Nissan LEAF: the new car

New generation electric cars aren't just 'normal' cars fitted with a battery instead of an internal combustion engine. They are a whole new type of car.

Nissan LEAF, the world's first electric vehicle that has similar affordability, performance and practicality of a 'normal' five-seat hatchback, is anything other than a typical hatchback. It's a revolution in zero emissions mobility.

If we start with the engine: There is no engine oil, camshafts, valves, inlet manifolds, exhaust or pistons. And because an electric car produces no tailpipe emissions, there is no need for a catalytic converter, anti-pollution plumbing, expensive electronic NOx or carbon monoxide controls, or pricey injection systems.

Rather, electric engines are incredibly simple. This cuts maintenance costs and boosts reliability. Their cleanliness includes noise: because there is no combustion, there is virtually no noise. There is also no exhaust.

Electric engines are small. So that's less space for the motor and more space for people and their belongings. And they have no conventional transmission, further reducing space devoted to the mechanicals.

Nissan LEAF, like all electric cars, can develop its maximum torque instantly. And it can maintain that big delivery of torque over a very
wide rev band. In some circumstances, Nissan LEAF is faster than a car with an internal combustion engine. That 'instant' torque means Nissan LEAF has excellent initial acceleration. This is particularly useful in urban or suburban driving, the natural habitat of the electric car (and it's also where an EV can do most good – in polluted cities where loads of people live.) The electric car's much wider torque and rev bands also enables Nissan LEAF to offer more linear acceleration than the typical gas.

Plugging in for more power.

Although Nissan LEAF is a whole new kind of vehicle, it is probably easiest to think of its major 'power' components, the electric motor and battery, in 'normal' car terms.

The electric motor is the equivalent of the gas motor. It makes the car go. It has many advantages over an internal combustion engine including greater simplicity, easier and cheaper maintenance and far greater torque spread – maximum torque comes straight from zero revs. The bigger rev range means you don't need a 'normal' multi-gear transmission. In fact, you don't need a conventional gearbox at all. An electric motor is also much more efficient than an internal combustion engine.

The battery is the equivalent of the gas stored on board in a tank. It provides the energy. The battery also means that Nissan LEAF has no fuel tank. There is no need to visit a gas station. You refuel an EV like you recharge your mobile phone or laptop. Simple overnight recharging is probably the easiest option,

and usually the cheapest (it's when the electricity price is typically off-peak). A full charge, from zero, on a 220-240V outlet takes about eight hours. But with a 'quick charger' the battery can be recharged up to 80 percent of its full capacity in about 30 minutes.

Charging your Nissan LEAF with a home charging dock is just like charging your phone. Compared to a 'normal' car that uses gasoline, it's a bit like having your own filling station at home or in your own garage. Charging at home through a dedicated 220V outlet will take approximately eight hours, from empty to a full charge. So that's ample time for an overnight fill-up. Under normal daily use, the battery will not usually be fully drained, so the actual recharge time is likely to be much less – often no more than the time it takes to have a meal, take a shower and watch a TV program.

It's so convenient. It's also much cheaper. Studies show that EVs can be a fifth the price to refuel compared with gas cars.

You really should never run out of charge. The new Nissan LEAF has a likely driving range of 100 miles (US-LA 4 mode)*. Lots of research shows that that will easily satisfy the daily demands of most drivers. The average daily driving distance for 95 percent of the US population is under 100 miles per day.

Driving range is obviously dependent on how the vehicle is used. Just as a mobile phone will run down faster if you use graphic intense features, so an EV's range will be reduced if you do a lot of hill work, run at constant high speeds on freeways, or run in very hot or very cold temperatures. Equally, if lower speeds are used, and the car is driven carefully, range will be boosted.

The easiest way to avoid running out of charge, of course, is to get into the habit of charging every day, just as you do with your mobile phone.

Some people may choose to recharge their Nissan LEAF at their office, following their commute to work. Or they may use the growing infrastructure of recharge points, which are becoming more common in major cities, encouraged by environmentally conscious governments and utilities. Recharging points are much easier to set up than gas stations. Charging devices will be fitted in parking lots outside convenience stores, family restaurants, shopping malls and department stores, or alongside parking meters. Frequent recharging will obviously boost the car's range, just as frequent recharging will boost the operating time of your mobile phone. Increasingly, these will be 'quick chargers' – which can recharge 80 percent of the battery's capacity in about 30 minutes.

Nissan, along with alliance partner Renault, has already formed partnerships with more than 60 governments, local bodies or corporations to promote the global spread of electric cars – and that number keeps growing.

Powering the new car.

Nissan LEAF's new lithium ion battery, is much more advanced than any previous battery. It has half the weight and stores double the energy. Its unusual manganese base further cuts costs and boosts safety. Unlike the last-generation cylindrical type, its thin laminate cell structure increases design possibilities. The battery is an array of 48 modules, each achieving the optimum performance.

While it gets most of its energy from the electrical grid during recharge, the lithium ion also captures kinetic energy during braking or deceleration. Every time you brake, the car's kinetic energy boosts battery energy levels, especially during stop-start city driving.

Nissan LEAF's advanced on board IT (Intelligent Transport) systems further boosts the car's practicality and enables easy range management by providing the driver with support and information. First, it keeps the driver fully aware of battery charge levels. It's like a fuel tank gauge – but much more. You are always getting the latest and most accurate information, including crucial driving range.
An on-board timer can be pre-programmed to recharge the battery, allowing you to use electricity at the cheapest and most environmentally friendly time. This is usually at night, when the grid is often generating surplus energy. Nissan LEAF's advanced connected navigation system links your car to a global data centre, your personal web portal and your smart phone.

The IT system can be linked to your smart phone, such as an iPhone. Your smart phone can turn on the charging function of the car, for instance. It can remotely turn on air conditioning or heating – so you're comfortable the moment you step on-board – when the car is being charged, preserving your battery's power. Your smart phone can also remotely confirm the charge level of your car's battery.

EVs are particularly useful for urban or suburban use. They're ideal for commuting, shopping, and school drop-offs. Statistically, this is the type of driving that most of us do daily. This is why the Nissan LEAF is potentially so appealing to so many people. In many cases the Nissan LEAF will be an ideal 'primary car'. The 'secondary car' will be used for long distance drives or to provide increased carrying capacity.

The Nissan LEAF is perfect for daily trips, and drivers will be producing far less carbon than a normal internal combustion-engine car and absolutely no tailpipe emissions at all. And the Nissan LEAF will get even cleaner as the grid gets cleaner.

The lithium-ion battery is a new-generation energy storage device that will revolutionize the practicality and affordability of electric cars. Its far superior energy density translates into better driving range, better reliability and quicker performance.

The 48-module battery is mounted under the seats and floor. The platform is new as befits a 'new car'. The whole vehicle is 175" long and has a long wheelbase of 106.3". The floor is flat, to aid underbody airflow, and the sharp V-shaped front design includes distinctive LED (light emitting diode) headlights using an unusual blue internal reflective design. The LED lights consume half the energy of 'normal' headlights, improving the car's range. The headlights are also designed to redirect airflow away from the door mirrors,

reducing wind noise and drag. A rear diffuser and large rear spoiler further cut drag.

Appropriately on such a pioneering electric vehicle, Nissan LEAF makes big strides in connected mobility. The car is connected to a global data center, the owner's personal web portal and smart phone, all to ensure range management. The revolutionary on-board IT (Intelligent Transport) system gives 'live' guidance on driving range and remaining battery charge. If your remaining range becomes low, other routes are advised. Charging spots will also be recommended.

Your smart phone communicates with the car. It can check battery charge level, ask the climate control system to heat-up or cool-down the car while it's still plugged into the recharging network, and can also tell when charging is complete.

Unlike most other small-volume EVs now on sale, Nissan LEAF meets exactly the same safety standards as other cars in its class. Nissan engineers have also ensured that the electrical side is equally safe. For example, when the charger is not in use, the internal relay shuts off power to the charging port. The charging port lid is completely weather proof and is unaffected by rain or snow.

A little history…

Nissan LEAF is the first in a new breed of electric cars. It offers all the traditional benefits of the EV, especially zero tailpipe emissions, but adds practicality, comfort and competitive cost of ownership.
Yet the electric vehicle is not a new phenomenon. Over 100 years ago, at the beginning of the 20th century, there were more EVs on American roads than gas-powered cars. Sales peaked in 1912. They were quieter, cleaner and easier to drive.

Nissan is also not new to EVs. Its first electric car was built in 1947. The Tama was made by Tokyo Electric Cars Company, one of the ancestors of the Prince Motor Company, which later merged with Nissan. It utilized a bank of lead-acid batteries and had a top speed of 35 km/h. The car was launched in the austere post-war period and was withdrawn from sale in 1950, when oil supplies improved.

Nissan has been a long-time pioneer of lithium-ion batteries. In 1995, its Prairie EV was the world's first car to use lithium-ion battery power. Thirty vehicles were sold to Japanese fleets.

More unusually, a Prairie EV supported the Japanese North Pole Exploratory team from 2000-2006. They wanted a zero emissions vehicle, so as not to contaminate any research data with exhaust pollutants. This was a particularly tough test for an EV, for battery energy is always diminished by extremely cold weather. Yet the car performed flawlessly, and was only recalled to Japan – there was no Nissan dealer nearby! – when a small fault (it turned out to be a disconnected condenser) could not be fixed on site.

In 1997, Nissan launched the lithium ion-equipped Altra EV, an award-winning electric minivan sold in limited volume in the US and Japan.

Nissan's battery knowledge blossomed at the turn of the century. Compact lithium-ion batteries, replacing

cylindrical cell batteries, were developed in conjunction with NEC. These were used in a number of innovative electric concept vehicles, most notably the Pivo (2005) and Pivo2 (2007). Utilizing the much greater design flexibility that EVs can offer, both Pivos featured rotating cabins and the ability to make all four wheels steer individually, greatly increasing maneuverability.

Nissan LEAF is the climax of all that development work, a pioneering vehicle that ushers in a new age of electric 'zero tailpipe emissions' mobility.

Nissan and its alliance partner Renault believe that EVs have a bright future. They not only help the environment, by greatly reducing carbon emissions, and producing no tailpipe pollution. They actually suit many people's needs. And, thanks to new technological developments, such as the latest generation lithium ion batteries, they do so without compromise.

There's no doubt that electric cars will grow in popularity and that the electrification of the car – all cars – will be a major automotive trend. Nissan LEAF is at the forefront of a sea change in automotive mobility.

*Based upon US EPA LA4 city cycle conducted in laboratory tests. See http://www.fueleconomy.gov/feg/fe_test_schedules.shtml Gradual loss of capacity in battery will result with time and use. Actual range will vary depending upon driving/charging habits, speed, conditions, weather, temperature, and battery age.