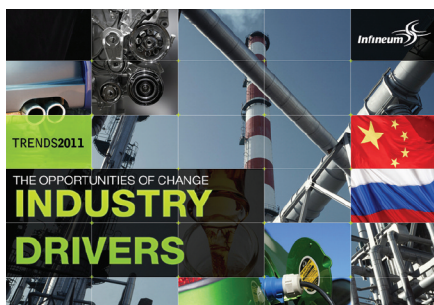


## Infineum Trends

### Industry Drivers



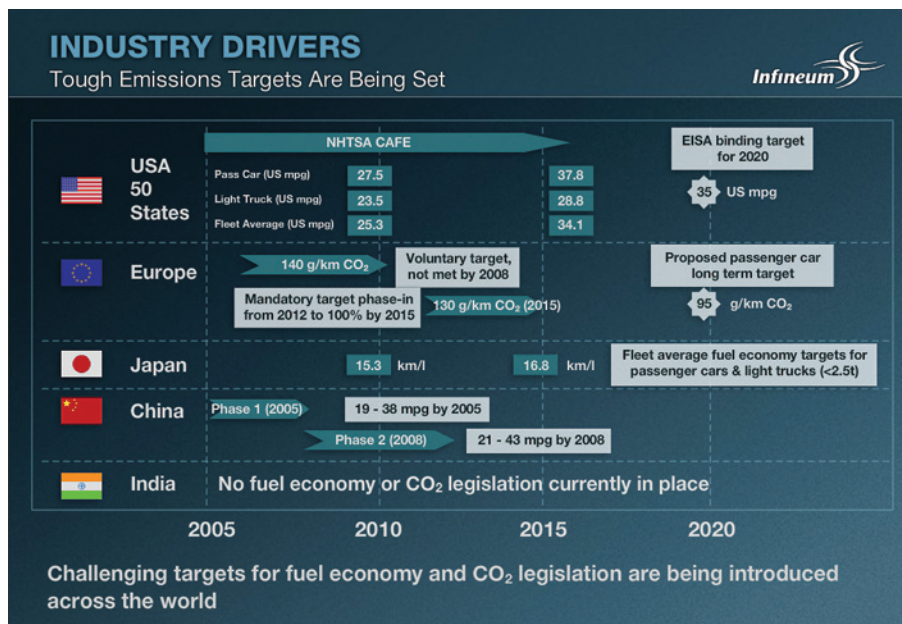
Climate change, fuel economy, emissions legislation, globalisation, and the rise of new markets have all created changes and opportunities in our industry. The future that is emerging looks very different from our pre-recession world – and it's likely to take us all some time to adapt.

Uncertainty and caution have been the themes in recent Trends presentations. This year's theme is 'The Opportunities of Change' and we hope to explore some of the growth opportunities building on the initial signs of recovery we saw last year.

Undoubtedly, the biggest driver for change is the environmental legislation arising from concerns about climate change. Last year climate talks took place in Mexico, and over 190 countries adopted the Cancun Agreement, setting the stage for ongoing negotiations on greenhouse gas reductions.

While several positive steps were taken – including a way to help developing nations, recognition that some in-place targets must change and a framework to limit deforestation; neither a mechanism for deeper cuts nor agreement on the legal status of any new global limits were agreed.

Whatever the outcome of that political wrangle, governments around the world are introducing and tightening both CO<sub>2</sub> emissions limits and fuel economy targets. As an example, the USA fuel economy target for passenger vehicles increases from about 25 mpg to 35 mpg by 2020. In Europe already tight CO<sub>2</sub> emissions targets of 140g/km will be reduced to 95g/km by the same date.



None of these targets are easy to meet and they will drive changes in both vehicles and power trains around the globe. OEMs will need to do some very creative juggling of product mix to maximise fuel economy and profitability – something we are already seeing with the emergence of the smaller car premium sector.



CO<sub>2</sub> reduction legislation will affect almost all forms of transport in the not so distant future and present new challenges to fluid formulators. OEMs will be looking for every possible way to improve fuel economy and reduce CO<sub>2</sub>. No doubt they will be expecting even more help from the fluids we supply. However, this improved fuel economy cannot come at the expense of either engine protection or oil drain interval!

Globally, governments are also continuing pressure to reduce emissions of other pollutants through the use of more efficient engines and aftertreatment technologies. They are also looking to improve the security of their energy supplies through increased use of indigenous fuels and sustainable biofuels.

In the USA the Environmental Protection Agency celebrated the 40th anniversary of the Clean Air Act Amendments, under which the EPA has gradually introduced more and more stringent tailpipe emission standards. Having already reduced on-road emissions by over 90%, the scope is widening to now address pollution from a wide range of non-road sources.

If you believe the mainstream consumer media our new found environmental conscience means all of us will soon be driving plug in electric, hydrogen or fuel cell vehicles. However, Infineum and many other informed commentators believe the internal combustion engine will continue to be the powertrain of choice for the foreseeable future.

# Lube-Tech

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No.78 page 2

In a competitive industry that is always governed by cost, it is simply more cost effective to improve conventional gasoline or diesel engines than it is to move to alternative technologies.

The cost of hybrid vehicles is really quite significant compared with the environmental benefits they deliver, while plug-ins and fuel cell vehicles depend on a carbon-neutral energy source for any significant environmental benefits to be achieved. Without very significant government incentives or taxation, product cost will rule and powertrain developments will be evolutionary, not revolutionary. Although the powertrain picture to 2030 is far from clear we think the internal combustion engine will have a major part to play.

However, as alternative power systems enter even as niche markets, they may bring new challenges.

In the short term we see an assortment of advanced internal combustion engine powertrains, along with the emergence of a variety of hybrids and a few electric vehicles.

In the medium term, electrification is likely to take a bigger role, but advanced engines, either alone, or deployed in hybrid vehicles will remain dominant in the mix.

The long term trends are difficult to call. As the demand for personal mobility continues and fossil fuels are replaced by alternatives it is likely the number of electric and fuel cell vehicles will grow, but such growth must be accompanied by fundamental changes in the energy supply sector.

Internal combustion engines will see downsizing, lean operation, alternative fuel use, valve train complexity, turbo boosting, the use of new materials and improvements in emissions controls. Automatic transmissions will have six, seven or more gears and some regions will use DCT and CVT technology.

Some of the technologies that started in passenger cars, such as hybrid drives and exhaust aftertreatment, will expand to other vehicles segments. These changes provide opportunities for the development of innovative and advantaged lubricants and fuels.

One growing market that is presenting significant opportunity is China. Reports from the IMF indicate that in 2010 it overtook Japan to become the world's second-largest economy.

Vehicle sales topped 18 million in 2010 – up 32% on the previous year. Some 90% of last year's economic growth was driven by domestic demand, and GM reported more vehicle sales in China than in the USA. Some industry analysts suggest that there could be 125 million vehicles on China's roads by 2020. China is a huge market and most OEMs are looking to increase sales in the region. This changing market offers opportunities for fuel and lubricant suppliers.

Recognising this growing demand, global automakers are investing in production facilities through out Asia.

Trends 2011 looks at how Global changes and industry challenges are impacting specifications, formulations and developments and aims to share Infineum's views on some of the key issues.

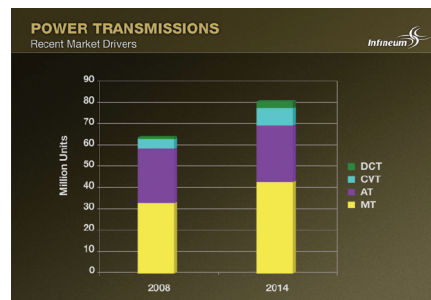
## Power Transmissions



Improved fuel economy, to meet tough CO<sub>2</sub> targets in Europe and escalating CAFE Standards in the USA, is the key driver for changes in transmissions. It is increasingly important that both transmissions and their fluids help improve fuel economy – while simultaneously enhancing other performance attributes.

Several alternative transmission technologies are currently in use, and there is no consensus about which is the best. DCT growth is expected in Europe and China, where the existing manufacturing infrastructure makes production easier. CVT are more popular with Japanese and Chinese OEMs for small

low torque vehicles. However, it is the conventional planetary automatic – with an increasing numbers of forward gears – that will continue as the dominant auto-shifting technology.



Historically, automatic transmissions used a torque converter and had three or four speeds – with just a handful having five. In North America, DEXRON® and MERCON® fluids represented more than two-thirds of ATF volume and were typically formulated in Group I base stocks to provide the high viscosity required.

The need for improved low temperature operability led to specifications which cut Brookfield Viscosity by more than 60%. At the same time, requirements for better fluid durability led to tougher oxidation tests and essentially eliminated Group I base stocks from ATF applications.

OEMs began to look at how to minimise losses by reducing the viscosity of transmission fluids. A number of low viscosity fluids followed and today there are more than half a dozen low viscosity fluids in the marketplace, along with a myriad of high viscosity fluids – making life more complicated for service centres and lube shops.

Today, there are at least ten OEMs that each produce over a million automatics a year. Most make multiple transmission models – each being slightly different in design, size, torque capacity and each using different materials for gears and clutches. To optimise performance, fluids are specified to provide exacting performance requirements. The net result is that ATF's must be pretty much OEM-specific – or even transmission specific! The ATF service fill business, once based on bulk economics, is quickly becoming a business of expensive small volume fluids.



Just when you thought it couldn't get any more complex today's ATFs must have lower viscosities to reduce fuel consumption – while at the same time maintaining protection for gears and bearings despite the lower lubricant film thickness.

In an attempt to reduce complexity almost every major ATF marketer offers a Multi-Vehicle fluid of some sort. However, most are formulated to meet high viscosity ATF requirements. Today's market is clearly ready for a low viscosity multivehicle ATF to reduce complexity and provide the required fuel economy and hardware protection.

Looking to the future, demands to reduce fuel consumption and improve efficiency will increase.

OEMs will continue to increase the number of gears and transmission components will continue to get lighter and smaller. With smaller sump sizes, containing less fluid, new fuel-efficient transmissions will have higher operating temperatures adding extra stress to the ATF.

The question that remains is just how low can the viscosity of future fluids go? Whatever the answer, the desire for improved fuel economy must be carefully balanced with the need to deliver the excellent hardware protection.

## PCMO (Passenger Car Motor Oils)

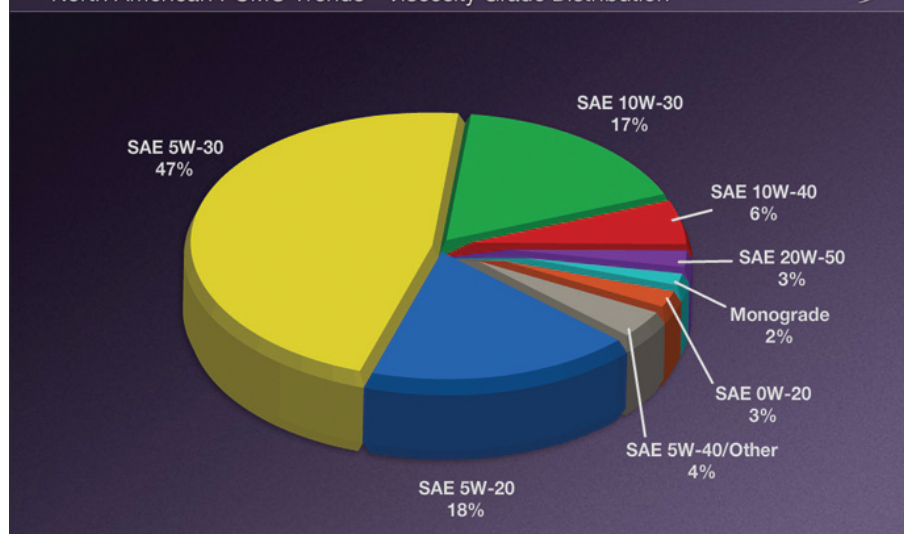


Once again, the improved fuel economy and reduced CO<sub>2</sub> emissions are the main drivers of change for passenger cars. As legislation is introduced across the world and penalties for non-compliance increase, OEMs are looking for every possible saving.

ILSAC GF-4 and GF-5 quality oils comprise some 60% of the North American PCMO market, and the move

## PASSENGER CAR ENGINE OILS

North American PCMO Trends - Viscosity Grade Distribution



towards GF-5, which started last October, is progressing. Top tier, high mileage and other SM licensed products account for another 30% of the market.

SAE 5W-20 and 5W-30 viscosity grades account for almost two thirds of this market, and SAE 0W-20 for Honda and Toyota and have reached measurable volumes. Responding to requests from some Japanese OEMs, the SAE EOVC (Engine Oil Viscosity) Task Force is working to define even lower viscosity new grades for addition to SAE J300. However, much work remains before these new grades are finalised.

In Europe, December 2010 was the last date for oil marketers to upgrade products to meet ACEA 08 requirements. ACEA also released some minor upgrades which become mandatory December 2012. New chemical limits drive a split between the A/B and C sequences, and TBN limits were added to A3/B4. Hardware and fuel issues may limit availability of some tests and cause delays in approval programs.

This plot of light duty engine testing over the last decade represents over \$1B in 2011 money, with GF-5 alone costing over \$100M.

As with any new category development, viewpoints differ regarding its success. ILSAC GF-5 is expected to last until at

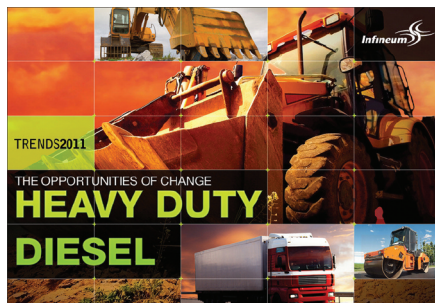
least 2015, but replacement parts for many of the current engine tests may run out before then. Also, it is not clear that all ILSAC members are committed to future test or standard developments.

Industry is already behind on developing replacement tests to evaluate key oil properties. In addition to replacements for existing performance parameters, several new issues may require new test developments.

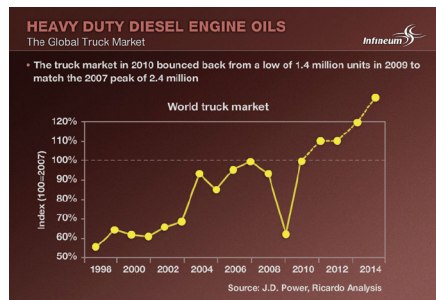
While most OEMs are expected to specify ILSAC GF-5, GM has taken a different path. GM produces vehicles in 37 countries, and had previously set lubricant specifications on a country or regional basis. Last year it introduced its new global engine oil specifications for gasoline and light-duty diesel engines, which will replace all previous specifications.

GM charges fees for approvals, and this has both caused concerns with some oil marketers and added uncertainty regarding market penetration. Our industry experts shared varying comments and view points regarding dexos™. As of early 2011, the estimated North American market volumes for dexos licensed and unlicensed products were almost evenly split.

## Heavy Duty Engine Oils



As we predicted last year, 2010 was a recovery year for the heavy duty vehicle market. However, the rate of recovery has surprised most industry observers with sales bouncing from a low of 1.4MM units in 2009 to 2.4MM units in 2010, matching the previous high in 2007.



API CJ-4 oils were developed to protect 2007 and newer engines and their emission control systems. Volvo Trucks developed their own global oil specification using the CJ-4 tests as its core.

Starting last year, NOx limits were reduced for all on-highway diesel engines sold in the USA. Most engine manufacturers are using SCR with DEF as their primary NOx control technology. However, Navistar continues its use of heavy EGR and advanced combustion controls. The use of SCR, EGR and DPF seems to be the global standard for emission control in markets with strict limits.

While API CJ-4 oils are performing well, several of the engine tests used to define the category have experienced issues with both fuel and hardware.

While there is general agreement that there is no short term need for a new HD category, there is a potential need around the middle of this decade. The

API DEOAP met in March 2011 to begin planning for this possibility. EMA members are not yet ready to make a formal new category request, but they expect to develop a request by year end. Several potential areas for improvement were noted. They did note that CJ-4 testing can be supported through 2015.

With rising fuel prices, HD truck fuel economy and the potential contribution of lubricants is rapidly gaining interest.

Reduced HTHS viscosity is a powerful lever to improve fuel economy. However, OEM concerns about increased wear have forced an HTHS limit of 3.5 cP minimum into CJ-4 as well as many other global specifications.

Changing HTHS limits will require universal support from Global engine builders, and that may be difficult to achieve. In addition, comments from API staff suggest that concern over backward compatibility could force a change in category rather than a 'supplement'. Individual OEMs may be willing to make changes to allow the use of lower viscosity oils, and these changes could represent opportunities for oil marketers.

In Europe, the ACEA HD requirements were updated late last year, but the changes were relatively minor.

We concentrate on oils for engines with advanced aftertreatment systems, but almost half of last year's global truck production was not so equipped! China is one market where this is true, and engine builders there are reluctant to move to higher quality lubricants.

The Chinese commercial vehicle market is dominated by local producers. However, these companies currently cannot compete in markets with advanced emission control requirements. Recognising the importance of the Chinese market, both Cummins and Daimler have formed JVs with local companies, and this could allow the Chinese OEMs access to advanced technologies and enhance their future global competitiveness.

In the more sophisticated markets there will be continuing pressure to reduce

CO<sub>2</sub> emissions and improve fuel economy. In the US, the EPA and NHTSA have proposed harmonised limits which will phase in from 2014 through 2018.

Europe is expected to impose new targets later this decade. Infineum does not believe these changes will drive 'breakthrough' technology into the market. However, there will be increased emphasis on 'known' technologies which are already recognised by the EPA 'Smartway' program.

For well into the future, the four stroke cycle compression ignition engine will remain the power system of choice for commercial vehicles, with some penetration of hybrid drives for stop and go service. Biodiesel usage will vary with local mandates and taxation policies, and natural gas usage may develop in market niches where the distribution infrastructure either exists or is installed.

## China Market



With China's economy now holding the number two slot globally, it seemed appropriate to move China to a stand alone segment in Trends 2011. China's population is over 1.3 billion people making it the most populous nation in the world. One of every five people on earth live in China, and if everyone lined up to walk past you in single file the line would never end.

In 2009 the global economic downturn reduced foreign demand for Chinese exports for the first time in many years but China rebounded quickly outperforming all other major economies. Last year China's GDP grew to just over \$6B US – a year on year change of just over 10% after correcting for inflation.

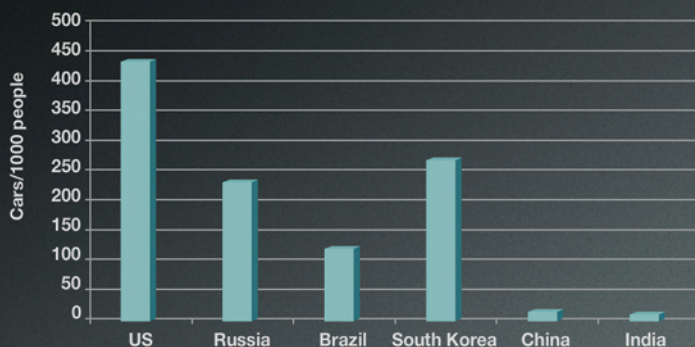


## CHINA MARKET

Vehicle Population



- 2010 vehicle population up 19.3% to 74 million
- Estimates suggest 125 million vehicles by 2020
- Car density is still relatively low



China's vehicle population hit 74MM last year, and it is estimated to reach 125MM by 2020.

Still, car ownership per 1000 people is low compared to other markets – indicating the probability of even more growth.

With these additional vehicles come the challenges of increased congestion and pollution in major cities. In Beijing for example – a city that covers a similar area to Las Vegas but has a population over six and a half times larger – the municipal government announced that it will take steps to limit car ownership. Total vehicle sales and production hit some 18MM units in 2010, truck production rose almost 30% to just under 4MM units.

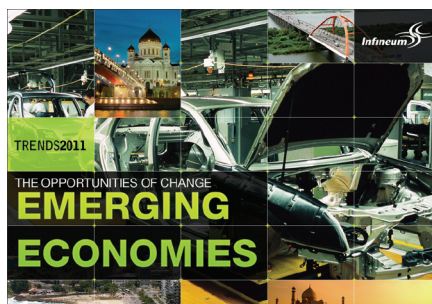
Last year the Chinese government implemented Euro IV emission limits for Passenger and Commercial vehicles nationwide. This provides an opportunity for oil marketers to promote high quality, long-drain lubricants to meet the needs of the advanced hardware technologies of Euro IV vehicles.

The government has concerns about the energy sector's ability to support continued economic growth. Fuel prices have risen since market changes 2008, and fuel economy is becoming an important consideration for car buyers.

However, hybrid cars have not caught on. Passenger car fuel economy standards move to phase III in 2012, but SAE 15W-40 viscosity oils still hold most of the market – presenting an opportunity for the use of lower viscosity oils to improve fuel economy. HD fuel economy standards are under development.

Pollution and energy security concerns have prompted the Chinese Government to focus its attention on new energy and clean-energy cars. The current five year plan makes the development of new-energy cars a top priority for the auto industry. To meet the target of one million new-energy vehicles by 2015 China plans to invest more than 100 billion yuan – or 15 billion dollars – over the next decade and make China the world leader in green car production.

## Emerging Economies



Beyond China, Brazil, Russia, India and Korea present significant new opportunities to vehicle OEMs and to lubricant and fuels suppliers – but they also bring a set of unique challenges and a certain level of uncertainty.

## EMERGING ECONOMIES

Brazil



We'll start with a look at Brazil, a country with a population of over 200 million – the 5th largest in the world, behind China, India, the US and Indonesia.

The onset of the global financial crisis hit Brazil late in 2008, and the country experienced two quarters of recession. However, Brazil was one of the first emerging markets to begin a recovery. Consumer and investor confidence revived and GDP growth of over 7%, was reported in 2010.

Vehicle sales in Brazil hit an all time high in 2010 – up almost 12% on the previous year – surpassing Germany to become the fourth largest car market in the world.

Although diesel fuels with sulphur levels of 1800 and 500ppm are still in use – 50ppm sulphur fuel is now available for urban transport fleets in selected cities, and 10ppm will be available from 2013. There is concern that the availability of varying sulphur level fuels may lead to confusion and misuse.

Biofuels usage has been promoted for some 40 years, and ethanol use in gasoline grades is currently E25 and E100. B5 has been mandated since January 2010, and requirements will rise gradually to B10 by 2015. These changes in fuel quality present new opportunities for both auto and truck makers and fuel marketers. In addition, upcoming changes in emissions limits will impact both light and heavy duty hardware, fuels and lubricants.

# Lube-Tech

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## Russia



Our next look is at Russia. At over 17 million square miles Russia is the largest country in the world. Although it is 1.8 times the size of the US its population of just over 139 million means it has less than half the number of people.

In the last 10 years the country has had a higher GDP growth than other European countries, the USA, and Brazil although not as strong as China and India. Being largely dependent on crude oil, gas and raw material exports, the Russian economy was battered by the recession. With crude and gas prices soaring, the economy is now recovering and the outlook is that GDP growth will remain strong.

Russia ranks 10th in the world for passenger car sales and in 2010 sales of new passenger cars and light commercial vehicles in Russia rose by 30%. Foreign brands account for over 60% of the new sales market. With a relatively low car density compared with developed economies – there is clearly significant growth potential in the future. High import duties and bureaucracy make local manufacturing attractive and the most major players either have or are building their own plants in Russia.

Despite the recession, Russia is the largest truck market in Europe. However, high import duties – currently running at 25% – and slow replacement of the vehicle fleet mean foreign brands have a much lower market penetration.

Russia is the fourth largest global lubricant market, with future growth expected to be significant as the vehicle population builds. However lubricant quality is fairly low and almost all high quality lubes are imports from the west. The quality of lubricants is being driven

up both by plans to move to Euro V emissions standards and the increasing use of foreign vehicles requiring higher quality lubricants.

## India



From Russia we move to a country one third the size of the US, but which has the second largest population in the world – India. Last year, the Indian economy grew by more than 8% – largely from strong domestic demand.

The Society of Indian Automobile manufacturers – SIAM for short – reports that local vehicle production grew almost 33% last year to over 17 million units with most going to export markets. However, rising disposable incomes, the launch of new models and a robust economy are driving more customers into showrooms, and industry analysts suggest India will become the fourth largest auto market in the world, overtaking Europe, by 2015.

India expects to benefit from a period of direct foreign investment as over two billion dollars a year comes in over a sustained period to enable auto manufacturers to set-up more new plants.

In spite of this significant growth in passenger car production, current production in India is still dominated by two wheelers – predominantly motorcycles. In 2009 India was the second largest motorcycle producer in Asia at just under 10 million units.

The Indian government is also supporting the introduction of alternative energy with a 20% subsidy for two and four wheel Electric Vehicle makers on the ex-factory prices of their vehicles. In the future, the Electric vehicle incentive will

be merged into the National Electric Vehicle Policy that is currently being formulated.

## Korea



For a relatively small country Korea's capital city, Seoul, at over 10 million is one of the most populated cities in the world!

With the global economic downturn in late 2008, Korean GDP growth slowed, but by the third quarter of 2009, the economy began to recover, and last year growth exceeded 6%.

Korean emissions standards are based on European specifications and many vehicles now have to meet Euro V limits. Both gasoline and diesel fuel have come under new specifications with limits on a number of chemical and performance attributes. A Fleet Average System or FAS covering CO<sub>2</sub> limits, similar to the US CAFE standards was introduced in January 2009. It allows OEMs to produce cars with various emission levels and bank and trade credits as long as their average emissions meet FAS limits.

Korea has had a biodiesel mandate, starting at 0.5% since 2006. Last year the blending ratio was increased to 2% as part of the government's aim to have alternative energy sources contribute up to 5% of the nation's energy demand by 2011. It is also working to increase the quality of Biodiesel to meet the European EN14214 standard.

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