**Dump the pump: When oil will lose its lustre**

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Car manufacturers have plenty of ways to improve gasoline engines *(Image: Herwig Prammer/Reuters)*

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*Oil production may fall in 10 years – not because it is running out but because electric cars will be cheaper and gasoline engines will be better*

PEOPLE have fretted about when the world's oil will start to run out ever since M. King Hubbert came up with the idea of ["peak oil"](http://www.newscientist.com/article/mg20427375.900-extreme-oil-scraping-the-bottom-of-earths-barrel.html) back in the 1950s. The American geologist, who worked for Shell, pointed out that we are destined to reach a moment when oil production stops rising and goes into terminal decline. With it, the era of cheap oil that fuelled the post-war economic boom would end. The idea still provokes great debate, and many forecasters are predicting that global production will peak by the end of this decade as supplies dwindle.

Now there is a different view. A small number of analysts forecast that oil production will start to fall by 2020 - not because we are running out, but because we just won't need it.

They argue that the world will wean itself off oil voluntarily, through major advances in vehicle technology. Peak oil will not be a supply-side phenomenon brought about by shrinking reserves, but by motorists buying electric cars and conventional cars with highly efficient engines. If they are right, this shift will start the long-term transition from oil to electricity as the main transport fuel, reduce economies' vulnerability to spikes in the oil price, and cap greenhouse emissions from crude oil.

It is a bold prediction. Could it be right?

Judging by motor industry investment and the number of new models being launched, the prospects for the electric car are brightening. All the major manufacturers are producing cars with varying degrees of electrification, ranging from hybrids, such as the [Volvo V60](http://www.volvocars.com/uk/all-cars/volvo-v60/Pages/default.aspx?utm_source=google&utm_medium=cpc&utm_term=volvo%20v60&utm_campaign=V60%20-%20Brand%20-%20Pure%20-%20Exact), that run on petrol and electricity to cars such as the [Nissan Leaf](http://www.nissan.co.uk/vehicles/electric-vehicles/electric-leaf/leaf.html#vehicles/electric-vehicles/electric-leaf/leaf) that are powered entirely by an electric battery (see "[Six degrees of electrification](http://www.newscientist.com/article/mg21428651.700-dump-the-pump-when-oil-will-lose-its-lustre.html?full=true#bx286517B1)"). There are now about 130 models in total.

Sales so far have proved disappointing, though. Total car sales in the US last year jumped by a tenth over the previous year. But electric vehicle sales rose just 2.3 per cent, according to research firm [WardsAuto](http://wardsauto.com/). Sales of General Motor's [Chevy Volt](http://www.chevrolet.com/volt-electric-car/) missed their target by a fifth, and those of the pioneering [Toyota Prius](http://www.toyota.com/priusc/) hybrid have been falling since 2007. So can electric vehicles really make a serious dent in global oil demand?

Investment analysts at Deutsche Bank in New York argue in a series of reports that the electric vehicle is a disruptive technology and its short-term potential is widely underappreciated. "Transportation is likely to change more in the next 10 years than over the last 50," says Dan Galves, the bank's chief car-industry analyst. That's not because of some imminent technological breakthrough, but because he expects that the relative costs of electric and petrol cars will soon be transformed.

Electric cars are far more expensive to buy than their petrol equivalents, largely because the cost of the lithium-ion battery that powers the vehicle is so high - currently about $12,000. But the fuel costs of electric vehicles are already far lower than for petrol-powered ones. In the US, for example, the petrol for an average car costs about 8 cents per kilometre, compared with less than 2 cents for the electricity to power an electric car. In Europe, where fuel tax is higher, the numbers are 12.5 cents and 2.5 cents, respectively. Either way, that is a huge gap. So for electric vehicles to compete on price, battery costs need only fall far enough to be swallowed by that gap, and Galves believes that it is likely to happen sooner than most people think.

First, he expects the costs of batteries to plummet as mass production ramps up - just as they did for laptops - to less than $7000 by 2015. Second, the gap is likely to widen with most analysts expecting oil prices to keep rising. "On a 10-to-15-year view, it's almost impossible for electrification not to carve out a decent portion of the market," says Galves, who expects electric vehicles to be economic within a decade even without the subsidies that many governments currently give.

The effect of falling electric vehicle costs will be reinforced by strengthening fuel efficiency and emissions policies in the world's most important car markets. The policies of the world's biggest gas guzzler will soon be among the toughest. In 1975, US president Jimmy Carter passed a law forcing vehicle manufacturers in the US to meet [average fuel efficiency standards](http://www.newscientist.com/article/dn11020-bushs-address-tackles-energy-and-climate.html). For cars, that number has languished at around 27 miles per gallon (11.5 kilometres per litre) since the early 1990s, but recent legislation means average fuel economy must double to 54.5 mpg by 2025. The standard has been rising since 1978, and by 2020 the targets become so demanding, says Galves, that car manufacturers will not be able to meet them without selling a significant number of electric vehicles. Galves expects them to make up a fifth of US car sales in 2020.

The impact will be dramatic. Every day, US vehicles guzzle about 9 million barrels of oil - the biggest single element in our daily global consumption of almost 90 million barrels ([see chart](http://www.newscientist.com/articleimages/mg21428651.700/1-dump-the-pump-when-oil-will-lose-its-lustre.html)). Deutsche Bank oil analysts expect US petrol consumption to plummet, almost halving by 2030.

The story is the same in the European Union, which regulates carbon dioxide emissions per kilometre rather than miles per gallon ([see chart](http://www.newscientist.com/articleimages/mg21428651.700/2-dump-the-pump-when-oil-will-lose-it-lustre.html)). Cars manufactured there in 2020 must reduce their average emissions by more than a quarter compared with models made in 2015. Such standards will especially encourage electrification because they govern "tailpipe" emissions pumped out in the day-to-day running of car engines and not those emitted while they are being built. By this measure, electric vehicles are zero emission. Deutsche Bank expects them to make up 25 per cent of Europe's car sales in 2020, accelerating the decline in demand for petrol.

**Petrol still rules**

So much for the world's richer nations. In China, where the developing car market is booming, the demand for petrol will continue to rise for at least a decade. Yet the global impact will be limited because the size of China's car fleet is currently just a fifth of that of the US. The Chinese government too is strongly committed to electric vehicles as one way of tackling appalling air quality in the cities and the country's dependence on imported oil. Deutsche Bank forecasts that Chinese petrol demand will start to fall from 2025, as electric vehicles become more common ([see chart](http://www.newscientist.com/articleimages/mg21428651.700/3-dump-the-pump-when-oil-will-lose-it-lustre.html)).

The net effect is that global petrol demand will peak as early as 2015. "From that point forward," writes Deutsche Bank's lead oil analyst Paul Sankey in a company report. "We believe gasoline demand will be on an inexorable and accelerating decline." And as a result, he argues, global demand for crude oil will go the same way in about 2020.

Others disagree with Deutsche Bank's analysis. The [International Energy Agency](http://www.iea.org/index.asp) has long been dismissive about predictions of an early peak in the global oil supply. It is just as dismissive that demand will decline within the next couple of decades. It forecasts that daily oil demand will rise to 107 million barrels by 2035 on the basis of current government policies. Fatih Birol, the agency's chief economist, believes that there are simply too many cars in the world - about a billion and rising - for electric vehicles to have a meaningful impact in the short term. Although most governments have policies to encourage electrification, they are very unlikely to achieve their targets. Even if they do, says Birol, the number of electric vehicles on the road in 2020 will be just 20 million - about 2 per cent of the total fleet.

Stefanie Lang, a London-based automobile analyst at investment-research firm Sanford C. Bernstein, agrees that electric vehicles will make only limited progress over the next 10 to 15 years. She argues that they will struggle because they will remain far too expensive and will face fierce competition from the incumbent technology - the internal combustion engine.

Even after a century of development, the internal combustion engine has the capacity to make major improvements in fuel economy, says Lang, rattling off three examples. "Stop/start" mechanisms that kill the engine when the car pauses in traffic can produce average fuel savings of 5 to 9 per cent, and will probably come as standard on all European models by 2015. Fitting cars with smaller engines and turbochargers will use 3 to 6 per cent less fuel to deliver the same performance as conventional engines. Injecting fuel directly into a petrol engine, rather than mixing it first with air, can raise fuel economy by another 3 to 5 per cent. "They aren't headline grabbing technologies, necessarily," says Lang, "but they are the low-hanging fruit of fuel efficiency and can reduce fuel consumption across the board." She forecasts that these and other known technologies will lead to an improvement in efficiency of up to 30 per cent by 2020.

The upshot, according to Lang, is that car manufacturers can meet US and European standards simply by investing in incremental improvements to existing models, rather than struggling to sell more electric vehicles.

Such investment could still have a dramatic impact on global oil demand. Although cars would still be fuelled largely by oil, another study shows how the increased efficiency of traditional engines would have much the same effect as electric vehicles. Analysts at engineering consultancy Ricardo in London surveyed the energy efficiency improvements being planned by car manufacturers and plugged them into a global model that includes factors such as government policies, demographics and gross domestic product. They were surprised to find that [global oil demand would peak by the end of this decade](http://www.ricardo.com/en-GB/News--Media/Press-releases/News-releases1/2011/Ricardo-study-suggests-global-oil-demand-may-peak-before-2020/), and could drop 10 per cent by 2035.

Like others, Ricardo concluded that electric vehicles would make little headway this decade, and that improvements in the efficiency of conventional engines would be the primary factor.

Despite an 80 per cent rise in vehicle numbers by 2035, oil demand will fall largely because vehicle efficiency will more than double, claims Peter Hughes, head of Ricardo's energy practice in London. Other factors lower fuel consumption too: the ageing population in key markets, because older people drive less; working from home; and the oil price, even though the model in Ricardo's research assumes just $100 per barrel to 2035. The factors working against a growth in demand for oil are increasing in number and intensity, says Hughes. "The world is nearing a paradigm shift in oil demand."

So what does the motor industry itself think lies ahead? That the internal combustion engine's days are numbered, for one thing. In a [recent survey](http://www.kpmg.com/uk/en/issuesandinsights/articlespublications/pages/globalautomotiveexecutivesurvey2012.aspx), consultants KPMG asked 200 top executives of car companies how long they thought the traditional engine would continue to prevail over electric vehicles. Some 70 per cent answered 1 to 10 years, but only 18 per cent thought 10 to 20 years.

One reason for the result could be that electrification is now widely seen as the best way to make major reductions in transport emissions, even taking into account the emissions from generating the electricity in the first place. That is because electric vehicles are far more efficient than petrol cars. Take the Nissan Leaf. It is responsible for just 99 grams of CO2 per kilometre, even when charged on electricity generated by the average mix of coal, natural gas, nuclear and renewables. That makes it 40 per cent cleaner than a typical petrol car in Europe. And as electricity generation becomes cleaner, the emissions of electric vehicles will fall further still - unlike those of cars powered by biofuel or natural gas (see [*New Scientist*, 25 February, p 48)](http://www.newscientist.com/article/mg21328532.600-natural-gas--a-fuel-too-far.html).

Lang points out that future improvements to the internal combustion engine will become progressively more expensive and less effective, while legally binding standards get tougher. She reckons the turning point will be 2025, when the US fuel economy standard reaches 54.5 miles per gallon (23 kilometres per litre) and Europe's upper limit on CO2 emissions for new cars could be as low as 70 grams per kilometre. "It's going to be very difficult to achieve that with low electrification," says Lang. Both she and Hughes see electric vehicle sales beginning to take off from around that time.

**Rebound effect**

In one sense it doesn't matter when electric vehicles supplant the internal combustion engine. As long as the motor industry delivers the expected efficiency gains somehow, the climate will benefit. But what if both sides of the argument are wrong, and neither technology delivers large cuts in oil demand?

Super-efficient engines may fail to change oil demand if their efficiency gains are eroded by the ["rebound effect](http://www.ukerc.ac.uk/support/tiki-index.php?page=0710ReboundEffects)", by which rising efficiency stimulates increased consumption. Researchers at the UK Energy Research Centre in London concluded that 10 to 30 per cent of the benefits could be lost because efficiency gains make it cheaper to drive, encouraging people to use their cars more.

Economic growth could hamper progress too: one [scenario considered by the International Energy Agency](http://www.worldenergyoutlook.org/) indicates that improvements in fuel economy will be overwhelmed by rising vehicle numbers even if governments rigorously enforce tighter rules on energy efficiency. On the other hand, recession and fiscal austerity could hamper progress if governments start cutting back their financial support for electric vehicles.

If the forecasts of Deutsche Bank, Ricardo and Sanford C. Bernstein are anything to go by, the transition away from oil could be far less painful than many expect. But if technology fails to slake our thirst for oil, then supply will struggle to keep up with demand and peak oil may turn out to be a supply-side phenomenon after all, just as predicted all those years ago.

**Six degrees of electrification**

• A micro hybrid has a conventional internal combustion engine (ICE) with a "stop/start" mechanism that kills the engine whenever it pauses in traffic. This means it needs a more powerful lead-acid battery and starter motor. Advanced versions use this not just to start the engine, but also to drive the car briefly after it restarts, when running an ICE is at its least efficient. Offered as standard on many new cars, it can deliver fuel savings of 5 to 9 per cent. It is not generally considered to be an electric vehicle.

• A mild hybrid is somewhere between a micro and full hybrid. It has regenerative braking, which uses energy that would otherwise be lost as heat during braking to recharge the battery; a traction battery that is used to power the car instead of just the starter motor and peripherals; and an electric motor. But unlike the full hybrid, its electric motor only ever supplements the ICE and never powers the vehicle entirely by itself - so it is not considered an electric vehicle. One version of the Honda Civic is a mild hybrid.

• A hybrid, or full hybrid, such as the Toyota Prius, has an internal combustion engine, an electric motor and a small nickel-metal hydride traction battery. All the electricity is generated on-board by the ICE or regenerative braking. The motors are arranged in parallel, so each can drive the wheels independently. Many combinations are possible, but typically the car will rely on electric power up to about 40 kilometres per hour, when the ICE takes over. The new Prius C can do up to 53 miles per gallon (22.5 kilometres per litre).

• A plug-in hybrid, such as the Volvo V60, has the same configuration as a hybrid, along with a socket to charge the battery from the grid.

• A range-extended electric vehicle, such GM's Chevy Volt (or Vauxhall Ampera in Europe), is similar to a plug-in hybrid except that the ICE is only there to generate electricity for the battery and electric motor, and never drives the wheels directly. The vehicle travels on grid electricity only for the first 45 kilometres or so, and then switches to electricity from the ICE until the next recharge. The Volt does the equivalent of 40 kilometres per litre.

• A battery electric, such as the Nissan Leaf, has only a battery and electric motor and is entirely dependent on grid electricity and regenerative braking. The Leaf can travel about 160 kilometres on a single charge.

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