GLOBAL FUEL ECONOMY INITIATIVE
www.globalfueleconomy.org

International Energy Agency

International comparison of light-duty vehicle fuel economy: Evolution over 8 years from 2005 to 2013

Working Paper 11

FIA FOUNDATION

UNEP

International Transport Forum

International Energy Agency

icct THE INTERNATIONAL COUNCIL ON CLEAN TRANSPORTATION

ITS UCDAVIS INSTITUTE OF TRANSPORTATION STUDIES

International comparison of light-duty vehicle fuel economy

Evolution over 8 years from 2005 to 2013

Alexander Körner, Pierpaolo Cazzola, François Cuenot

Executive Summary

The last update of global fuel economy trends, published in 2013, concluded that, while global average fuel economy was improving, more needs to be done to meet the ambitious, yet realistic, GFEI target to cut by half the specific fuel consumption of new passenger light-duty vehicles (in Lge/100km) by 2030.

This update adds two more years (2012 and 2013) and three more countries to earlier analyses (GFEI, 2011 and GFEI, 2013) and includes substantial methodological changes. The normalization to the NEDC test cycle is the main methodological revision. It aims to deliver more robust and internationally comparable results.

The latest analysis shows that the improvement rate of fuel economy did not change significantly over time, remaining close to 2.0% per year. Recent developments point to a slow down in this rate (1.6% between 2012 and 2013). This is mainly due of the growing importance of non-OECD markets, where fuel economy improvements have been limited. The 2.0% improvement rate represents about two thirds of the 3.1% per year improvement required to reach the GFEI target (Table ES1). The only modest improvement emerging from global historical data is counterbalanced by a number of encouraging signs. First, when looking at individual countries, more than half of the OECD countries taken into consideration by this analysis have improvement rates well above 3%. Further to this, remarkable progress has been made with respect to the adoption of transformative fuel economy policies in the very recent past in non-OECD economies. In the last few years, Brazil (2012) implemented fiscal and regulatory instruments capable to reduce the average fuel consumption of vehicles, while major vehicle markets such as Mexico (2013), India and Saudi Arabia (2014) introduced fuel economy standards for passenger light-duty vehicles (Figure ES1).

Table ES1 • Fuel economy evolution compared to GFEI target

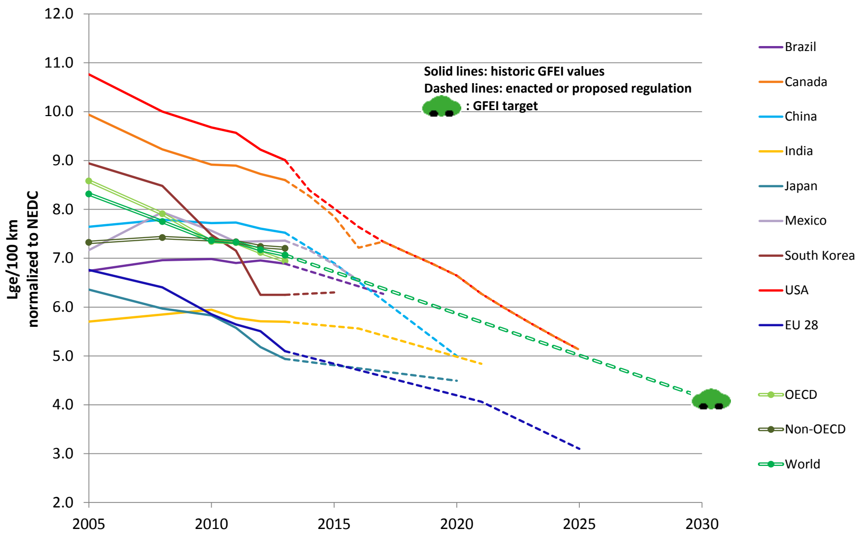
			2005	2008	2011	2013	2030
OECD average	average fuel economy (Lge/100km)		8.6	7.9	7.3	6.9	
	annual improvement rate (% per year)			-2.7%	-2.6%	-2.6%	
			-2.6%				
Non-OECD average	average fuel economy (Lge/100km)		7.3	7.4	7.3	7.2	
	annual improvement rate (% per year)			0.5%	-0.4%	-0.9%	
			-0.2%				
Global average	average fuel economy (Lge/100km)		8.3	7.7	7.3	7.1	
	annual improvement rate (% per year)			-2.3%	-1.9%	-1.8%	
			-2.0%				
GFEI target	average fuel economy (Lge/100km)		**8.3**				**4.2**
	required annual improvement rate (% per year)	2005 base year	**-2.7%**				
		2014 base year	**-3.1%**				

Regional results show that historical improvement rates are stronger in OECD economies, where fuel economy policies have a longer historical record and a wider implementation, than in non-OECD markets, where major developments took place only in the recent past. The market dynamics, and the growing importance of new vehicle registrations in non-OECD countries explain why the global annual improvement rate did not show an acceleration in recent years, despite higher improvement rates between 2010 and 2013 (compared to 2005 to 2010), both in OECD and the non-OECD countries.

The gap between OECD fuel economy improvement rates and the GFEI target, indicates that policies adopted in OECD countries should be strengthened in forthcoming years. This is consistent with the idea that the OECD market structure, with a higher fraction of vehicles larger than the global average, is instrumental to delivering cost reductions capable of making technologies more affordable in less refined markets. The enacted fuel economy targets in Canada, the European Union and the United States already anticipate tightening fuel economy targets, getting these countries on track to reach and even exceed the GFEI target (Figure ES1). This also suggests that exceeding a 50% reduction of fuel consumption by 2030 in the most developed markets could ease the achievement of the GFEI target on a global scale.

Non-OECD countries show absolute specific fuel consumption values lower than the OECD average. This is mainly due to the smaller average size, mass and power of vehicles. Non-OECD trends show encouraging signs of progress in the 2010-2013 period (further strengthened by the prospects for improvements in the future), although their average fuel economy improvement to date remained weaker than in the OECD. This reflects the following aspects: a) an increasing tendency to shift consumer preferences towards larger vehicles, driven by rapidly growing incomes; b) a lower diffusion of fuel economy policies than in the OECD; and c) a certain time lag needed for the conversion of the recent policy developments into actual fuel economy improvements. This also indicates that scaling up the fuel economy improvement rate of non-OECD in order to reach the GFEI target will continue to require very proactive action: scaling up the market coverage of fuel economy regulations and setting strengthened fuel economy improvement targets for the 2015-2030 period are fundamental developments in this respect. The expected rise in the importance of the non-OECD passenger car market (which is already almost 20% larger than within OECD) indicates that meeting GFEI targets cannot be achieved without effective action undertaken in these markets.

Figure ES1 • Average new LDV fuel economy evolution by country, 2005 to 2013



Key message • Reaching GFEI targets requires to maintain existing long term policy targets and to implement them where they do not exist, namely in the non-OECD[1].

[1] Historical values are based on the GFEI analysis. Proposed and enacted policy targets are based on ICCT (2014c).

Introduction

The Global Fuel Economy Initiative (GFEI) has been leading an effort to track the evolution of worldwide average fuel economy of new vehicles since 2005 (GFEI, 2011). Earlier reports showed that, between 2005 and 2011, the rate of fuel economy improvement was not fast enough to reach the long term GFEI goal to halve the specific fuel consumption of new passenger light-duty vehicles (expressed in energy use per km) by 2030.

Have recent fuel economy policy developments[2] accelerated the rate of improvement of new vehicle average fuel economy since 2011? This update provides results reflecting information on the years 2012 and 2013 and aims to shed light on the latest improvement of new light-duty vehicle average fuel economy for a vast portion of the global light-duty vehicle market.

New light-duty vehicle average fuel economy

Evolution by country

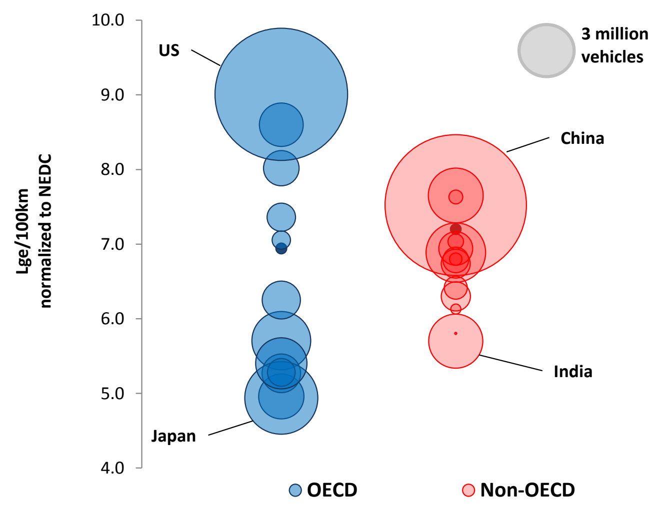
Latest year, 2013

2013 was a record year in terms of new light-duty vehicle registrations, with almost 63 million passenger cars sold globally (OICA, 2014).

The average fuel economy of the countries covered in this analysis (representing more than 80% of the global market), ranged from 4.9 to 9.0 Litres of gasoline equivalent (Lge) per 100 km (115 to 209 gCO_2/km), reflecting almost a factor of two between the most efficient and least efficient market.

Figure 1 • Fuel economy distribution for OECD and non-OECD, 2013

Least efficient



Most efficient

Key message • Average fuel economies in the OECD markets are very heterogeneous, containing both the

[2] The generic term fuel economy policies is used in this report to identify regulatory measures that refer to fuel economy, CO_2 and GHG tailpipe emissions from light passenger vehicles, as we consider them largely equivalent for the purpose of this analysis.

most and least efficient markets[3]. The difference between both ends is almost 100%.

The spectrum of the average fuel economy values is much wider in OECD countries than in non-OECD countries (Figure 1). The OECD region has both the most and least efficient markets and contains two main clusters, either well below (Europe, Japan) or well above (North America, Australia) the regional average.

Latest evolution, 2012 to 2013

The worldwide annual fuel economy improvement rate between 2012 and 2013 was 1.6%, about half of the improvement required to reach the GFEI target by 2030.

OECD countries, on average, improved by 2.5% per year. When looking at individual countries, more than half of the OECD countries taken into consideration by this analysis have improvement rates well above 3%. Like in the 2010-2011 update, the OECD average improvement rate is lower than the values seen in most of the countries listed in Table 1 because of the higher importance and growth of the least efficient markets within this group of countries.

Fuel economy standards, and in particular the greenhouse gas and fuel economy CAFE standards of the United States, resulted in stronger fuel economy improvements between 2012 and 2013 with respect to earlier years. In the OECD, all the countries with high improvement rates have such standards in place.

The picture appears less homogeneous in the non-OECD, with some of the markets showing increases in the average specific fuel consumption of light passenger vehicles, and others showing fuel economy improvements. Some growing markets, especially in Asia (China is now the world's largest vehicle market), show very impressive 2-digit growth rates in terms of size. These areas are widely seen as the future of the automotive industry, and many manufacturers have focused their attention to them in recent years. With a limited number of long lasting fuel economy policies in place (China is the only non-OECD country – except European Union member States that are not in the OECD – where the enforcement of fuel economy regulations dates back to 2005, most of other fuel economy policies in the non-OECD were enforced after the year 2012) the average fuel economy of the non-OECD countries covered in this analysis is improving at a rate more than four times slower than in OECD countries, while the market size is growing twice as fast.

[3]The dark dots show the OECD and non-OECD averages. They were kept small for visualization purposes. For other data points, bubble size represents the new vehicle market size.

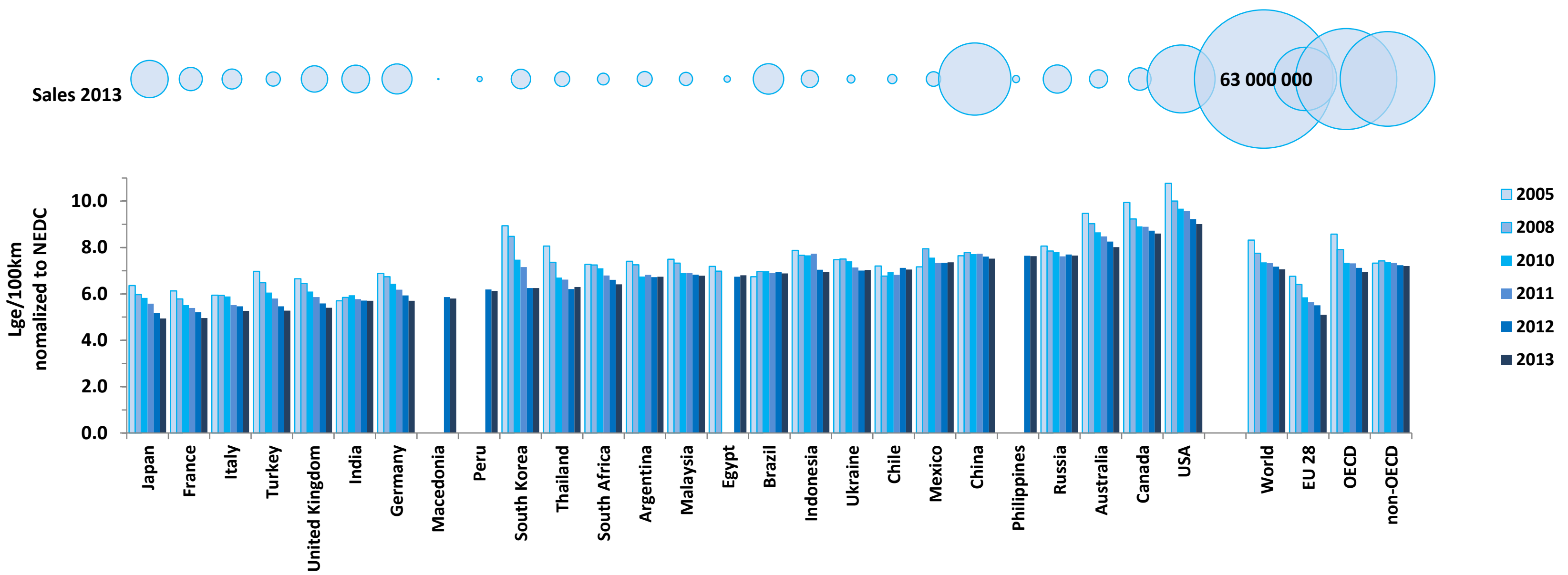
Table 1 • Market evolution between 2012 and 2013 - average fuel economy and market size

	Average fuel economy Lge/100 km		Vehicle sales thousands		Fuel economy improvement rate	Market growth
	2012	2013	2012	2013	2012 - 2013	2012 - 2013
Japan	5.2	4.9	4,572	4,562	-4.7%	-0.2%
France	5.2	5.0	1,861	1,756	-4.8%	-5.6%
Italy	5.5	5.3	1,396	1,287	-3.6%	-7.8%
Turkey	5.5	5.3	556	665	-3.4%	19.5%
United Kingdom	5.6	5.4	2,045	2,265	-3.3%	10.8%
Germany	5.9	5.7	3,082	2,952	-3.8%	-4.2%
Mexico	7.3	7.4	645	690	0.2%	7.1%
South Korea	6.2	6.3	1,255	1,242	0.0%	-1.1%
Chile	7.1	7.1	255	288	-1.0%	13.0%
Australia	8.3	8.0	1,053	1,079	-2.8%	2.5%
USA	9.2	9.0	14,051	15,094	-2.3%	7.4%
Canada	8.7	8.6	1,555	1,638	-1.4%	5.3%
OECD Average	**7.1**	**6.9**	**32,326**	**33,518**	**-2.5%**	**3.7%**
Macedonia	5.9	5.8	4	4	-1.1%	-8.3%
India	5.7	5.7	2,720	2,525	-0.2%	-7.2%
Peru	6.2	6.1	91	88	-1.0%	-3.6%
Thailand	6.2	6.3	657	732	1.4%	11.4%
South Africa	6.6	6.4	444	450	-2.9%	1.5%
Egypt	6.7	6.8	144	134	0.9%	-7.2%
Argentina	6.7	6.7	616	720	0.3%	16.9%
Malaysia	6.8	6.8	543	565	-0.6%	4.0%
Brazil	7.0	6.9	3,114	3,040	-1.0%	-2.4%
Indonesia	7.0	6.9	722	979	-1.4%	35.5%
Ukraine	7.0	7.0	218	204	0.4%	-6.3%
China	7.6	7.5	15,219	17,139	-1.1%	12.6%
Philippines	7.6	7.6	141	165	-0.1%	17.4%
Russia	7.7	7.7	2,736	2,586	-0.6%	-5.5%
Non-OECD Average	**7.2**	**7.2**	**27,368**	**29,330**	**-0.5%**	**7.2%**
World	**7.2**	**7.1**	**59,694**	**62,848**	**-1.6%**	**5.3%**

8-year evolution, 2005 to 2013

The way the data have been processed in this update, normalizing all markets to the NEDC test cycle for better cross-country comparisons, altered the 2005 to 2011 evolution. This makes the comparison with previous editions inappropriate. All non-OECD markets have adopted the NEDC test cycle (or a close adaptation of it, as in India) except Brazil, which has adopted the US FTP test cycle. In the OECD, test cycles are not homogeneously used. The US FTP is used in North America and South Korea, the NEDC is the cycle adopted in Europe, while Japan uses the JC08 cycle. This implies that the new methodological approach is affecting OECD countries to a higher extent than non-OECD countries. In general, a conversion from US FTP based fuel economy values to NEDC values is coupled with a 15% increase (in Lge/100km), while the conversion from JC08 based fuel economies to its NEDC counterpart leads to a 3.5% decrease.

Figure 2 • Average new LDV fuel economy by country normalized to the NEDC test cycle, 2005 to 2013



Key message • Most markets have improved since 2005, but there is still almost a factor of two between the most and least efficient markets[4].

[4]Due to market characteristics and data availability, Canada, USA and Australia include all light-duty vehicles bar vans; see Annex I. Macedonia, Philippines and Peru data are not available for 2005 and 2010.

The fundamental message resulting from earlier analyses purely focused on historical data remains unchanged: fuel economy in OECD countries is improving at a much higher rate than non-OECD countries (Figure 2). This is primarily due to a much wider implementation of fuel economy policies and the subsequent diffusion of fuel saving technologies in OECD countries, combined with the shift in consumer preferences towards larger vehicles alongside rapidly growing personal incomes in non-OECD economies.

The normalization to NEDC also affected the ranking: while the United States is now the country with the least efficient new vehicles within the sample, France has been overtaken by Japan on the other side of the scale.

The modest historical improvements in non-OECD markets are counterbalanced by remarkable progress that has been made with respect to the adoption of transformative fuel economy policies in the very recent past. Brazil (2012) implemented fiscal and regulatory instruments capable to reduce the average fuel consumption of vehicles, while major vehicle markets such as Mexico (2013), India and Saudi Arabia (2014) introduced fuel economy standards for passenger light-duty vehicles. This is expected to significantly change the fuel economy trends in the non-OECD countries in future updates of this analysis.

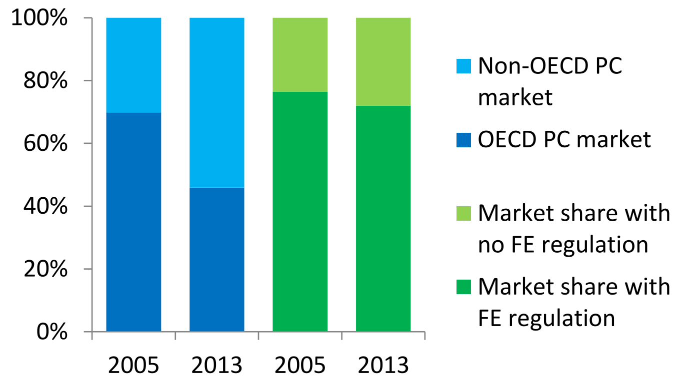
Market Analysis

The relative changes in the size of different markets have a very significant impact on the evolution of the global average fuel economy.

Light-duty vehicle sales increased globally by 5% between 2012 and 2013. The Asian market was the most dynamic, with two-digit growth in most ASEAN countries and in China.

2013 is the year when sales of road vehicles (including trucks and buses) in non-OECD countries exceeded those of the OECD (OICA, 2014a). For passenger cars, this was already the case in 2011. By 2013 the non-OECD passenger car market was almost 20% larger than the OECD market (Figure 3). The comparison with 2005 is striking and shows a major shift in the automotive market from OECD to non-OECD countries. This also impacts the share of passenger car markets regulated by fuel economy policies, which decreased from 2005 to 2013. Thanks to the recent (2014) measures taken in India and Saudi Arabia, this share is set to increase in future updates of this report.

Figure 3 • Market shares of passenger cars (PC) for OECD and non -OECD regions (Source: OICA, 2014b) and coverage with fuel economy (FE) standards[5]



Key message • The growing importance of non-OECD markets led to a decline of the share of markets covered by fuel economy regulations.

[5] Brazil, which adopted fiscal policies, is excluded from the list of countries with fuel economy standards. India and Saudi Arabia, which adopted standards in 2014, are also not included, as Figure 3 focuses on 2012 and 2013.

Evolution by vehicle size

Until 2010, the OECD market showed a trend towards smaller vehicles. The latest analysis shows a stabilization of sales shares of large vehicles, a growth in the medium-sized vehicle segment and a contraction of the small vehicle segment (Figure 4).

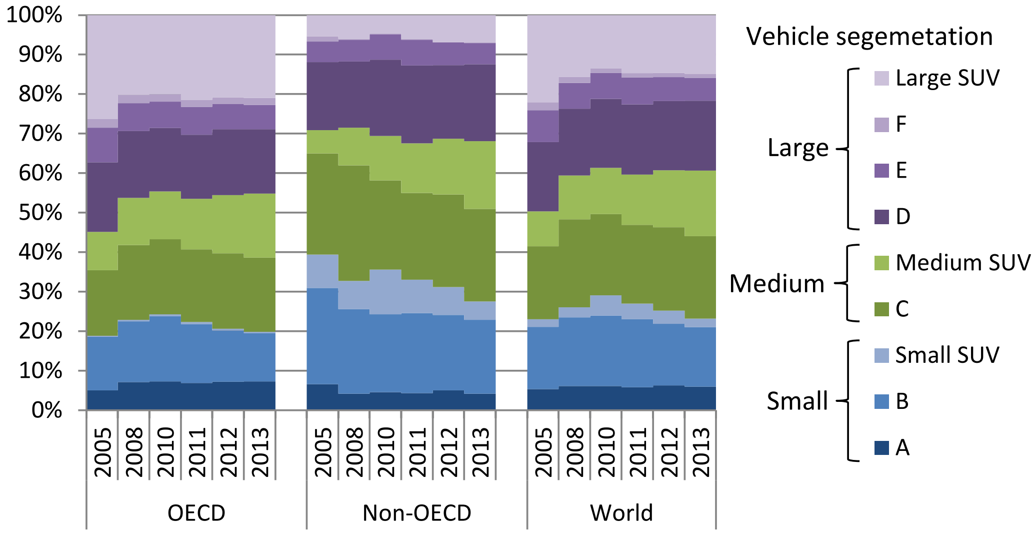
In non-OECD countries the share of large vehicles is still significantly lower than within the OECD and the shift in vehicle segmentation from small to medium vehicles is more pronounced than in the OECD.

Overall, the share of larger light-duty vehicles is stabilizing, with a constant market share increase for mid-sized sports utility vehicles (SUV).

The most plausible reason for the recent increase in the share of sports utility vehicles within the OECD is the growing importance of the North American markets, always characterized by much higher penetration of large passenger vehicles, and the influence of shrinking markets in Europe and Japan.

The evolution of consumer preferences, in line with rapidly growing income is the main explanatory element behind the increasing sales of larger vehicles in non-OECD countries. Here, the higher market diversification also plays a significant role with respect to the size shift: more and more models are available over all segments as developing markets grow.

Figure 4 • Vehicle size evolution, major regions, 2005 to 2013



Key message • Globally, a trend towards medium sized vehicles is gaining momentum.

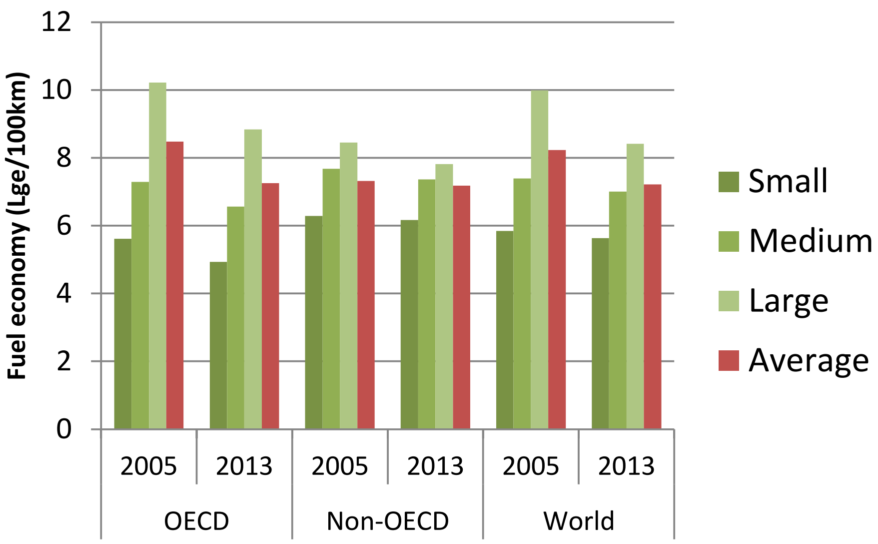
Size and weight shifts have a significant impact on fuel economy trends, as the average specific fuel consumption (in terms of energy per km) tends to increase with increasing average vehicle size and weight. Medium and large vehicle segments often show larger vehicle mass and frontal surfaces, requiring higher engine loads and hence higher fuel use to deliver similar performances (not to mention the better performances often offered by manufacturers on high-end models).

This effect can be offset by larger fuel economy improvements taking place on high-end segments (Figure 5). This can be explained by the higher average revenues made by vehicle manufacturers on high-end vehicle segments, justifying the earlier and wider deployment of fuel saving technologies on these models, and can have a positive impact on the evolution of the fuel consumption of the whole vehicle feet[6].

[6] High-end vehicle segments tend to be associated with larger margins for vehicle manufacturers. This justifies an earlier and wider deployment of innovative fuel saving technologies on these models. Technology learning, having

Overall, the large vehicle segment has improved the most over the eight years analysed, starting from 10.2 Lge/100km down to 8.4 Lge/100km. Large vehicles are the ones that are usually driven the most, so this is an important outcome when looking at on-road fuel economy improvements.

Figure 5 • Fuel economy trend by vehicle size, major regions, 2005 and 2013



Key message • Fuel economy improvements in large vehicles were more significant than in small ones.

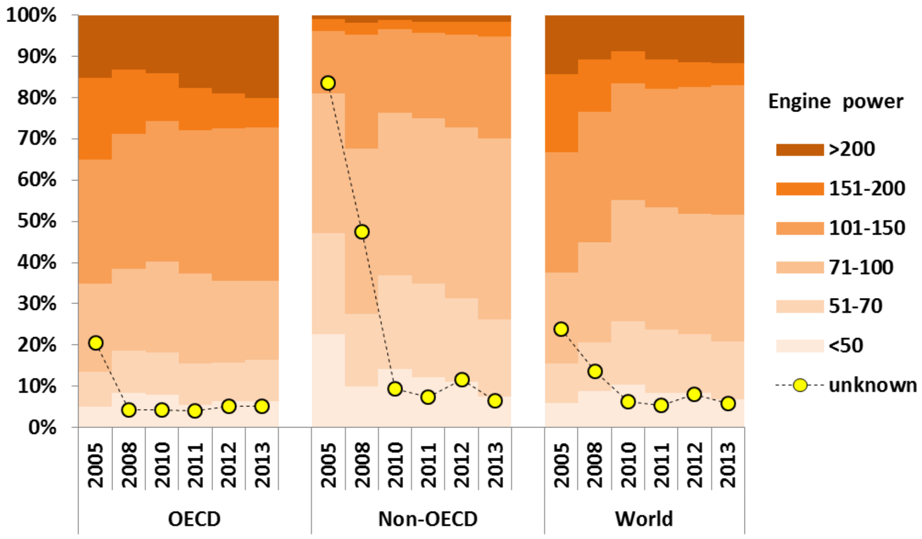
Evolution by power and engine displacement

Efficient technologies are not only used for the sole benefit of improving the vehicle's fuel economy. They are also very often used to increase refinement, power and/or performance of vehicles with a more limited fuel economy benefit. Demonstrating whether or not technologies are used to deliver fuel economy improvements is a challenging task. The evolution of engine power is a meaningful proxy to detect the impact of engine technologies on improved vehicle performances.

Figure 6 shows the evolution of vehicle shares by engine power. The results show a recent trend reversal towards more powerful vehicles within the OECD. Again, this is mainly due to market shifts towards the North American region. Figure 6 clearly indicates that non-OECD countries require less average power than vehicles sold in OECD markets: more than 60% of the vehicles have more than 100 kW in OECD, when this share is only about 30% in non-OECD regions.

the capacity to reduce the unit cost of innovative solutions (e.g. via improvements in the manufacturing process), benefits the most from early technology deployments, as these lead to the largest cost reductions for newly deployed technologies. These cost reductions make innovations viable for a broader range of market segments and allow scaling up the deployment of fuel efficient technologies also in markets with a higher share of vehicles belonging to low-end segments.

Figure 6 • Engine power evolution for OECD and non-OECD, 2005 to 2013



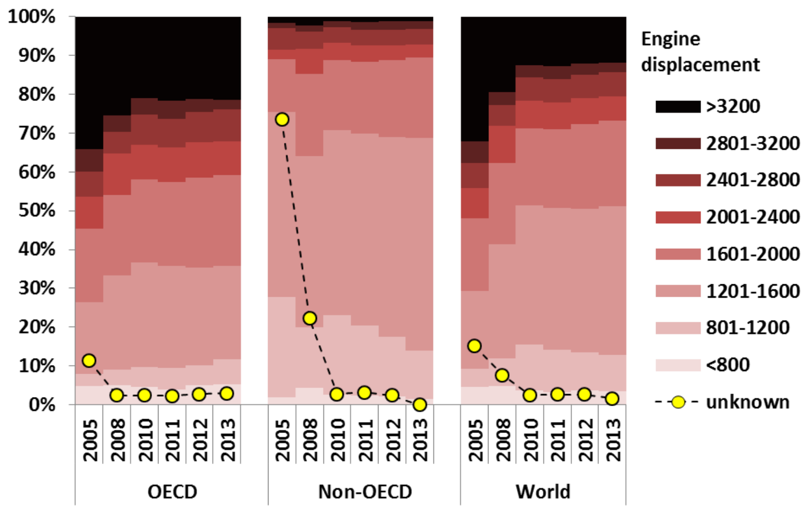
Key message • Globally, half of the vehicles are powered with less than 100 kW.

With the exception of small powertrains, engine size stabilized both in OECD and non-OECD after 2010 (Figure 7). Combined with the results of Figure 6, Figure 7 reflects the effect of engine downsizing, i.e. the deployment of internal combustion engine technologies allowing the delivery of higher power outputs per unit volume. More detailed analysis, however, is needed to grasp the impact of the deployment of downsized engines in the new light-duty vehicle market.

The stabilization levels of engine volumes are very different between OECD and non-OECD markets. In non-OECD countries, engines bigger than 2 litres have a low penetration of just below 10% in 2013, and show a slowly decreasing share. Roughly 20% of the engines in the OECD are above 3.2 litres, and more than 40% above 2 litres (Figure 7).

Globally, the size category between 1.2 and 1.6 litres is most popular, and has grown to almost 40% of the market in 2013. Engines below 1.2 litres are slowly growing in OECD regions as engine downsizing on small vehicle segments is gaining importance. In non-OECD, the same engine size category is sharply decreasing as car buyers are increasingly opting for larger and more powerful vehicles.

Figure 7 • Engine displacement evolution for OECD and non-OECD, 2005 to 2013

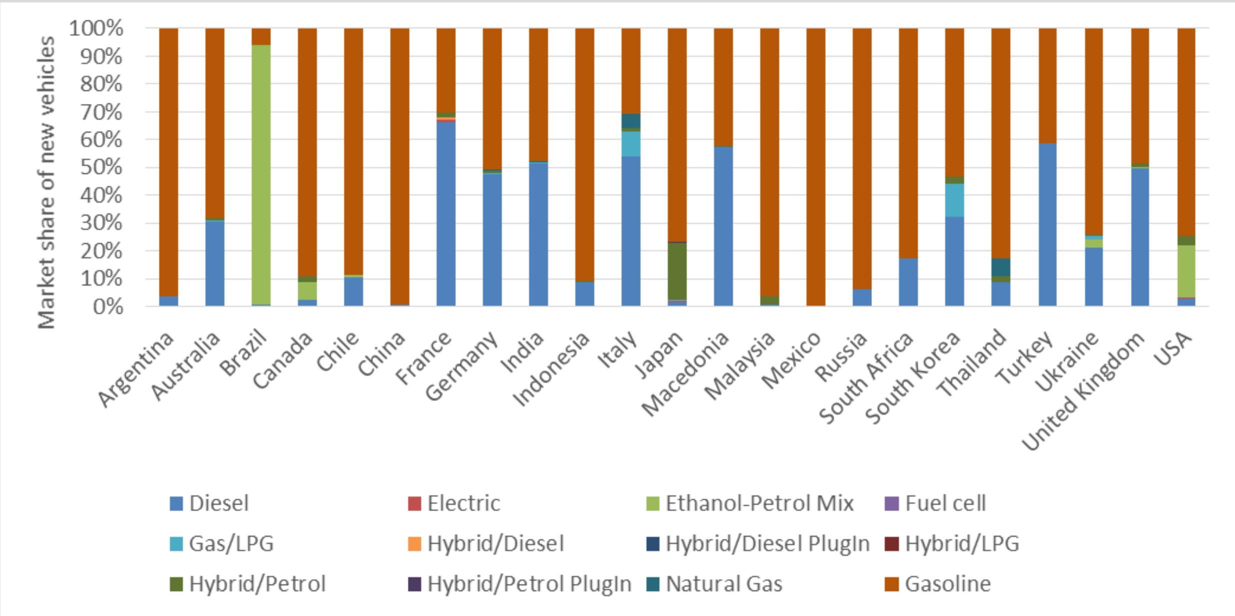


Key message • Big engines over 2 litres are not likely to become very popular in non-OECD regions, with their share already slowly decreasing.

Evolution by Fuel Type

Gasoline powered vehicles still dominate the global car market. Diesel engines lost market shares because the fast growing markets (e.g. China) are almost exclusively relying on gasoline cars. Places where non-gasoline vehicles have a significant market share usually had or still have a specific policy to deploy such alternatives, showing that with no specific policies, the competition with the gasoline powered vehicles for light-duty vehicle applications is challenging. Nevertheless, 10 markets of the 26 analysed are reporting diesel share over 30% (Figure 8).

Figure 8: New vehicles' market shares by fuel and powertrain type, 2013



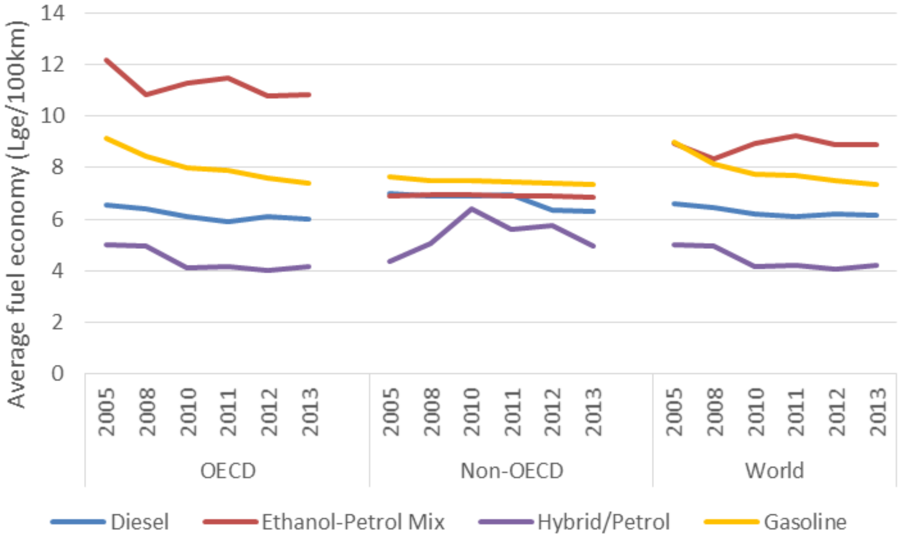
Key message • Region specific drivers led to heterogeneous powertrain choices in the main vehicle markets.

Diesel car models are very popular in Europe and India, but are struggling to achieve significant shares in other regions. Some manufacturers are trying to unlock new markets for diesel engines to get back on the significant R&D investment, spent during the last decades to get diesel engines to comply with pollutant emission regulations.

Diesel fuel economy in non-OECD countries has been closer to the average fuel economy of petrol cars (Figure 9). This may be due to the fact that diesel vehicles are fitted with older technologies (making their energy efficiency saving gap smaller) or more frequently fitted to bigger cars (characterized by higher energy needs) than in the OECD region. Flex-fuel vehicles (FFVs) are much more efficient in non-OECD than in OECD countries, as the models available in the leading market in each of these regions (Brazil and the US, respectively) have very different characteristics with respect to power, size and engine displacement. In Brazil, FFVs are mainly small cars, whereas in the US, FFVs are mainly pick-ups and SUVs.

Globally the gap between diesel and gasoline cars is getting smaller (Figure 9), with the strong effort towards engine downsizing now hitting petrol engines in most markets, and diesel engines being fitted more and more frequently on premium cars, because of the rising diesel powertrain cost and the higher average vehicle mileages of high-end segments.

Figure 9: Average Fuel Economy by fuel type, 2005 to 2013



Key message • Globally, hybrid cars are the most efficient vehicles showing an average fuel consumption of 4Lge/100km.

Box 1: Tested versus on-road Fuel Economy

This report uses tested fuel economy to derive average fuel economy of the new vehicles. Recent evidence (ICCT, 2014a) has shown that the gap between tested fuel economy and real-life on-road fuel economy has grown substantially in the latest years, with manufacturers optimizing their vehicles to get a better performance on the test cycle. Indeed, fuel economy labelling, and CO_2-based vehicles taxes are now common in many OECD countries, making the tested fuel economy value a key parameter to be taken into account by consumers when considering a vehicle purchase. Legal actions for false fuel economy ratings are being pursued in some countries (Altroconsumo, 2014). In some cases, car manufacturers had to compensate the car owner for the inaccurate fuel economy claims (EPA, 2013; Hyundai, 2013).

US EPA is publishing fuel economy values, which are higher than the laboratory value in order to correct the gap to reality to a certain extent, and UNECE has recently adopted a more representative new test cycle (World Light-duty vehicle Test Cycle –WLTC) that is likely to gradually substitute the NEDC and JC08 in the coming years.

Conclusions and recommendations

This new edition of the “International comparison of light-duty vehicle fuel economy” report now includes the normalization of fuel economy values to a common test cycle (NEDC). This improves the cross-country comparison of average fuel economy of new vehicles and also leads to more robust average fuel economy values within the regions.

Looking purely at historical developments, this analysis re-emphasizes the conclusion of earlier reports (GFEI, 2011 and GFEI, 2013) that **the global average fuel economy is improving, but not fast enough to be on track to reach the 2030 GFEI target**. The historical trend has not significantly evolved since the last update. As a result, the gap to reach the target value is getting wider. As of 2014, the annual improvement rate needed to meet the GFEI target is up from 2.7% to 3.1%.

Recent policy developments show very substantial progress and offer encouraging signs for what will be reported in future updates of this analysis. Further encouragements come from the fact that a large number of countries have already achieved this rate over the past years.

The gap between OECD fuel economy improvement rates achieved to date and the GFEI target, as well as the weaker fuel economy improvement observed in non-OECD economies, indicate that meeting the GFEI target requires:

a) to keep scaling up the market coverage of fuel economy regulations;

b) to set strengthened fuel economy improvement targets for the 2015-2030 period (especially in the non-OECD);

c) to monitor the stringency of fuel economy improvement targets already in place;

d) to keep monitoring the developments of fuel economy worldwide.

Annex 1. Data and methodology

Similarly to earlier analyses (GFEI, 2011 and GFEI, 2013), this report builds on information obtained from IHS Polk databases, combined and crossed with additional information extracted from technical sources.

The IHS Polk databases contain information on the amount of vehicles registered at the model level, as well as a number of complementary characteristics (e.g. driven wheels, engine volume, engine power, valves per cylinder, fuel type, transmission type, turbo, empty weight, fuel economy, CO_2 emissions per km).

The technical sources (listed in table A1) report information on the model characteristics in different global markets.

Crossing the information contained in these sources leads to the generation of a multi-year enhanced database that is the source of most of the results shown in this report.

Table A1 • Data sources used to enhance the original IHS Polk databases

Country	Source
Australia	Green Vehicle Guide Factsheets
	http://www.greenvehicleguide.gov.au
Brazil	Programa Brasiliero de Etiquetagem
	http://pbeveicular.petrobras.com.br/TabelaConsumo.aspx
Chile	Comparador de Autos
	http://www.consumovehicular.cl/?q=comparador
China	轻型汽车燃料消耗量通告 **通告日期**
	http://chinaafc.miit.gov.cn/n2257/n2280/index.html
France	Consommation conventionnelles de carburant et émissions de gaz carbonique
	http://www2.ademe.fr/servlet/getDoc?cid=96&m=3&id=52820&p1=00&p2=12&ref=17597
Japan	**自動車燃費一覧**
	http://www.mlit.go.jp/jidosha/jidosha_fr10_000019.html
Mexico	Indicadores de Eficiencia Energética y Emisiones Vehiculares
	http://www.ecovehiculos.gob.mx/
Singapore	One Motoring Fuel Cost Calculator
	https://vrl.lta.gov.sg/lta/vrl/action/pubfunc?ID=FuelCostCalculator
South Korea	소비자 체감에 부합하는 새로운 연비표시 방법 확정
	http://bpms.kemco.or.kr/transport_2012/main/main.aspx
South Africa	COMPARATIVE PASSENGER CAR FUEL ECONOMY AND CO2 EMISSIONS DATA
	http://www.naamsa.co.za/ecelabels/
Switzerland	Automobil Revue catalogue
	http://katalog.automobilrevue.ch/
UK	Car Fuel Data Booklet
	http://carfueldata.direct.gov.uk/
US	DoE / EPA Fuel Economy ratings
	http://www.fueleconomy.gov/

Three new countries have been added to the analysis: Macedonia, Peru and the Philippines. Additional information on the countries supported by the GFEI in their baseline setting work is expected to become available in future editions of this report.

The 26 markets included in this analysis represent more than 80% of worldwide LDV sales in 2013, and close to 90% when all monitored EU countries are included. With the multiplication of models available in developing markets, the database developed by the IEA based on the Polk data now holds over half a million records.

Some changes in the methodology have been performed for this update. The definition of passenger cars has been refined: passenger cars now include all pick-ups and SUVs but exclude commercial vans in the US, Canada and Australia, where this kind of vehicles represents a significant share of the market. In other markets, the default classification available in the original Polk dataset has been adopted.

Furthermore, the fuel economy information has been normalized to a single test cycle, so that countries can be compared to each other in a more rigorous way than in previous editions. This also improves the accuracy of sales-weighted regional averages. Each fuel economy record has been attributed to the test cycle – NEDC, FTP, JC08 or their derivatives - see Table A2.

Table A2 • Type approval test cycle by country

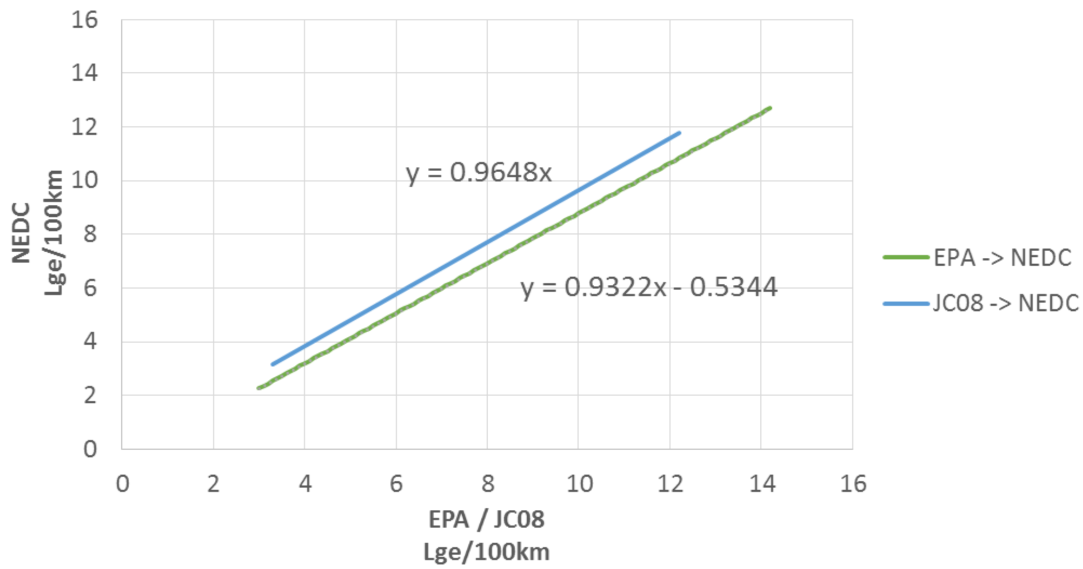
Country	Test cycle	Country	Test cycle	Country	Test cycle
Argentina	NEDC	Brazil	FTP-like	Japan	JC08
Australia	NEDC-like	Canada	FTP		
Chile	NEDC	Mexico	FTP		
China	NEDC-like	South Korea	FTP-like		
Egypt	NEDC	USA	FTP		
EU	NEDC				
India	NEDC-like				
Indonesia	NEDC				
Macedonia	NEDC				
Malaysia	NEDC				
Peru	NEDC				
Philippines	NEDC				
Russia	NEDC-like				
South Africa	NEDC				
Thailand	NEDC				
Turkey	NEDC				
Ukraine	NEDC				

Given the dominance of NEDC globally and the lack of available data on the conversion to the newly developed World Light vehicle Test Cycle (WLTC) at the time of the analysis (the ICCT published a study that addressed this point only in late 2014 – ICCT, 2014b), all countries have been converted to NEDC-equivalent fuel economy. The conversion was carried out relying on available conversion functions at the time of the analysis: ICCT, 2007 and JAMA, 2007. The conversion of fuel economy values published by the US Environmental Protection Agency (EPA) into NEDC – a case not covered by existing approaches, required the development of a cycle conversion function and was performed in sequential steps. EPA on-road estimates (www.fueleconomy.gov) were first converted, using a regression on the sample of the 20 top selling vehicles of the United States, into US FTP equivalents for city and highway cycles. This allows removing the correction for the "on-road" gap factor included in the EPA values. The resulting city and highway converted values were then used to calculate the combined US FTP equivalent. The latter was normalized to NEDC, using the function developed by the ICCT (ICCT, 2007).

Similar models, which are sold in countries covering all three test cycles, were identified to check the conversion factors. To do so, it has been assumed that those vehicles have similar engine calibration regardless of the country they are sold (or that the changes in calibration are part of the test cycle optimization strategy, hence to be included into the conversion factor).

The conversion factors used to convert US EPA values to NEDC as well as JC08 values to NEDC have a significant impact on average fuel economy, affecting the specific fuel consumption of individual models by almost 20% (Figure A1).

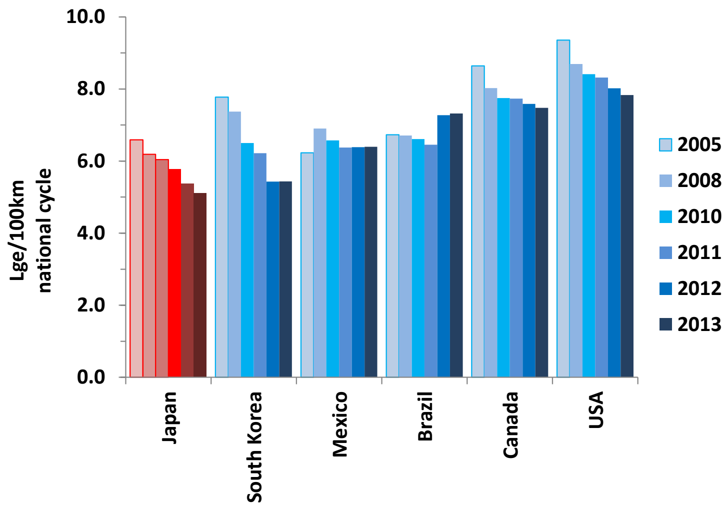
Figure A1: Linear correlation between EPA and NEDC, and JC08 and NEDC



Key message • JC08 is matching NEDC more closely than EPA values.

Figure A2 shows average new vehicle fuel economies prior to the NEDC normalization for countries included in Figure 2 of this report, which do not use the NEDC cycle. Differences are primarily impacting countries using the FTP cycle (Canada, Brazil, Mexico, South Korea and the United States) and Japan, which uses the JC08 test cycle.

Figure A2: Average new LDV fuel economy in selected countries before the NEDC normalization, 2005 to 2013



Key message • Vehicles markets based on the FTP cycle see the biggest change when normalizing to NEDC.

Acronyms and abbreviations

GFEI	Global Fuel Economy Initiative
IEA	International Energy Agency
UNEP	United Nations Environment Programme
ICCT	International Council on Clean Transportation
LCV	Light commercial vehicle
LDV	Light-duty vehicle, the sum of LCV and PLDV
PLDV	Passenger light-duty vehicle
CO_2	carbon dioxide

Units of measure

Lge/100km	litre-gasoline-equivalent per 100 kilometre
gCO_2/km	gram CO_2 per kilometre

Acknowledgements

This publication was prepared by the Directorate of Sustainable Energy Policy and Technology (SPT) of the International Energy Agency (IEA). Pierpaolo Cazzola coordinated this activity. François Cuenot carried out the initial phase of the database development and worked on an early draft of the analysis. Alexander Körner and Pierpaolo Cazzola were in charge of the refinement of the work performed on the database and drafted the current report.

Reviewers included Drew Kodjak and John German of ICCT, Sheila Watson of FIA Foundation, Rob de Jong of UNEP, and Lew Fulton of University of California, Davis.

The FIA Foundation provided funding for the development of this work.

References

Altroconsumo, 2014, Scopri il rimborso che puoi chiedere partecipando alla class action, http://www.altroconsumo.it/landing/rimborsocarburante/acnws

EPA (United States Environmental Protection Agency) (2014), EPA Investigation Prompts Carmaker to Correct Inflated Mileage Claims, http://www.epa.gov/fueleconomy/labelchange.htm

GFEI (Global Fuel Economy Initiative) (2013), International comparison of light-duty vehicle fuel economy: An update using 2010 and 2011 new registration data www.globalfueleconomy.org/Documents/Publications/wp8_international_comparison.pdf

GFEI (2011) International Comparison of Light-Duty Vehicle Fuel Economy and Related Characteristics, IEA, Paris, www.globalfueleconomy.org/Documents/Publications/wp5_iea_fuel_Economy_report.pdf

Hyundai (2013), Litigation Resolved After Fuel Economy Restated, https://hyundaimpginfo.com/news/details/hyundai-resolves-litigation-following-restatement-of-fuel-economy-ratings/

ICCT (the International Council on Clean Transportation) (2007), Passenger Vehicle Greenhouse Gas and Fuel Economy Standards, http://www.theicct.org/passenger-vehicle-greenhouse-gas-and-fuel-economy-standards

ICCT (2014a), From laboratory to road: a 2014 update, http://theicct.org/laboratory-road-2014-update

ICCT (2014b), Development of test cycle conversion factors among worldwide light-duty vehicle CO_2 emission standards, http://www.theicct.org/sites/default/files/publications/ICCT_LDV-test-cycle-conversion-factors_sept2014.pdf

ICCT (2014c), Global PV standards chart library, Global_PV_Standard_GHG_tailpipe_20140513.xlsx, http://www.theicct.org/global-pv-standards-chart-library

JAMA (Japan Automobile Manufacturers Association) (2007), Verification concerning ICCT conversion of the Japanese fuel efficiency value to its CO2 equivalent in Europe, http://www.jama-english.jp/europe/news/2007/no_3/ICCT_comment_by_JAMA.pdf

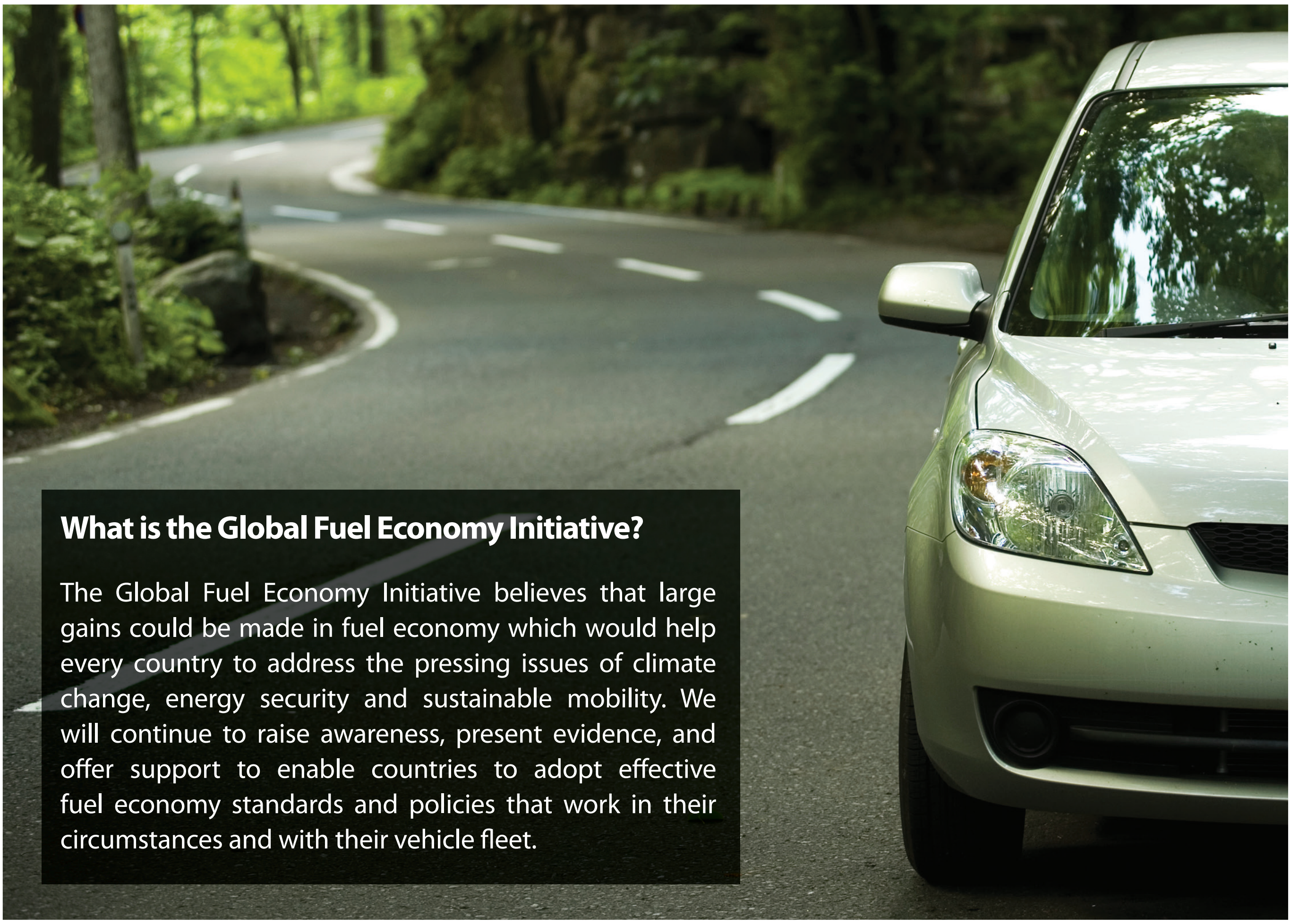
OECD (Organization for Economic Cooperation and Development) (2014), The Diesel Differential; Differences in the Tax Treatment of Gasoline and Diesel for Road Use, http://www.oecd-ilibrary.org/taxation/the-diesel-differential_5jz14cd7hk6b-en

OICA (International Organization of Motor Vehicle Manufacturers) (2014a), World Motor Vehicle Sales, All vehicles, http://www.oica.net/wp-content/uploads//total-sales-2013.xlsx

OICA (2014b), World Motor Vehicle Sales, Passenger cars, http://www.oica.net/wp-content/uploads//pc-sales-2013-June-2014.xlsx

GLOBAL FUEL ECONOMY INITIATIVE
www.globalfueleconomy.org

GLOBAL FUEL ECONOMY INITIATIVE
www.50by50campaign.org



What is the Global Fuel Economy Initiative?

The Global Fuel Economy Initiative believes that large gains could be made in fuel economy which would help every country to address the pressing issues of climate change, energy security and sustainable mobility. We will continue to raise awareness, present evidence, and offer support to enable countries to adopt effective fuel economy standards and policies that work in their circumstances and with their vehicle fleet.

Contact GFEI

Secretariat
Global Fuel Economy Initiative (GFEI)
60 Trafalgar Square
London
WC2N 5DS
United Kingdom

Tel: +44 (0)207 930 3882
Fax: +44 (0)207 930 3883
Email: info@globalfueleconomy.org
Web: globalfueleconomy.org

twitter.com/GlobalFuelEcon

#GFEINetwork

linkedin.in/I9ItFd2

GFEI Partners: