MARKETS of the future

Ricardo researchers identify the nations that promise the greatest growth

Interview
Maxime Picat, PSA Peugeot Citroën
Peugeot’s brand chief on China, Gen Y and advancing up market

Emissions statement
Syner-D’s downsized diesel gives luxury cars an efficiency boost

Euro 6 and beyond
What challenges are in store as emissions regulators tighten their grip?
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Ricardo contacts and locations:
www.ricardo.com/contacts
RQ subscriptions:
www.ricardo.com/rq
Sales enquiries:
business.development@ricardo.com

Conceived and produced for Ricardo by:
TwoTone Media Ltd
Editor: Tony Lewin
Contributors: John Challen and Anthony Smith
TwoTone Media Ltd contacts:
Anthony Smith: AnthonySmith@2tmedia.com
Tony Lewin: tonylewin@2tmedia.com

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Motor industry promotional and executive resources were stretched to the limit in late November as two major international motorshows – Tokyo and Los Angeles – chose precisely the same dates for their media days and public opening. Three significant new models, in the shape of the third-generation Mini, the Porsche Macan and the Jaguar F-Type Coupé, were given simultaneous debuts either side of the Pacific; yet, despite this, common trends were hard to spot.

While Los Angeles allowed a strong showing for power and performance, it also played host to the reveal of the fuel cell powered FCEV concept from Honda, still the only automaker to have marketed a fuel cell car; Tokyo, on the other hand, tempered its traditional diet of way-out concepts and oddball design fantasies with the unashamed speed of the upcoming Honda NSX and the even more potent Nissan GT-R Nismo.

Upholding Tokyo's reputation for originality was Nissan's inventive BladeGlider (above), a possible production electric vehicle inspired by the narrow-fronted DeltaWing and ZeOD RC race cars. Mitsubishi showed a trio of plug-in hybrid concepts of different sizes, while Honda looked to its past with the tiny and very effective mid-engined S660 sports car, a close echo of the Beat roadster of the 1990s.

Not to be outdone, Volkswagen surprised commentators with the Twin Up, a plug-in hybrid version of its baby hatchback using the 0.8 litre twin-cylinder diesel engine from the ultra frugal XL1 coupe. Diesel and electric units are both rated at 35 kW and a CO2 figure of just 27 g/km is claimed.

A leading trainmaker has developed what it describes as a driver assistance system for its trams. Bombardier's system, which has yet to be given a commercial name, uses specially developed optical 3D sensors to scan the vehicle's forward path to detect obstacles and assess their potential danger.

Monitoring up to 60 metres ahead of the tram, the system promises increased protection for cyclists, pedestrians and other vulnerable road users, say Bombardier officials. Automatically identifying and pinpointing potential hazards, the system is already giving promising results in a field trial in Frankfurt, says the company.
Solar storage breakthrough claimed

A significant world first is being claimed for a solar plant which is able to store enough energy to generate electricity for a further six hours after sunset. Abengoa’s Solana plant, near Phoenix, Arizona, is already the world’s largest parabolic trough plant for concentrating solar power. Now the company has announced the successful testing of a thermal storage system which allows the water heated in the parabolic reflectors to be used later to power the conventional steam turbines that then generate the electricity. The six hours of extra electricity are enough to satisfy Arizona’s peak energy demands during summer evenings and the early night time hours, says Abengoa, which has signed a 30-year supply agreement with the state’s largest utility. Separately, Shell has predicted in a discussion paper that solar will become the world’s largest energy source by 2070, by which time the passenger vehicle market could become “nearly oil free”.

BMW innovations

The latest version of BMW’s R1200 RT tourer features several innovations for the motorcycle segment. Claimed firsts include a gearshift assistant that allows faster shifts without having to use the clutch, and a hill start control to simplify manoeuvring, especially when heavily laden. The latter feature is also included on the sumptuous six-cylinder K1600 GTL Executive super cruiser (below), launched at the Los Angeles show in November.

Renault’s engine advances

In a recent engineering workshop Renault has revealed some of the technologies it is exploring to make its upcoming engines even more efficient. Tilting its three-cylinder 90 hp gasoline engine by 49 degrees reduces the installation space required and opens up new architecture possibilities, while for diesels twin turbochargers allow strong low-down torque to be combined with high top end power. Machined steel pistons offer less friction than aluminium designs, says Renault, and future glass tailgates will be bonded to lightweight frames to save weight and cut CO2 emissions.

NEWS IN BRIEF

Emergency brake systems rated

Euro NCAP has turned its attention to autonomous emergency braking systems prior to their inclusion as credits within official crash safety ratings from January 2014. Of the eight vehicles assessed, top marks were given to PRE-SAFE on the Mercedes E-Class, with Volvo’s City Safety & Collision Warning with Full Auto-Brake on the V40 very nearly as good; the forward collision mitigation system on Mitsubishi’s Outlander was also rated good. Coming under the ‘adequate’ heading were the similar city-only systems on the Volvo XC90, Fiat 500L and Ford Focus.

Energy efficiency matters most

Energy efficiency should be regarded as the world’s first fuel, says the International Energy Agency. The organization has valued worldwide investments in energy efficiency at $300 billion in 2011 – a level which the agency says is on a par with the global funding of renewable energy and fossil fuel power sources combined.

VW is R&D leader

The Volkswagen group is the world’s biggest spender on research and development according to a survey carried out by the European Commission. The Commission’s annual Industrial R&D Scoreboard shows that VW spent €3.5 billion in 2012, up from €7.2 the year before. Going forward, Volkswagen CEO Martin Winterkorn says the group will invest €84.2 billion in new models and environmental technologies over the coming five years. More than 60 percent of this investment will be concentrated on Germany, while a further €18.2 billion will be focused on Chinese joint ventures which are unconsolidated and therefore not included in the total.

Volvo body panels to store energy

Volvo is part of an EU-funded nine-member consortium exploring the use of novel techniques to store and generate electricity. Researchers are developing a carbon fibre polymer which sandwiches a structural supercapacitor energy storage layer, with the ensemble moulded to fit the car’s external shape and serve as components such as door skins or trunk lids. Tests have shown that the material can charge and discharge faster than standard batteries; the trunk lid alone is 50 percent lighter than the standard component and is powerful enough to supply the vehicle’s 12 volt electrical system.

Diesel and gasoline converge

As evidence that the two different fuel technologies are steadily converging, leading supplier Delphi is opening a combined advanced diesel injection and combustion technical laboratory in Bascharage, Luxembourg. The move will prompt synergies between the two previously separate engineering teams, says Delphi, and will concentrate on enabling vehicle manufacturers to deliver the same performance while satisfying increasingly demanding economy and emissions needs.
Yamaha picks up Murray’s minicar inspiration

After having been on offer to the auto industry for several years, free-thinking ex-F1 designer Gordon Murray’s revolutionary iStream construction system has been picked up by motorcycle maker Yamaha in a small car concept presented at the Tokyo motor show.

The Motiv, at present still awaiting production approval, is Yamaha’s first-ever car and is designed around the principles of iStream’s low-investment manufacturing system. The technique combines a simple steel frame and bonded composite body panels, eliminating the need for costly stampings and spot welding.

Where the Yamaha differs from Murray’s original T25 technology demonstrator is that it dispenses with the three-passenger layout and instead adopts a two-person side-by-side arrangement similar to that of a Smart. The rear mounted power unit is either an electric motor or a 1-litre Yamaha gasoline three-cylinder linked to a six-speed dual clutch gearbox. This version weighs some 650 kg – 100 kg less than a Smart.

The elegantly styled prototype is trimmed and equipped to a high standard, hinting that it could compete against the Smart ForTwo in the premium city car segment.

Honda goes turbo – and DCT

In the latest round of announcements in the roll-out of its Earth Dreams range of eco-friendly engine and transmission technologies, Honda has revealed a range of modular turbocharged engines to replace the current small-capacity four-cylinder naturally aspirated line-up.

The new one-litre direct injection gasoline three-cylinder VTEC turbo will be fitted to “a number of future global models”, as will the 1.5 litre four-cylinder – replacing today’s 2.0 litre units – and a high performance 2.0 litre to power the next-generation Civic Type R and promising over 280 hp. All units claim low friction, class-leading output and environmental performance.

Honda confirmed at the Tokyo show that the dual clutch gearbox for its upcoming NSX supercar would have “more than six speeds”. Persistent media stories point towards a ratio count of eight, even for more modest models such as the Civic Type R, but Honda has confirmed only that CVT will be its transmission of choice for smaller cars. Compact hybrids such as the Jazz/Fit have an e-motor integrated into Honda’s own seven-speed DCT.

GM and US military develop fuel cell power

General Motors is expanding its collaboration with the US Army’s Tank Automotive Research, Development & Engineering Center (TARDEC) to develop hydrogen fuel cells as a source of power for the military.

The organizations will design, test and evaluate fuel cell technologies in the military context in applications ranging from ground vehicles to mobile generators. GM is currently building a new fuel cell development laboratory in Pontiac, Michigan, not far from TARDEC’s equivalent facility in Warren. One use being explored for fuel cell technology is to power remote controlled robot vehicles (pictured).
Monsoon-proof trains for Mumbai

The Indian city of Mumbai is to get ‘flood-proof’ trains on its local rail networks in early 2014, according to the Indian Express. The new stainless steel trains, built by Bombardier, will ensure that commuting does not come to a grinding halt during the monsoon, says the publication, and will be capable of running even if there is eight inches (200 mm) of water above rail level.

In such conditions the new trains will still be capable of running at 8 km/h, a Bombardier official is quoted as saying. At present, all services are stopped as soon as the water rises to 100 mm above rail level in order to preserve passenger safety, and stranded trains have to be towed out by an independent engine.

In addition, the new trains, with an in-service stop speed of 110 km/h, will have improved wiper systems to enable drivers to see out more clearly during heavy rains. The broad gauge Mumbai commuter service runs on AC, in contrast to many other Indian rail networks that are still in the process of converting from DC.

Taxis: London calling

Toyota provided a back-handed compliment to the iconic London black taxicab with its JPN Taxi concept, presented at November’s Tokyo motor show. As a dedicated taxi it has been designed in line with the Japanese government’s initiative to make buses and taxis more user friendly; it seats five, its build is higher than that of the standard sedans found in the taxi ranks of most major cities, and it has a low floor and electric sliding doors.

No production plans have been announced for the LPG-hybrid powered JPN Taxi, but another taxi concept also exhibiting in Tokyo could prove attractive to hot-climate cities facing air quality problems. Developed in co-operation with technical universities in Munich and Singapore, the TUM CREATE EVA (below) is a taxi designed from the outset for battery power and taxis more user friendly; it seats five, its build is higher than that of the standard sedans found in the taxi ranks of most major cities, and it has a low floor and electric sliding doors.

As cities and conurbations expand, capacity on existing routes can rapidly become exhausted and the requirement for new capacity places a significant burden on local, regional and national capital expenditure. In many cases – particularly in the newer and fast-expanding cities of Asia and South America, and for major inter-city corridors – there is no alternative to new build.

But recent history is demonstrating that in the areas where industrialisation occurred many years ago, there are frequently options to harness underused, abandoned and dismantled routes to serve new functions. For example, while London is currently seeing the investment of significant resources in the new-build east-west Crossrail network, the past decade has also witnessed the quiet but highly effective creation of ‘Overground’, a 124 km metro network developed largely from underused and closed lines – including the recently completed orbital route. Travelling through 21 of London’s 33 boroughs, the stations of the Overground network are within a 15 minute walk for 30 percent of Londoners. This success follows the development in the 1980s of the Thameslink service linking the outer northern and southern suburbs, again based on a nucleus of a long-abandoned route through the city centre.

But while the rejuvenation of urban networks in this way may seem attractive to other mature cities – such as Paris with its long disused ‘Petite Ceinture’ railway – the real potential in my view comes from exploring the wider connectivity improvements that can be made to the extra-urban network. Here, in countries such as the UK where much rail infrastructure was abandoned in previous decades, there are cases where new passenger and freight routes can be realized at comparatively low cost, making use of existing and abandoned track alignments together with new build where necessary. For example, through its ‘Evergreen’ projects, Deutsche Bahn-owned Chiltern Railways is progressing a series of enhancements

By using modern, self-powered diesel rolling stock, such services can be developed quickly, efficiently and at comparatively very modest cost against that of building completely new lines.

Recycling old rail routes can unlock urban and extra-urban capacity at low cost

Jim Buchanan – Ricardo head of rail vehicle technology

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Are you finding that consumer interest in cars is declining in Europe but still holding up in China?
Yes, our analysis supports this. This is one of the reasons why cars have such a bright future in China in the coming decades – they are still an object people want to buy; people still get married, live in a flat, buy a car. But for Europe and Western countries in general that is beginning to change and we have to adapt to the fact that it will not be the same product and solutions in China and emerging countries as it is in the mature markets. So, outside Europe China is the most important region for us and by 2014 or 2015 China will overtake France as the top market for Peugeot.

So what is the issue in Western markets?
It’s not simply a question of selling good cars to customers who want to buy them: we need to offer full mobility solutions. What we see in Europe is that buying a car is no longer the dream of every 18-year old: what they want is first a smartphone, then maybe a flat and only then a car. The relationship between society, young people and cars has changed and we have to follow that. We have to change the Peugeot brand to include not only cars but also scooters, bicycles and the mobility solutions for our future customers.

Is this Generation Y a concern to the industry in general?
Yes, and one of the worst threats is Generation Y in China. The way this generation will buy or rent cars is key: they no longer want the older, official-type cars that they see those born earlier driving. We will align our launches worldwide, so they get the very latest designs, and we are very confident of attracting more and more Chinese customers with the products we have in the pipeline. In Western countries it is very different: to get that generation it’s more about connectivity and mobility. Anything we can give them to help them use cars differently will make a difference.

How will this affect the way you do business?
We are used to working on a cycle of six, seven or eight years between launching and replacing a model, but this no longer fits the pace at which Generation Y is living. This means we need to change the way we do business: we cannot organise ourselves the same way. It’s a profound change and we are

Maxime Picat poses in front of Peugeot’s HX-1 concept car at the 2013 Buenos Aires motor show

The lion awakes

Named as director general of Automobiles Peugeot in October 2012, Maxime Picat brings the benefit of a background in manufacturing and many years’ experience in the fast-growing Chinese market. Will this help him restore the fortunes of the Peugeot brand as its parent PSA group struggles to ride out the economic crisis? Tony Lewin puts the questions
finding our own way to adapt to that population and the new pace, but [even] with our huge R&D expenditure we cannot develop a new car as fast as a new piece of software.

How will it be with the next generation coming through? Are you looking beyond 2020?
We always have one horizon – the time to develop a new car. We have to anticipate what customer reaction will be when it arrives on the market. But after that there is a further perspective: the new types of mobility that will grow after 2020 could dramatically affect the market, the fact that possessing a car may no longer be the main idea, but that it will be used and consumed like any other product or service.

How will this show itself in the model policies of Peugeot and [sister brand] Citroën?
In realigning the brands we are taking a more differentiated approach: we don’t want to compete with the same cars in the same segments and with the same story. We know it takes time, but the decision is made.

Will you introduce a new sub-brand, as Citroën has successfully done with DS?
No we won’t. The Peugeot brand clearly has the potential to go up market, for many reasons. Everything we’ve got in the pipeline, the ideas from Gilles Vidal and the design team – we are thinking further than just the automotive industry. We have all the ingredients to bring the brand up market, and every single day I tell myself “don’t copy Citroën”. When I took this job, everyone in the company said Peugeot’s position was blurred but Citroën’s was clear – DS. It’s not the same today: people have understood the direction we are going in. This is the reason why we have made our market segmentation and chosen different customers: we know that with C-Cactus, with Peugeot and with DS we can focus on different customers. But it will take maybe ten years for our customers to be in a truly different segment.

Your latest model, the new 308, comes across as very similar to a Volkswagen Golf. Why should somebody choose the Peugeot and not a Golf?
Yes, they are similar in their dimensions but when you sit in the 308 you know you are in a totally different car. You will have a very simple experience – a buttonless dashboard which is completely different to what a Golf offers, the way we lay out the driver compartment; our car is lighter, has lower fuel consumption thanks to the new technologies and new platform, and a very innovative interior. And I think some customers will want to buy something different to the model which has a 25 percent share of the market.

How far up market do you want to go? Do you want to compete with Audi, or just Volkswagen?
We are happy to compete with Volkswagen. We need to go one step at a time. We know that it takes time. Even if we produce something that is as good as a Golf, which is the case with 308, it will take time for everybody [to become aware of this]. Everything has to be good; the quality of service, the image of the company, the quality of the car.

What is your strategy to deal with the depressed European market?
We need to be strong both inside Europe and outside Europe. We are gaining market share in China; in Argentina we are gaining share and will sell 100,000 cars this year; we are also gaining in Algeria, which is the second biggest market in Africa and will be about 70,000 cars this year. So we are gaining in fast-growing markets outside Europe, but we need to fix the situation in Europe by going up market. The fact that 40 percent of our 208 sales and 70 percent of our 2008 sales are [trim] level 3 or above shows that we are on track, and the feedback on the new 308 also shows this. But at the same time we also have to reduce our costs, which is why we had to take that difficult but important decision to close a factory in France.

Where does the UK sit in Peugeot’s overall sales figures?
On the podium. Our top five have changed a bit since last year: there has been an interesting battle between France and China for first place, with France still first this year; the UK is third, then you’ll find Argentina and Algeria. So it isn’t the European “G5” of France, UK, Italy, Germany and Spain any more.
How will your “01” and “08” lines evolve in the global context?

When you look at the worldwide market and our French European range, we don’t have a pickup or any very small light commercials like you find in China. But there is a big sector where we had no offer – affordable medium sized sedan cars. Today, in the B and C segment, these are only 2 percent of the market in Europe, but in the rest of the world they are 50 percent. That car was clearly missing in our portfolio, so we decided to do the 301 and sell it in those countries where it is clearly not a low cost car. If you drive in Istanbul you’ll see the 301 – it’s roomy, has a big trunk and you get the latest engines. And when you drive it, you know it’s a Peugeot and it’s affordable. We sell lots of them in those countries.

Is your alliance with GM proving fruitful?

We have always had co-operation agreements with lots of carmakers – Ford for engines, for instance, and Dongfeng in China. GM is the latest one and we are already reducing our costs thanks to them as our joint purchasing organization is working. Many suppliers at the Frankfurt motor show were surprised to meet two people – one from GM and one from PSA. The quick wins are with raw materials and very common parts like batteries, but as we begin working on new cars we will have all the cost reductions due to the fact that we will have common parts on [shared] developments such as the B-segment MPV and C-segment SUV.

What are your predictions for electric vehicle sales?

Our forecast for the electric car market in 2020 is that it won’t be a huge market in any scenario, whatever the price of oil and so on. We think it will be below 5 percent for pure electric cars. Our policy today is to have solutions for all customers – we’ve got the hybrid, the plug-in, the pure electric. But in the future we will be clearly focusing on the development of hybrid solutions: we think this is the most efficient compromise between R&D cost and cost for the customer, and in CO₂ reduction to allow us to reach 95 g CO₂. The market for pure electric vehicles is below our very lowest forecasts – we have sold more Hybrid4 models than the total EV market in France this year. In hybrids we are number two in Europe after Toyota.

What is the outlook for the Hybrid Air technology you have recently shown?

The situation is clear: we cannot launch this technology alone because the investment requires a certain minimum production volume, so we are in discussion with all our competitors about forming a partnership. We’re continuing development, with Bosch, and the prototypes are really good, with a good level of NVH and the targets in terms of CO₂ have been reached. So it’s simply a question of finding the right partnership to invest. This isn’t a hybrid that costs thousands of Euros more: it’s about being able to sell to the largest number of customers a hybrid version that can clearly pull down the CO₂ emissions.

How many do you need to sell to make it viable?

For the first phase we would need to sell between 400,000 and 500,000 a year.

Will the 95g CO₂ target for 2020 require any changes to Peugeot’s range?

No. By putting forward all the technologies we have, it will be enough.

Maxime Picat

2012 Director General, Automobiles Peugeot
2011 Director General of Dongfeng Peugeot Citroën Automobiles, Wuhan, China
2008 Assistant Director General of Dongfeng Peugeot Citroën Automobiles
2007 Plant Director of the Wuhan production plant
1998-2007 Succession of roles in Peugeot Citroën manufacturing, France
1997 Scientific intern at French National Agency for Nuclear Energy
What do Thailand, Turkey, Peru, Malaysia and Mexico have in common? One answer is that they have all been identified as prime markets for automotive expansion in the post-2020 future. Tony Lewin speaks to the authors of Rising 15, a groundbreaking Ricardo Strategic Consulting study which looks at 150-plus nations to pick out an elite 15-strong group with the very best qualifications to power the growth of the auto industry once China, Brazil, Russia and India begin to level off.

Years of stagnation in mature markets such as North America, Europe and Japan have prompted international automakers to switch their attention to the so-called BRICs nations of Brazil, Russia, India and China. As a result, three of these have become part of the mainstream, with all the big Western and Japanese players represented. Brazil is very nearly there, too, and is now experiencing a rush of inward investment as more and more multinationals set up shop.

But what happens when, say, China,
Vehicle ownership rate versus GDP per capita

Peru. Nobody really thought that it would be one of the brightest upcoming vehicle markets, but some very interesting facts emerged from our study.

The vehicle market in Peru has the fastest percentage growth in the world – 33 percent CAGR over the last ten years and doubling between 2009 and 2012,” reveals Heuser. “though from a low baseline of only 100,000 vehicles a year currently. Peru used to have very limited imports of used cars, and still plans for limitations in the future. This will lead to an increase in the sales of new vehicles and as these are substitutes for used models, the market will be mainly budget vehicles.”

The vehicle parc in Peru is very old – the average age of a vehicle is 17 years. This provides important opportunities for parts manufacturers and service networks as most of the current provision is basic ‘mom-and-pop’ shops at the roadside. Chinese and Indian carmakers are already selling their vehicles in Peru, and have begun to set up professional service networks; so too have Hyundai and Toyota. European manufacturers are not yet focused on the country.

Ricardo’s research also revealed strong growth in Peruvian vehicle financing: this, says Heuser, is important as it allows people on low incomes to buy budget cars. Financing options, observes Andreas Schlosser, Managing Director of Ricardo Strategic Consulting, are one of the key triggers to accelerate vehicle sales in those markets because people simply cannot afford to make an outright purchase of a new car.

Nevertheless, adds Heuser, there was one discovery about Peru that was surprising and at first puzzling: unusually, most of the growth in the market is not in the big cities but in the countryside. Further research revealed that in rural Peru people saw cars as their basic mobility device and also to use for small business and light goods transport.

“Within the capital Lima public transport is growing, and so too is vehicle ownership,” says Heuser. “But the largest share of new vehicle sales are outside the large cities: this isn’t very common in the countries we researched: vehicle sales are normally within the big cities. That’s where the money is, where people can begin to afford vehicles.”

In-depth research

The example of Peru gives just a taste of the methodology of the study and the range of factors analysed for each country. Of the 193 countries that are members of the United Nations, Ricardo researchers selected the 53 on the IMF/World Bank list of developing countries or other international trade and political organizations; next, all those with populations of less than 25 million were filtered out, leaving 23 countries for in-depth analysis. This analysis in turn yielded what Ricardo has termed the Rising 15 markets – the most promising countries in terms of personal transport, commercial transport or for the production of vehicles or components in the future.

Data from each country is scrutinised under three separate headings to develop overall indices for private mobility, commercial transport and production environment. These indices are then combined to generate an overall country score taking into account all the 1200+ individual parameters in the analysis.

Under the heading of personal mobility, for instance, considerable weighting is given to the nation’s GDP per capita, and to a ten-year rolling average of GDP growth. Also important, explains Philipp Seidel, another co-author of the report, is the so-called human development index: this is a UN-calculated formula taking into account 20-25 separate factors such as education and social mobility. Gasoline prices are a strong but negative influence on the personal mobility score; urban population is generally a positive correlation, despite the exception of Peru described above. Further influences include the existing level of

→ already the world’s largest car market, begins to go off the boil? Many industry analysts are beginning to forecast a levelling off of its frantic growth rates in the next decade, and India and Russia, too, have yet to prove their long-term stability.

So, what will come next? Where will the world’s carmakers and supplier’s look next if they are to keep expanding and secure the future for their many stakeholders?

These were the questions raised by senior consultants at Ricardo Strategic Consulting earlier this year as they placed themselves in the shoes of auto industry business leaders keen to stay ahead of the game and develop a global strategy for the post-BRICS era. Recognizing the vital importance of forward-looking strategic business planning to the automotive community, Ricardo decided to embark on a major new study in precisely this area, analysing the economic, industrial, social and political climate in over 150 countries to identify which markets hold the greatest potential to take over the growth path from the BRICS and assure the industry’s next phase of expansion to 2030 and beyond.

Surprise findings

Ricardo’s research, taking into account hundreds of data streams and many thousands of individual values, yielded results which will surprise many, as senior consultant and report co-author Christoph Heuser explains:

“One of the biggest surprises was...
car ownership and any restrictions on the import of used cars: some countries limit imports to recent models, so as to improve the environmental and safety performance of the nation’s car fleet.

The frequently mentioned role of a thriving motorcycle market is less clear. While strong two-wheeler sales do help build retail and repair networks and credit facilities, it could be argued that the motorcycles already meet some of the mobility needs of the population, therefore reducing the requirement for cars. Climate, too, is an important determinant: it is hard to imagine strong two-wheeler demand in freezing, mountainous regions. And in Vietnam, with its strong indigenous light two-wheeler industry, imports of cars are discouraged by substantial tariff walls.

Vietnam is an interesting example, agrees Heuser. “There are many anti-car initiatives that make them less attractive. There are high import taxes on vehicles and vehicle parts; volume-produced vehicles are basically not allowed in, and annual taxation on vehicles is very high.”

Seidel, “and the price of diesel fuel clearly affects our commercial transport index.” The microvans that are so popular in China and South East Asia come under the label of private vehicles, even though they are used for business and small trader purposes, he notes.

Beyond this, a further key determinant is the proportion of goods transported by road – it is a very high 92 percent for Peru – and there is a clear negative correlation between the nation’s rate of inflation and the index. “Having a high rate of inflation generally reduces the willingness to take the risk of investing in those transport-related businesses, and access to loans is harder too,” he explains.

Production environment
In many ways the most interesting of the three areas of exploration, the assessment of a nation’s production environment encompasses a wide range of factors from international trade agreements to taxation, education, intellectual property rules and even corruption and government instability. Together, these parameters set the climate that determines the success – or otherwise – of inward investment.

“From the Ricardo point of view, the production environment is a very different thing to the private and commercial vehicles markets,” says Seidel. “We look at things like electricity and other utility prices, as well as industrial infrastructure features such as ports and railways and whether any automotive industry related suppliers or manufacturers are already present.”

Membership of free trade organisations counts positively towards the production environment score, while trade tariffs and tax rates are negative; the researchers also look at the proportion of the population going in to secondary education, as well as the degree of corruption endemic in the country and the likely stability of the government and official structures.

Data on perceived corruption is very important to inward investors as most western companies of any size

But what happens when, say, China, already the world’s largest car market, begins to go off the boil? Many industry analysts are beginning to forecast a levelling off of its frantic growth rates in the next decade, and India and Russia, too, have yet to prove their long-term stability.
are bound by their own internal rules forbidding bribery or corrupt practices of any kind. The figures, drawn from research by Transparency International, show Bangladesh and Venezuela with the highest levels but Nigeria – often perceived as a corrupt country – with a relatively low score of 27 on a scale from 0 to 100.

Likewise, data on competitiveness is taken from the World Economic Forum’s Global Competitiveness Index; the same organization also supplies the figures for government instability. Christoph Heuser explains their significance: “Having a weak government makes a country less competitive with others as you won’t be able to protect your investment as strongly as you would in other countries.

“We try to derive our factors from globally respected sources like the UN, the World Bank and the World Economic Forum,” he explains.

**The international shopping list**

What, then, are the most important factors for an automaker or component supplier to take into consideration when making an international investment decision?

The most important for a vehicle manufacturer, argues Philipp Seidel, is the size of the market – not just the population of the target country but also that of neighbouring nations. “In the case of Malaysia, this could also be the whole of the ASEAN region,” he explains by way of example. Malaysia has the highest private car ownership rate (325 vehicles per 1000 population) in South East Asia and is already home to several hundred automotive components suppliers; nevertheless, its prospects are rated highly as a major automotive hub in the ASEAN region.

The next most important consideration on the checklist is likely to be everything that goes into creating the climate for investment in that country. “Government stability and the extent of corruption are weighted very heavily in our analysis – they are part of the overall competitiveness picture.”

Third most important, adds Christoph Heuser, is the level of education of potential employees. “Vehicle manufacturing is not as standardized as some other jobs perhaps are: you still need a certain level of skill even though many production processes are automated.”

For component suppliers, finally, much will depend on the nature – and especially the size and weight – of the parts being produced. In general, the stipulations around competitiveness and wages still stand and in most situations it will be advantageous to have customers, in the shape of the OEM plants, located close by.

In Peru ([above left]) most of the growth in the market is not in the big cities but in the countryside, but in many developing markets, the quality of infrastructure can be challenging.

**Ricardo’s Rising 15 markets**

Governments, trade organizations and automotive manufacturers and suppliers would do well to take on board the conclusions of this forward-looking study: there are important lessons to be learned and some of the developments anticipated in the report are already taking place. In many African and South American markets, for instance, Chinese brands are already moving in and establishing sales and dealer networks for future expansion, often with dedicated designs for those regions: Chinese automakers with combined 15 percent share of the Peruvian market, while Chery-based Speranza models outsell Toyota in Egypt. Indian truckmakers, meanwhile, are establishing themselves in former VW, Peugeot and Mercedes plants in Nigeria.

“While OEMs from Europe and the US focus on exploiting market opportunities...
in China and India, Chinese and Indian OEMs [mainly Chinese] are already tapping those next markets,” warn the report’s authors. “Established automakers should carefully observe the activities of Asian manufacturers and must not miss the right time for action.”

For governments eager to attract inward investment and build up an automotive industry there are lessons too. The main hurdles for automotive growth in fast-developing countries are the infrastructure [mainly roads and fuel supply], import requirements and taxation, the lack of vehicle financing options, and shortcomings in sales and service networks. Another major block for the development of a healthy production environment is the lack of a qualified workforce.

For automakers from countries such as China, India and other emerging markets, finally, the Rising 15 markets offer major opportunities in the personal and commercial budget vehicle segment as buyers move from imported used cars to new budget cars, low-cost new vehicles being nearly as cheap as scarce used cars. A further benefit for emerging market producers is that by exporting to (or producing in) fast-growing Rising 15 markets they can sidestep the prohibitive safety and eco-friendliness barriers to market entry in established Triad markets such as Japan, the US and Europe.

### Who are the Rising 15?

<table>
<thead>
<tr>
<th>Country</th>
<th>Key points</th>
<th>Total score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>Member of MERCOSUR, second largest market in South America</td>
<td>105</td>
</tr>
<tr>
<td>Egypt</td>
<td>Unclear politics but stable production and global suppliers present</td>
<td>120</td>
</tr>
<tr>
<td>Indonesia</td>
<td>Large population, 16th largest economy in world, automakers present</td>
<td>190</td>
</tr>
<tr>
<td>Iran</td>
<td>Currently sanction-bound, but has indigenous automakers and joint ventures</td>
<td>120</td>
</tr>
<tr>
<td>Malaysia</td>
<td>High car ownership, well developed infrastructure and local brands</td>
<td>173</td>
</tr>
<tr>
<td>Mexico</td>
<td>Already a major assembly hub for the Americas</td>
<td>175</td>
</tr>
<tr>
<td>Morocco</td>
<td>Already a supplier hub for Europe and assembly base for Renault</td>
<td>102</td>
</tr>
<tr>
<td>Nigeria</td>
<td>Largest population and workforce in Africa; history of vehicle production</td>
<td>91</td>
</tr>
<tr>
<td>Peru</td>
<td>Fastest-growing vehicle market in past 10 years; low cost labour, high demand</td>
<td>113</td>
</tr>
<tr>
<td>Philippines</td>
<td>Low car ownership but growing middle class; Japanese and Chinese investment</td>
<td>86</td>
</tr>
<tr>
<td>South Africa</td>
<td>Largest vehicle market in Africa; manufacturing sites of western and Asian OEMs</td>
<td>99</td>
</tr>
<tr>
<td>Thailand</td>
<td>9th largest production site globally, leading producer of pickup trucks</td>
<td>163</td>
</tr>
<tr>
<td>Turkey</td>
<td>1m-plus annual production by global OEMs; close to Europe, high GDP per capita</td>
<td>178</td>
</tr>
<tr>
<td>Ukraine</td>
<td>Chinese OEM assembly sites; good road network but poor car and public transport stock</td>
<td>92</td>
</tr>
<tr>
<td>Vietnam</td>
<td>Established hub for automotive parts production but two-wheelers still main mode of transport.</td>
<td>89</td>
</tr>
</tbody>
</table>
With one eye on the forthcoming Euro 6 engine regulations, vehicle manufacturers continue to push for reductions in harmful emissions of their latest models, taking every opportunity to engineer in improvements to help overall efficiency. Many vehicles now have CO2 outputs of under 100 g/km, but the majority of them are small cars or those that have the benefit of an alternative powertrain.

For the Syner-D programme – a project led by Ricardo and part-funded by the UK’s innovation agency, the Technology Strategy Board – the aim was clear: to deliver a premium diesel demonstrator vehicle displaying a CO2 reduction of 30 percent, achieving Euro 6 tailpipe emissions, and suffering no compromise in transient driveability and overall performance. At the completion of the programme the results exceeded the target, with a measured CO2 reduction of 32.5 percent.

The goal was to achieve these targets without costly hybridization, instead integrating cost-effective CO2 technologies in a synergistic manner. “Ricardo is a firm believer in hybrid technology, but there is an argument that it represents currently a relatively high cost for the CO2 benefits delivered,” explains Andy Ward, Ricardo’s head of light duty diesel engines. “While hybrid cost benefits continue to improve, with Syner-D, we wanted to target what was possible with a conventional powertrain.”

The collaborative three-year effort included input from Jaguar Land Rover, Valeo, SKF, Shell and Lontra – each company supplying specific components and expertise in its specialized area. An important factor for the development team was to make use of technologies that were available off the shelf, the challenge being to demonstrate they could all perform on a vehicle together to amplify the overall benefit. “These components are already available, so instead of developing new technologies, a lot of effort went into tailoring them to work with the rest of the system,” explains Raoul Day, chief engineer, performance and calibration, at Ricardo: “Valeo and Jaguar Land Rover proved very helpful in helping us achieve that.”

There were a number of key areas that Ricardo and its partners wanted to focus their efforts on in order to achieve their desired CO2 target: these included aftertreatment, advanced lubricants, the thermal system, the turbocharger/supercharger setup and friction reduction. “In the light duty market, the technologies required to achieve Euro6b emissions levels are well understood,” explains Ward. “But the real challenge for Ricardo is the same as any OEM faces – to select the right combination that will give the best result at the lowest cost and lowest CO2. What we were looking for in particular was a combination of technologies in one demonstrator vehicle and test bench set-up – something that we thought would work well and give greater benefits than using each technology individually.”
Powertrain start point
The base vehicle for the Syner-D project was a Jaguar XF, powered by a 3.0-litre Euro 5 diesel engine. The first step of the project would be to downsize this to the 2.2-litre DW12 inline four-cylinder unit calibrated for Euro 6 emissions levels.

"The objective was to achieve comparable transient performance, and going from a 3-litre to a 2.2-litre goes against that, so we then have to add some technology to increase the performance beyond the baseline 2.2-litre," explains Ward. To achieve the targeted torque, analysis was carried out using Ricardo’s WAVE program, identifying the optimal systems configuration. "We selected an advanced boost system comprising a low-pressure turbocharger and high-pressure mechanical supercharger, which is quite a novel approach," reveals Ward. The low-pressure turbo was retained from the larger engine, while a Roots-type belt-driven supercharger was added. The supercharger would be declutched to minimize losses when not required. In this situation, the air path is bypassed around the supercharger.

In addition to the advanced boosting, a low pressure EGR circuit is used in combination with SCR aftertreatment,

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**Thermal management and ‘Efficient Calibration’**
Alongside downsizing, thermal management was a key part of the Syner-D programme: here, Ricardo used its VTherm to optimize the engine’s thermal system. "By reducing friction losses during warm-up, mainly by getting to a higher oil temperature quicker, we are able to realize CO2 benefits, without resource to any other technologies," explains Andy Ward, head of light duty diesel engines at Ricardo.

Ricardo also used its Efficient Calibration toolset to optimize the powertrain system. This involves the use of a complex design of experiments (DoE) approach, which enables the calibrator to develop a model of the engine responses to multiple variables in order to find the optimal calibration settings. In the case of Syner-D, test matrices were performed at 40, 60 and 90 Celsius coolant and oil temperatures.

The combination of Efficient Calibration with the global DoE approach has demonstrated a reduction in tested hours on development programmes of between 20 and 50 percent, and, using advanced Stochastic Process Models (SPMs), it has been proven to outperform other engine modelling tools. Benefits to its users include: one DoE for multiple vehicle applications; a lower calibration effort; a system approach to optimization; and improved calibration robustness.

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The Syner-D CO2 walk: cumulative effect of technologies on CO2 emissions

<table>
<thead>
<tr>
<th>System Improvement</th>
<th>Delta % CO2 Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0ℓ V6 Euro 5 Baseline</td>
<td>-2.5%</td>
</tr>
<tr>
<td>Gearbox (from 6 to 8 speed Auto)</td>
<td>0.0%</td>
</tr>
<tr>
<td>Downsize Engine to 2.2ℓ DW12C</td>
<td>+2.5%</td>
</tr>
<tr>
<td>Apply Stop-Start</td>
<td>+5.0%</td>
</tr>
<tr>
<td>Friction Reduction (Oil Based)</td>
<td>+7.5%</td>
</tr>
<tr>
<td>Performance Hardware (Supercharger)</td>
<td>+10.0%</td>
</tr>
<tr>
<td>Thermal Management</td>
<td></td>
</tr>
<tr>
<td>Euro 6 Calibration &amp; Aftertreatment</td>
<td></td>
</tr>
<tr>
<td>Shift Schedule (8th gear ≥ 100km/h)</td>
<td></td>
</tr>
<tr>
<td>Fuel Injection System</td>
<td></td>
</tr>
<tr>
<td>Roller Crank Including Oil Pump Reduction</td>
<td></td>
</tr>
<tr>
<td>Vacuum Pump Losses set to Best in Class</td>
<td></td>
</tr>
<tr>
<td>Electric Power Steering</td>
<td></td>
</tr>
<tr>
<td>Variable Displacement Oil Pump</td>
<td></td>
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<tr>
<td>Turbocharger Design</td>
<td></td>
</tr>
</tbody>
</table>

**Vehicle Test Results**

| Delta % Original Assumptions                                    | 0%                  |
| Delta % From Test Data                                          | 5%                  |
| % CO2 Change Status                                             | 10%                 |
| Target                                                          | 15%                 |
| VISM Simulation – tested                                        | 20%                 |
| Vehicle Test Results                                            | 25%                 |
| Friction tear down data                                         | 30%                 |
| Thermal management and ‘efficient Calibration’                  | 35%                 |

**Low CO2 diesel**
giving more capability than is required to meet the Euro 6 emissions targets. As a result this enables re-optimization of the engine calibration for more efficient operation and hence providing a further fuel consumption benefit.

“We could have selected a two-stage boosting setup, as that technology is already in the market, but our approach presented a more interesting research and development proposition,” says Ward, adding that the target of Euro 6 emissions could not be ignored. “If we had used two-stage turbo boosting, adding NOx aftertreatment would have meant temperature issues from the two turbines because of the temperature drop along longer pipe lengths; this in turn would mean the NOx aftertreatment would be less effective. Having a supercharger at the high-pressure stage means the exhaust system layout is unaffected, and you’re left with the same high temperature as you would get on a standard, single-stage turbo variant. Basically, while there are some synergies between supercharging and NOx aftertreatment, you don’t find the same synergy between two-stage boosting and NOx aftertreatment.”

At the same time as changing the base engine, the Syner-D team also swapped the original six-speed transmission for an eight-speed unit, which has the ability of being able to operate at more efficient speeds and load points. Additional calibration work was carried out to minimize up-shift speeds, and with the new unit, it is now possible for the enhanced torque delivery of the engine to be used when operating off-cycle, limiting the perceived changes in performance in the process.

System temperature control
As well as the selection of boost technology configurations, another consideration at the beginning of the project was in the thermal system – more specifically, deciding if the powertrain required an intermediate intercooler stage. The challenge was to incorporate a number of different systems into the powertrain, such as an intake manifold with integrated water charge air cooler, a three-way control valve (which replaced the thermostat), and a low temperature cooling circuit consisting of a pump and radiator.

“The coolant heat storage tank was a key technology in helping to achieve our

Friction reduction
To reduce friction, Ricardo used a number of measures including a roller bearing crankshaft from SKF and low-viscosity lubricants courtesy of Shell. The challenge was to develop the world’s first high-speed diesel with a roller bearing crankshaft, a technology typically applied to specialized gasoline engines. The main benefit to the Syner-D development team of using this crankshaft configuration was the reduction in frictional losses within the engine – especially in the warm-up phase, thus helping to cut CO₂ emissions. In the case of Syner-D, the inner bearing race is the actual crank face machined to suit the barrelled roller elements. The oil feed to the connecting rods is maintained through the crankshaft.

The project partners wanted to ensure no stone was left unturned so, together with SKF, Ricardo embarked on a rigorous test bench-based evaluation programme. “We ran an intensive, high-load 100-hour durability test on the system, because one of the key concerns around a development such as a roller bearing crank is that it is durable,” says Ward. “During testing we also encountered a material hardness issue that was rectified, so it was a doubly good result as we learned something about the engine but also got the result that we needed. Another four-cylinder engine was used as a donor test unit, with SKF leading the design and manufacture of the prototype parts. “SKF had wanted to produce this component for a long time, and the project lent itself to it perfectly,” reveals Ward.

The engine oil was specified using test bed mapping data at a range of operating conditions to identify the overall optimum oil for warm up and fully hot fuel consumption benefits. Data compared the standard 5W/30 to 0W/20 and 0W/30 formulations. The testing resulted in 0W/30 being chosen for its lower temperature friction improvements, with key learning that the consideration of oil shear stability and the speed and load conditions used over the test cycle have a key bearing on the choice of lubricant for fuel economy benefits. The 0W/30 oil supplied by Shell was also successfully used for the durability test of the roller bearings.
Low CO2 diesel catalytic reduction (sCR) technologies.

The ability to meet Euro 6 standards and simultaneously reduce CO2 was made possible through the adoption of low pressure exhaust gas recirculation (eGR) and selective catalytic reduction (SCR) technologies.

Driving the Syner-D’

Tony Lewin sampled the downsized powertrain of the Syner-D project vehicle back in September 2012.

Even early on in the Syner-D programme it was easy to see the potential for the design concept and its applicability to a wide spectrum of target vehicles. Many further improvements have been made to the prototype since this test took place, but back in 2012 it was already impressive in terms of its refinement and response.

Cruising at a steady and relaxed 100 km/h and around 1800 rev/min, the supercharger is idle; however its benefit is immediately felt as soon as the throttle is squeezed to overtake another vehicle; the transient response is much better than would be the case with a plain turbo diesel turning at a similar speed.

Even with the transmission locked in top gear, thus blocking any kick-down, the response is impressive, especially between 1500 and 2200 rev/min.

Sensibly, too, the load-dependant activation of the supercharger means that it is not enabled in town driving where torque demand is much lower; this improves NVH and saves fuel, also underlining the intelligence of the project’s approach which prioritises the delivery of strong and responsive torque at low rpm rather than headline peak power at higher engine speeds.

Next steps

Through the Syner-D project Ricardo believes it has identified areas that will become common on passenger car vehicles in the future. “We have demonstrated the feasibility of systems that might not be achievable in today’s cars, but which are certainly technically possible,” reasons Ward.

Now that the project has been completed, the next step for Syner-D is to convince Ricardo customers of its potential. “As a demonstration project it has been a phenomenal success in achieving its goals, and we are already in discussions with clients about what we have learned from this programme and the tools that we’ve developed throughout it,” concludes Ward.

“While it is perhaps unlikely that a vehicle of precisely the configuration of Syner-D will appear on the market very soon, I believe that many of the constituent technologies that it demonstrates may well prove attractive in the short to medium term,” he predicts.
The current consensus within the automotive industry appears to be that homologation for the initial parts of Euro 6 will not be too onerous. The major challenge is the new much lower NOx levels for diesel vehicles, levels which will require automakers to apply either the well-established catalytic solutions of LNT and SCR – or novel combustion strategies for gaseous emissions – along with the DPFs effectively mandated by the particle number limits. To put this into perspective, Ricardo demonstrated engine-out sub-Euro 6 NOx emissions levels around a decade ago.

But while the initial implementation in January 2014 is comparatively straightforward, the requirements for subsequent parts of Euro 6 may be rather more challenging. These will include, for example, mandatory diesel-equivalent particle number (PN) levels for gasoline direct injection, which may require implementation of advanced calibration and fuel injection equipment technology if limits are to be met without ‘positive ignition particle filters’.

In addition wherever active urea SCR is used – and this will largely be in heavier diesel vehicle classes – there will be a requirement to limit emitted ammonia concentrations at the tailpipe to 10 ppm. The impact of this is that it effectively introduces a new emission to be controlled and measured. Other requirements for demonstrating the effectiveness of NOx aftertreatment were introduced at Euro 5b, including a minimum operational efficiency in a minus 7°C NEDC test, including EGR.

Further challenges in store
While the above might seem fairly incremental in terms of new vehicle and powertrain development resources and timescales, Euro 6/VI could ultimately bring some rather more profound challenges, as Jon Andersson, manager of aftertreatment and chemical analyses at Ricardo explains: “The prospect exists for the introduction of game-changing factors in the final Euro 6c phase of the latest legislation. These could include a move to the WLTP cycle, random cycle emissions compliance, and...”

As the midnight chimes of December 31 signal the start of the New Year across Europe, so the new Euro 6 regulations come into force for passenger cars, one year following their heavy duty Euro VI equivalent. These norms are now fixed but Anthony Smith investigates what lies ahead for emissions testing technology as the regulatory grip tightens still further.
Emissions reduction

> requirements for on-road testing and the introduction of ‘new’ regulated emissions, such as N₂O, NO₃, aldehydes and alcohols.

Technologies for the accurate, real-time measurement of NOₓ species (NO, NO₂, N₂O and NH₃) have been employed by Ricardo for almost 20 years, but a future development challenge may come, Andersson contends, if regulators choose to regulate NO as a fraction of total NOₓ, or by ratio to NO. “In this case, it is conceivable that a vehicle equipped with a highly efficient NOₓ aftertreatment system could have an extremely low total NOₓ emission of, for example, 20 mg/km, with 60 percent (12 mg/km) of this as NO. If the emissions limit was 30 mg/km and the permissible fraction of NO was 50 percent, this vehicle would fail homologation, while another vehicle with tailpipe emissions of 30 mg/km NOₓ but NO emissions of 14 mg/km would pass. At these levels the ppm of NO and NO₂ measured would be very low and subject to significant measurement uncertainty. The regulatory process will need to take these and other factors into consideration.”

If NO is regulated as a species in its own right, as Andersson explains, this also presents an unexpected quandry: “NOₓ is currently quantified as NO + NO₂, with both species measured as NO₂. If NO is converted by oxidation to NO₂, as a consequence, the actual mass of NO emitted is overestimated. If NOₓ and NO were to be quantified separately, then it is conceivable that the mass emission of NO, as an individual regulated emission, could be determined accurately. At this point it is perhaps questionable whether should NOₓ be abandoned as an outdated composite emission?”

Prospects for transatlantic convergence

While globalization has transformed so many aspects of international trade today, discrepancies between US and European emissions regulations remain an additional burden for multinational car and truck manufacturers. The European Commission is a strong proponent of the Worldwide harmonized Light-duty vehicles Test Procedures (WLTP), and it seems likely that it will look to convince the US to converge the emissions requirements on a near-global basis. While the US is not a formal signatory to the development of the new drive cycle and procedures, it remains engaged in the process so convergence cannot be ruled out.

In considering the potential for such convergence it is perhaps worth recalling how things came to be as they are today. While fuel was plentiful, the US was generally less concerned about fuel consumption than it was about air quality in some of its major cities: elimination of the Los Angeles smog being a prime example. In the US, freeways frequently run straight through the centre of cities and these have a much larger health impact than highways in Europe, especially in terms of the contributions from diesel trucks. Conversely, Europe has always tended towards smaller vehicles, with governments using fuels sales for generating revenue, and thus effectively taxing higher CO₂ emitters; consequently, Europe has progressively regulated reductions in other emissions. Emissions limits for diesel passenger cars in the US will soon be so stringent that the technologies required to meet them could make them prohibitively expensive, and gasoline hybrids may come to dominate the vehicle parc in the US. However, if the WLTP were to be adopted globally, the emissions requirements may be rewritten in the US and similar technologies applied around the world. This would be advantageous to both automakers and consumers, as a limited set of emissions control technologies, and thus lower production costs, will be appropriate globally.

While this may be a longer term ambition, the likely key imperatives for regulators in both Europe and the US in the meantime will be to ensure that future homologation CO₂ figures represent real-world emissions more realistically than they have in previous regulatory stages. Similarly, with regard to urban air quality, there is likely to be a much greater focus on NOₓ emissions and aftertreatment technologies.

New testing challenges

From the latter stages of its implementation, Euro 6/VI will also bring significant changes to test processes themselves, with new rules for some of the fundamentals of chassis dyno testing where changes to inertia classes, road load determination and the impact of auxiliary devices such as air conditioning will have substantial impacts on type-approval testing. “Even at this stage as we approach the initial implementation of Euro 6, the final requirements of Euro 6c remain uncertain,” Andersson continues. “This phase of legislation is also likely to introduce stringent OBD requirements to ensure long-term real-world emissions compliance.”

Testing is likely to become more challenging in future for a number of reasons. The requirement to assess regulated emissions on-road and in typical usage will make portable emissions measurement systems (PEMS) mandatory for test and development organizations. In addition, the possibility of new low-temperature tests of sub -20°C as well as high altitude requirements may also require the development of a completely new breed of test facility. There is also likely to be a need to improve the precision of CO₂ measurements, to include the impacts of ancillaries, and even the influence of battery state of charge in hybrid vehicles.

Considerations of battery state of charge are just one way in which increasing hybridisation will complicate the emissions testing challenge, with energy-saving technologies such as stop-start and regenerative
braking becoming the norm in both gasoline and diesel applications. “While emissions from hybrids will be measured in a similar manner to those from current diesel and gasoline vehicles while allowing for the variations in state of charge, the potential complexities and differences in outcomes do not end there,” explains Andersson. “Hybrids that undergo short periods of engine shut-down and that efficiently restart may have helpful effects on emissions, depending on the application. For example, a gasoline vehicle with a three-way catalyst will be able to retain more heat in its catalyst when stationary if the engine is shut down, as the exhaust flow through the catalyst at idle has a cooling effect. Similarly, while diesel vehicle SCR systems will remain hotter for longer, there may be situations in which it would be preferable for other emissions to keep the engine running.”

**Plug-in vehicle emissions**

Current regulations contain specific requirements on how testing for plug-in and range extended vehicles should be undertaken. The actual deployment of these powertrains in the field may result in falls in regulated emissions if they are found to spend extended periods in pure electric mode. Market uptake at present remains too low to predict if most users will use these vehicles as intended; that is, for frequent short periods of EV driving with only occasional extended use requiring operation of the combustion engine. The impacts on emissions from fuel deterioration or lube-fuel interactions that have occurred during long periods of engine shutdown may in these circumstances prove to be significant.

“The current requirement for the internal combustion engine of a range-extended vehicle to meet full emissions compliance during its operation is likely to be subject to future discussion,” Andersson contends, “since the on-cost of meeting the latest legislation for a powertrain possibly infrequently used might be seen as a barrier to greater adoption of this otherwise potentially attractive low-carbon vehicle technology. Treating the engine as a periodic battery regeneration device – and thus quantifying emissions in the same manner that contributions from periodic emissions control devices are factored into the total drive cycle emissions result – could be a pragmatic and effective solution to this problem.”

**New testing infrastructure**

While the complexity of impending emissions regulation is likely to drive a major reinvestment in testing technology, Andersson argues that Ricardo's early experiences of many of the new aftertreatment and measurement technologies has helped the company in formulating its future testing strategy; “Ricardo believes that ultra-low emissions analyzers will be required to provide both whole-cycle results and real-time data. The new Vehicle Emissions Research Centre (VERC), currently under construction at Shoreham, UK, will bring a new level of testing capability for future low carbon, low emissions vehicles.

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**The end game for emissions?**

With emissions legislation already tightened almost beyond comparison with the earliest stages of implementation and with further new regulatory limits and controlled pollutants on the horizon, will a time come when a fundamentally new approach to measurement is required? Andersson concludes that this remains some way off:

“There is a limit to the benefits of measuring at extremely low levels. Conceivably there could be a time when just pass/fail regulations are required – for example post-DPF PN emissions are in many cases 100 times lower than the regulatory limit, and that limit is in itself equivalent to a particle concentration cleaner than the background ambient air in many areas. At that time we may require a qualitative rather than quantitative measurement, but I think it’s probably at least 30 years away.”
Wind turbine drivetrain reliability remains one of the most pressing issues for developers and operators of wind farms. The drivetrain is a crucial element in the turbine system, allowing the energy captured from the wind to be converted to usable shaft power that can be fed to the electric generator. However, wind turbines can be susceptible to levels of reliability that would be considered unacceptable in other industrial processes; the problem is compounded by the difficulties of carrying out significant maintenance on turbines once installed. Replacement part lead times and turbine access can be challenging for land-based systems in remote locations, and even more so for offshore wind farms, where repairs are contingent upon the availability of support vessels and calm sea conditions.

The Ricardo-led OWDIn (Offshore Wind Drivetrain Innovation) project was announced by the Rt Hon Edward Davey MP, UK Secretary of State for Energy and Climate Change, speaking at the annual RenewableUK conference in Birmingham. The project takes a broad drivetrain approach to improving reliability through the development of sub-systems that will be applicable to a wide range of different drivetrain architectures. The project will see the deployment of the Ricardo ‘MultiLife’ wind turbine bearing management system for gearbox planet bearings at ScottishPower Renewables wind farm locations that are known to experience aggressive wind conditions. Already, this technology has been shown on a test bench environment to have demonstrated the potential to extend bearing life by as much as 500 percent.

In addition, the project will involve the development of a Ricardo concept for a unique, dual-function coupling that avoids drivetrain overloads: the Torque-Only Coupling and Torque Truncation system will be applicable only to new offshore wind turbines but offers the prospect of enabling them to survive in the harshest conditions for their full 25 year operating life without major maintenance intervention.

Finally, the project aims to develop a next-generation condition monitoring and prognostics system targeted at offshore wind farms but capable of retrofit to existing wind farms. This system will use advanced sensors to provide early indications of potential fault development in order to enable preventative measures to be taken, hence avoiding the costs and lost production of enforced downtime through damage.

“These new Ricardo technologies offer the prospect of transformative improvements in wind power operational reliability, particularly in the offshore environment,” commented Paul Jordan, Ricardo’s global market sector head for clean energy & power generation. “The award of funding for this project by the Department for Energy and Climate Change provides the opportunity for industry to make significant progress in developing and demonstrating these technologies through practical deployment in challenging wind farm environments.”

Greaves launches D Series engine family

The new Greaves Power D Series engine was unveiled in October by Greaves group Chairman Karan Thapar, at a ceremony held at Bengaluru, India, marking the successful conclusion of a collaborative project with Ricardo announced less than two years ago. The new engine has been designed to be capable of meeting international emissions regulations, being fully engineered from the outset for US Tier 3 emissions levels and with clear upgrade path protection for Tier 4 compliance without the need for significant hardware changes.

“Greaves Cotton Ltd and Ricardo both have long histories and a strong heritage of engineering innovation and technology development,” commented Prakash Bhalekar, CEO of Greaves Industrial Engines Business, Auxiliary Power Business and Engine Component Technologies. “We are pleased to have been able to continue our longstanding collaboration with the development of the D Series engine family over the past two years. We now look forward to bringing this high quality, low emissions engine to market for the benefit of our customers in India and abroad.”
Ricardo Knowledge service launched

Ricardo has provided a technical support service to selected clients on an annual subscription basis since the 1930s. As the company has developed and grown over the years, the range of services offered has similarly expanded to include, for example, the renowned industry databases offered by the library and information team. The breadth of technical advice has similarly extended to encompass all of the industries and markets in which the Ricardo group is actively engaged.

Over the last eight months, the Ricardo Knowledge team has carried out an in-depth review and has sought the opinions of its subscribers and other Ricardo customers as to how the service could best be optimized for the coming decade. This work has led to the launch announced today of Ricardo Knowledge, a new system of technical support comprising three primary service lines of Technical Assistance, Training and Information Services.

In the area of Technical Assistance, customers will now be able to manage their accounts online and can access the expertise of the expanded Ricardo group including Ricardo-AEA. In the area of Training, the service builds on the very successful model of face-to-face classroom style training at Ricardo and customer sites, with online courses that are accessible around the world to a much wider potential audience.

Finally, access to the Ricardo library databases – widely acknowledged as some of the most prestigious independent repositories of technical information within the automotive and related industries – will be improved. This will include a significant upgrade of the very popular EMLEG exhaust emissions legislation database, and the Powerlink database, which provides a comprehensive global online library of technical papers. For more information see: www.ricardo.com/knowledge

Thailand’s DTI partners with Ricardo on new 8x8 military vehicle

The Defence Technology Institute (DTI) – the Thai ministry of defence’s research and development agency – has announced that it will partner with Ricardo on the next phase of development of its Black Widow Spider 8x8 armoured vehicle programme in support of the Royal Thai Army.

DTI was set up to develop Thailand’s defence technology capability and to help build the local defence industry; the Black Widow Spider represents its first major military vehicle programme. DTI and Ricardo have already completed the initial phase of technology development for the Black Widow Spider 8x8, and displayed the vehicle configuration at the recent Defence & Security 2013 exhibition hosted in Bangkok in early November. The vehicle has been designed to provide protected firepower and extreme mobility in reconnaissance, command and control and fire support roles.

"DTI and Ricardo have agreed to work together to develop the next phase of the Black Widow Spider 8x8 project," confirmed Colonel Tawiwat Veeraklaew, DTI’s executive director of R&D. "I am looking forward to working closely with Ricardo on this important project for Thailand’s defence industry.”

Ricardo News

The Automobile Division of the Institution of Mechanical Engineers has awarded its prestigious Prize for the Environment to Ricardo, Ford Motor Company, Controlled Power Technologies and Valeo engineers for their paper HyBoost – An Intelligently Electrified Optimized Downsized Gasoline Engine Concept. The award recognizes the most outstanding paper contribution made in the previous year in this area. The winning paper described the UK Technology Strategy Board (TSB) sponsored HyBoost project, a collaborative research programme to develop an ultra-efficient optimized gasoline engine using a concept that Ricardo terms ‘Intelligent Electrification’.

“Intelligent Electrification is an extremely promising technology that this project has shown to have the potential to deliver extremely good fuel economy, low carbon dioxide emissions, and a performance equivalent to that of a much higher capacity conventional powertrain,” explains Ricardo chief engineer for the HyBoost project, Jason King. “In effect, it provides a pathway to achieving the real-world and regulated cycle fuel efficiency of a hybrid, but at significantly lower cost.”

The demonstrator vehicle produced by the project used a highly downsized 1.0 litre boosted engine in conjunction with relatively low cost synergistic ‘12+X’ Volt electrical management system and electrical supercharger technologies. This successfully delivered fuel economy and CO2 equivalent to a full hybrid powertrain, with performance equal or better than the baseline 2.0 litre vehicle but at a projected cost premium significantly less than a diesel.

Moreover, the project highlighted a potential pathway to delivering less than 85 g/km CO2 as measured over the NEDC. Ricardo was supported in the HyBoost project by a consortium comprising the Ford Motor Company, Controlled Power Technologies, Valeo, the European Advanced Lead Acid Battery Consortium, and Imperial College London.

Following the success of HyBoost, Ricardo is now exploring the implementation of intelligent electrification on diesel powertrains in the ADEPT project announced in early September.
NCEC celebrates 40 years of chemical safety and emergency response

The UK National Chemical Emergency Centre (NCEC) – part of Ricardo-AEA – recently celebrated its 40th year of successful operation and underscored its position as one of the world’s most experienced chemical emergency response organizations. Endorsed by the UK government and supported by industry through bodies such as the Chemical Industries Association, NCEC has been providing its fast response service of expert advice and assistance during chemical emergencies since 1973. While originally focused solely upon the UK, the organization now has an international customer base including hundreds of companies in the chemical supply chain and around 50 percent of the world’s top 100 chemical manufacturers. NCEC currently receives around 4500 calls per year in all world languages and employs a specialist chemical emergency response team at its Oxfordshire headquarters.

To coincide with its 40th anniversary celebrations, NCEC hosted a seminar at the Royal Society of Chemistry in London on future global regulatory challenges affecting the international chemicals industry. The seminar and reception that followed were attended by senior representatives from government, regulatory agencies, and the organization’s many partners around the world. "When Ricardo-AEA was formed through acquisition a year ago, we were hugely attracted by the opportunity to bring NCEC into the Ricardo family," commented Ricardo CEO Dave Shemmans. "NCEC is a world-leading organization in its field, which has set global standards in chemical risk management over the last 40 years. Its mission is to provide services and knowledge that allow chemical emergencies to be avoided wherever possible, and when they do occur, to be dealt with quickly and safely. With its increasingly international presence and global success, I look forward to working with the management of NCEC to see it further grow and develop as part of Ricardo.”

Ricardo automotive legend receives 007 seal of approval

One of the Ricardo group’s legendary automotive achievements played a starring role in the new James Bond book – “Solo”, by William Boyd. Launched in the mid-1960s, the Jensen FF was the world’s first production four-wheel drive car, the revolutionary driveline of which was developed by (Ferguson Formula) Developments, the forerunner of the FFd company acquired by Ricardo plc in 1994.

In the new novel ‘Solo’, James Bond celebrates his 45th birthday at The Dorchester, London, and, refreshed after an excellent night’s sleep, he carries on his celebrations by heading into a car showroom on Park Lane and taking one of the most sought after cars of the time, the Jensen FF, for a spin. “Bond felt he was in a low flying plane rather than an automobile as he accelerated the Jensen… If you needed a car to boost your ego, Bond thought, then the Jensen FF would do the job admirably.”

To this day Ricardo has a fully restored Jensen FF in its historic vehicle fleet, demonstrating the company’s proud heritage in advanced automotive driveline technology.
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