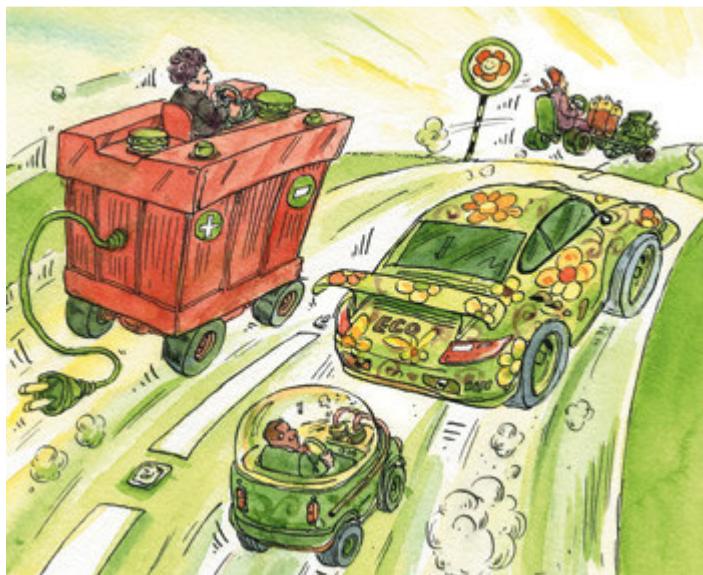


The road ahead



THERE is nothing like high oil prices, panic-selling of big cars and the prospect of swinging new penalties on carbon-spewing vehicles to concentrate the minds of the world's carmakers. In less than two years something remarkable has happened. Technologies once regarded by horsepower-obsessed marketing departments as politically correct public-relations fluff, never likely to see the light of day, are entering the mainstream just as fast as the car firms can get them there.

Only 18 months ago it was common to hear Toyota's pioneering Prius hybrid joked about as a funny-looking niche vehicle with which Hollywood stars could painlessly flaunt their green credentials. Although General Motors (GM) had exhibited a plug-in hybrid concept car, called the Chevrolet Volt, early in 2007, hardly anyone took seriously the claim that it might reach production in 2010. And just ten months ago carmakers in America were lining up to lobby Congress against proposed legislation that would oblige them to achieve a fleet-average fuel consumption of 35 miles per gallon (mpg) by 2020. It simply could not be done, they wailed.

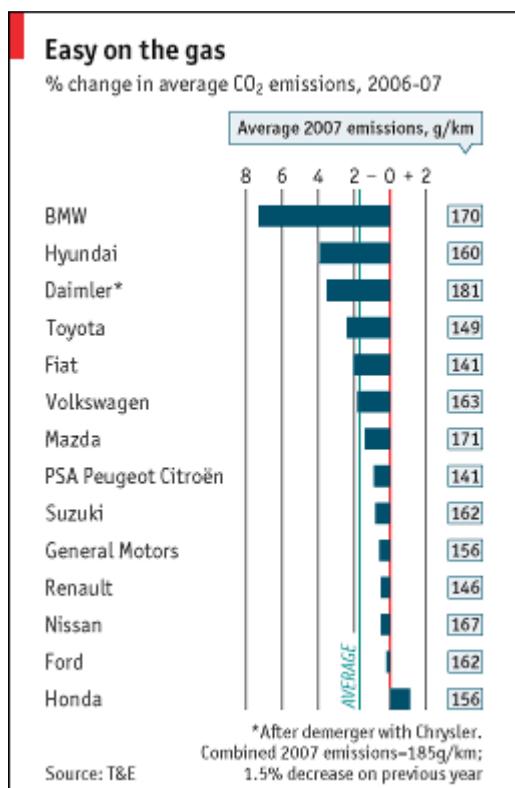
In Europe a similar campaign, with the German carmakers to the fore, was being waged against a plan by the European Commission to impose financial penalties by 2012 on companies if their fleets emitted, on average, over 130 grams of carbon dioxide per kilometre (g/km). It was, they said, technically impossible to comply with the new rules, which they saw as a wicked plot to emasculate a proud and successful industry.

The grumbling about tighter emissions laws will continue, but spurred on by rocketing prices at the pump and changing customer preferences, the manufacturers have quietly got on with the job of transforming the fuel and CO₂ efficiencies of their vehicles. Moreover, the blue-sky thinking of the recent past which, encouraged by large government subsidies and conveniently elastic time horizons, appeared to favour the hydrogen fuel-cell, has been dumped for the practical and achievable. Although carmakers differ over the details of the coming revolution in efficiency, there is now a consensus across the industry about its thrust, and about both the role of the underlying technologies and when they will be on sale.

And they're off

The first stage, happening now, is an effort to wring efficiency from the internal-combustion engine. "It is important to recognise that there is not a single solution, and that the internal-combustion engine will continue to dominate for at least 20 years," says Jürgen Leohold, head of group research at Volkswagen (VW).

Lots can be done with today's technologies. On August 26th T&E, a Brussels think-tank that lobbies for greener transport, bestowed an unlikely accolade on BMW, which is synonymous with performance. According to T&E, BMW cut the average CO₂ rating of its fleet by 7.3% last year, thanks to a suite of technologies, called "efficient dynamics", now used throughout its range. BMW's rate of improvement was four times the European average (see chart). Even Porsche, which makes sports cars and improbably rapid sport-utility vehicles (SUVs), has shown what can be done. The latest version of its 911 achieves a CO₂ output of 225g/km—15% less than the previous model—despite an increase in power to 341bhp (brake horsepower). Jaguar Land Rover, another firm that makes big, thirsty SUVs and high-performance cars, thinks that by refining its powertrains it can lower emissions by around 25% over the next few years.



Makers of powerful vehicles may achieve the most spectacular improvements, partly because they have more scope and partly because their high-priced models can absorb the cost of technologies such as the dual-clutch gearbox and direct injection that Porsche uses. But volume producers will soon be making cars that crack 80mpg. The direction of travel for them is clear. Engines will become smaller and lighter, and will have clever new valve-control systems and superchargers to boost power. For example Fiat's new Multiair, which should be on sale in a year or so, uses hydraulics and electronics to optimise the engine's valve settings. When this combines with a supercharger or turbocharger, Fiat reckons, a "downsized" two-cylinder engine can be made to perform like a bigger four-cylinder one—though it will use some 20% less fuel.

The second stage of the journey will begin about two years from now. Despite his conviction that the internal-combustion engine will remain, VW's Mr Leohold concedes that the car industry needs to start moving away from mineral energy and towards electric-powered vehicles. After deriding Toyota's Prius for its complexity, expense and slightly dubious environmental benefits (on highways it is less efficient than powerful modern diesels), almost every carmaker is now planning hybrid powertrains of one kind or another within a few years. These are no longer seen as a niche market, but as central to the carmakers' survival. GM's Volt has gone from being an interesting sideshow to the model that could do more than any other to secure the ailing car giant's future.

Nearly all the coming hybrids are "plug-ins". That means their batteries can be recharged from an ordinary power socket. They will use industrial-strength versions of the lithium-ion batteries that power mobile phones and laptop computers, giving them greater staying power and performance than the older nickel-metal-hydride battery in today's Prius. Under pressure from car firms, the battery-makers have rapidly increased the energy density, robustness and stability of their products. The next generation of hybrids will be closer to all-electric vehicles than today's Prius: its petrol engine cuts in at speeds above about 10mph (16kph).

The carmakers disagree about which kind of hybrid technology is best. The familiar approach is the "parallel" hybrid in which an electric motor and an internal-combustion engine combine to improve fuel-efficiency and boost power. This is the system in Toyota's Synergy Drive, found in the Prius, and the "bi-mode" jointly developed by GM, Daimler and BMW to reduce the fuel consumption of their biggest vehicles. The electric motor is used at low speeds, and to give extra acceleration at higher speeds. VW has a variation, called Twin Drive, that reverses this idea, using the electric motors as the main propulsion, with a diesel engine to provide a boost when needed.

An alternative is the "series" hybrid, in which the internal-combustion engine does not drive the wheels directly, but runs at a constant, optimal speed, acting as a generator or "range extender" when the batteries have almost run out. This system, which GM calls E-Flex, will be in the Volt and, from 2011, in other GM cars. It should enable drivers to go 50 miles a day using electric power alone. As long as the car is recharged overnight, the average commuter should rarely have to use its internal-combustion engine. Bob Lutz, GM's product supremo, reckons that within a decade E-Flex vehicles will be coming off the production lines at the rate of 1m a year. He says the battery pack, being developed for GM by CPI, a joint venture between LG and Continental, is "new core knowledge for the auto industry".

Almost nobody disputes that hybrids are a bridging technology, however, and that eventually most cars will be powered by batteries alone. Given today's progress, by 2020 batteries should have a range of more than 200 miles—enough for the bulk of journeys. In short most carmakers think mainstream all-electric vehicles are still more than a decade away.

Bucking this consensus is the Renault-Nissan alliance. Encouraged by the fruits of its partnership with NEC, an electronics giant, Renault-Nissan wants to have all-electric cars ready for mass production by 2010. Renault will supply an all-electric Mégane to Better Place, a start-up that is building a network of 500,000 battery-charging points in Israel, and has similar plans in Denmark and Portugal. Nissan has promised to launch an electric car in America in 2010. It will have the performance of a V6 petrol engine, a range of 100 miles and should be capable of an 80% recharge in one hour, the company says.

Carlos Ghosn, who runs both Renault and Nissan, sees the chance to steal a march on slower rivals. Although he sidesteps the question of how the power for millions of electric vehicles would be generated, Mr Ghosn recently declared that "we must have zero-emission vehicles—nothing else will prevent the world from exploding." The car industry now knows where it is going. The race is on to be the first to get there.

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