent of the time, their batteries could be used to let electricity flow from the car to the power lines and back, with a value to the utilities of up to $4,000 per year per car.

**Variable Displacement:** Variable displacement is an automobile engine technology that allows the engine displacement to change, usually by deactivating cylinders, for improved fuel economy. The technology is primarily used in large, multi-cylinder engines. Many automobile manufacturers have adopted this technology as of 2005, although the concept has existed for some time prior. Also known as displacement on demand (DoD). Active Fuel Management is a trademarked name for the automobile variable displacement technology from General Motors. It allows a V6 or V8 engine to "turn off" half of the cylinders under light-load conditions to improve fuel economy. Estimated performance on EPA tests show a 5.5%-7.5% improvement in fuel economy.

**ZEV: Zero Emission Vehicle:** ZEVs have zero tailpipe emissions and are 98% cleaner than the average new model year vehicle. These include battery electric vehicles (BEVs) and hydrogen fuel cell vehicles.

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