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International Energy Agency

International comparison of light-duty vehicle fuel economy: An update using 2010 and 2011 new registration data

Working Paper 8

FIA Foundation for the Automobile and Society

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ITS UCDAVIS INSTITUTE OF TRANSPORTATION STUDIES

François Cuenot

Alexander Körner

Executive Summary

In the first edition of this report, the main finding highlighted that global fuel economy improved by an average of 1.7% per year between 2005 and 2008, far below the required 2.7% annual improvement rate to reach the GFEI target of halving new light duty vehicle fuel economy (in l/100km or gCO_2/km) by 2030 (GFEI, 2011). New data analysis presented in this report highlights that the pace of improvement has slightly accelerated between 2008 and 2011, but at 1.8% annual improvement rate is still lagging behind the overall GFEI target (table ES1). Improving fuel economy from 8 Lge/100km to 4 Lge/100km between 2005 and 2030 required an average annual improvement of 2.7%. Given the slower rate of improvement between 2005 and 2011, average fuel economy from 2012 to 2030 needs to improve by 3% per year. Reaching this target at a global level is ambitious but appears achievable. For example, the enacted fuel economy standards around the globe require rapid annual improvements, up to 4.7%. Such improvement rates will hopefully become evident in future updates, but in any case many countries do not yet have standards. In particular, non-OECD countries have not been making sufficient progress towards better fuel economy over the 6-year period, and as non-OECD market growth is increasing much faster than OECD markets, most focus in the near future should be placed in helping non-OECD countries to develop and deploy more stringent fuel economy policies. OECD countries are on the right track but need to slightly accelerate the trend to meet the GFEI target in 2030, which will be more and more challenging as the target gets closer. The technical potential to reach the GFEI target has been demonstrated, but policies are needed to ensure these technologies are widely adopted in the mass market (IEA, 2012a and IEA, 2012b).

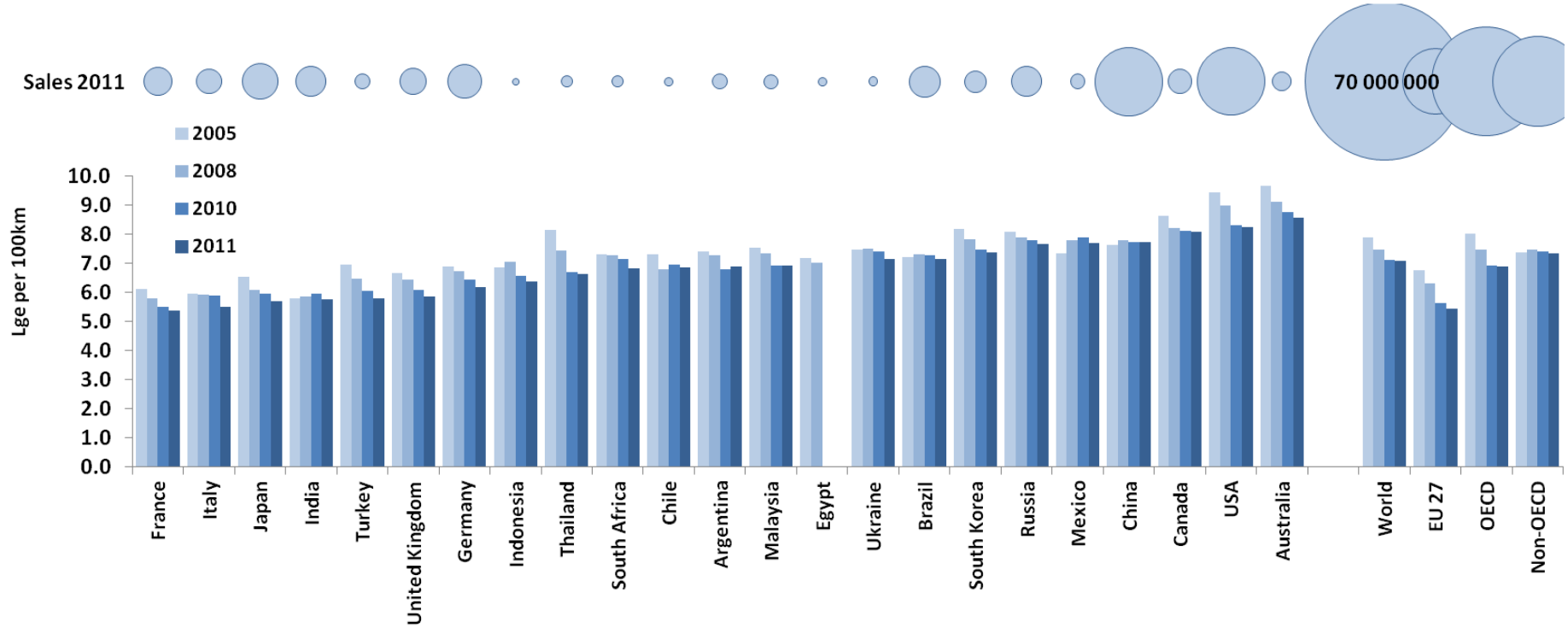
Table ES1 • Fuel economy evolution compared to GFEI target

		2005	2008	2011	2030
OECD average	average fuel economy (Lge/100km)	8.1	7.6	7.0	
	annual improvement rate (% per year)	-2.2%		-2.7%	
		-2.4%			
Non-OECD average	average fuel economy (Lge/100km)	7.5	7.6	7.5	
	annual improvement rate (% per year)	0.4%		-0.6%	
		-0.1%			
Global average	average fuel economy (Lge/100km)	8.0	7.6	7.2	
	annual improvement rate (% per year)	-1.7%		-1.8%	
		-1.8%			
GFEI target	average fuel economy (Lge/100km)	**8.0**			**4.0**
	required annual improvement rate (% per year)	**-2.7%**			
		2012 base year ⟶			**-3.0%**

Most countries covered in this analysis have shown continuous fuel economy improvement, and the global trend is towards improvement of average new light-duty vehicle fuel economy (Figure ES1). Tremendous progress has been made in recent years regarding the interest, development and deployment of fuel economy policies and related vehicle technologies. This trend nevertheless needs to be sustained and accelerated in the near future in order to reach the GFEI target of 4Lge/100km for the average new vehicle sold around the world in 2030.

As shown in Figure ES-1, the overall trend is encouraging, even though some countries are showing very limited progress over the 6-year period. The major non-OECD markets (Brazil, India, China) are working on fuel economy policies that should change this picture and provide results in the coming years. GFEI will pursue the tracking of average new vehicle fuel economy efforts. Data consistency and transparency still need to be improved to give a clearer picture of the worldwide average vehicle fuel economy and how it evolves over time.

Figure ES1 • Average new LDV fuel economy evolution by country, 2005 to 2011



Note: Due to market characteristics and data availability, Canada, USA and Australia include all light duty vehicles; see Annex I. Egypt data is no longer available after 2008. Canada and Korea are only available from 2010. Only the major EU markets are shown.

Introduction

The Global Fuel Economy Initiative (GFEI) has been tracking worldwide average fuel economy of new vehicles and how it has evolved since 2005 (GFEI, 2011). Between 2005 and 2008, the rate of fuel economy improvement was not fast enough to reach the long term goal fixed by the GFEI in 2030: the average global fuel economy of new light duty vehicles (LDVs) should be cut by half (in l/100km or gCO_2/km) by 2030. Have recent fuel economy policies developments accelerated the rate of improvement of new vehicle average fuel economy? This update containing new data analysis for years 2010 and 2011 sheds light on the latest improvement of new light-duty vehicle average fuel economy in most of the big markets worldwide.

Data and methodology

The data and methodology used to generate the updated results are identical to the first edition of this analysis (GFEI, 2011). New countries have been added to the analysis (Canada and Korea), in order to almost complete the G20 countries (only Saudi Arabia is missing). Egypt has not been updated after 2008, as data are no longer available. The 22 markets included in this update represent more than three quarters of worldwide LDV sales in 2011, and more than 80% if we include all EU27 countries for which average FE numbers are available. Thus the data capture only a sample of global sales, but a large and diverse sample, including most automobile-producing countries. As described in the previous report, other caveats include that the data are not from official databases for all countries (and are obtained by a third-party provider), and that the test procedures used are not the same for all countries, although they are the same in each country over time, and the EU NEDC is used for most countries; See Table 5 from GFEI (2011) for more details on this.

New light duty vehicle average fuel economy

Evolution by country

Latest evolution, 2010 to 2011

Between 2010 and 2011, global average new light-duty vehicle fuel economy improvement was about 0.5%, much lower than the 3% needed from now on to reach the 2030 target of average fuel economy of 4Lge/100km. A closer look at non-OECD countries reveals that they have improved at a higher rate than in the past, reaching 0.9%. In OECD countries, the improvement slowed down to only 0.5% compared to the 2.5% average annual improvement rate between 2005 and 2011. Looking at the individual country level, only Korea and Canada are showing rates below 0.5% (Table 1). This discrepancy between the strong improvements in individual countries and the weak improvement in OECD overall can be explained by market dynamics: on one hand the most efficient markets (e.g. EU, Japan) had significant reduction in their vehicle sales, and on the other hand, the least efficient markets (e.g. USA, Mexico, Chile to a lesser extent) had strong increases in their vehicle sales between 2010 and 2011. As different countries start from different fuel economy values in absolute terms, and the OECD market has seen more sales in countries with worse fuel economy during this time frame, the resulting average improvement was significantly slowed by this effect. Changes in vehicles sales from one country to another can

have a big impact on the weighted average for a region. No policies can easily address this issue and hence it is important that all markets converge towards a similar fuel economy target to avoid this market fluctuation effect. If all national sales number had evolved the same way, the improvement rate would have been of approximately 2.5%, much in line with the expected performance of the OECD region.

Table 1 • OECD markets evolution between 2010 and 2011, average fuel economy (measured as gCO_2 per km) and market growth

	Average emissions (gCO2/km)		Emission reduction rate	Sales evolution	
	2010	2011	2010 - 2011	2010 - 2011	
France	130.5	127.7	-2.1%	-2.1%	
Italy	132.7	129.5	-2.4%	-11.6%	
EU 27	140.3	135.7	-3.3%	-9.6%	Big Markets shrinking
Japan	140.5	134.4	-4.3%	-16.4%	
Turkey	145.2	139.3	-4.1%	16.4%	
UK	144.2	138.1	-4.2%	-4.4%	
Germany	151.2	145.6	-3.7%	8.8%	
Chile	163.7	160.8	-1.8%	22.4%	
South Korea	171.3	171.5	0.1%	0.6%	
Mexico	186.2	180.8	-2.9%	17.4%	
Canada	190.5	189.6	-0.4%	1.4%	Big Markets growing
USA	194.7	192.8	-0.9%	9.9%	
Australia	207.9	204.2	-1.8%	-2.6%	
OECD	165.1	164.3	-0.5%	-1.8%	

6-year evolution, 2005 to 2011

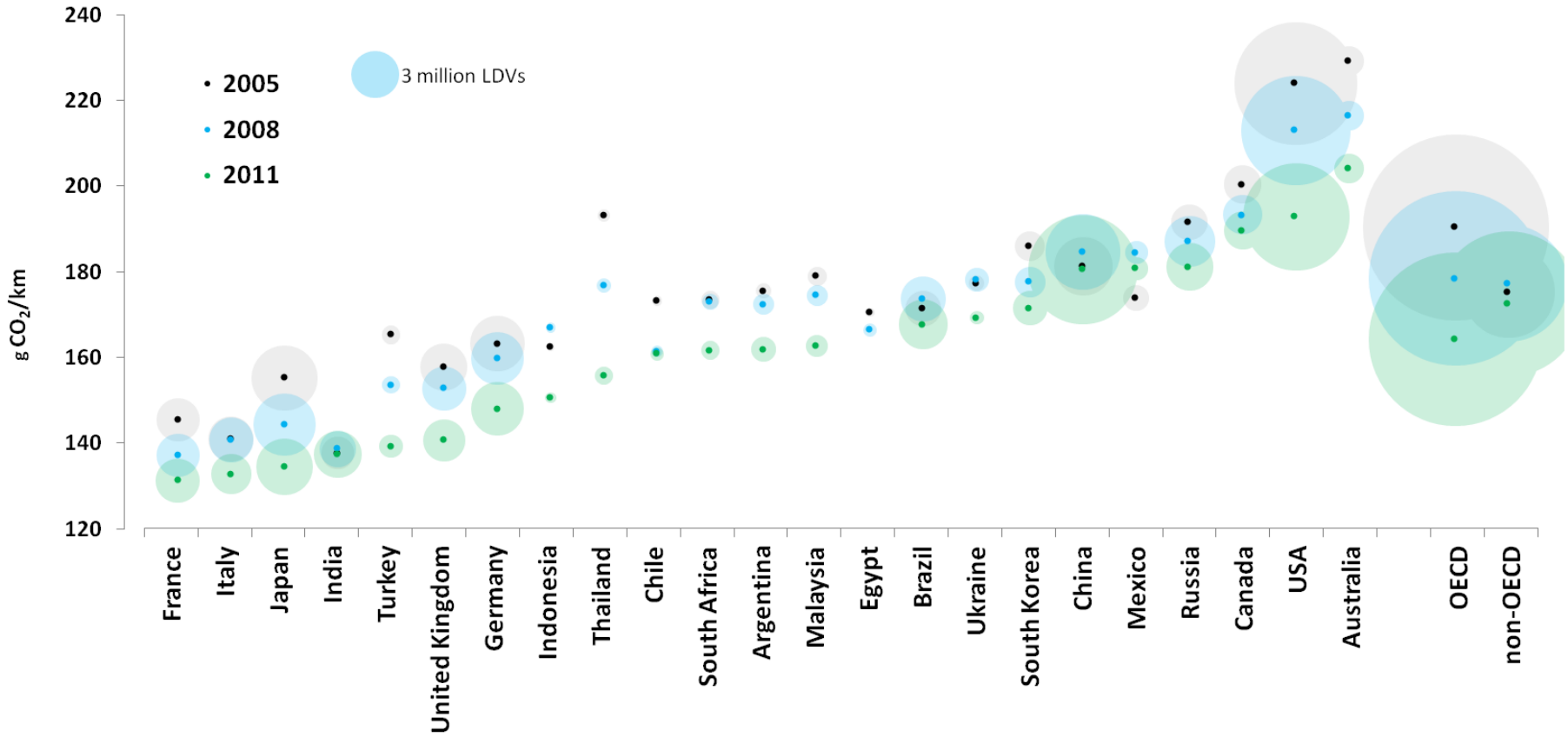
Between 2005 and 2011, most countries significantly improved their new light-duty vehicle average fuel economy (Figure 1). In addition, the LDV market has significantly changed, with non-OECD countries representing almost half of the global LDV sales in 2011, up from a third in 2005 (IEA, 2012c). Non-OECD new vehicle registrations will overtake the OECD new vehicle registrations by 2015 or sooner.

Of the 22 markets analysed, France is now the most fuel-efficient market, partly because of its high diesel penetration rate which accelerated since 2008, probably by the French feebate system introduced in January of that year. In 2011 the least fuel efficient country (Australia) is 55% worse than the most fuel-efficient country. Though this large difference is partly due to size mix of vehicles, it also reflects technology differences. In any case, it indicates that, for most countries, there remains a big margin for improvement.

Differences among countries can be partially explained by the fuel economy policies in place, and how these policies have been deployed over the last decade. The Fuel Economy Readiness Index

introduced in the Technology Roadmap on Vehicle Fuel Economy (IEA, 2012a) ranks each country depending on the level of implementation and stringency of the main fuel economy policies. Six out of the top seven fuel efficient countries analysed in this paper have the entire policy package in place to promote fuel efficient vehicles based on the Fuel Economy Readiness Index. The only notable exception is India where the final steps towards the introduction of fuel economy standard are being discussed but still fuel economy is among the top countries. This is mainly due to Indian vehicles being much smaller than in most other countries.

Figure 1 • Average new LDV fuel economy by country, 2005 to 2011



Note: Due to market characteristics and data availability, Canada, USA and Australia include all light duty vehicles; see Annex I. Egypt data is no longer available after 2008. Canada and Korea are only available from 2010.

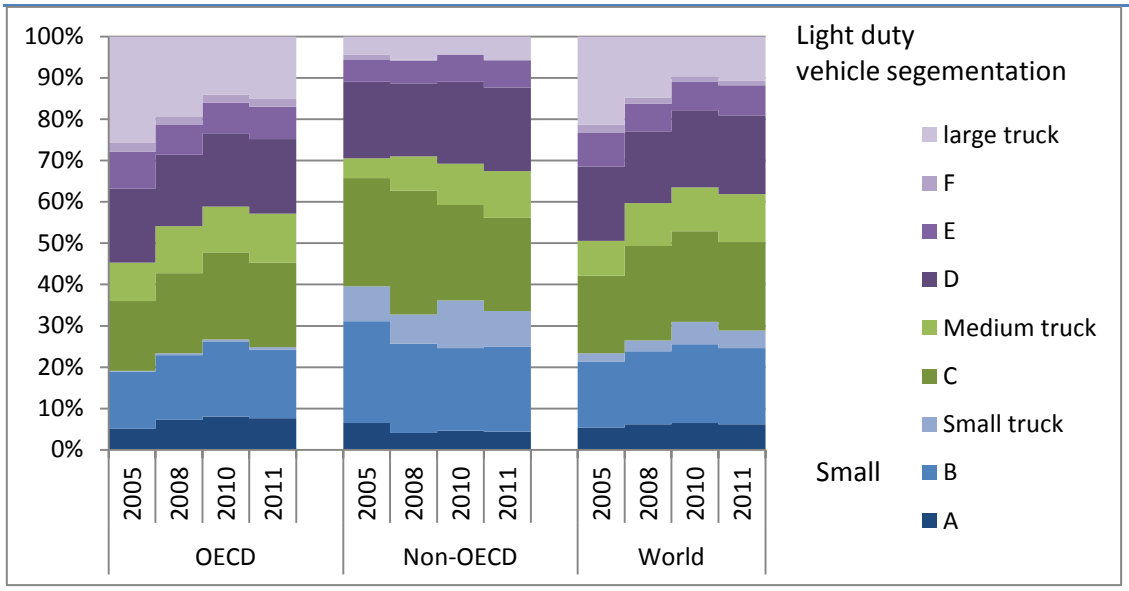
Key message • Fuel economy improvement has been continuous and significant between 2005 and 2011 for most countries. Some key non-OECD market have stagnated during the time period.

Evolution by vehicle size

Vehicle size is a key determinant of fuel economy, with weight and engine power also important, but closely related to the vehicle size itself. The data used in this analysis needed to be post-treated to assign each model to the appropriate vehicle segment (GFEI, 2011). The analysis shows that vehicle size has significantly evolved over the last six years (Figure 2). OECD countries started with much larger vehicles than non-OECD, but show a strong reduction in size over the time period. The slight rebound towards larger vehicles between 2010 and 2011 is mainly due to the fact that the US sales increased whereas the EU and Japan new vehicles' markets shrunk substantially in 2011. Still the overall trend is towards smaller vehicles.

In non-OECD countries, the opposite trend is present, towards bigger vehicles, together with higher penetration of light trucks (comprising SUVs, pick-ups, minivans and light commercial vehicles). Light trucks are often not very aerodynamic and are usually heavier than a typical passenger car, with bigger and more powerful powertrains. The global trend seems to indicate a convergence towards markets with approximately one-third small vehicles, one-third medium size vehicles, and one-third large vehicles. Whether this continues will be monitored in future updates of this analysis.

Figure 2 • Vehicle size evolution, major regions, 2005 to 2011

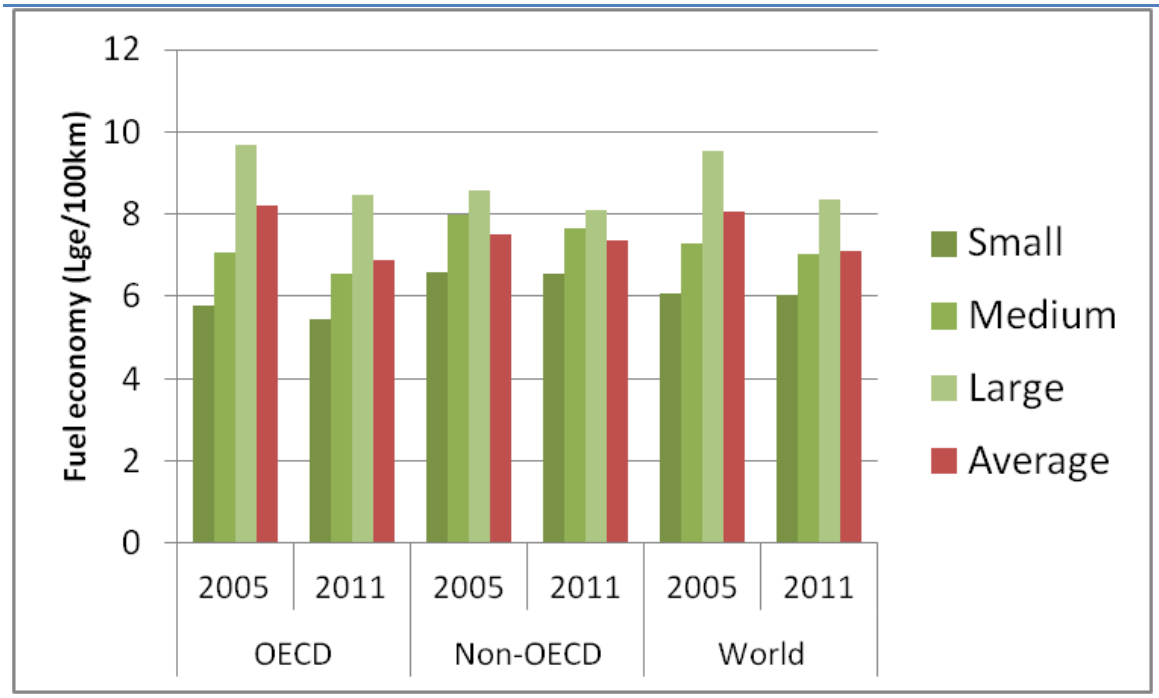


Key message • There seem to be a convergence towards equal partition of small, medium and big vehicles worldwide.

When looking at fuel economy evolution by vehicle size, the biggest fuel economy improvements have taken place among larger vehicles (Figure 3). In OECD, the combined effects of the individual vehicle size class improvements together with a trend towards smaller vehicles led to the significant overall improvement of 2.5% improvement per year over the six year time frame. In non-OECD countries, fuel economy in each of the individual vehicle size classes has only slightly improved, and this efficiency gain was then counterbalanced by a shift towards bigger vehicles. As a result non-OECD countries showed a near-constant fuel economy trend between 2005 ad 2011. However, large vehicles within OECD countries are still less fuel efficient than in non-OECD countries, suggesting that there is a size difference for large vehicles between OECD and non-OECD countries. On the other hand small vehicles in OECD countries are considerably

more fuel-efficient than in non-OECD countries, probably indicating that more advanced technologies are fitted in small cars in the OECD countries.

Figure 3 • Fuel economy trend by vehicle size, Major regions, 2005 and 2011



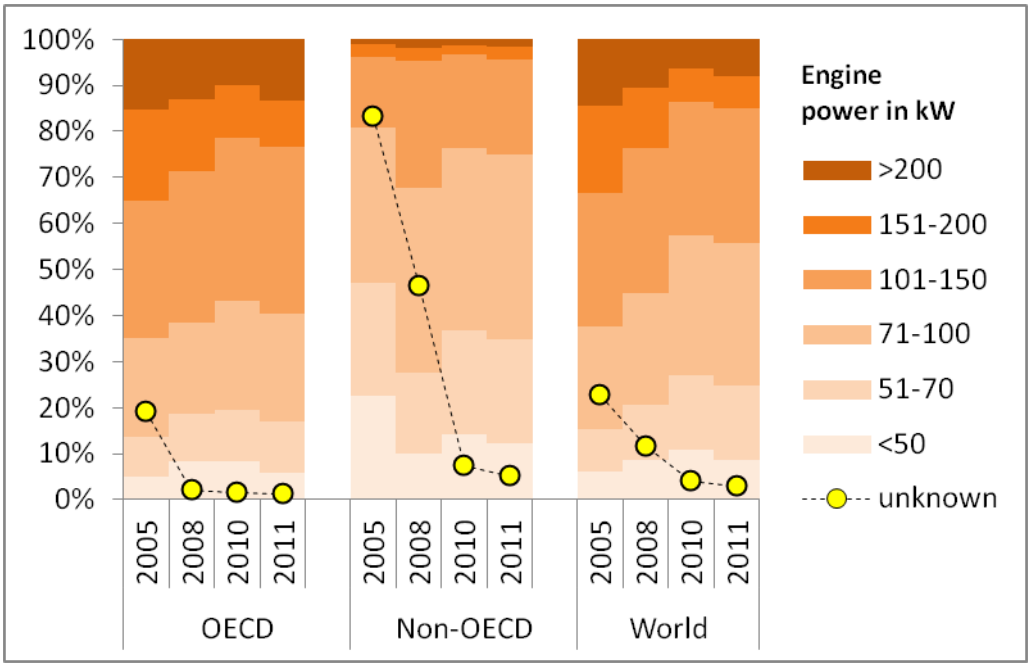
Key message • Larger vehicles have improved most in all regions, whereas small vehicle only made marginal progress globally.

Evolution by power and engine displacement

Engine displacement and power greatly affect fuel economy. Often it can be observed that both higher power and larger engine displacement have a negative impact on fuel economy.

Over the last six years, the analysis shows a strong increase in the share of vehicles with medium sized engines (between 50 and 100 kilowatt, kW) while the share of vehicles with large engines (above 150 kW) is decreasing (Figure 4). In non-OECD countries, the trend towards medium powered engines comes with a reduction in the sales share of cars with smaller engines (below 50 kW). In OECD countries, a slight increase in high power engines can be seen from 2010 to 2011, again mainly due to the market shift from EU and Japan to the US and Mexico. Comparing the OECD and the non-OECD market it is clear that the average new LDV in non-OECD countries has less power than in OECD countries. Whilst in non-OECD countries the share of vehicles with engines up to 70 kW is almost twice the share in OECD countries, there are almost no vehicles with engines above 150 kW whereas about 20% of the new vehicles in OECD countries have more than 150 kW engines.

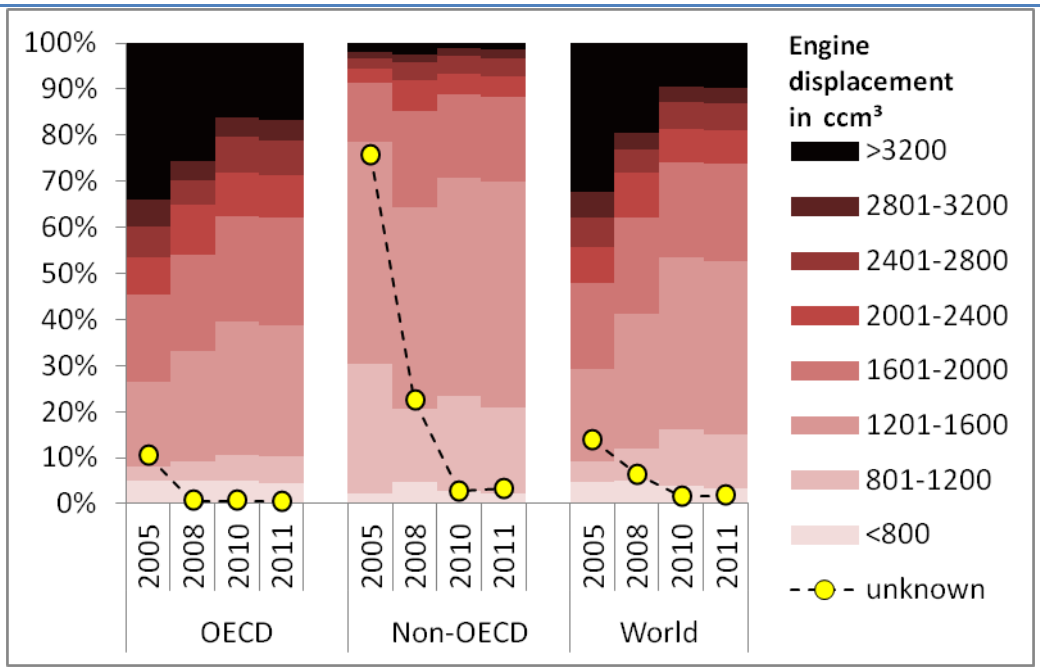
Figure 4 • Engine power evolution (market share by class)for OECD and non-OECD, 2005 to 2011



Key message • The market share of medium powered vehicles between 50 and 100 kW is increasing both in OECD and non-OECD countries.

A similar trend can be observed for engine displacement as for vehicle power. Globally cars with medium sized engines (1200 cm³ to 2000 cm³) saw a strong increase over the 2005 to 2011 time frame. In particular, vehicles with engines from 1200 cm³ to 1600 cm³ almost doubled their marked share (Figure 5). In OECD countries, vehicle sales with very large engines (above 3200 cm³) declined by around 50%. These vehicles are mainly sold in the US, Canada and Australia. As the light-truck share of light duty vehicle sales in these countries declined only a little over the last six years, the decrease in engine displacement comes from a general trend towards the use of smaller engines (though with more power per unit displacement). In non-OECD countries, a trend towards medium-sized engines can be seen and the vehicle share with engines below 1200 cm³ is declining. As for engine power the engine size difference between OECD and non-OECD countries is large: in non-OECD countries almost 90% of new passenger LDVs have engines below 2000 cm³, whilst this market segment accounts for only 60% of new vehicles in OECD countries.

Figure 5 • Engine displacement evolution for OECD and non-OECD, 2005 to 2011



Key message • The share of medium powered vehicles between 50 and 100 kW is increasing both in OECD and non-OECD countries.

Conclusion

The development and deployment of fuel-economy policies have accelerated in recent years and these have begun to bear fruit as evidenced by the 2005-2011 trends presented here, particularly for the OECD. Recent trends show improvement rates are getting closer to the required annual improvement of 3% per year that is now needed to reach the 2030 GFEI target of 4 Lge/100km. Recent trends will hopefully continue and indeed accelerate, as more policies take effect. The next report update will shed light on whether this is in fact the case.

Non-OECD countries, with few fuel economy policies, have shown very little progress over the 6-year period, though when looking closer, there seems to be a recent acceleration in the trend towards fuel economy improvement that will hopefully get more substantial in the coming years. The fuel economy policy agenda in non-OECD countries needs to be ambitious and cover not only the currently major markets, but all markets in order to anticipate the expected rise in vehicle sales in most countries in the coming years.

The set of fuel economy standards adopted in most major markets of the OECD should ensure significant progress in the coming years, particularly if current standards are continuously tightened. Moreover, improvements in the major manufacturing countries appears likely to pull the global car market towards wider fuel efficient technologies adoption that will help lead to a better worldwide average fuel economy.

The GFEI partners will carry on working with governments and industry to make sure there is strong support to promote the adoption of fuel efficient technologies in motorized road vehicles and that evolving policy frameworks show a strong commitment towards better fuel economy.

Acronyms and abbreviations

GFEI	Global Fuel Economy Initiative
IEA	International Energy Agency
UNEP	United Nations Environment Programme
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

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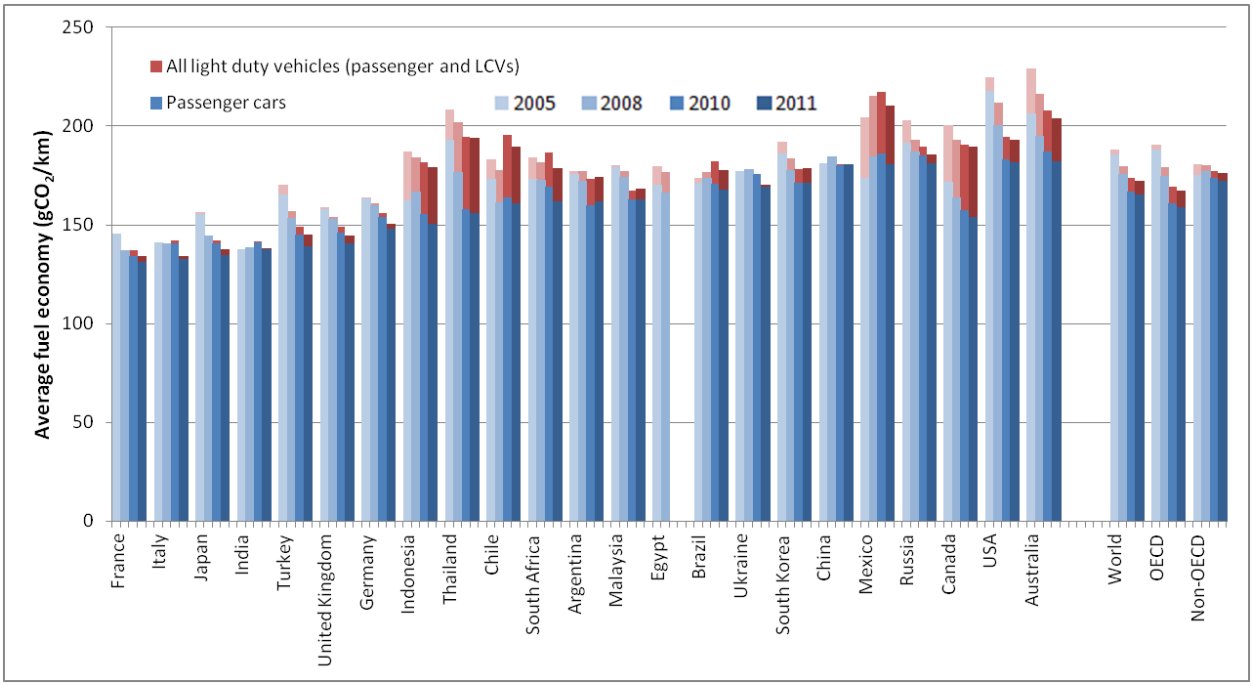
IEA (2012c), Energy Technology Perspectives 2012, IEA, Paris.

Annex I: Difference between passenger light duty and light commercial vehicles

In the database acquired to perform the analysis, Polk gmbh distinguishes “passenger cars” from “ light commercials” vehicles. For this exercise, more effort was put into the passenger car category, and only for Canada, the US and Australia were the light commercials included to calculate the new vehicle average fuel economy used in this analysis. This is due to the fact that Polk included most of the pick-up trucks that have a significant market share in those 3 countries into the light commercial category, whereas those types of vehicles, in those countries, are mostly used for individual passenger transport. The difference between considering only passenger cars or all light duty vehicles (passenger cars and light commercials) is sometimes substantial (Figure A1). Until now, the GFEI has mostly relied on the passenger car average for its analysis, but may consider all light duty vehicles in all countries in future editions, as light commercial vehicles (LCVs) are very similar vehicles, and it is often hard to distinguish the type of use (commercial, goods or personal transport), and they are becoming subject to similar fuel economy policies.

In other countries where the difference between passenger cars and passenger light duty vehicles was substantial, we have considered that those vehicles were mostly used for mass transportation (minibuses type vehicles) and goods transportation, and hence we have relied only on passenger car average values.

Figure A1 • Fuel economy trend by vehicle type, by country, 2005 to 2011



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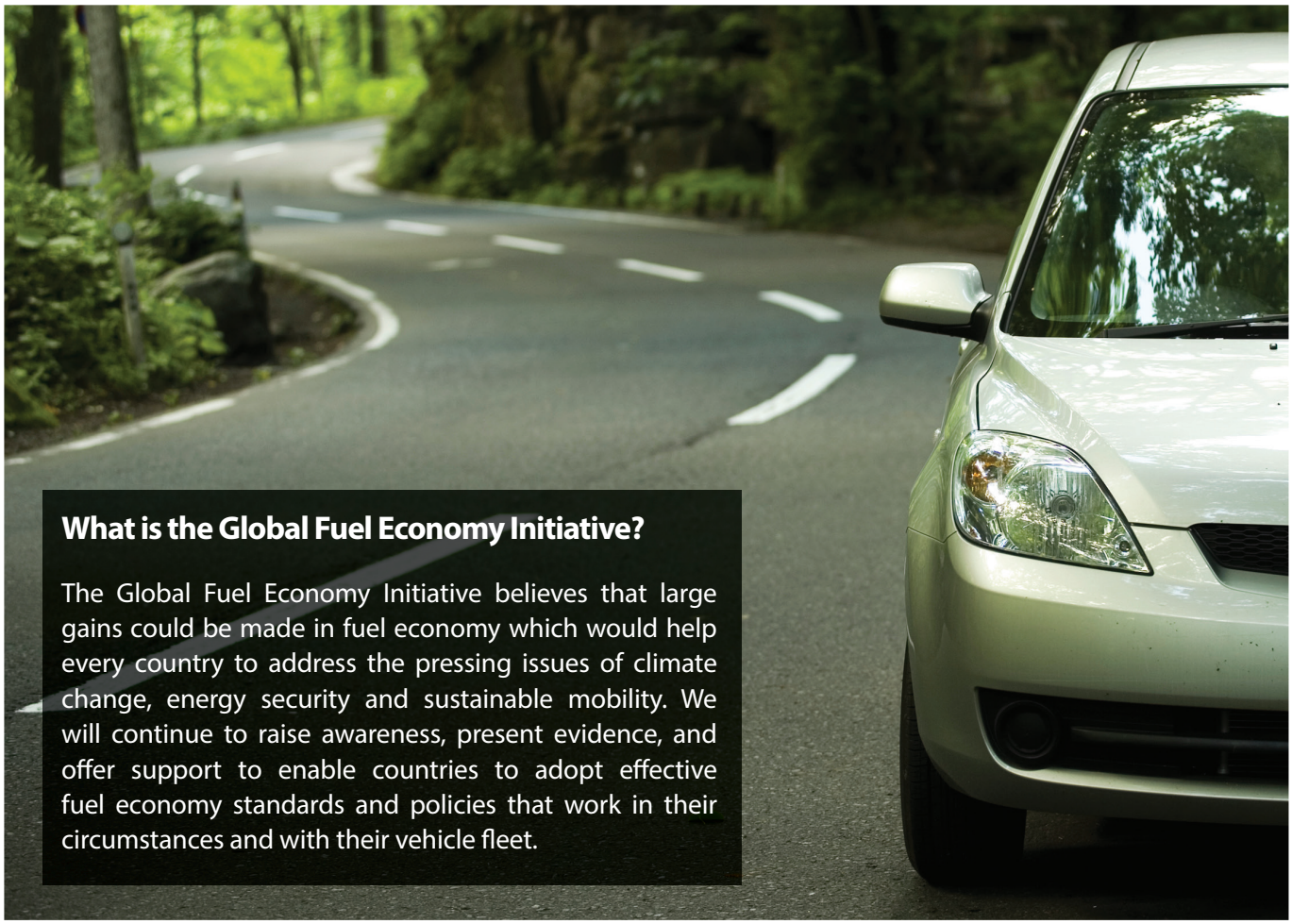

What is the Global Fuel Economy Initiative?

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

Sheila Watson,
Executive Secretary
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
globalfuelecon.blogspot.co.uk/
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