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Policy Handbook for the Regulation of Imported Second-Hand Vehicles

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Policy Handbook for the Regulation of Imported Second-Hand Vehicles

by

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2. Executive Summary

The international trade in second-hand vehicles has been growing very rapidly in the last decade. In 1997, the worldwide flow of second-hand vehicles was of 1.2 million units and had jumped to over 4.7 million just 10 years later. This trade has significant impacts for health, road safety, energy consumption and GHG-emissions.

For source countries, there might be a moderate reduction of GHG-emissions. At first glance, this might seem obvious, because bad quality vehicles are sold to other countries. However, many of these vehicles failed smog and road safety checks and could no longer be used according to environmental criteria, or their continue use would have been too expensive. The only alternative for these vehicles would be to scrap them, but now, there is the possibility of exporting them to countries with weaker regulations.

In destination countries, the importation of cheap ISV means more people can afford to purchase vehicles. Additionally, these vehicles are used for many more years (i.e., in the case of Mexico they already enter with an average age of 11 years). Some of them are used for up to 30 years. During the first 10 years of vehicle use fuel efficiency basically remains constant. In the subsequent years, when vehicles are exported and form part of its fleet, its fuel efficiency decreases at a growing rate. In particular, after 15 years in use it declines rapidly for most passenger vehicles, loosing up to half their efficiency over 25 years of use.

Therefore, the worldwide effect of the trade of second-hand vehicles across international borders is an increase in GHG- and criteria pollutant emissions, fuel consumption, and road safety problems. The following public policy recommendations are designed in accordance with international trade agreements. These recommendations are:

- **Border Inspection:** Border inspections, and environmental and safety certificates have significant advantages compared to other policy actions. Entrance barriers focus exclusively on ISV and do not affect the national fleet. Therefore, they are easier to implement and execute. In comparison to an Inspection and Maintenance program or a compulsory vehicle insurance program, entrance barriers need less time, less administration (including enforcement costs) and cause less public attention.
- **Scrapping Program:** A scrapping programme is a good complement to entrance barriers. Vehicles that fail border inspections or do not have environmental or safety certificates have a certain amount of time to comply with regulations. If they fail a second time, they are scrapped, thus eliminating the least fuel-efficient and safe vehicles from entering the national fleet.
- **Inspection and Maintenance (I&M):** This policy action represents another good complement to border inspections and entrance barriers. If well implemented, such programmes improve maintenance levels of the national fleet, encourage vehicle renewal, reduce emissions, and create jobs. They can however face significant resistance from the public, require specialized equipment, and require stringent enforcement.
- **Compulsory Vehicle Insurance:** Compulsory vehicle insurance is important because of the risk created by motorists for other traffic participants, and the danger borne by motorists to their own health and life. This danger of road accidents has to be internalized and compulsory vehicle insurance represents the perfect policy action to do so.

Based on the results presented in the study, it is highly recommended that countries implement a border inspection as a first step to dealing with some of the negative side-effects of older vehicles entering the national fleet through international trade.

3. Introduction

> "[f]urther aggravating the energy and environmental concerns of the expansion of motorization is the large-scale importation of used vehicles into the developing world."[1] (IPCC, Fourth Assessment Report)

The objective of the present study is to establish a series of policy actions that can be used to counteract the negative impacts of the trade of older vehicles across international borders. In order to achieve this, Chapter 4 will describe the international trade in second-hand vehicles and its evolution over the last years. This will include a description of source and destination countries, as well as a discussion of exceptions. It will also include a brief section on the elements structuring the international flow of vehicles, and will close with an overview of the effects of international agreements.

Chapter 5 explores the trade of second-hand vehicles between the U.S. and Mexico, which will be case study upon which the policy actions will be built. It includes an analysis of the impact of the North American Free Trade Agreement (NAFTA) on the trade of second-hand vehicles. It continues with a characterization of the world´s biggest exporting country - the U.S. – and continues with a focus on the world´s biggest import market -Mexico. The chapter will then discuss the main characteristics of the ISV fleet in Mexico, their impacts on the border region and for road safety, as well as establishing the BAU scenario upon which the policies will be evaluated.

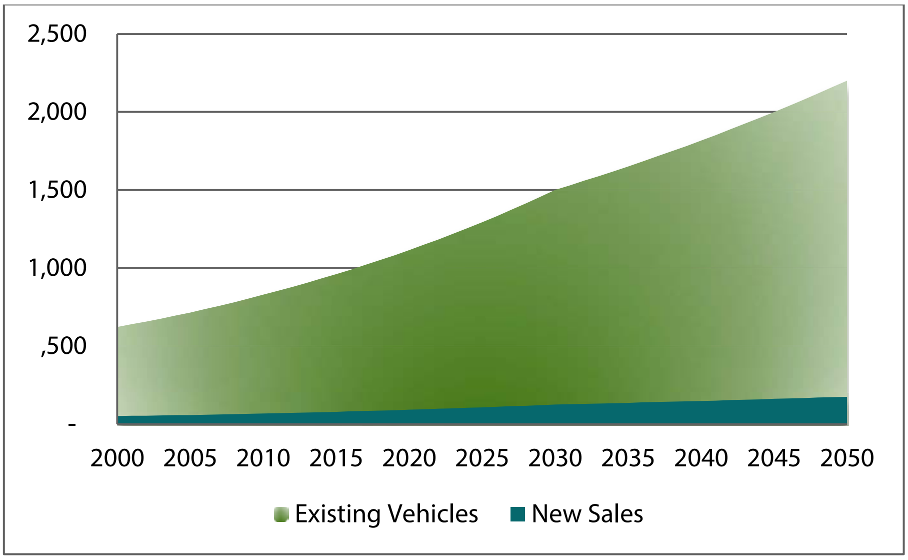
The sixth chapter offers an analysis of four different types of public policy actions that can be used to tackle the problem of imported second-hand vehicles (ISVs). These are: border inspection, scrapping, inspection and maintenance (I&M), and compulsory vehicles insurance. Finally, Chapter 7 presents the policy action conclusions.

[1] Ribeiro, K., et al.: Transport and its infrastructure. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the IPCC. 2007.

4. The growing flow of second-hand vehicles

Globally, the light duty vehicle (LDV) stock is increasing, and this is very important to transportation sector analyses. This tendency comes from the growing use of private vehicles as means of transportation. Graph 1 shows the worldwide sales trend and the evolution of the total private vehicle fleet.

Graph 1 World LDV stock divided by existing vehicles and new sales



Source: CTS Mexico with IEA estimates and projection (baseline scenario).

Between 2000 and 2050, IEA projections estimate that yearly sales of new vehicles will represent 8% of the total vehicle stock[1]. The previous Graph also reflects that new vehicle additions are higher than vehicle mortality, otherwise vehicles stock would not be growing in absolute terms. In other words, evidence and projection of a baseline scenario suggest a global trend of LDV accumulation.

Another issue arises when looking at second-hand vehicle trade trends: worldwide LDV accumulation is characterized by LDVs leaving the country of their original registration as they age. Figures 1 and 2, representing global flows of used cars for 1997 and 2007 respectively, were built from available data, mainly from Fuse, Kosaka and Kashima (2009), based on information from: the United Nation Database, Global Insight, Global Trade Information Service, local national trade statistics and Eurostat Database.

The volume of second-hand light-duty vehicles traded increased from 1.24 million in 1997 to 4.7 million units in 2007. This represents an average annual growth rate of 14.4% for the ten year period, but part of this might also be due to an improvement in data availability.

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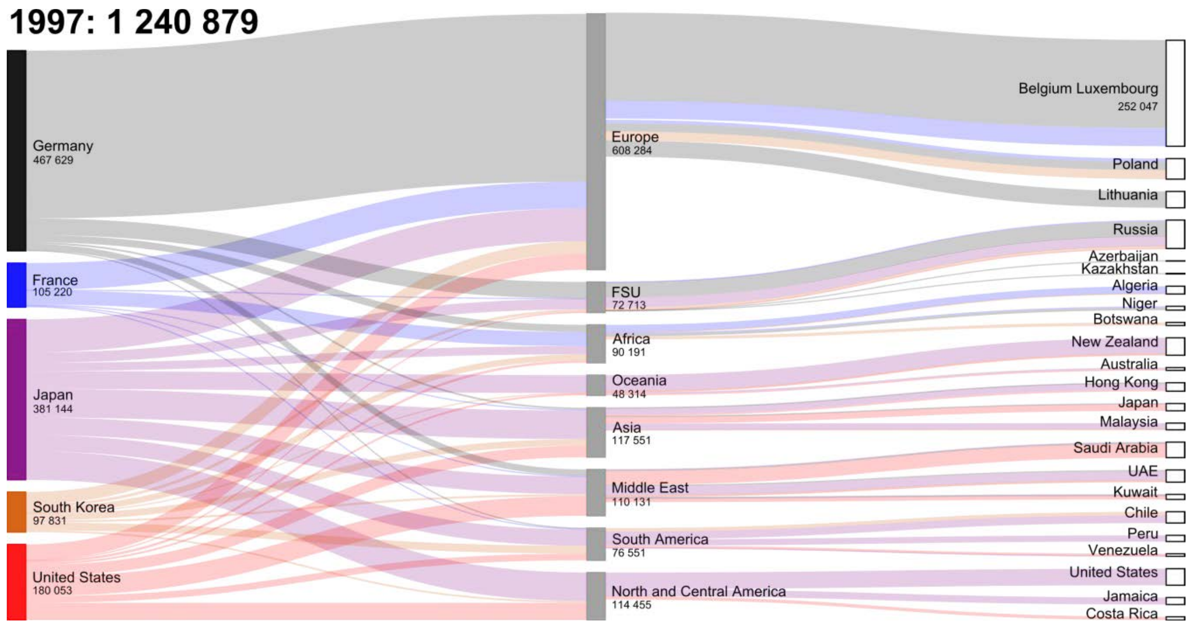
[1] IEA: Transport, Energy, and CO_2, 2009.

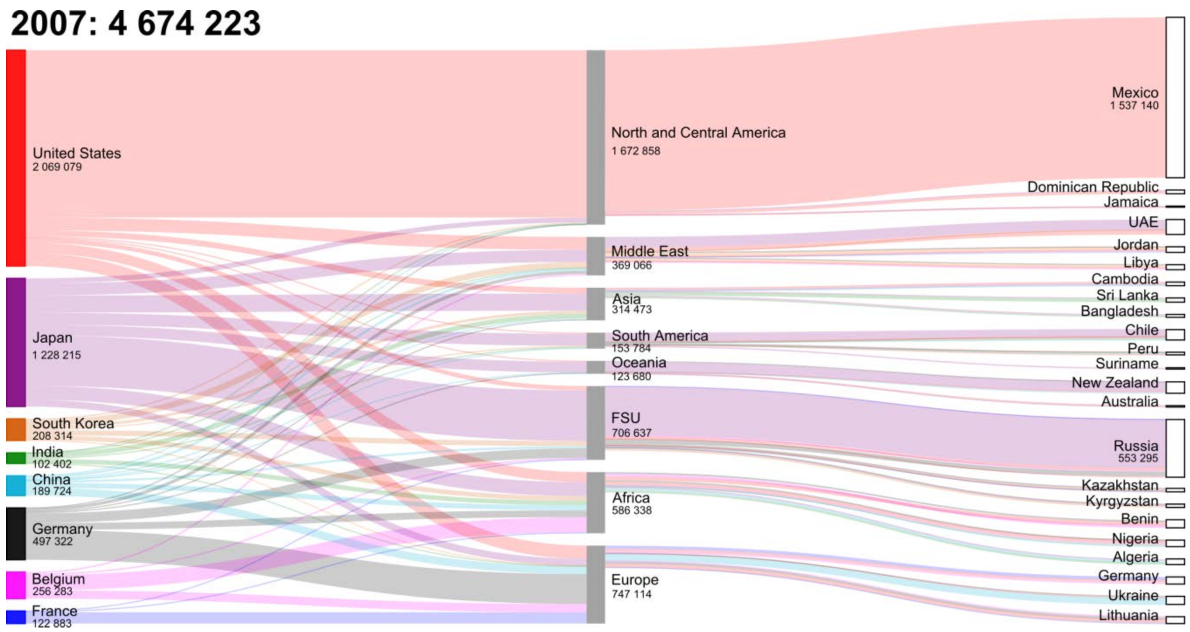
Figure 1 International Commerce of light-duty ISVs 1997



*** Note: Significant share of imports to Belgium-Luxembourg likely shipped to other EU countries or abroad.**

Source: CTS Mexico with information from Fuse, M. Kosaka, H. and Kashima, S., "Estimation of World Trade for Used Automobiles", 2009.

Figure 2 International Commerce of light-duty ISVs 2007



Source: CTS Mexico with information from Fuse, M. Kosaka, H. and Kashima, S., "Estimation of World Trade for Used Automobiles", 2009; and national data including re-calculation of US-Mexico flows from US and Mexican national data.

4.1. Overview of Exporting and Importing Countries

The data shown in the previous figures provides insight to characteristics shared by importing and exporting countries. Those similarities can be classified into three categories:

1. Income
2. Fleet characteristics, and
3. Vehicle pricing structure.

Looking at this information shows more typical second-hand vehicle exporting and importing countries. As will be seen, these factors have important influence on the survival rate of vehicles and the price differential between exporting and importing countries that allows for profitable trade in second-hand vehicles. This section also presents a review of countries, which, though atypical, have become exporting or importing countries.

4.1.1. Exporting Countries

Main income and fleet characteristics

According to a study by Dargay, Gately and Sommer "vehicle ownership grows relatively slowly at the lowest levels of per capita income, then about twice as fast as income at middle-income levels (from $3,000 to $10,000 per capita), and finally, as fast as income at higher income levels, before reaching saturation at the highest levels of income"[2]. Exporting countries have already passed the income segment at which vehicle ownership accelerates; thus, they are classed as high income countries. Their vehicle stocks are high, and vehicle ownership growth has stabilized. At the same time, because the population can afford to buy new vehicles, their new vehicle markets remain large. The fact that their vehicle ownership growth rates are not high reflects that a large share of new LDV will not add to their vehicle stock but rather replace older vehicles. The high rate of vehicle replacement creates a potential supply of older vehicle that can be sent to other countries.

Vehicle pricing structure

Typically, exporting countries present a vehicle pricing structure that tends to create a relatively high price for using a second-hand vehicle and that reinforces the tendency to generate a supply of vehicles for export. The first element that can be identified as creating this kind of pricing structure is the set of environmental, fuel consumption and road safety regulations. When consumers must meet regulations on pollution emission levels, safety requirements, and maintenance controls they must "spend" money to keep the car in optimal mechanical conditions. If instead of fuel subsides, there were fuel taxes, the cost of getting a new (fuel efficient) car goes down because of the savings that new technology can generate on fuel consumption. Hence, as a general rule, the existence of a complete set of strict regulations that internalize the costs of private vehicles will decrease the relative cost of new cars compared to older vehicles.

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[2] Dargay, J., Gately, D., and Sommer, M.: Vehicle Ownership and Income Growth, Worldwide: 1960 – 2030, the Energy Journal, Vol. 28, No. 4, 2007.

Since the regulatory environment will put pressure on consumers, they will demand the latest models and will be willing to pay for the newest technology to save on fuel expenses, and for devices that make the vehicle comply with the environmental regulations for longer periods of time. In a highly competitive market, automakers will have incentives to offer state-of-the-art technologies and innovations in order to get a higher share of sales. This reinforces the options that consumers have and increases the technological differences between new and older vehicles. In the end, the relative cost of new cars versus used cars goes down further and vehicle renovation rates increase.

Selected exporting countries

In 1997, the major second-hand vehicles exporting countries were the United States, Japan, Germany and South Korea. These countries represented about 90% of the volume traded. By 2007, the participation of these countries remained high, at 85% of total traded volume. Table 1 shows the main income and fleet characteristics for these countries.

Table 1 Information for Selected Exporting Countries

	2007 GDP per cápita PPP (constant 2005 USD)	Motor Vehicles per 1000 population	Motorization Growth (2002-2007)	New LDV sales 2007
U.S.	43,662	820	-5%	13,002,000.00
Japan	31,659	595	-1%	5,172,033.00
Germany	33,363	623	1%	3,369,932.00
South Korea	25,021	346*	4%	1,219,335

* 2008 data (2007 not availalbe).

Source: CTS EMBARQ Mexico, 2012. Data from World Development Indicators and national manufacturer association and Transport Ministries.

As can be seen, all of these countries have a relatively high income, their vehicle stocks show that a significant proportion of the population has a private vehicle and vehicle ownership growth is either low or negative. Still, they have a large new LDV market, which indicates a high rate of vehicle renewal.

In the case of South Korea, it is important to note that the income level in 2007 was lower than in the rest of the exporting countries. Correspondingly, their motorization was not as high as in the other countries presented (although still significant), nor was their motorization growth rate as low. Finally, although new vehicle sales may not seem as high in absolute terms, they were quite high when one considers that the population of South Korea was 48 million compared to Germany with 83 million and the U.S. with 300 million.

4.1.2. Importing Countries

Main income and fleet characteristics

Contrary to the situation in exporting countries, importing countries are at an income level where their vehicle stock is still small compared to their population. They are mainly low-middle income countries. Therefore, their vehicle ownership growth rates are either growing fast or poised to do so. New vehicle markets in these countries tend to be small to medium in relation to the population. This reflects the fact that an important part of vehicle demand is not being met by sales of new vehicle. This is logical since in low-middle countries it is harder for consumers to afford new vehicles. These conditions create incentives to import second-hand vehicles that are affordable to a larger segment of the population.

Vehicle pricing structure

In importing countries, the vehicle pricing structure is likely to create a relatively low cost of second-hand vehicle use and to strengthen the incentives to demand second-hand vehicles from other countries. This vehicle price structure is defined by the low or non- existent safety, environmental and fuel regulations. If consumers face no regulations, they have no reason to spend extra money to acquire a vehicle that meets minimum quality standards. Instead, consumers can choose freely among all the available options. Consumers are not obliged to invest in vehicle maintenance either. Hence, the cost of used cars decreases, which in turn increases the relative cost of new cars.

Selected Importing Countries in 2007

Importing countries are more numerous than exporting countries. Despite this limitation, regional relevance can be easily identified, with North and Central America as the largest importing regions (33% of the total), followed by Europe (16%), Former Soviet countries (13%), Africa (12%), Middle East (10%), Asia (9%), South America (5%) and Oceania (2%) in 2007. Mexico is clearly the premiere destination not only regionally, but globally in 2007. The incoming flow to Mexico accounted for 32% of total trade in 2007. Russia is the second biggest global importer with 12%. For the rest of the regions, the incoming flow is distributed among a higher number of countries. In the Middle East, Jordan and Saudi Arabia had a large share of the region's imports in 2007. In Africa the distribution was even more divided but Benin and Nigeria can be identified as interesting cases. The following Table shows some elements of income and main fleet characteristics for these countries.

Table 2 Information for Selected Importing Countries

	2007 GDP per cápita PPP (constant 20005USD)	LDV per 1000 population	Motorization Growth (2002-2007)	New LDV sales
Mexico	13,370	264*	6%	1,093,294
Russia	14,016	245	6%	2,341,628
S. Arabia	21,301	286**	2%	362,000
Jordan	4,840	137	9%	
Sri Lanka	4,007	58	7%	28,500
Benin	1,336	21	27%	
Nigeria	1,872	31	10%	79,700

*2008 (2007 data not available).

** The Economist Intelligence (World Bank data not available).

Source: CTS EMBARQ Mexico, 2012. Data from World Development Indicators and national manufacturer associations and Transport Ministries.

Most of these countries are still in the middle income range. The proportion of the population that owns a private vehicle is relatively low and new vehicle sales are not particularly high. Still, vehicle ownership is growing at a high rate, which shows that a large number of people are acquiring private vehicles, just not new ones.

The case of Saudi Arabia might seem strange because its motorization rate seems to be growing very slowly However, it is worth noting that its population growth was high (17%) from 2002-2007; which might help explain a lower motorization growth rate. Saudi Arabia is also different because vehicle ownership seems too high in comparison to other importing countries and its income level, which is high relative to the rest of the countries in the Table, would suggest the creation of a larger market for new vehicles rather than second-hand vehicles. This can be explained by the fact that Saudi Arabia has one of the highest gasoline subsidies in the world. Finally, Saudi Arabia has no taxes on ISVs, and the age restriction for second-hand vehicles that can enter the country is set very high: they have to be less than 25 years old.

4.1.3. Importing and Exporting Country Examples

Other exporters that appear in the flow chart are interesting case studies:

1) In 2007, France and Belgium represented about 8% of the total light-duty ISV out-flow, of which a significant share went to other European Union members. This reflects the intensity of trade in the euro zone, but it is hard to follow because there is no need to register private transactions within its borders. Therefore, despite the fact that Belgium is exporting an important volume to Africa, those vehicles can come from other euro members.
2) China and India recently became exporters of second-hand vehicles. Although the volume is still relatively low it is foreseeable that they will become important second-hand vehicle exporters. This is because they are becoming important car manufacturers with well-developed markets for new vehicles. As their populations reach a high level of motorization, new vehicle sales will probably account for vehicle renewal and this will in turn provide them with a larger potential second-hand fleet to export. For 2007, their exports already accounted for 6% of total trade.

3) Japan represents the most global player in the world´s second-hand vehicle market, by exporting to more than 160 countries in all continents. Japan's exports of second-hand vehicles are global because it poses a flexible distribution system, which systematically collects as many second-hand vehicles as possible from Japan and seeks sales to as multiple markets. Japan has historically been a trading partner for New Zealand, with trade between these two countries being mainly by sea. As vehicle maintenance costs were raised because of strict environmental regulations (such as the *shaken* system) in Japan, the trading infrastructure already built between Japan and New Zealand was modified to include second-hand vehicles. As the shipping system from Japan evolved, it allowed second-hand vehicles to reach many other markets. The development of this distribution system played an important role in the growth of second-hand vehicle flows. Indeed, there are websites that allow people from different countries to buy second-hand vehicles form Japan.

Just as in the case of exporting countries, the flowchart shows some interesting cases of importing countries. Three exceptional sets of conditions are present in the following cases:

1) In 1997, Belgium and Luxemburg appear as big importers for vehicles coming from Germany. As previously mentioned, the intensive euro-zone trading means that vehicles do not necessarily stay in these countries but rather later move into other European countries, which can in turn export them to other regions. This movement is not very clear in the 1997 flow-chart, but by 2007 Belgium and Luxemburg are importing second-hand vehicles, while Belgium is also exporting them, both to other European countries and to Africa.
2) Chile and the United Arab Emirates show a significant volume of ISVs in their regions. Both these countries belong to free trade areas: MERCOSUR (South Common Market) and Gulf Cooperation Council, as well as having trade agreements with Japan, which enables them to introduce vehicles to their continents and then distribute them to neighbouring countries. Therefore, Chile and United Arab Emirates can be seen as gateways for ISVs.
3) In 2007, New Zealand accounted for nearly all the ISVs of Oceania. However this country represents an exception with respect to other importers, particularly because of their income level. Hence the case should be treated separately.

4.2. Elements structuring international vehicle flows

The information presented in the flowcharts at the beginning of this chapter suggests that certain international conditions have created a global market for second-hand vehicles.

- The first of these conditions is the improvement of global distribution systems. An important condition for vehicles to move between countries is that sellers of second-hand vehicles must have direct or indirect access to a dealer that transports second-hand vehicles abroad or direct contact with the final consumer. This is more likely to occur in bordering states (i.e., trade within the EU) rather than in distant states.
- This is linked to a reduction of transport costs for second-hand vehicles, which includes the impact of free-trade areas, as well as regional and bilateral trade agreements.

4.3. International Agreements

4.3.1. Actions to regulate second-hand vehicle imports under WTO rules

The WTO provides a framework for negotiating and formalizing trade agreements. Regional Trade Agreements must be consistent with the WTO rules. Additionally, the WTO´s dispute resolution process shall be used by all members, if they believe fellow-members are violating trade rules.[3] In short, the WTO has an important influence on all regional trade agreements and on trade conflicts raised by the commerce of any good, among them second-hand vehicles.

According to Pelletiere and Reinert [4] it can be stated that strict trade restrictions on second-hand vehicles, enforced by many countries, were not GATT 1994 compliant. Consequently, these restriction policies have been subject to trade policy reviews and accession agreements. However, the fact that there are no significant consequences suggests that there is no significant opposition to these policies within the WTO. Moreover, there have been no enforcement actions and justification of several countries to impose restriction for safety, environmental, and corruption reasons have generally been used without penalties being imposed.

The grounds for discrimination against the importation of second-hand vehicles given by Latin American countries most often fall into one of two categories: 1. Safety and environmental concerns, and 2. Problems with valuation and protection against fraud and corruption. In most cases, a mix of these two arguments is used. In order to justify homeland protectionist policies before the WTO, Brazil´s representatives cited customs valuation concerns and the potential for fraud as well as: "*negative impacts for the environment and public safety arising from the commercialization of used consumer goods in the domestic market*" *CITA*. Brazil also pointed out that such policies were common to many WTO Members.

In addition, Ecuador made the claim that, due to domestic consumer preferences, there is little demand for second-hand vehicles in the country, and hence the ban should not be considered as distorting trade. The notion that trade in second-hand vehicles is trivial would seem to be an argument in opposition to restrictions not for them, and in any case the empirical evidence at this time – from the millions of smuggled second-hand vehicles in Mexico – suggested otherwise.

Colombia was more precise, citing Article XX (b) of GATT 1994, which allows general exceptions for countries to accomplish "non-economic" objectives including the safety and health of human, plant and animal life.

The principal categories of trade regulation are the following:

- **Taxes**: In most cases these are *ad valorem* tariffs. However, in some cases environmental tariffs which are also known as "green" tariffs or "eco-tariffs" were found.
- **Minimum mechanical and technical standards.**
- **Minimum environmental standards:** Some countries perform emission inspection for entering second-hand vehicles and failed vehicles are not allowed in the country. Another option is that the ISVs must meet certain environmental standards (i.e., Euro III)

- **Import quotas for ISVs (Prohibition and Restriction):** Import restrictions are practiced by many countries. In most cases they refer to a vehicle´s age. For example, some countries in North Africa prohibit the entrance for second-hand vehicles older than 3 years. Import prohibition for all second-

[3] See WTO: Understanding the WTO. In: http://www.wto.org/
[4] See Pelletiere, D. and Reinert, K.: The Political Economy of Used Automobile Protection in Latin America, 2002.

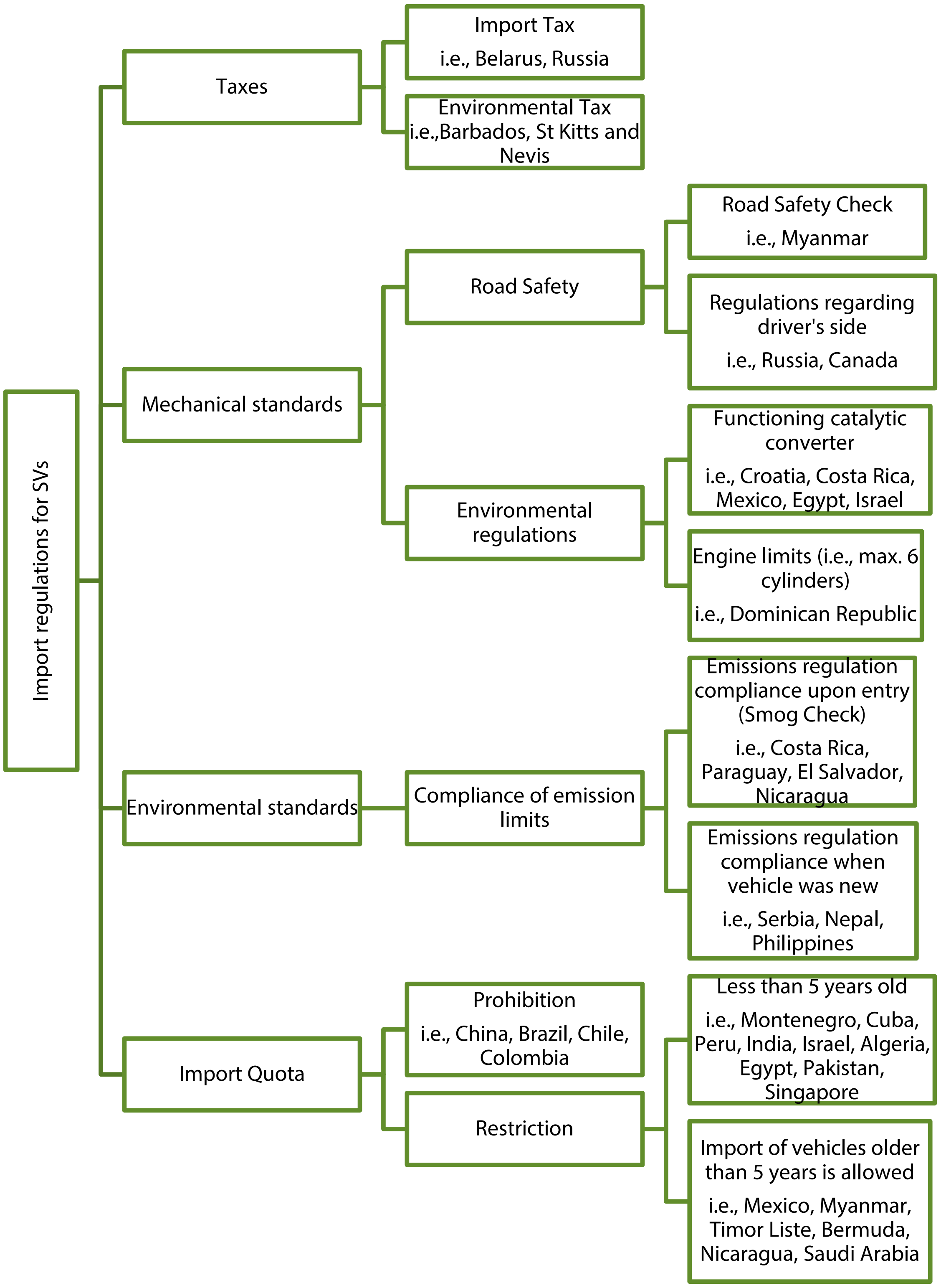
hand vehicles is the strongest political action a country can choose. China and Brazil are two countries that have a total prohibition on the entrance of ISVs.

Overall, regulations against the importation of second-hand vehicles are not unusual. In times of economic crisis – such as the economic crises in 2008 and 2009 –this might be even less surprising because of the enormous impact to the car industry. Pelletiere and Reinert published a study in 2004 establishing that, among 132 countries for which data are available, 74 have some kind of restrictions on the importation of second-hand vehicles.[5] Nonetheless, many of the actions taken by the different countries have proven to be less effective than could be expected, for example, due to poor implementation. The most popular import restriction refers to vehicle age limits.

Figure 3Figure 3 shows a categorization for the trade policy actions that are used to regulate the importation of second-hand vehicles through imposing rules directly on imports and countries that have used them.

[5] See Pelletiere, D., and Reinert, K.: Used automobile protection and trade: Gravity and ordered prohibit analysis, 2004.

Figure 3 Import Regulations for Second-hand Passenger Vehicles



4.3.2. Actions to regulate ISV´s in Free-trade areas

The development of free trade areas around the world has been an important element to structure specific flows of trade of all kinds of goods, including second-hand vehicles, within regions and partners. Nowadays, many different types of free trade areas exist with different levels of integration. Examples are Economic and Monetary Union (i.e., EU/Euro), Economic Union (i.e., CSME), Customs and Monetary Union (i.e., CEMAC/franc), Common Market (i.e., EEA, EFTA), Customs Union (i.e., CAN) and Multilateral Free Trade Area (i.e., NAFTA). Member states of the WTO (153 countries in 2010) are bound to notify the regional trade agreements in which they participate. Almost all of the WTO's member states have notified participation in one or more regional trade agreements. In the period 1948 – 1994, the GATT (General Agreement of Trade and Tariffs) received 123 notifications of regional trade agreements, and since the creation of the WTO in 1995, over 300 additional arrangements covering trade in goods or services have been notified.[6]

The level of integration of a free-trade area has implications on the policy space left for a government to impose trading restrictions and thus, on the treatment of used vehicle flows. However, even in the highest levels of integration, some rules can be set for the regulation of ISVs. In other cases, specific interests of the parties of a trade agreement have influenced a high degree of trade liberalization even when the level of integration of the type of agreement is not that high.

[6] See WTO: Regional Trade Agreements. In: http://www.wto.org/

5. Case Study: U.S.-Mexico Second-Hand Vehicle Trade

This chapter explores the trade of second-hand vehicles between the U.S. and Mexico. This trade has, for several years, been the highest volume worldwide. Understanding this case will aid the analysis for implementation of adequate policy actions to regulate the importation of second-hand vehicles. The first part of this chapter analyses the NAFTA and its impact on the trade of second-hand vehicles. It explains the global context of free trade areas and of policies implemented by some countries to regulate the importation of second-hand vehicles directly through implementing trading rules. It also describes Mexico´s actions, since 2005, to regulate the importation of second-hand vehicles and how these actions correspond to NAFTA guidelines.

The second part of this chapter provides a profound analysis of the main elements that have created the supply (U.S.) of second-hand vehicles. It describes the fleet´s main characteristics, some data on income, and the vehicle pricing structure in the U.S. It is important to understand what elements foster the supply of these vehicles. However, policy actions recommended in Chapter 7 concentrate exclusively on demand-side regulation.

The third part of the chapter focuses on the elements that create the demand for second-hand vehicles. It begins looking at the fleet´s main characteristics, followed by a deep analysis of income data in Mexico. Finally, it provides a detailed analysis of vehicle pricing structure in this country.

5.1. The North American Free-Trade Agreement

On January1994, NAFTA came into effect and immediately eliminated tariffs on many goods and established a timetable for tariff reductions on many others. For example, between Canada[7] and the U.S. restrictions for second-hand vehicles were immediately eliminated. Import restrictions for new vehicles were phased out by 2004, beginning immediately upon implementation of the agreement in 1994.[8]

Mexico chose a different way, which is mainly expressed in Paragraph 24 of Appendix 300A (2) of NAFTA[9]. Mexico agreed to a timetable under which restrictions would be eliminated in five phases beginning on January 1, 2009 and ending, with complete liberalization by January 1, 2019. Before 2009, Mexico was free to impose restrictions on ISVs.

The reasons behind the inclusion of Paragraph 24 of Appendix 300A (2) in the Treaty were economic considerations and not environmental ones. The central motive was the protection of the Mexican automotive industry. In order to secure sales of new vehicles originating from the Mexican factories, the "Big Three" (Ford, GM and Chrysler) - among other actors - pushed intensively for a clause that would prevent the importation of second-hand vehicles from Canada and the United States. It is important to recall that these three companies are US-based, and therefore the inclusion of the ISV regulation topic in NAFTA came more from North to South than vice versa. In addition to the Big Three, other vehicle producers in Mexico (Nissan, Honda, Toyota, Volkswagen and Renault) - which are generally represented through AMIA[10] (Mexican Association of the Automotive Industry) - are still in favour of import restrictions on second-hand vehicles.[11]

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[7] Canada has in NAFTA a similar appendix as Mexico in relation to Mexico but not to the U.S. See NAFTA: Annex 300-A.
[8] See Pelletiere, D., and Reinert, K., The Political Economy of Used Automobile Protection in Latin America, 2002.
[9] See Appendix 1
[10] AMIA (" Asociación Mexicana de la industria automotriz"):
[11] See for example AMIA. In: http://www.amia.com.mx/index.php (July, 2010).

Until 2005, Mexico implemented a general and strict import policy regarding second-hand vehicles. However, importing licenses for special cases were granted. For example, second-hand vehicles to be used for business could enter the country. Also, vehicles that were to be used in some border zones could be imported[12], as long as they were between 4 and 15 years old[13] Officially, they were not allowed to sell them outside these regions, though in reality many of these did get farther south.

The Mexican President Vicente Fox decided to open the border for vehicle importation in 2005, accelerating the deregulation process for a large share of second-hand vehicles (older than ten years). This action lacked an environmental justification, but had a social and political reason: in Latin America, and worldwide, there appears to be considerable popular pressure to open the market to second-hand vehicles. This is best illustrated in the case of Mexico, where the proximity to the U.S. second-hand vehicle market makes these particularly attractive.[14] Added to this, the fact that the second-hand vehicles reaching the Mexican market were the oldest ones also meant that they were the cheapest ones. Moreover, people prefer having a larger set of vehicle-acquisition choices, and this implies fewer trading restrictions.

In the case of Mexico, liberalization and legalization of second-hand vehicles has been a recurring political ploy. Mexican politicians have a long history of "regularizing" (legalizing or granting amnesty to) smuggled second-hand vehicles before elections. The issue came to a head in 1999 in a clash between the Mexican government and the Peasant Democratic Union over regularizing second-hand vehicles smuggled in previous years.[15] The then Minister of Trade and Industrial Development, Herminio Blanco, allegedly declared that the position of the government was clear and that Mexico would not regularize illegal vehicles. Even when exceptions were introduced for pick-up trucks that were at least ten years old, protests outside the Ministry of Finance grew. The issue spread throughout 2000 and became a discussion point in the presidential campaign. While the Mexican motor industry and the elected Fox administration opposed regularization of smuggled second-hand vehicles, they were defeated by the opposition-dominated legislature when it passed a bill allowing such regularization. Popular opinion in Latin America appears to support the free import of second-hand vehicles.[16]

President Calderon reinstated trade restrictions by mid-2008. This was to last until January 1, 2009, when NAFTA restrictions came into effect. On one hand, public opinion may be the initial factor to allow free import of second-hand vehicles. On the other hand, restrictions on imports of second-hand vehicles appear to be driven by political pressure from the new automobile production (both domestic and foreign). Also, the decision may have been a reaction to the exceptionally high numbers of ISVs from 2006 to mid-2008.

On December 24th 2008, the Mexican government introduced a decree[17] to establish condition for the importation of second-hand vehicles; it came into effect on January 10, 2009. The establishment of the decree responded mainly to the pressure created by the vehicle production and distribution associations (AMDA[18] and AMIA). The conformity of the decree with NAFTA is questionable, but as the U.S. and Canadian governments did not claim any prejudice, the Mexican government has not formally been obliged to justify this action. It imposes import duties on certain vehicles over 10 years old, 1% when they are between 5 and 9 years, and differential treatment for vehicles remaining in the border region or exiting it.[19]

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[12] Formally they were not allowed to sell them outside these regions, though in reality many of these did get further south.
[13] See Pelletiere, D., and Reinert, K.: The Political Economy of Used Automobile Protection in Latin America, 2002.
[14] See Pelletiere, D., and Reinert, K.: The Political Economy of Used Automobile Protection in Latin America, 2002.
[15] See Financial Times: Mexican Farmers Stand by Their Rattling Pick-ups, April 17, 1999.
[16] See Pelletiere, D., and Reinert, K.: The Political Economy of Used Automobile Protection in Latin America, 2002.
[17] Decreto por el que se establecen las condiciones para la importación definitiva de vehículos usados".
[18] Asociación Mexicana de Distribuidores de Automóviles
[19] See Decreto por el que se establecen las condiciones para la importación definitiva de vehículos usados, 2008 and 2009.

Another important effect of NAFTA is that, ever since the signing of the agreement, the legal system regulating the financial system was reformed in order to permit the entrance to financial intermediaries other than banks. These intermediaries were created with the purpose of developing financial entities that could be more specialized in certain sectors, and that could develop into specialized banks in the future. Three of the most important entities that were created were leasing companies, factoring financial institutions, and SOFOLs (Financial Societies of Limited Object)[20]. As described by the CONDUSEF (National Commission for the Protection and Defence of Users of the Financial Sector), SOFOLs were the equivalent to non-bank banks in the United States and Canada.

Entities such as SOFOLs have gained importance and expanded the access to the financial market in a significant way compared to the scope that this market had when only pure banking entities existed. Credit for consumption has been an important component of the total loans of these new entities. Consumption loans have accounted, on average for 3.6% of GDP in the last years. In the article titled "Incentives and disincentives in the public transport system in London, Madrid and Mexico City", Rivas (2007) affirms that the expansion of automotive credits and the flexible conditions of these credits has permitted new segments of Mexican society access to this type of credit, and this has caused the expansion of the Mexican vehicle fleet.

[20] In a different manner than banks, SOFOLs cannot capture savings directly from clients. Instead, they receive contributions from partner institutions, governmental funds, and debt emission. SOFOLs specialize in credit granting for one specific sector, as for example real estate and automobile, and they focus in private non-financial public. Later in 2006, new entities were created called SOFOMs (Financial Societies of Multiple Object), with the intention that entities such as leasing companies, factoring financial institutions, and SOFOLs could merge and become more competitive with respect to banks.

5.2. Second-Hand Vehicle Supply – U.S.

5.2.1. Main Fleet Characteristics

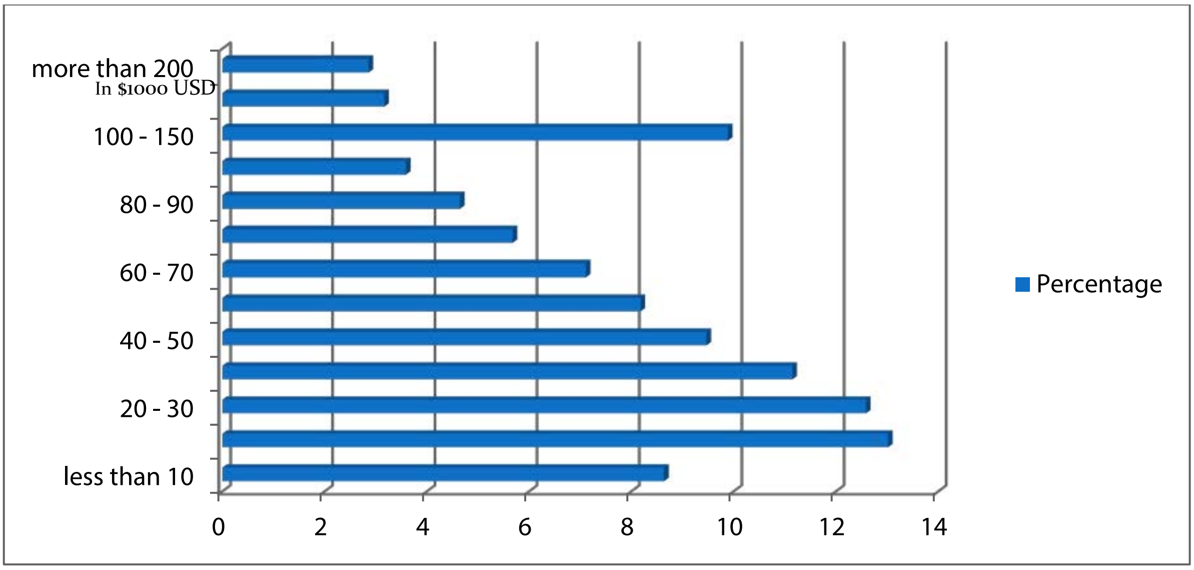
In 2008, approximately 52 million new vehicles were sold worldwide, of about which 13.2 were sold in the U.S. Due to the high growth rates of some countries in Asia (i.e., China) and in South America, 2009 was supposed to bring a slight growth of vehicles sold across the globe. However, in the U.S. sales of vehicles declined in 2009 to a total of 10 million, this represented a decline of 38% compared to 2007. Even though China overtook the U.S. in both vehicle production and sales in 2009, the U.S. is still by far the country with most vehicles in use. It has more than 250 million vehicles in circulation. The worldwide figure is around 900 million vehicles.[21]

The U.S. second-hand vehicle market is, until 2011, the biggest in the world. The possible supply of SUV´s, Pick-ups and Vans 10 years or older, from the state of California alone, represents 3 million vehicles. Furthermore, in the last four decades the number for these Light Trucks increased rapidly in the U.S., especially compared to growth in the sedan segment. As a consequence of this change of segment shares in the US market, supply of second-hand LDV for the Mexican market is likely to increase in the future.

5.2.2. Income

The U.S. is home to more than 300 million people. The average growth of population is forecasted to be 0.89% per year between 2010 and 2015. GDP per capita in 2010 was estimated to be over $47,000 USD which represents the sixth highest in the world. The total GDP is over $14.6 trillion USD, of which nearly 70% originates from private consumption. Household income includes not only all wages, but also unemployment insurance, child support payments, any personal business, investment, etc. The following Graph illustrates the income levels of U.S.-households in USD.

Graph 2 Income per household – U.S. 2005



CTS-Mexico with Info from CIA: The World Fact Book and The Economist: Pocket World in Figures, 2009.

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[21] See Plunkett Research, Ltd: Automobile Industry Introduction, 2008.

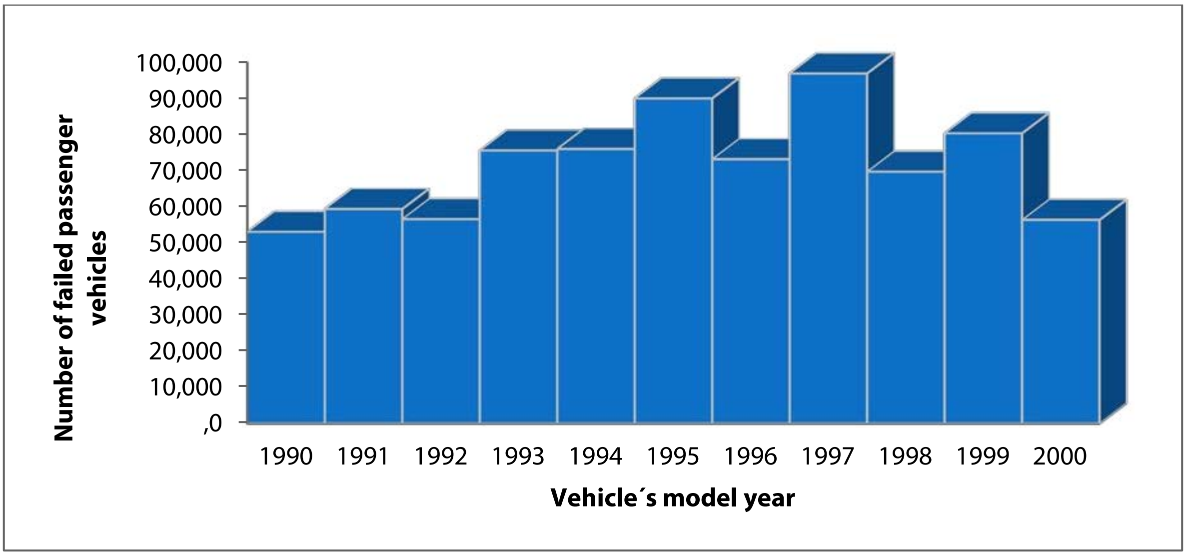
Only one-third of households earn less than $30,000 USD per year. If an income of over $30,000 USD per year enables a household in the U.S. to acquire a new private vehicle; about 70% of households in the U.S. can afford to renew their vehicle periodically.

5.2.3. Vehicle Pricing Structure

Certain policies within the US have an impact on the supply of vehicles entering the second-hand market in Mexico. These include:

- **California´s Smog Check:** In the context of environment and health regulations, stricter emission standards for new vehicles generally have a positive influence on the quality (emission performance) of exported second-hand vehicles in the long run. On the other hand, some environmental regulations lead to a short-term increase in the amount of second-hand vehicles exported to other regions or countries, especially the most polluting vehicles. This is the case of the California Smog Check. In the year 2009 alone, about 788 thousand vehicles failed the Smog Check. These vehicles constitute a potential supply of second-hand vehicles to be imported into Mexico. This number might increase in the following years, because of increasing stringency of the Smog Check in California. Graph 3 illustrates the number of failed passenger vehicles from model years 1990 to 2000.

Graph 3 Total failed passenger vehicles of the Smog Check in California in 2009 (vehicle model years from 1990 – 2000)



Source: BAR: Executive Summary Report, 2009.

- **Safety Regulations in Texas:** The vehicle safety inspection in Texas has an impact on vehicle mortality and thus on the potential supply of older vehicles to Mexico.[22] Vehicles which fail the inspection have just 72 hours to repeat the inspection or leave the state. It seems likely that many of these vehicles are exported to Mexico, especially since the number of vehicles with Texan plates circulating in the Mexican states near the border is very high.

- **Gas Guzzler Tax:** The gas guzzler tax has a tendency to influence which cars enter the second-hand market for export. The Gas Guzzler Tax is a fiscal imposition for new vehicles in the whole of the U.S.; the amount paid is set according to the fuel consumption of the vehicle. New vehicles of more than 2,218 kg are excluded from this tax. Therefore, the U.S. population has an incentive to purchase vehicles that exceed this weight, making their fleet consume even more fuel.

- **CARS (Scrapping program):** In contrast, CARS is probably the program with the most potential to reduce the supply of second-hand vehicles (particularly if it were long term). This is because it takes old polluting vehicles from the road and makes exporting them relatively more expensive in comparison to receiving the trade-in payment. The following Table shows the list of the top-ten cash-for-clunker trade-ins, and the list of top-ten traded vehicles between the U.S. and Mexico.

Table 3 Top 10 trade-ins and Top 10 sellers

Cash for Clunker Trade-Ins		ISVs into Mexico (2005 – 2008)	
1	Ford Explorer 4 WD	1	Ford Explorer 4 WD
2	Ford F-150 pickup 2 WD	2	Chevrolet S-10 (truck)
3	Jeep Grand Cherokee 4 WD	3	Dodge Caravan/Grand Caravan
4	Ford Explorer 2 WD	4	Ford Ranger
5	Dodge Caravan/Grand Caravan	5	Ford Windstar
6	Jeep Cherokee 4 WD	6	Chevrolet Silverado
7	Chevrolet Blazer 4 WD	7	Ford F-150 pickup 2 and 4 WD
8	Chevrolet C 1500 pickup 2 WD	8	Plymouth Voyager
9	Ford F-150 pickup 4 WD	9	Jeep Grand Cherokee 4WD
10	Ford Windstar minivan	10	Ford Taurus

Source: CTS EMBARQ Mexico, 2012. Data from The New York Times: The final number of clunkers, August 26, 2009 and Secretaría de Hacienda y Crédito Público de Mexico, 2010.

The top-ten cash-for-clunker trade-ins seem to be almost identical to the top-ten ISVs that enter Mexico from the U.S. In general this shows that US-citizens want to get rid of these vehicles, because they are expensive to maintain and to use. This becomes even more evident when one analyses the new vehicles purchased during the program: Toyota Corolla, Honda Civic, Toyota Camry, Ford Focus, Hyundai Elantra, Nissan Versa, Toyota Prius, Honda Accord, Honda Fit and Ford Escape FWD. All of these models have a much better fuel economy than the trade-in models and the exported second-hand vehicles.

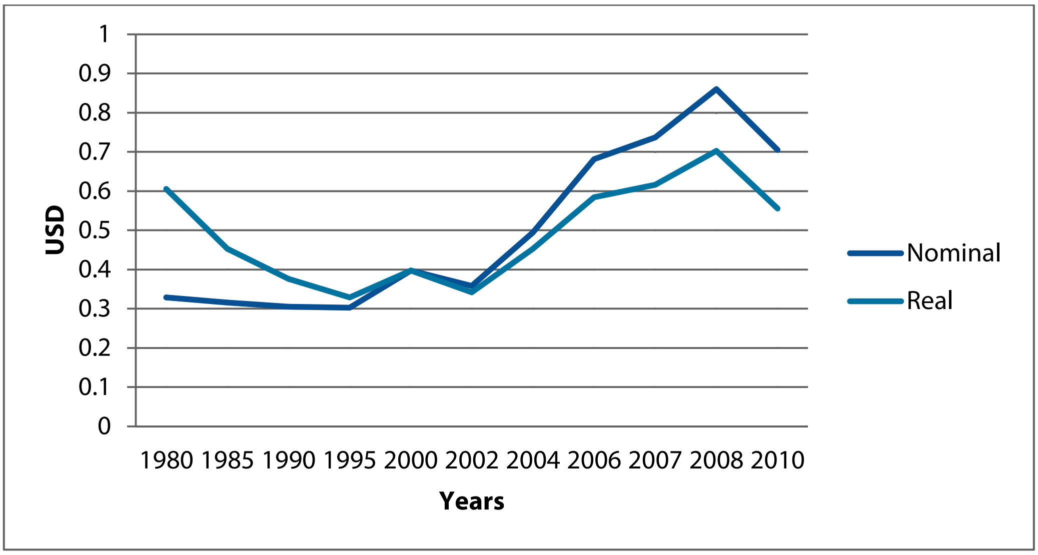
[22] Unlike the Smog Check Program in California, the prices for the annual safety inspection and emission test in Texas are fixed and cost $14.50 USD (safety inspection) and $25.25 USD [22] for the emission test (Prices are from January, 2009).

Price for Gasoline: The high price of gasoline in the U.S. (compared to Mexico), and the expectation of high gasoline prices in the future, influences the supply of second-hand vehicles. The higher the gas price is in the U.S., the more motorists tend to sell their fuel-inefficient vehicles.

Observing the last 30 years of regular unleaded gasoline prices in the U.S. (Graph 4), it becomes obvious that nominal prices have not changed significantly between 1980 and 2002, but from 2002 to 2008, there was a steep rise in the price of gasoline, in both real and nominal terms. In 2002, motorists paid $0.35 USD for one litre of gasoline. In 2008, the price rose to $0.86 USD.

High prices and high price expectations for gasoline affect the market value of vehicles with high fuel consumption and make them very cheap. James Kahn (1986) published a paper about the relationship between gasoline prices, gasoline price expectations, and the second-hand automobile market. Based on econometric models, he found a strong relation between the price of gasoline and the price of second-hand vehicles. It can be stated that the purchasing price for the more fuel-efficient second-hand vehicles increases as gasoline prices do, while the purchasing price for the less fuel-efficient vehicles declines.[23]

Graph 4 Real and Nominal Prices in the U.S. for 1 L regular unleaded gasoline

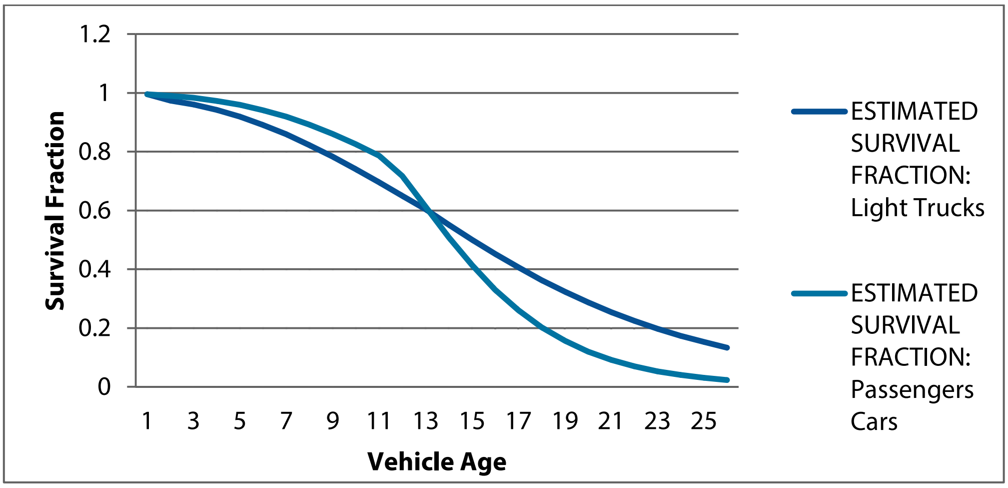


Source: U.S. Energy Information Administration.[24]

[23] See Kahn, J.: Gasoline Prices and the Used Automobile Market: A Rational Expectations Asset Price Approach, 1986.
[24] http://tonto.eia.doe.gov/dnav/pet/pet_cons_psup_dc_nus_mbblpd_a.htm (June, 2010).

All the previously mentioned elements have an effect on the survival rate of Light Trucks and passenger cars in the U.S., which is shown in the following Graph.

Graph 5 Survival Rates for Light Trucks and Passenger Cars in the U.S.



Source: CTS-Mexico with data from EPA and NHTSA: Final Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, 2010.

As can be seen, the survival rate for both Sedans and Light Trucks is quite high until they reach 10 years of age, but it decreases rapidly after 12 years of use. This trend suggests that the large amount of people that own a private vehicle in the U.S., in combination with the possibility of vehicle renewal and the introduction of environmental regulations that penalize the use of more polluting vehicles, has given U.S. vehicle owners incentives to eliminate vehicles older than 12 years, which have a low market value in the country.

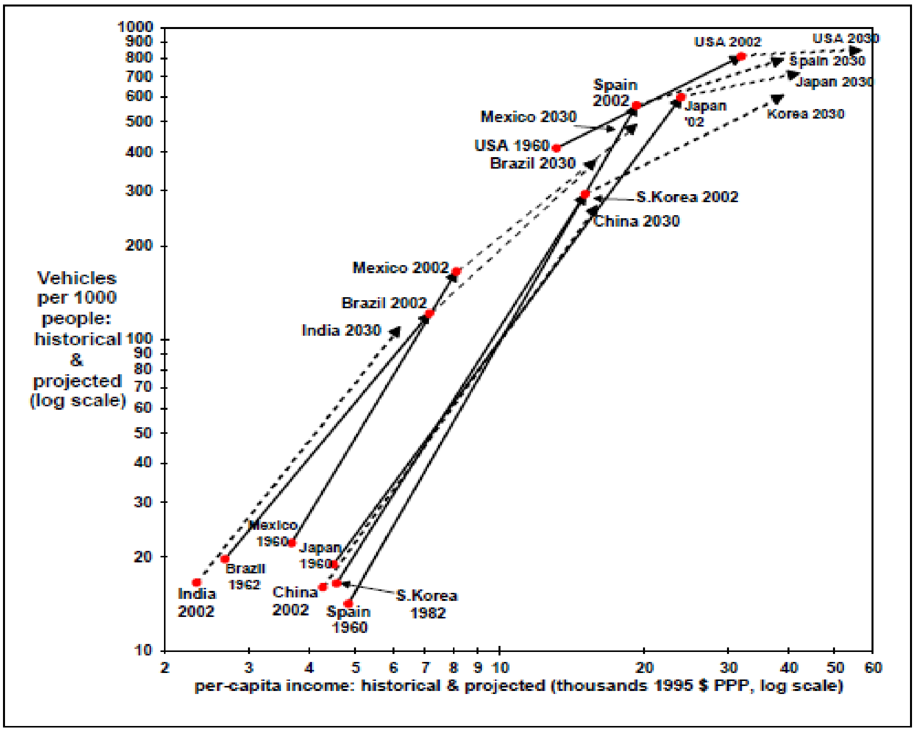
The proximity of the Mexican market makes it relatively easy and cheap to sell a second-hand vehicle instead of scrapping it. Additionally, vehicles in Mexico have a better survival rate and therefore older vehicles can be easily absorbed.

5.3. Second-Hand Vehicle Demand – Mexico

5.3.1. Main Fleet Characteristics

Dargay, Gately and Sommer calculated that the ratio of the vehicle ownership growth rate to income per capita in Mexico equals 2.58.[25] This means that as income increases 1%, vehicle ownership will grow 2.58%. The authors also calculated the total saturation level that Mexico may reach, which is very high, at 840 vehicles per 1000[26]. Over the next 25 years, Mexico's motorization rate[27] is projected to continue to increase, following a worldwide trend. To illustrate this point, the following Graph shows the vehicle growth for the U.S., Japan, South Korea, Brazil and Mexico. All of these countries will reach their vehicle saturation levels at relatively low income levels.

Graph 6 Relation Ownership/Per Capita Income



Source: Dargay, J Gately, D and Sommer, M. Vehicle Ownership and Income Growth, Worldwide: 1960 – 2030, the Energy Journal, Vol. 28, No. 4, 2007.

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25 Dargay, J., Gately, D., and Sommer, M.: Vehicle Ownership and Income Growth, Worldwide: 1960 – 2030, the Energy Journal, Vol. 28, No. 4, 2007.

26 The highest saturation level is 852 for the United States of America, Norway and South Africa

27 Defined as the number of vehicles per 1,000 inhabitants.

In this scenario,[28] the national fleet will increase from 24 million vehicles in 2008 to little more than 63 million vehicles in 2030. Passenger cars will account for the majority of this increase.[29]The following Table also shows the historical vehicle ownership development in Mexico. Table 4 does not include motorcycles (about one million), and includes only registered vehicles in Mexico.

Table 4 Registered vehicles in Mexico and motorization rate. Thousands (1970 – 2030)

	1970	1979	1989	1999	2007	2030	Annual Average Growth Rate
Passenger Cars	1,398	3,618	5,768	8,482	11,413	36,600	**8%**
Pick Ups and Light Trucks	275	882	2,107	4,310	6,944	24,164	**13%**
Trucks	191	530	556	1,078	1,522	1,171	**7%**
Autobuses	52	102	110	142	194	1,158	**8%**
Total	**1,916**	**5,132**	**8,541**	**14,012**	**20,073**	**63,093**	**9%**
Motorization Rate (vehicles/1000 population)	34	66	90	128	170	491	**8%**

Source: CTS EMBARQ Mexico, 2012. Data from IMP; Dargay, Gately and Sommer, 2007; World Bank.

According to the previous table, the annual growth rate of the Mexican fleet since 1970 and the projected growth of the Mexican fleet until 2030 are high. From 1970-2030, the total fleet will have grown an average of 9% each year; and the fastest growing segment is that of Pick-ups and light trucks (13% annually).

The growth in the fleet has been and will continue to be reflected as a significant increase in the rate of motorization. While in 1970 there were only 34 vehicles per 1000 people, by 2030 it is expected to be 491 vehicles per 1000 inhabitants. This equals an average annual increase of 8% in the motorization rate for this country.

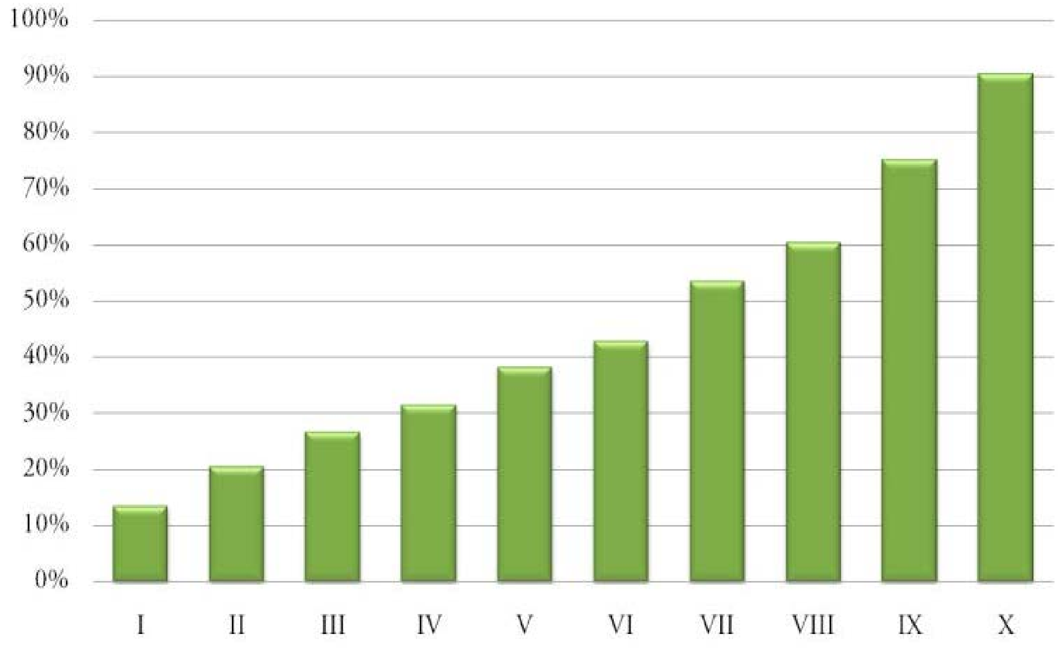
[28] The baseline scenario follows historical trends in Mexico and is consistent with the pattern of motorization growth worldwide.

[29] World Bank: Low-Carbon Development for Mexico, 2009.

5.3.2. Income

As is the case with other countries affected by cheap and low quality ISVs, Mexico is not a high income country. In 2006, Mexico had a GDP per capita of $7,800 USD, placing 70th in world income rankings.[30] However, purchasing power is more important to this analysis and Mexico ranks slightly higher (58) with $11,990 USD.[31] The following Graph illustrates vehicle ownership by income deciles in Mexican households.

Graph 7 Percentage of households with at least one vehicle



Source: CTS-Mexico with information from INEGI, 2009.

In the first decile, 12% of households own at least one vehicle and by the fifth decile, this rises to almost 40% of households. The monthly income for a household in the fifth decile is between $4,607 and $6,057 MXN per month, which suggests that it is unlikely that vehicles from these households were acquired when new (an average subcompact car cost 140,000 MXN in 2008).

Because income in Mexico is highly concentrated, 1% of the expenditure of the lowest deciles accounts for much less than 1% of the expenditure for higher deciles. Graph 8 shows the average amount spent per decile on different components related to transport.

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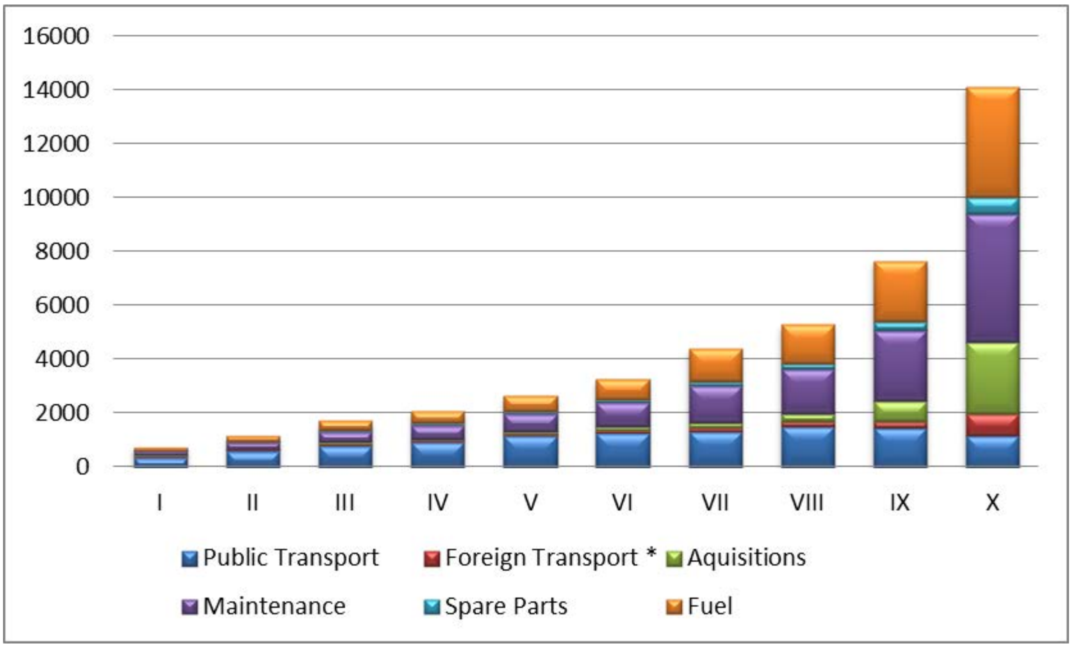
[30] The Economist: The World in Figures, 2009.
[31] Der Fischer Weltalmanach, 2009.

Graph 8 Transport expenses per decile in MXN



Source: CTS-Mexico with Data from INEGI, 2009*Foreign transport refers to transport between zones that are located in different cities

The amount spent on vehicle maintenance is higher in the last two deciles. Part of this is of course due to the fact that more households own cars in these deciles, but it is also because they have more income to spend on vehicle maintenance. Also, households in these deciles are those that can purchase a new vehicle with a higher market value and therefore, households generally place a higher value on its maintenance. The survey shows that households in the last decile have an average expenditure of $12,000 MXN related to private vehicle transportation. To put this in perspective, a household in the fourth decile earns $12,000 MXN in three months.

Vehicle acquisition does not represent a large portion of expenses in the first eight deciles, even when data shows that 12% to 50% of these households own a vehicle. This suggests that the price of the vehicles they acquire is not high; most probably because they buy second-hand vehicles. Expenditure in acquisition of vehicles begins to be substantial for the ninth and tenth deciles, which suggests that these not only buy more vehicles but buy the most expensive ones - new vehicles. The data above implies that most passenger vehicles owned in the first eight deciles are purchased as second-hand vehicles, either from the national market or imported from the U.S.

5.3.3. Vehicle Pricing Structure

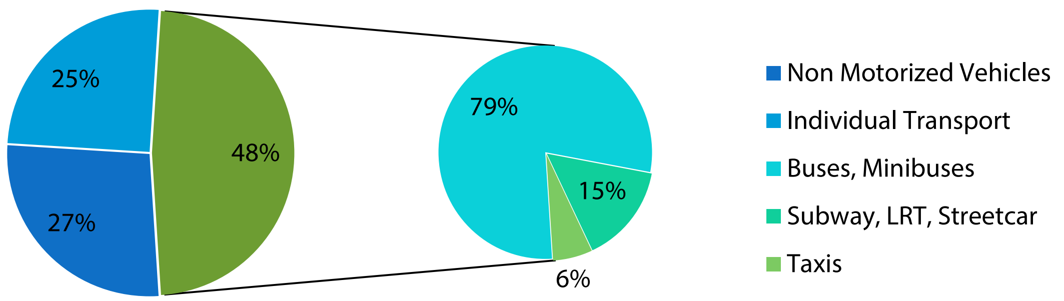
Price of related goods – Public Transportation

In absolute terms and compared to other OECD countries, public transport in Mexico is cheap. The fees in Mexico City for the use of minibuses are set according to distance travelled: from $3.00 MXN for a trip of up to 5 km, $3.50 MXN for a 5-to-12 km trip, and $4.50 MXN for a trip of 12 km or more. In Mexico an average trip with public transport costs $5.77 MXN.

Outside of Mexico City, prices for public transport are less regulated and depend more on the rules of the free market. Generally, they are higher than in Mexico City, but still lower than prices in most OECD countries.

However, public transport has other costs besides the fee; including time of travel, comfort, perceived safety and ease of access to public transport stations. In Mexico, public transport accounts for 48% of all trips. Graph 9 shows the mode split of public transport.

Graph 9 Percentage of daily trips in the different means of transport in Mexico, 2007



Source: Observatorio movilidad urbano. Estudio de indicadores de Política Pública, 2008.

It can be seen that 79% of the share of public transport trips use microbuses and auto buses; 15% use metro, light rail train and streetcar; while taxis account for 6% of these trips.

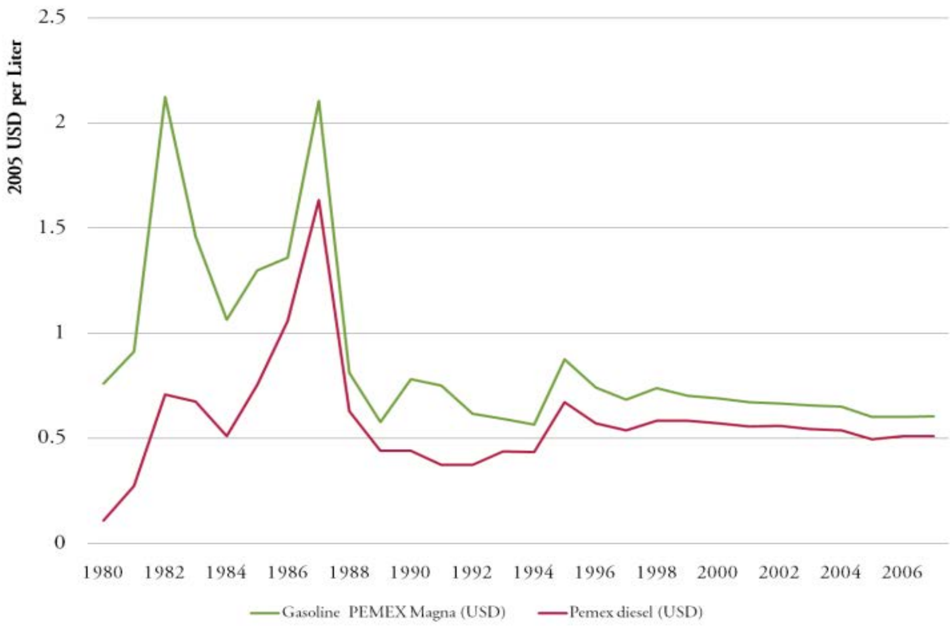
Access to diverse modes of public transportation differs between cities. It is quite common that in smaller Mexican cities and villages, the only types of public transport available are minibuses and auto buses. Added to this, even when in larger cities other modes of public transport, such as BRTs and metro exist, they rarely reach people living and moving in the peripheries of the city. All of this means that an important part of these trips are done in microbuses and auto buses because there is no alternative mode of transport.

Price of fuel

Fixed oil prices have been historically low, making ISVs highly attractive, especially large ones. Due to social and political pressure, Mexican policy regarding the price of gasoline and diesel has been aimed at controlling the real price for these products over time. Therefore, fuel prices do not reflect oil's scarcity and vehicle consumers factor in artificially low fuel price to decide whether to purchase a vehicle or not. This pricing policy works as a subsidy for vehicle owners and thus, promotes motorization.

This stable price policy has been justified by allegedly preventing high oil prices from affecting the economic performance of various sectors that are highly fuel dependent. The following Graph shows the real prices for consumers of gasoline and diesel in Mexico from 1980 to 2007 and shows how the prices have been controlled during the last two decades and, contrary to what scarcity would tell us, they even experience a decreasing tendency over time.

Graph 10 Real Fuel Prices



Source: CTS with data from SENER and INEGI.

In 2007, the Mexican Senate approved the gradual elimination of the gasoline subsidy. The implementation of the measure was postponed to the beginning of 2008. In 2008, the price of "magna" gasoline was increased by 2 cents a month and the price of "premium" gasoline was increased 2.44 cents a month. The measure was suspended in 2009 to help fight the economic crisis. By 2010 the measure was reinstated, and is supposed to last beyond Calderon´s mandate. However, after 2012 there is no guarantee that the policy will remain in effect, since a new President will come into power[32].

[32] There is no presidential re-election in Mexico.

In the chapter on supply analysis, we stated that an increasing price of gasoline in the U.S. increases the supply of second-hand vehicles with high fuel consumption. On the other hand, the lower price of gasoline in Mexico makes these vehicles attractive in the Mexican market. Furthermore, the lower gasoline price has significant effects on vehicle use and makes private transport cheap, even compared to public transport. Parity between Mexican and U.S. gasoline prices would decrease the demand for ISVs in the Mexican market. However, other elements that make these vehicles appealing and relatively cheaper, such as the lack of environmental and safety regulations and the poor enforcement of the existing ones, are important issues to be resolved.

Environment and health regulations (for ISVs)

In September 2006, the Mexican regulation PROY-NOM-041-SEMARNAT-2006 (NOM-041) came into effect in order to complement regulation NOM-047, adopted in 1999. The NOM-041 is a federal regulation and hence, applies for the entire Mexican territory. The norm's objective is to reduce emissions of vehicles of any age. ISVs are also affected by the regulation.[33] Table 5 illustrates the maximum emissions allowed for vehicles between 400 and 1,701 kg. All the ISVs which crossed the border after the 1st January 2009 belong to this last category - 1994 and younger. Compared to other countries in Latin America, the emission limits of the regulation are quite ambitious.

Table 5 Emission Limits for Vehicles in Mexico between 400 and 1,701 kg

				Dilution of $CO + CO_2$ (% Vol)	
Model year	**HC (ppm)**	**CO (% Vol)**	**O_2 (% Vol)**	**Min.***	**Max.***
1979 and older	450	4	3	13	16.5
1980 – 1986	350	3.5	3	13	16.5
1987 – 1993	300	2.5	3	13	16.5
1994 and younger	100	1	3	13	16.5

* Dilution of CO+CO2 (% Vol)

Source: SEMARNAT, NOM 041

As analysed above, many ISVs are SUV´s, pick-ups and vans. A significant part of these vehicles weigh more than 1,701 kg. The NOM-041 also includes emission limits for heavier vehicles. Table 6 shows the emission limits for vehicles that weight between 1,701 kg and 3,856 kg. Particularly, the limits for vehicles constructed after 1993 are high and in theory they secure low emissions of vehicles in Mexico.

[33] SEMARNAT: NOM-041.

Table 6 Emission Limits for Vehicles in Mexico between 1,701 kg and 3,856 kg

				Dilution of $CO + CO_2$ (% Vol)	
Model year	**HC (ppm)**	**CO (% Vol)**	**O_2 (Vol)**	**Min.***	**Max.***
1979 and older	600	5	3	13	16.5
1980 – 1985	500	4	3	13	16.5
1986 – 1991	400	3.5	3	13	16.5
1992 – 1993	350	3	3	13	16.5
1994 and younger	200	2	3	13	16.5

* Dilution of CO+CO2 (% Vol)

Source: SEMARNAT: NOM 041

As we described, the emissions caused by ISVs are on average higher than those established by regulation NOM-041. For example, HC emissions in Monterrey are, on average, seven times higher. A reason for this high discrepancy is that the responsibility to enforce the regulation lies with state authorities. Paragraph 4.3 of the regulation determines that verification programs can be implemented if the authorities of the affected community consider it necessary.[34] Mexico City and some cities in the border region (i.e., Tijuana, Ciudad Juarez) make use of this regulation and try to enforce it with regular inspection and maintenance (I&M) programs. However, fraud, corruption and other negative influences might diminish the effectiveness of NOM-041.[35]

Insurance rules

Vehicle insurance is not compulsory in Mexico, and therefore many drivers do not acquire it. This lowers the total cost of having and maintaining a vehicle in the country. Additionally, insurance is cheaper for ISVs, as premiums depend on the value of the vehicle. This creates a perverse incentive, because these vehicles pose a higher road safety threat, as well as imposing other costs on society, such as higher levels of emissions and fuel usage. Theoretically, an uninsured driver must be held accountable in case of physical or material damage. However, trials are long, laborious and expensive, and many insured drivers prefer to simply pay the deductible rather than to go to trial to force the responsible party to pay. This means that the driver responsible for the accident will face no consequences.

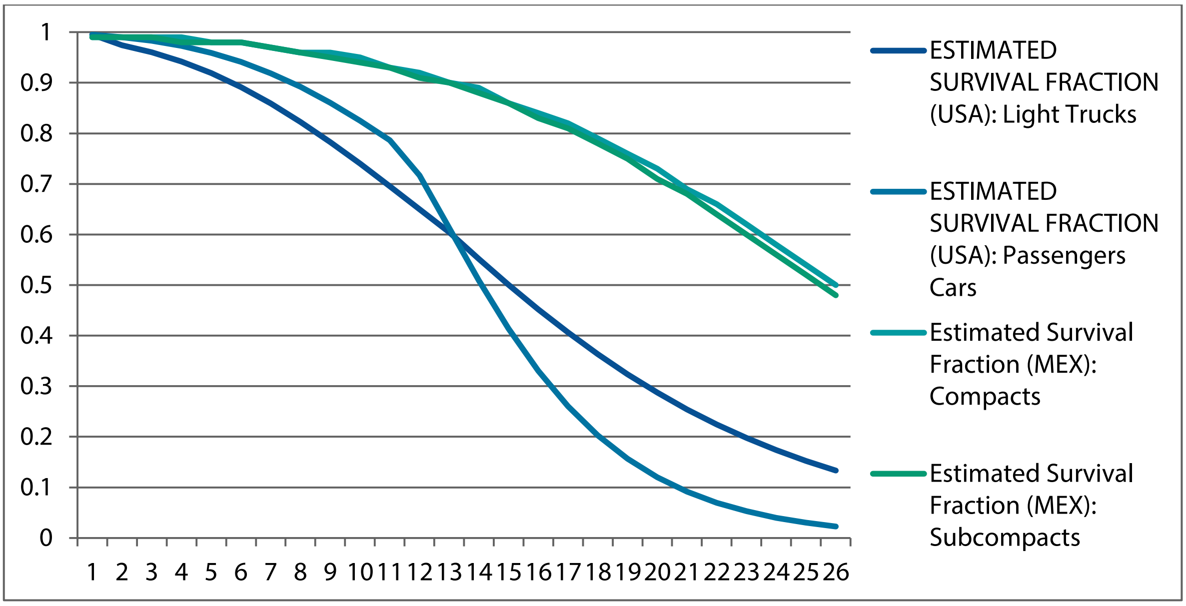
[34] SEMARNAT: NOM-041.

[35] See more about this discussion in the chapter "Public Policy Recommendations" See also Oliva, P.: Environmental Regulations and Corruption: Automobile Emissions in Mexico City, 2009.

5.3.4. Trends of Survival Rate and ISV Price in Mexico

The differences in purchasing power, regulations, quality standards, and gasoline price, among others, have resulted in a vehicular fleet that depreciates more slowly in Mexico, compared to the U.S. This difference is present in many developing and developed countries.[36] The following Graph shows the survival rate of Mexican and U.S. passenger vehicles.

Graph 11 Comparison of Survival rate of Sedans and Light Trucks between the U.S. and Mexico



Source: CTS with data from IMP and EPA, 2010.

The difference in survival rates causes an important price differential between similar vehicles in both second-hand vehicle markets. The average prices in the U.S. and Mexico of the four most demanded ISVs between 10 and 15 years-old, confirms the price differential between the two markets. The prices are from California, but do not differ considerably from other regions in the U.S. Additionally, all second-hand vehicles in Table 7 have about 160,000 km on the odometer. This number is equivalent to the driven average kilometres of the ISVs in Mexico. The Blue Book shows prices for vehicles in excellent, good and fair condition. The outlays below are for vehicles in a good condition and from private party prices.

[36] Grubel, H.: International trade in used cars and problems of economic development, 1980.

Table 7 American and Mexican prices for the most traded second-hand vehicles between the U.S. and Mexico (in USD)

	U.S. and Mexico					
Model/Model Year	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
FORD WINDSTAR						
MEX	$2,535	$2,747	$3,094	$4,097	$4,550	$5,406
U.S.	$1,535	$1,635	$1,760	$1,870	$1,585	$1,750
FORD EXPLORER						
MEX	$3,300	$3,462	$3,663	$4,544	$4,617	$5,013
U.S.	$1,535	$1,635	$1,910	$2,120	$2,385	$2,625
GRAND CHEROKEE						
MEX	$3,599	$3,625	$3,779	$4,058	$5,512	$5,861
U.S.	$1,435	$1,760	$2,070	$2,120	$2,460	$2,625
DODGE CARAVAN						
MEX	$2,352	$2,969	$3,663	$3,794	$3,856	$4,559
U.S.	$1,660	$1,960	$2,135	$2,320	$2,335	$2,475

Source: CTS EMBARQ Mexico, 2012. Data from the Bluebook, 2010.

In the U.S., prices for second-hand vehicles are between $1,400 and 2,700 USD. The prices for comparable second-hand vehicles are significantly higher in Mexico. The average difference is of 100%. A vehicle that could be sold for $2,300 USD in the U.S. can be sold for $5,900 USD in Mexico. Generally, the newer the second-hand vehicle, the greater the price discrepancy reported. This could suggest that as newer vehicles are allowed to be imported, the price differential between them and similar national vehicles will be even higher; and so the possibility of making large profits from this trade will also rise. Another interesting detail that arises from analysing prices and the description of these second-hand vehicles in Mexico is that many of the traded vehicles lack various original parts.[37]

Additional costs to using ISVs include a combination of fees and taxes which are between $800 and $1,500 USD (including VAT). The exact amount depends on the age and value of the vehicle. Using imported vehicles in Mexico also requires Mexican license plates. For this purpose, motorists have two possibilities:

- A national license plate that allows the motorist to drive the imported vehicle all over Mexico. The national license plate costs between $800 and $1,500 USD. The final price depends on the type and value of the vehicle.
- A sticker that enables the motorist to drive the imported car just in the border region. It costs between $700 and $800 USD.

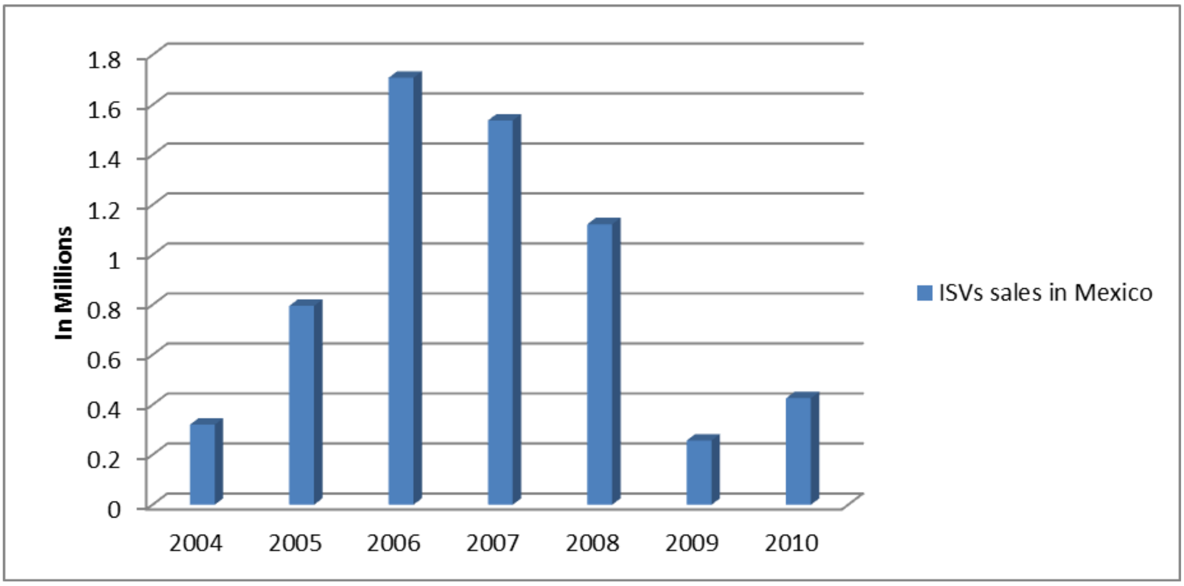
Another part of the price at which ISVs can be sold in Mexico includes taxes and the time spent in the transaction. These additional costs seem relatively high at first comparison with the costs arising from a vehicle purchased in Mexico. However, even including taxes, the final price at which ISVs can be sold in Mexican market tends to be lower than comparable local vehicles and this seems to compensate users for time and extra logistic costs. Also, there are some days in which government adopts a tax free policy for the entrance of ISVs.

[37] For example: http://www.autocosmos.com.mx/autos/usados.aspx (June, 2010).

Overall, the price differential makes it possible for second-hand vehicles to be exported at a price that is significantly higher than the price of the vehicle in the U.S. market, but that is still lower than a vehicle purchased in the Mexican market. This is one of the most important factors why trade of such vehicles is so appealing on both the supply and the demand sides. Profits from dealing ISVs in Mexico have generated a well-developed business with a network of dealers that can even further reduce transaction costs.

As a result, since trade restrictions were eliminated, the trade of second-hand vehicles increased rapidly until 2006. A decline between 2006 and 2008, from 1.7 million to 1.1 million vehicles can be observed in Graph 12, but numbers of ISVs remained high. In 2009, with the economic crises, in combination with a presidential decree that regulates the importation of second-hand vehicles, the trade of ISV has been reduced to 2005 levels, but almost doubled in 2010 compared to 2009. See the following graph.

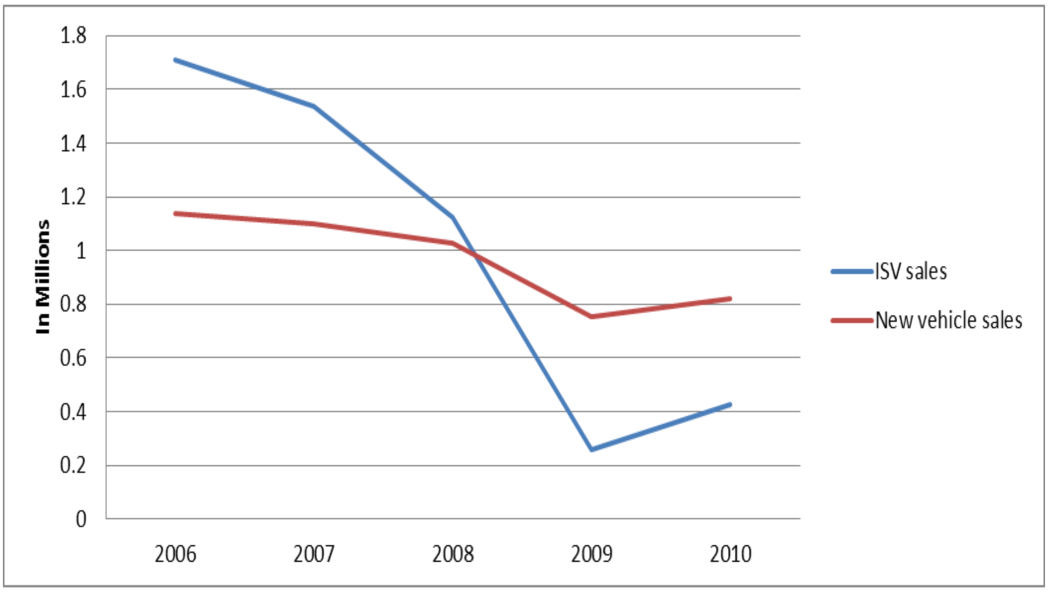
Graph 12 ISVs from the U.S. between 2004 and 2010



Source: AMDA, 2011.

The significance of the number of ISVs becomes more visible when comparing them with new vehicle sales in the country. According to AMDA, the absolute number of ISVs which crossed the U.S.-Mexico border between 2005 and 2010 is 5.8 million. This number is roughly equivalent to the number (5.9 million) of new cars sold across Mexico during the same period, as Graph 13 demonstrates.

Graph 13 New vehicles vs. ISVs sales between 2005 and 2010 (in thousands)

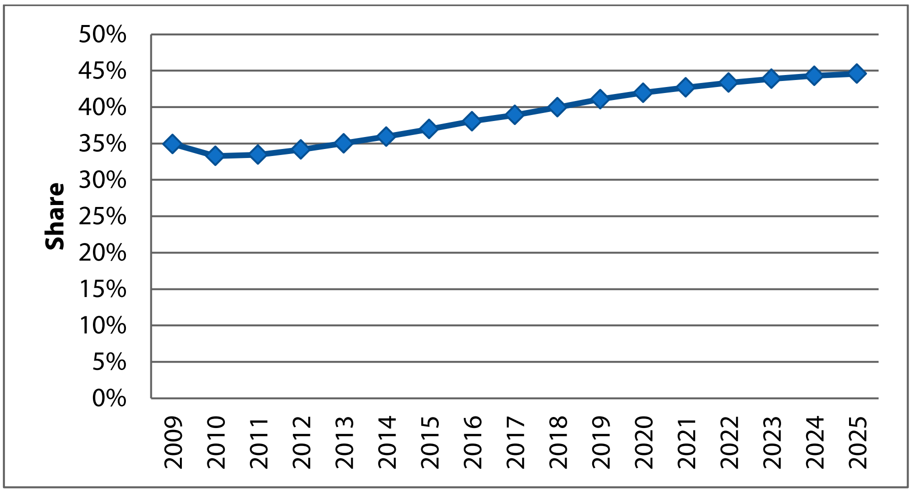


Source: AMDA, 2011.

Generally, the slowdown of ISVs in 2009 and its slow recovery in 2010 does not mean that the demand for ISV has been reduced. After the economic crisis and if the government decides to open the market again without any regulations, it is expected that ISV trade will return to 2007 levels. Additionally, for every period studied, the ISVs constitute a significant component of the increase of the Mexican vehicular fleet. Indeed, at times these increases are much greater than those due to the sale of new vehicles.

The high volume of ISVs has a significant impact on the total fleet composition in Mexico. Mexico expects to change the composition of its LDV fleet in the coming years, characterized by the growing share of ISVs. Graph 14 shows the projected share of imported second-hand LDVs between 2009 and 2025.

Graph 14 Share of ISVs from the LDV fleet between 2004 and 2024



Source: CTS with data from Instituto Mexicano del Petróleo (IMP), 2010.

It is expected that the share of imported second-hand LDVs will grow by 10% during the period between 2009 and 2025. By 2025, ISVs will constitute 45% of the total LDV fleet.

5.4. Characteristics of ISVs in Mexico

The IPCC wrote on its fourth assessment report: "Further aggravating the energy and environmental concerns of the expansion of motorization is the large-scale importation of second-hand vehicles into the developing world."[38] The importation of second-hand vehicles is an international environmental, health, road safety and energy security problem and is not limited to the border between Mexico and the U.S. The use of old second-hand vehicles, that have had low levels of maintenance throughout the years and belong to large engine and weight segments, has a huge impact on worldwide GHG-emissions and causes, in certain regions, significant health problems.

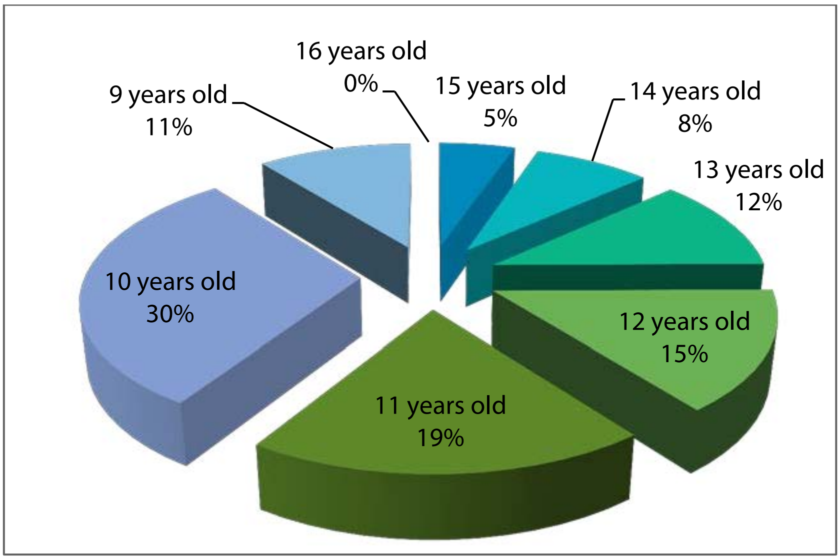
This chapter focuses on the characteristics of ISVs in Mexico and their implications. The first part describes their age, segment and other characteristics such as their engine size and average kilometres travelled before entrance. The second part shows their fuel efficiency and the fuel consumption consequences. The third part focuses on their GHG- and criteria pollutant emissions. The last part focuses on a business as usual (BAU) scenario for Mexico. In the centre of the scenario there will be GHG-emissions, fuel consumption, and NOx and $PM_{2.5}$ emissions.

[38] Ribeiro, K., et al.: Transport and its infrastructure. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the IPCC. 2007.

According to a data-set from the Mexican Finance Ministry, [39] the average age of the 3.4 million legal ISVs that entered between the 1st of October 2005 and the 31st of December 2008 is slightly over 11 years old at the moment of importation to Mexico. Graph 15 shows the age of the second-hand vehicles which crossed the border in the observed period.

Graph 15 Import of Second-hand vehicles from the U.S. to Mexico between 2005 and 2008

(Shares by vehicle age)



Source: CTS with Info from SHCP.

In the four years analysed, the demand for 10 year-old ISVs (almost the youngest vehicles allowed for import) was the largest, followed by 11 year old cars. Generally, very older vehicles were less demanded. Nine-year old ISVs might have been more demanded but because of national regulation during this time it was only possible to import them for a very short period each year. The trend to import younger vehicles will probably continue to grow up to a certain point because of NAFTA (which will allow the entrance of younger vehicles). However, the conditions explained in the previous chapter both for the growing supply and demand of these vehicles suggest that trade of relatively older vehicles will continue to present a benefit opportunity for the U.S. and the Mexican population.

Another important point in the context of vehicle composition is the type of the ISVs. The most traded vehicles across the U.S.–Mexico border in the previously mentioned time period are: Ford (Lincoln and Mercury), G.M. (Buick, Cadillac, Chevrolet, Hummer, G.M.C. and Pontiac) and Chrysler (Jeep, Dodge, Ram and Mopar).[40] The reason why these brands are so highly present is the constantly growing preference for SUVs, Pick-ups and Vans by the sector of the Mexican Population that buys ISVs. The type of ISVs in the observed period shows that approximately 69% of ISVs are SUVs, Pick-ups and Vans and only 31% are compact vehicles. In contrast, the new vehicle composition consists of 65% compact vehicles.

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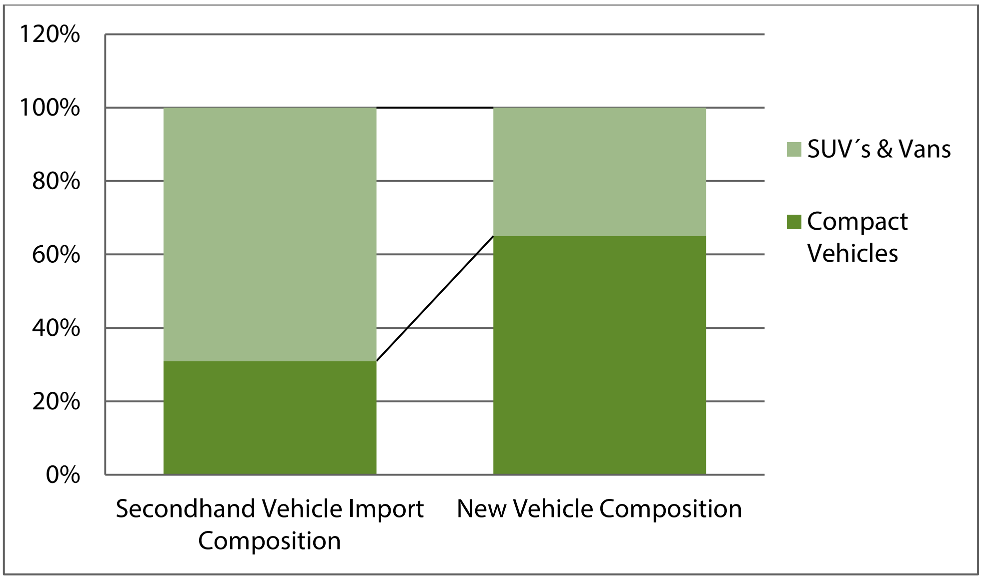
[39] For the following chapter we analyse mainly a data set from the Mexican Finance Ministry (SHCP). The data set contains all legal ISVs from January 2005 until December 2008. The overall volume from AMDA-data is higher for the ISVs, because they include also illegal ISVs.

[40] CTS with Info from Secretaría de Hacienda y Crédito Público de Mexico.

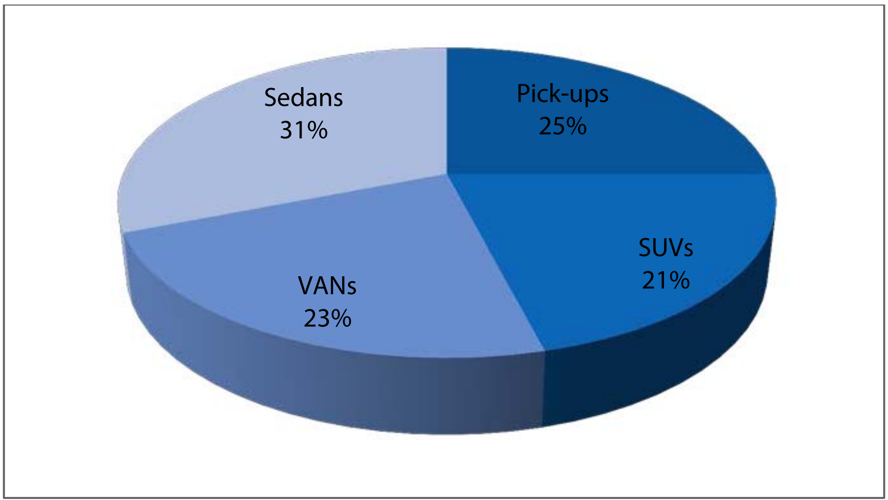
Graph 16 Second-hand vehicles import composition versus new vehicle composition in Mexico (2008)



Source: CTS with data from SHCP, 2010.

Most popular among the imported Light Trucks are the Pick-ups, with a total share of 25%. Pick-ups are particularly used by farmers and craftsperson that have to transport goods to the customers or the distributor. In addition, Pick-ups are also used as a means to transport people (like public transport, but without any regulation) or as substitute for sedans. Both, Vans (23%) and SUVs (21%) are also highly demanded and they are seen more and more in Mexico´s big cities such as Monterrey. Graph 17 illustrates the type of ISVs in Mexico.

Graph 17 Type of ISVs in Mexico



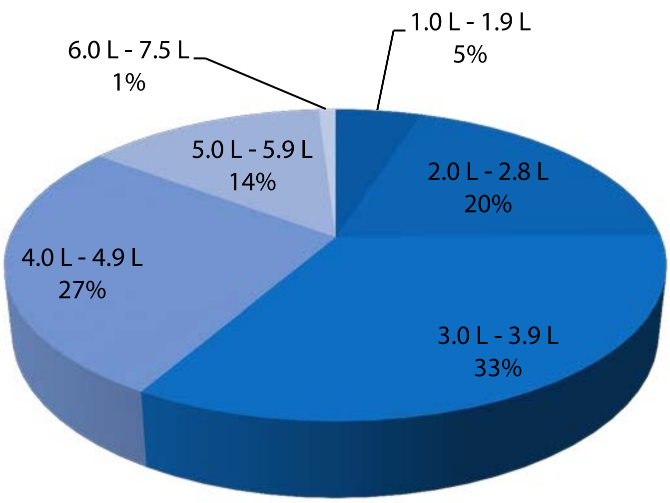
CTS with data from SHCP, 2010.

In 2008, SEMARNAT published a report about the environmental impact and characteristics of ISVs based on two studies performed by INE, SEMARNAT and CTS-Mexico. The most important results concerning the composition of ISVs in this report are:

- ISVs have an average of 160,000 km on the tachometer when entering Mexico.
- 84% were - according to mechanic-reports - in “Good condition”, 9% were “Salvage”, 2% were “Reconstructed” and 5% were “Junk”.
- Of the 84% in “Good condition” several problems were found, i.e.: 13% had problems with the odometer[41].
- The average fuel consumption of ISV is about 8L/km and on average they are driven 15,000 km per year.
- Most of the ISVs (75%) are equipped with an engine between 3 L and 7.5 L (see Graph 18) [42].

[41] SEMARNAT: Importación definitiva de vehículos usados. Consecuencias e Impactos ambientales, 2008.
[42] SEMARNAT: Importación de vehículos usados; Consecuencias e Impactos en Mexico, March, 2011.

Graph 18 Engine size of ISVs



Source: SEMARNAT: Importación de vehículos usados; Consecuencias e Impactos en Mexico, March, 2011.

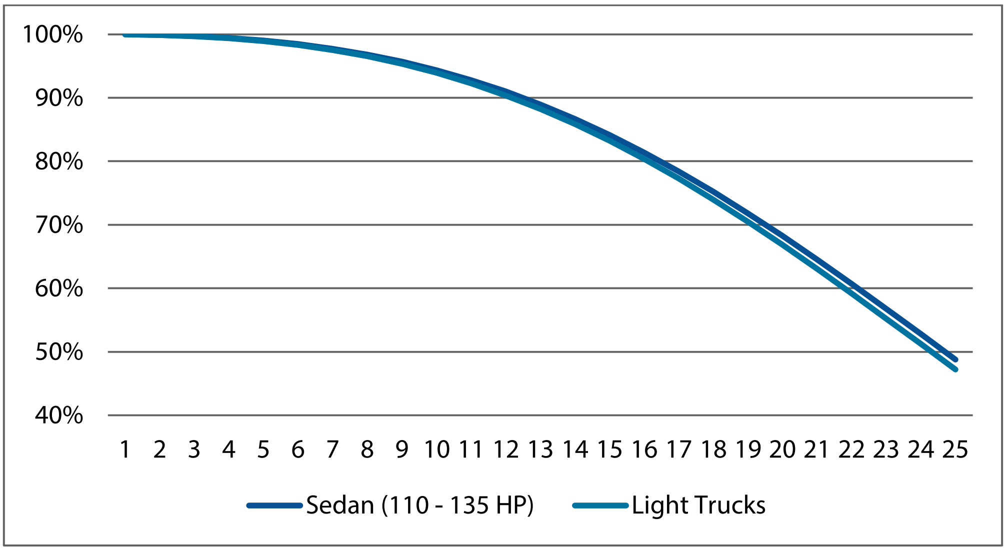
Finally, most ISVs are used in the northern part of the country, in cities such as Tijuana, Monterrey, Reynosa and Nogales. In Monterrey, the average use of private vehicles counts for almost 25,000 km per year. This represents one of the highest car uses in Mexico. Generally, the mileage per vehicle in the north is very high, particularly compared to Mexico City, where passenger vehicles run less than 15,000 km per year.

5.4.1 Fuel Efficiency and Fuel Consumption

The following Graph illustrates the average fuel efficiency change over the vehicle lifespan of the Mexican fleet. Vehicles that are younger than 10 years have a fuel efficiency that is close to their initial one. Vehicles that are older than ten years, many of which are ISVs, show a fuel efficiency that is significantly lower than the average of new vehicles. Particularly, after 15 years in use, the different models of passenger vehicles have rapidly decreasing fuel efficiency. There are several possible effects that lead to this decrease in efficiency:

- The presence of lemons.
- Lack of maintenance.
- Use intensity.

Graph 19 Average Fuel Efficiency of different passenger vehicle types over 25 years of vehicle life time in Mexico

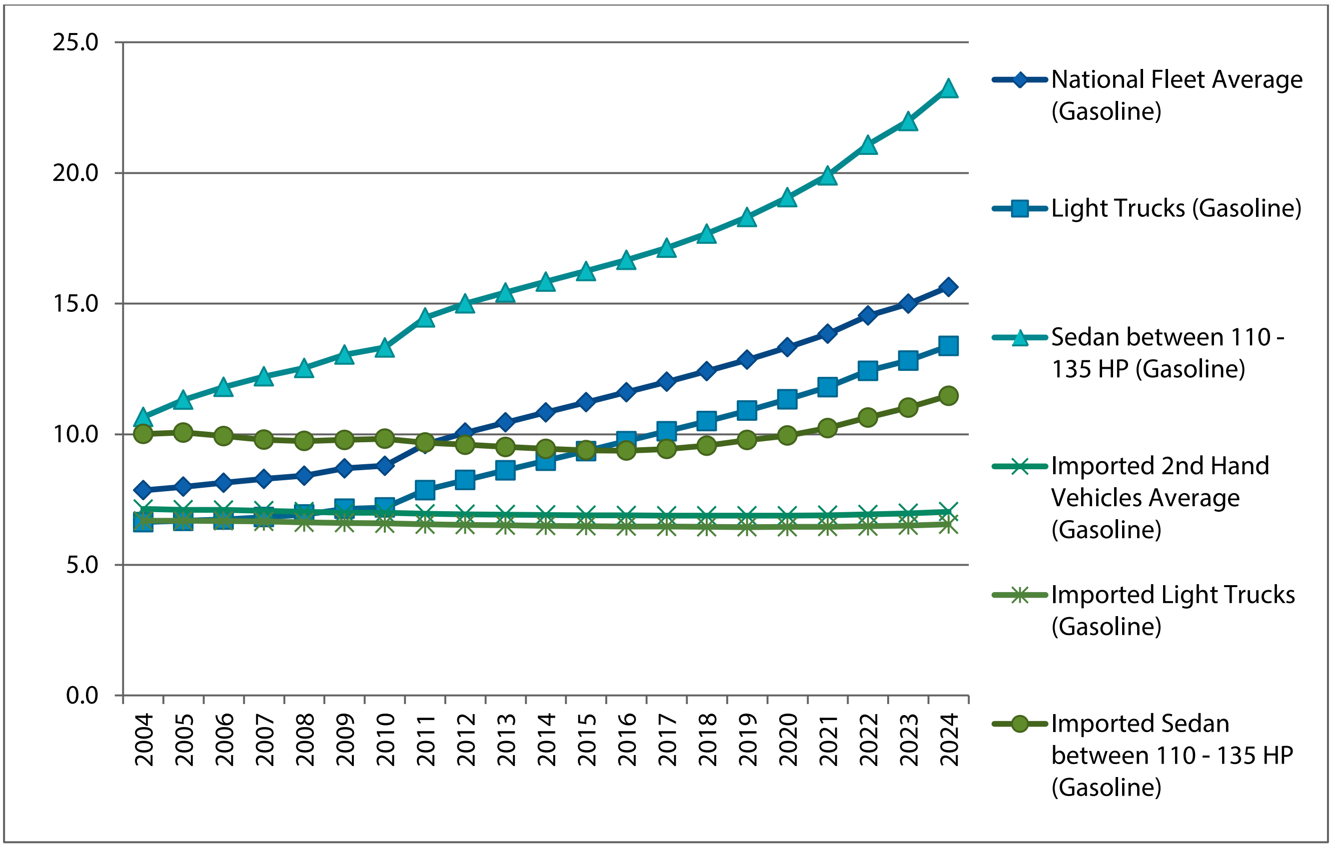


Source: CTS with data from IMP[43], 2010

As a consequence, ISVs tend to lower the Mexican fleet average fuel efficiency and this will continue to be the case, especially as they grow in proportion and in the case in which lack of regulations for the maintenance and initial state when imported continues.

43 IMP = Instituto Mexicano del Petróleo.

Graph 20 Fuel Efficiency for different passenger vehicle models in Mexico



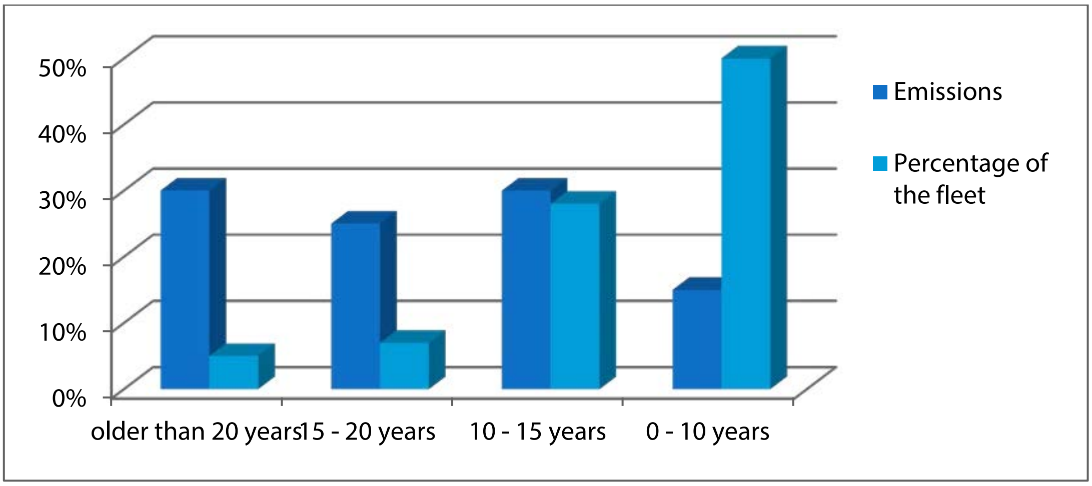
Source: CTS with data from IMP, 2010.

The average fuel efficiency for vehicles obtained by the national fleet in Mexico will be about 16 km/litre by 2024; however, the average fuel efficiency for an ISV will be just 7 km/litre by the same year. Because of the high number of imported Light Trucks, it is relevant to analyse how their fuel efficiency is expected to develop in the upcoming years. From 2010 onwards the discrepancy increases significantly. In 2024, almost twice the number of kilometres will be driven with one litre of gasoline by using a Light Truck from the national fleet in Mexico when new, instead of an imported second-hand Light Truck from the U.S.

5.4.2 Emissions

There exists strong evidence indicating that a small fraction of emitters in the vehicle fleet are responsible for a large share of total criteria pollutant emissions of the vehicle fleet. Graph 21 illustrates this argument with the example of the Mexican vehicle fleet.

Graph 21 Vehicle Criteria Pollutant Emissions in the context of the fleet age in Mexico



Source: CTS-Mexico with Info from SIGEA[44] and Eco-Securities, 2002.

In 2002, older passenger vehicles in Mexico (older than 15 years) made up only 12% of the total passenger vehicle fleet. However, they were responsible for 55% of total passenger vehicle criteria pollutant emissions. On the other hand, newer models (up to 10 years) represented 50% of the passenger vehicles and were responsible for less than 15% of total passenger vehicle criteria pollutant emissions.

The following Table shows the emission performance of the most traded models of ISV (Ford Explorer[45]) for a new vehicle in the year 2000 according to the U.S. Federal procedure, and compares it to the emission performance of the same model produced in 2010. The year 2000 was chosen, because these models will cross the border to Mexico in the next few years.

[44] SIGEA = Sistemas Integrales de Gestión Ambiental.

[45] Note that the Ford Explorer is a model which is still in production and just in the year 2000 more than 445,000 units were sold.

Table 8 Ford Explorer (4 L, 6 cylinder) 2010, and Ford Explorer (2nd Generation; 4 L, 6 cylinder) 2000, in comparison

	Ford Explorer 2010	Ford Explorer 2000	Difference in absolute terms	Difference in %
NOx (grams per km)	0.02	0.31	-0.29	-94%
CO (grams per km)	1.3	3.41	-2.11	-62%
NMOG (grams per km)	0.04	0.08	-0.04	-50%
PM (grams per km)	0.006	0	0.006	
Smog-forming pollution (kg/yr)	1.64	9.43	-7.79	-83%

Source: CTS EMBARQ Mexico, 2012. Data from EPA and INE.

The differences in criteria pollutant emissions are significantly higher for the 2000 model: NOx[46] are 94% higher, CO 62% higher, NMOG 50% higher and "SMOG forming pollution" 83% higher. The differences could become more extreme if the model produced in the year 2000 has been poorly maintained.

After a period of data collection and analysis[47] using the RSD method[48] on roadways that have significant number of ISVs, INE, SEMARNAT and CTS-Mexico performed two final reports[49], which summarized the results of these studies. Nearly 25,000 ISVs[50] were evaluated regarding their emission performance (CO, CO_2, HC and NO)[51] in the study. These vehicles were divided in five different groups according to their age, 1980 and older, 1981 – 1990, 1991 – 1992, 1993 – 1998 and 1999 and younger. Most units were measured in the last category and just 273 vehicles were constructed in 1980 or even before.[52] The emission performance of the different groups of vehicles in the northern city of Monterrey can be observed in the following Table 9.

46 For gasoline cars, 30 ppm sulphur gasoline is widely available in Mexico, making all current fuel-efficient gasoline technologies viable in the Mexican market. However, the universal availability of 150 ppm sulphur gasoline results in many cases of improper fuelling of vehicles designed to run on low sulphur fuel, with damage to their catalytic converters and high resulting levels of NOx emissions and also particulates to a lesser degree. See Mexican Climate Change Mitigation Workshop, 8 – 9 March 2010, in Mexico City.
47 Pre-analyses of this study began already in the year 2003.
48 More information about the RSD Method you will find in Unal, A.: Chocolate Vehicle Emissions Measurements on Mexico-US Border Cities: Data Collection Protocol, 2007.
49 One about the border cities Tijuana and Mexicali and the second about Monterrey and other eleven municipalities of Nuevo Leon, namely: Apodaca, Escobedo, Guadalupe, Monterrey, San Nicolás de los Garza, San Pedro Garza Garcia, Garcia, Santa Catarina, Santiago, Salinas Victoria and Juárez.
50 From the observed 42,989 vehicles about 12% plate number or at least it was not visible for the operating research team. More than 12,000 vehicles had identification marks that did not present readable information nor had information available in the vehicle registry; hence for this study the information of those vehicles is not employed.
51 PMs are not included, because of the use of RSD method.
52 This relative little amount of 273 vehicles – compared to the other groups - can lead to certain irregularities.

Table 9 Emission performance of ISVs (Monterrey)

	1980 and older	1981 - 1990	1991 - 1992	1993 - 1998	1999 and younger
Number of vehicles	273	1,604	1,043	4,862	16,909
Average value CO (% vol)	3.76	3.82	2.53	1.31	0.49
Average value CO_2 (% vol)	12.25	12.22	13.15	14.04	14.67
Average value HC (ppm)	2385.19	1848.48	1371.29	771.86	218.13
Average value NO (ppm)	1111.05	1095.08	1279.73	1238.61	545.1

Source: SEMARNAT, INE and CTS-Mexico: Campañas de Sensor Remoto en

A similar study for Mexicali and Tijuana (also performed by SEMARNAT, INE and CTS-Mexico) was done shortly before the study for the Monterrey Metropolitan Area. All in all, 14,778 ISVs were included and were separated in three different age groups, 1980 and older, 1981 – 1995 and 1996 and younger (Table 10). According to the emission performance, we observe similar results as in the study about the Monterrey Metropolitan Area.

Table 10 Emission performance of ISVs (Mexicali and Tijuana)

		1980 and older	1981 - 1995	1996 and younger
Number of vehicles	Mexicali	38	3202	6282
	Tijuana	52	2072	3132
Average value CO (% vol)	Mexicali	2.25	0.94	0.28
	Tijuana	2.93	1.02	0.34
Average value CO (% vol)	Mexicali	13.4	14.33	14.84
	Tijuana	12.92	14.28	14.79
Average value HC (ppm)	Mexicali	367	196	55
	Tijuana	254	168	57
Average value NO (ppm)	Mexicali	1090	1623	604
	Tijuana	893	1215	571

Source: SEMARNAT, INE and CTS-Mexico: Campañas de Sensor Remoto en Mexicali y Tijuana, 2008.

Regarding their emission performance, there is enormous variation between the different age groups in the two studies. In general newer vehicles are producing fewer criteria pollutant emissions. HC emissions for example from the oldest group are ten times higher than from the group with the youngest vehicles.

In the case of CO_2 emissions, these are higher among the younger vehicles. The key reason for that phenomenon is that technologies for private vehicles have evolved in a way in which they have developed more efficient ways for fuel burning; i.e. catalytic convertor. Such features have significantly reduced emissions from criteria pollutants like CO. The offset of this advantage is that reducing CO emissions in the fuel burning process causes an increase in the CO_2 emissions produced. Nevertheless, many technologies that go from low resistance tires to hybrid vehicles have been developed throughout the years to reduce CO_2 emissions.

5.5. Border region

5.5.1. Environmental Impacts

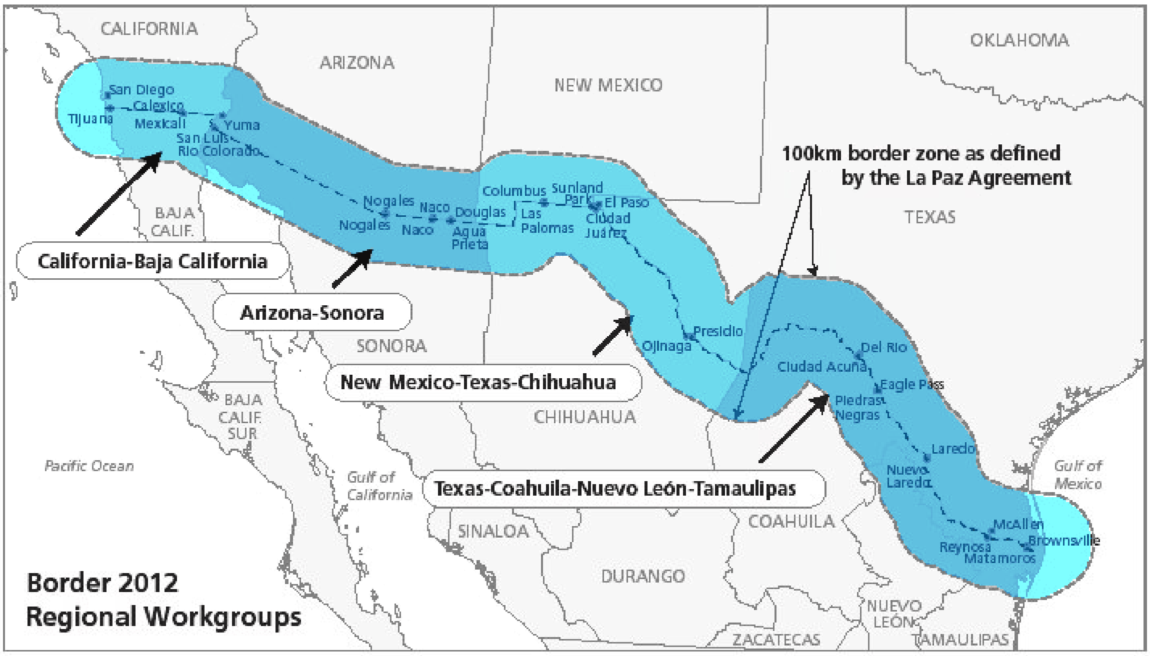
An enormous share of ISVs are used in the north of Mexico, in cities like Ciudad Juarez, Tijuana, Nogales, Reynosa, Monterrey[53] and smaller municipalities and villages in the border region. The reason for this is that ISVs are normally linked to migrant populations or populations that are constantly crossing between the two countries. However, as more time passes, the ISVs are more and more visible in other regions of the country as well, such as Merida and Guanajuato. The explanation is that there is already a well-developed internal market for cheap vehicles in Mexico.

The U.S. - Mexico border region is home to twelve million inhabitants and extends more than 3,100 km from the Gulf of Mexico to the Pacific Ocean. As an outcome of the 1983 La Paz Agreement on Cooperation for the Protection and Improvement of the Environment in the Border Area, both the U.S. and Mexico concluded that the "border region" would extend 100 kilometres on each side of the international border. The border region as designed in the La Paz Agreement is depicted in Figure 4. Projected population growth rates in the border region exceed anticipated U.S. average growth rates (in some cases by more than 40%) for each country. By 2020 the population is expected to reach 19.4 million.[54]

[53] Monterrey is the capital city of the north-eastern Mexican state of Nuevo León and the home for about 3 Million people (2005). It has the second largest metropolitan area in Mexico after the valley of Mexico. Monterrey is located in northeast Mexico, at the foothills of the Sierra Madre Oriental and Monterrey is an important industrial and business centre. The city is not a part of the here defined region of the La Paz Agreement, but highly occupied by second-hand vehicles from the U.S. and hence highly effected by the problem.

[54] 90% of the border population resides in 14 paired, inter-dependent sister cities. These "sister-cities" are metropolitan areas in both countries. Rapid population growth in urban areas has led to unplanned development, greater demand for land and energy, increased traffic congestion and waste generation, overburdened or unavailable waste treatment and disposal facilities, and more frequent chemical emergencies. The diverse area includes large deserts, numerous mountain ranges, rivers, wetlands, large estuaries, and shared aquifers. See EPA: US-Mexico Border 2012 Program. See http://www.epa.gov/usmexicoborder/framework/index.html (March 2010).

Figure 4 U.S. – Mexico Border Region



Source: EPA: US-Mexico Border 2012 Program.

5.5.2 Health Impacts

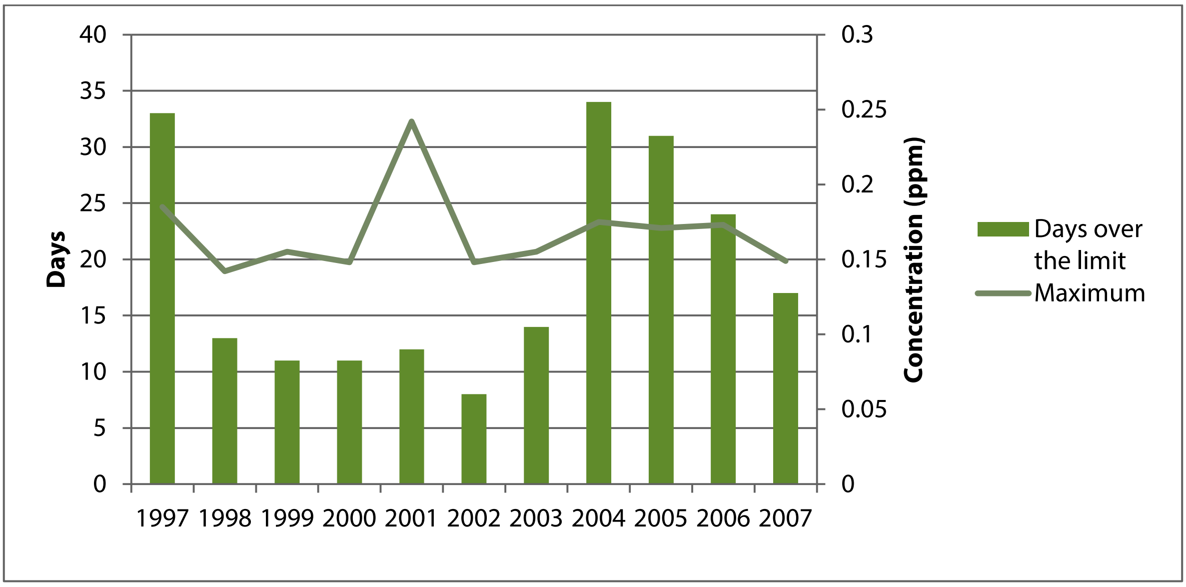
The following is an overview and description of the health impact of the most important gases (O_3, CO, PM and CO_2) caused (mainly) by ISVs in the border region (especially by those that have lacked adequate maintenance and have big engines).

Ozone (O3), NOx and VOCs55:

The reactivity of O_3 causes health problems because it damages lung tissue, reduces lung function, and predisposes the lungs to sensitivity to other irritants. This decrease in lung function is generally accompanied by symptoms including chest pain, coughing, sneezing, and pulmonary congestion. Scientific evidence indicates that ambient levels of O_3 not only affect people with impaired respiratory systems, such as asthmatics, but healthy adults and children as well.[56] O_3 is one of the main concerns in the border region and all control stations have reported extremely high O_3 values during the last years. Graph 22 demonstrates the number of days over the limit of 0.11 ppm (1 hour average) in the northern city of Monterrey and the yearly maximum concentration of O_3. Both values provide enough reasons to act rapidly in the effort to reduce O_3 rapidly.

[55] Sometimes they are also called: “Smog forming pollution”. This is created by two types of vehicle emissions – hydrocarbons (including non-methane organic compounds, or NMOG) and oxides of nitrogen (NOx) – which, when combined with sunlight, form smog. See for more information EPA: Green Vehicle Guide.
[56] See for example Schoik, V.: Air Quality in the United States Mexican Border Region, 2003.

Graph 22 Maximum concentration and number of days over the limit of O_3 in the Monterrey Metropolitan Area



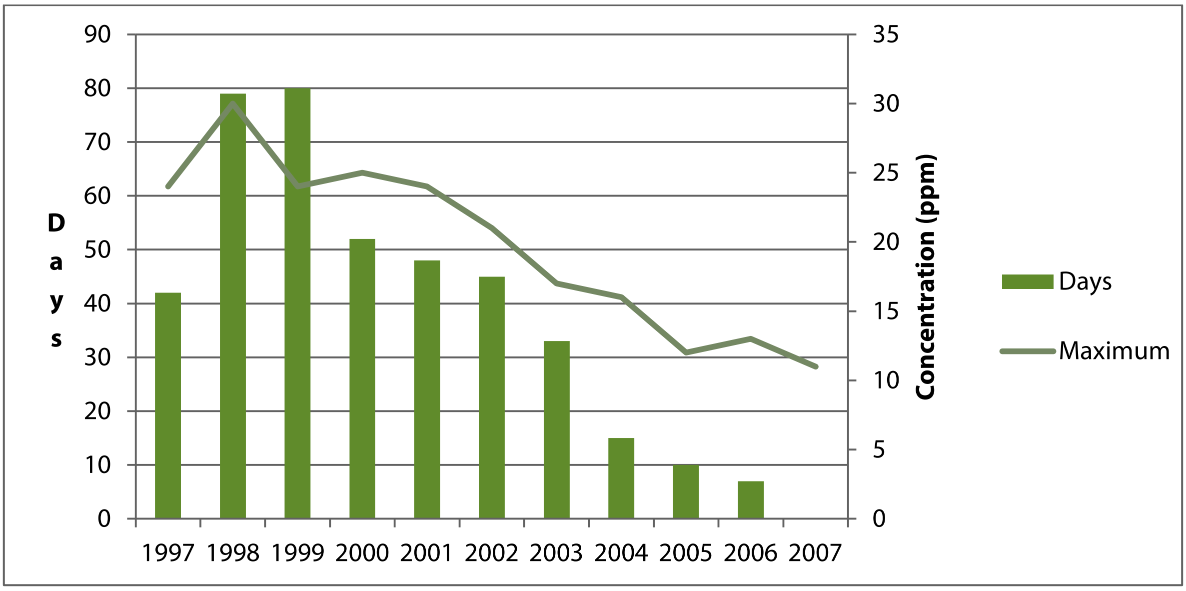
Source: INE: Resultados del procesamiento de información de las redes de monitoreo atmosférico de los estados, recopilada por el INE-DGICUR, 2008.

Carbon Monoxide (CO)

CO is a colourless, odourless, and poisonous gas produced by incomplete combustion of fuels. When CO enters the bloodstream, it reduces the blood's ability to carry oxygen to the body´s organs and tissues. Overexposure may be fatal. Exposure to elevated CO levels can cause impairment of visual perception, manual dexterity, learning ability, and performance of complex tasks. For example, in the U.S., more than ¾ of the CO emissions are from transportation sources; motor vehicles on highways contribute the most emissions.[57] In the U.S. border city of El Paso, CO emissions caused by transport were 76% of total CO emissions in 2002 and declined to 66% in 2005.[58] Even though CO emissions – maximum value and days over the limit - declined slowly during the last years (Graph 23), the values are still high and provide enough motivation for political actions.

[57] See Schoik, V.: Air Quality in the United States Mexican Border Region, 2003.
[58] See Joint Advisory Committee (JAC): El Paso Air Quality Trends 1999 – 2007, 2008.

Graph 23 Maximum concentration and number of days over the limit of CO in Mexicali

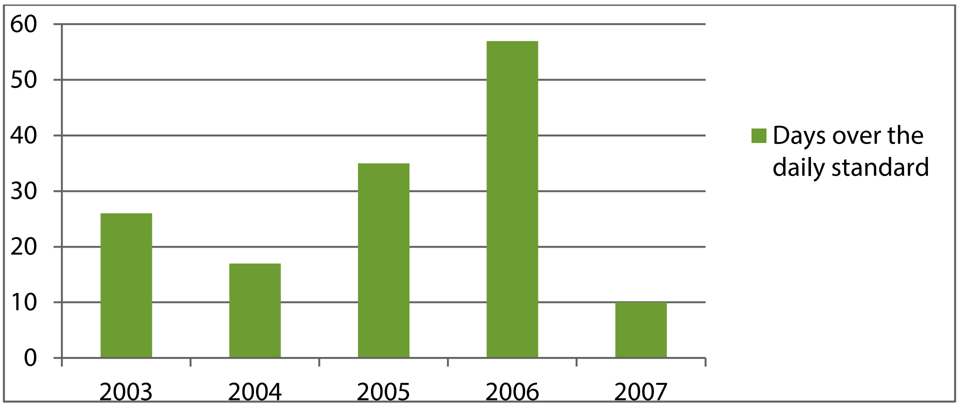


Source: INE: Resultados del procesamiento de información de las redes de monitoreo atmosférico de los estados, recopilada por el INE-DGICUR, 2008.

Particulate Matter (PM)

Studies of human populations exposed to high concentrations of particles and laboratory studies of animals and humans show that PMs represent the biggest concern for human health. The smallest particles pose the greatest health risk, because they can be aspirated deep into the lungs with each breath and can evade the respiratory system´s natural cleansing abilities.[59] Graph 24 shows the amount of days over the daily standard ($PM_{2.5}$) in the Monterrey Metropolitan Area between 2003 and 2007.

Graph 24 Days over the daily standard ($PM_{2.5}$) in the Monterrey Metropolitan Area (2003 – 2007)



Source: SEMARNAT, INE and CTS-Mexico: Campañas de Sensor Remoto en la ZMVM, 2008.

[59] See Schoik, V.: Air Quality in the United States Mexican Border Region, 2003.

5.6 BAU-scenario: GHG-emissions and fuel consumption of ISVs

GHG-emissions emitted from vehicles include not just CO_2, but methane (CH_4) and nitrous oxide (N_2O) and relatively small amounts of hydro fluorocarbons (HFCs) and black carbon. In 2006, transport accounted for 13% of global GHG-emissions while 23% of global CO_2 emissions from fuel combustion were transport related. It is important to notice that GHG-emissions from the transport sector increased by 130% globally between 1970 and 2006.[60]

In Mexico, transport represents the largest and fastest-growing sector[61] in terms of GHG-emissions. It is responsible for about 18% of total GHG-emissions, with road transport accounting for about 90% of energy consumption and CO_2e emissions from the transport sector. According to the Ministry of Environment, by 2030 GHG-emissions form the transport sector will account for 30% of total emissions and will reach 296 $MtCO_2e$. This is more than double the emissions calculated for 2006 (144.7 $MtCO_2e$).

CTS-Mexico constructed a business as usual (BAU) scenario with the aim of estimating the impact of ISVs imported into Mexico from 2009 until 2035. It is assumed that the Mexican government will not regulate the ISV-market and Mexicans will be able to import second-hand vehicles without additional regulation other than the age restriction schedule stated in NAFTA: Before 2011 only vehicles 10 years and older (according to the model year[62]) can enter, by 2011 vehicles 8 years and older can enter, by 2013 vehicles 6 years and older are allowed, by 2015 vehicles 4 years and older are permitted, by 2017 vehicles 2 years and older are allowed, and finally by 2019 no age restriction is in placed on these vehicles.

The BAU scenario was built based on the number of vehicles by segment and fuel-type existing in 2009 according to the Mexican Institute of Petroleum (IMP, 2010[63]). The age division was done according to the shares reported by Melgar (2004), which is the only available source of information that allows division of fleet by age. It was assumed that no relevant changes in the composition of fleet by age occurred between 2004 and 2009.

New vehicle sales and ISV sales for the years 2009 and 2010 are taken from available data from the Mexican Association of Car Distributors (AMDA[64]). Projections on new vehicles sales for the period 2011-2035 were made based on historical information from the Mexican Association of the Automotive Industry (AMIA[65]). For projections on second-hand vehicles imported for the period 2011-2035 the numbers were set as equivalent to the number of new vehicles sold. As can be seen in the historical data, during years without the regulatory decree (such as 2006 and 2007) ISV sales have been higher than new vehicle sales. However, during these years, legalization of existing ISVs may have accounted for a portion of the registrations. Therefore, national institutions recommend using the assumption that, without regulation, imports of second-hand vehicles are equal to new vehicle sales.

The survival rate for the different types of vehicles used was that provided by the IMP. The average fuel efficiency by type of vehicle used was also taken from the IMP. Finally, in order to calculate GHG-emissions the emission factors were taken from IPCC[66] and the emission factors for NOx, PM_{10}, and $PM_{2.5}$ emissions were taken from the Inventory of Criteria Pollutants for the Metropolitan Zone of the Valley of Mexico.[67]

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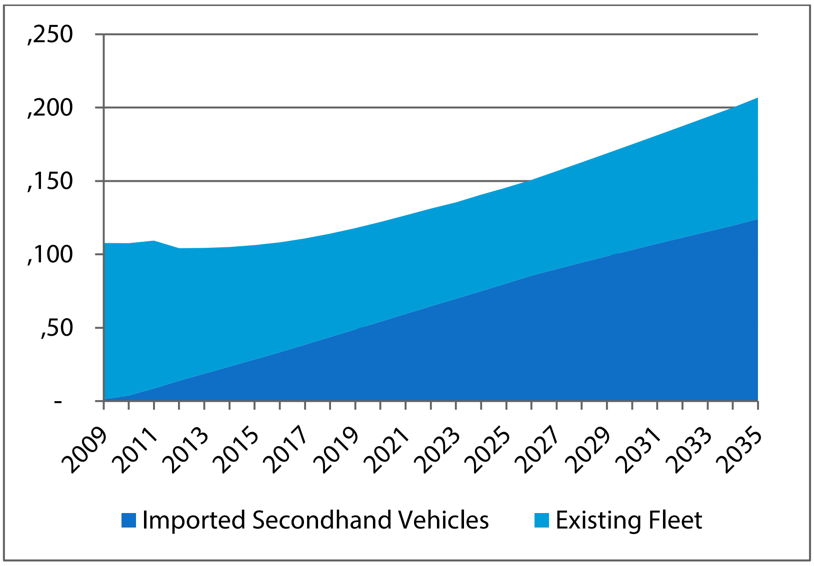
[60] See Bridging the gap: Bellagio Declaration on Transportation and Climate Change, 2009.
[61] The sector consists of the road, air, rail and water transport subsectors.
[62] This means that vehicles sold on the last months of 2009 that correspond to model year 2010 can also enter.
[63] Institution in charge of calculations for the Ministry of Energy
[64] AMDA = Asociación Mexicana de Distribuidores de Automotores
[65] AMIA = Asociación Mexicana de la Industria Automotriz
[66] IPCC = Intergovernmental Panel on Climate Change
[67] SEMARNAT, 2010.

Annex 2 shows the information used regarding new vehicle sales, ISVs, survival rates, fuel efficiency and emission factors.

It is worth mentioning that there is no available information on how ISVs will be distributed by ages when the age restrictions in NAFTA are periodically shortened until they disappear. Therefore, it was assumed that the current distribution will be maintained but shares will shift to the newest allowed vehicles. For example, currently model year 1991 is the newest one allowed. Hence, all vehicles that are 10 years old and vehicles that were sold in 1992 (really 9 years old) but that were still 1991 model year are the newest vehicles allowed. In the current configuration 10 year older vehicles make up 44% of entering ISVs and 9 year older vehicles make up 14% of those. When by 2011 model year 1993 will be allowed, then in the BAU scenario 8 year older vehicles will make up 44% of entering ISVs and 7 year older vehicles will make up 14% of them. This will tend to underestimate the impact of regulations aimed at ISV regulation since it will assume that by 2017, when the market is totally liberalized regarding age restrictions, the vehicles entering will be relatively new. However, as no information is available for a more precise assumption we have considered that it is better to underestimate than to overestimate the impact of the analysed trend. Graph 25 illustrates Mexico´s BAU scenario from 2009 – 2035 for GHG-emissions).

Graph 25 BAU GHG-emissions (Mt CO2e) from ISVs and the existing fleet in Mexico from 2009 - 2035



Source: CTS-Mexico with data from IMP, MELGAR, AMDA, AMIA.

GHG-emissions of all ISVs that entered Mexico before 2009 are included as a part of the existing vehicle fleet. In 2009, Mexico´s passenger LDV vehicle fleet was responsible for about 108 Mt CO_2e. According to the BAU scenario constructed, by the year 2035 CO_2e emission from LDVs will increase up to 207 Mt CO_2e and this fleet will emit a total of 3,780 Mt CO_2e in the whole 2009- 2035 period.

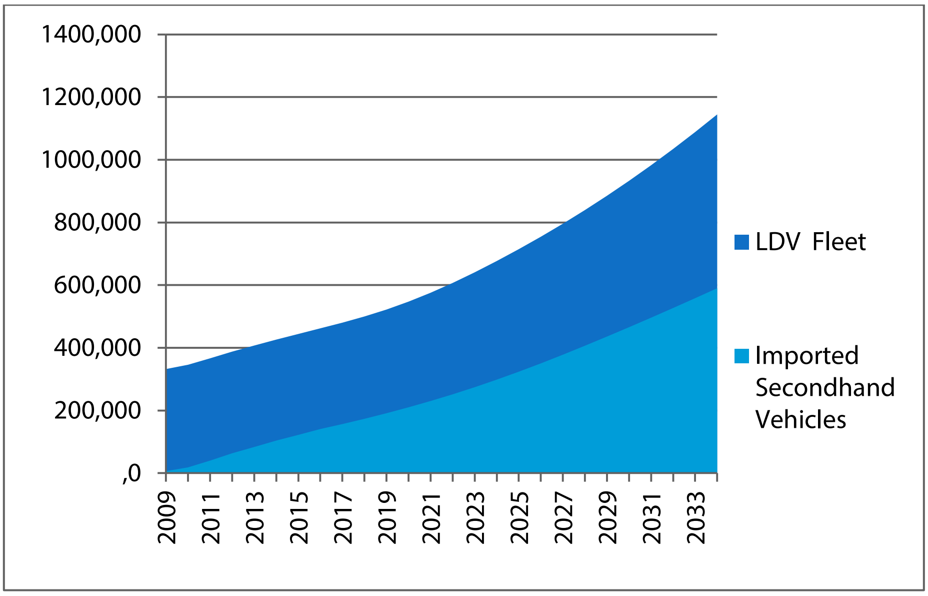
With respect to GHG-emissions specifically from ISVs entering after 2009, without any ruling to regulate their entrance and use, the GHG-emissions percentage resulting from them will reach 60% of LDV GHG-emissions by the year 2035. In absolute terms this represents 124 Mt CO_2e. The short downfall in the year 2012 can be explained due to the economic crisis in 2009 and 2010. In both years, new vehicle- and ISVs sales decreased with the consequence that Mexico´s passenger vehicle fleet hardly grew. The impact in the GHG-emission of the economic crisis recovery will be noticeable in 2012. Finally, Mexico´s fuel consumption of ISVs will increase in proportion with the GHG-emissions caused by them.

As with GHG-emissions, ISVs will be responsible for 60% of passenger vehicle´s fuel consumption in 2035, total fuel consumption from LDVs will reach 93 billion litters of gasoline and total fuel consumption of ISVs entering in 2009 and after will reach 55 billion litters of gasoline.

According to this scenario it is possible to state that in the case that a zero entrance policy had been implemented starting in 2009 and maintained through 2035, the LDVs would reach 83 Mt CO_2e in 2035, and would emit a total of 1,716 Mt CO_2e less in the whole period.

A BAU scenario was also calculated for three pollutant criteria emissions: NOx, and $PM_{2.5}$. The following Graph shows NOx emissions in a BAU scenario for the existing vehicle fleet (all vehicles that entered the fleet before 2009) and for imported second-hand LDVs entering in 2009 and later.

Graph 26 BAU NOx (tons) emissions from ISVs and the whole LDV fleet in Mexico from 2009 – 2035



Source: CTS-Mexico with data from IMP, MELGAR, AMDA, AMIA.

As can be appreciated, ISVs entering from 2009 until 2035 will cause about 590,250 tons of NOx emissions by 2035. This will be equivalent to about 51% of the total 1,144,740 tons of NOx emissions caused by all LDVs in these years. The total NOx emissions of ISVs entering from 2009-2035 will be 16,895,649 in the whole period (41% of total LDV emission).

$PM_{2.5}$ from ISVs entering after 2009 will reach 3,476 tons by 2035. This is equivalent to 45% of the total 7,801 tons estimated for the whole LDV fleet in that year. In the whole period ISVs will be responsible for 40,967 tons of $PM_{2.5}$ (35% of total LDVs emissions).

5.7 Road Safety

The phenomenon of the growing flow of second-hand vehicles is relevant because ISVs are a growing share of the fleet of many countries, and contribute to high fuel consumption, low air quality and road-safety issues faced by these countries. An important portion of exported second-hand vehicles would otherwise be scrapped in their country of origin. CO_2 emissions contributing to worldwide climate change would have likely been avoided if these vehicles had been scrapped rather than exported[68]. The emissions caused by these vehicles are higher when they have had little maintenance and belong to larger engines and higher weight categories.

The number of people killed in worldwide road traffic crashes is rising constantly and in 2004, approximately 1.2 million people died of this cause. Additionally, the number of people injured was 50 million. The total number of road traffic deaths and injuries worldwide is forecast to rise by some 65% between 2000 and 2020.[69]

There exist many factors which influence risk in road- traffic, such as rapid motorization, increased need for travel, choice of less safe forms of travel, human behaviour (speed, alcohol, drugs), hand held mobile telephones, road related factors and finally vehicle related risk factors, which is the relevant factor for this document. Vehicle design has considerable influence on crash injuries, its contribution to crashes, through vehicle defects, is generally around 3% in high-income countries, 5% in Kenya and 3% in South Africa.[70] The European Commission has stated in its road safety program that if all vehicles were designed with the same standards of the best car currently available in each class, an estimated 50% of all fatal and disabling injuries could be avoided.[71]

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[68] It could be argued that scrapping potential ISVs in their country of origin would result in higher new vehicle sales in the importing country and therefore in more emissions, since these would be driven more. However, as will be explained in Chapter 2, a significant part of ISV buyers could not afford new vehicles. Still some new vehicle sales could be fostered because more national second-hand vehicle sales would allow their sellers to buy new cars.

[69] See WHO and WB: World report on road traffic injury prevention, 2004.

[70] See WHO and WB: World report on road traffic injury prevention, 2004.

[71] See European Commission: European Road Safety Action Program. Halving the number of road accident victims in the European Union by 2010: a shared responsibility, 2003.

A study published by Blows, et al (2003), demonstrates that there exists a strong relationship between vehicle age and accident injuries. This study, conducted in Auckland, New Zealand, takes into account the problems related to the use of cross-sectorial data and inadequate control of many important confounding variables[72]. The following table illustrates the association between vehicle age and accident injuries. The number of accidents resulting in injury for cars over 15 years old is approximately three times higher than for vehicles 4 years old[73] or younger.

Table 11 Odds ratio (95% CI) between vehicle year and car-crash injury

Vehicle age	Unadjusted	Driver´s age and sex adjusted	Multivariable adjusted
<15 years	5.94	4.8	2.88
10 to 14 years	2.27	1.81	1.02
5 to 9 years	2	1.66	1.38
> 5 years	1	1	1

Source: Blows, S., et al: "Vehicle year and the risk of car-crash injury", 2003.

Several studies on safety defects have found that 12% of vehicles involved in accidents had defects that were likely to have caused the accident or contributed to its severity. DEKRA observed that in 5% of private vehicle crashes the direct cause was a technical defect. Additionally, in 4% of the cases a technical defect was one of the causes, and in another 4% a technical defect was probably the cause. This report also demonstrates that 24.6% of the vehicles involved in a crash had serious defects and, in 24% of these, the vehicle defects were considered to be the cause of the crash; 45% could be blamed on brakes, 23% on tires, and another 25% on suspension.[74]

A second important concern in the context of older vehicles relates to crashworthiness or the secondary threat of severe injury to occupants when a vehicle is involved in an accident. Older vehicles are less likely than newer ones to have safety features, such as airbags and side impact systems.[75] The following Table shows the impact of safety features on injured occupants according to a study of the International Transport Forum and the assumed percentage reduction in injured occupants in an accident for each one.

[72] Variables are drivers age, sex, education level, ethnicity, time of day, acute sleepiness score, marijuana and alcohol use before the crash, seatbelt use, driving exposure in hours per week, license type, current vehicle safety inspection certificate, insurance status of the vehicle, number of passengers, travelling speed, and engine size.
[73] See Blows, S., et al: Vehicle year and the risk of car-crash injury, 2003.
[74] DEKRA: Internationale Strategien zur Unfallvermeidung. In: Technische sicherheit im Strassenverkehr. DEKRA Fachschrift 58/05. DEKRA Automobil GmbH, Stuttgart, 2005.
[75] See for example Vaughan, R.: Analysis of the effect on safety of the ageing of the car fleet in NSW, 1996.

Table 12 Safety Feature and Reduction in Injured Occupants in an accident (in %)

Safety Feature	Percentage Reduction in Injured Occupants in an Accident
Electronic Stability Control	46%
Head Side Air Bags	37%
Thorax Side Air Bags	26%

Source: CTS EMBARQ Mexico, 2012. Data from ITF.

Additionally, road accidents cause high economic costs in developing and economic transition countries. In general, in low- and middle-income countries, road traffic deaths are relatively high compared to their motorization rate.[176] The forecasts for these countries is that there will be an increase of 80% of road traffic deaths between 2000 and 2020. According to a study performed by TRL Ld, average annual cost of road accidents was 1% of GNP in developing countries, 1.5% in economic transition countries and 2% in highly motorized countries.[77] The magnitude of these losses has adverse and severe implications for poverty reduction given that every 1% increase in economic growth is estimated to reduce poverty levels by 0.7%.[78]

5.8 Summary

5.8.1 Supply

- The U.S. second-hand vehicle market is huge and until recently, the largest in the world. From the state of California alone, the possible supply of 10 year or older SUV´s, Pick-ups and Vans is of 3 million vehicles each year.

- The large proportion of the population that can afford to renew their vehicles periodically is an important factor that turns the large amount of existing vehicles in the U.S. into a potential source of motorization for the Mexican population

- The relatively high recent price of gasoline in the U.S. increases the cost of using these vehicles inside the U.S. This cost is even higher because of the environmental, safety and fuel consumption regulations introduced in the whole country, but focusing on border states. Therefore owners of vehicles with high emissions and low fuel efficiency want to sell them but because of these conditions, the price at which they can do so is low.

5.8.2 Demand

- The Mexican vehicle fleet will increase dramatically in the next years and decades. Because of low income levels, most Mexicans are not able to afford new vehicles and hence, their motorization will happen through the acquisition of national second-hand vehicles and ISVs.

[76] International Road Federation: World Road Statistics, 2009.
[77] Rumar, K.: Transport safety visions, targets and strategies: beyond, 2000.
[78] Watkins, K., and Sridhar, D.: Road Traffic Injuries: the hidden development crises, 2009.

- Low costs of using vehicles with low fuel efficiency and high emissions because of the lack of strict and well implemented environmental and safety regulation in Mexico make it a fertile market with a large demand and a higher valuation of ISVs vehicles.
- Bad quality public transport alternatives for a large share of the population increase the value that people assign to ISVs
- The fact that insurance is not compulsory, the wide selection of available ISVs, the rumour that vehicles sold in the U.S. are better than those sold in Mexico, and the sense that having a private vehicle gives status to a person are other factors that increase the attractiveness and value assigned to ISVs in Mexico.
- The price differential (100% on average) of similar second-hand vehicles between the U.S. and Mexico allow them to be sold at a price that is higher than the price they would be sold for in the U.S., even with the taxes charged for importing second-hand vehicles, and at a lower price than comparable vehicles in the Mexican market
- The price difference between similar second-hand vehicles in Mexico and the U.S. decreases with vehicle age. This will be particularly important once newer vehicle are allowed into Mexico.
- The number of ISVs in Mexico has reached very high numbers; up to 1,708,214 vehicles have been imported during years where no regulations have been set by the Mexican government.
- ISVs have surpassed the number of new vehicle sales in Mexico
- By 2009 ISVs made up 35% of the total LDV Mexican fleet and by 2025 they will account for 45% of it without regulation.

5.8.3 Characteristics of ISVs in Mexico

- Records of second-hand vehicles imported into Mexico between 2005-2008 show an age composition dominated by 10 year older vehicles (30%), followed by 11 year older vehicles (19%), and 12 year older vehicles (15%). The average age of ISVs is 11.2 year old.
- The share of 9 year older vehicles is significant although it was only possible to import them for a very short period each year.
- The trend to import younger vehicles will probably continue to grow up to a certain point because of a high demand for younger ISVs and due to changes of regulations in NAFTA. However, the conditions for the growing supply and demand of second-hand vehicles suggest that trade of relatively older vehicles will continue to present a benefit opportunity for the U.S. and the Mexican populations.
- The most traded vehicles across the U.S. – Mexico border are from brands that tend to produce SUVs, Vans and Pick-ups, which make up 69% of ISVs entering Mexico
- Studies from the Mexican Ministry of Environment show that ISVs are, in general, vehicles that have been heavily used, have high fuel consumption, a big engine and that will still be used significantly when they are in the Mexican fleet:

- ISVs average 160,000 km on the tachometer when entering Mexico.
- On average they are used 15000 km per year once they enter Mexican territory.
- The average fuel efficiency of ISV is 8 L/km.
- Most of the ISVs (75%) are equipped with an engine between 3 L and 7.5 L
- Many ISVs are used for transporting goods or passengers (above average mileage), while others are used as a second vehicle (lower than average mileage). Hence, average driven km per year of ISVs is likely similar to those driven on new passenger vehicles in Mexico.

5.8.4 Fuel efficiency and fuel consumption

- Vehicles that are older than ten years show a fuel efficiency that is significantly lower than the average of new vehicles. Specifically, Light Trucks (which is the preferred segment for ISVs) only have 40% of their initial fuel efficiency after 25 years in use.
- ISVs tend to lower the Mexican fleet's average fuel efficiency and this will continue to be the case, especially as they grow in proportion to the total fleet and without any regulation to promote their maintenance and prevent those in bad conditions from entering. The average fuel efficiency for vehicles obtained by the national fleet in Mexico will be 16 km/litre by 2024; however, the average fuel efficiency for an ISV will be just 7 km/litre for the same year.

5.8.5 Emissions

- In 2002 the older passenger vehicles in Mexico (older than 15 years) made up only 12% of the total passenger vehicle fleet. However, they were responsible for 55% of total passenger vehicle´s criteria pollutant emissions. On the other hand, newer models (until 10 years) were represented 50% of the passenger vehicles and were responsible for less than 15% of total passenger vehicle criteria pollutant emissions.
- According to the Mexican Ministry of Environment (SEMARNAT), the ISV fleet generated: 18 Mt CO2e (including 0.14 Mt CO2e CH4 and 0.59 Mt CO2e N2O), one million CO, 98,000 tons HC and 57,000 tons NOx in 2008.[79]
- Criteria pollutant emissions of ISVs cause serious health problems, particularly in the U.S.-Mexico border region where most ISVs are used. Concentration of criteria pollutant emission caused by older vehicles, such as CO, frequently exceeds limits set by border cities.

[79] See SEMARNAT: Importación definitiva de vehículos usados. Consecuencias e Impactos ambientales, 2008.

5.8.6 BAU Scenario

- In 2009, Mexico´s passenger LDV vehicle fleet was responsible for 108 Mt CO2e. By the year 2035 CO2e emission from LDVs will increase up to 207 Mt CO2e and this fleet will emit a total of 3,780 Mt CO2e in the whole 2009-2035 period.

- Without any ruling to regulate the entrance and use of ISVs, the GHG-emissions percentage resulting from them will reach 60% of LDV GHG-emissions by the year 2035. In absolute terms this represents 124 Mt CO2e.

- ISVs will be responsible for 60% of passenger vehicle fuel consumption in 2035; total fuel consumption by LDVs will reach 93 billion litters of gasoline and total fuel consumption of ISVs entering in 2009 and after will reach 55 billion litters of gasoline.

- In the case that a zero entrance policy had been implemented starting in 2009 and maintained through 2035, the LDVs would reach 83 Mt CO2e in 2035, and would emit a total of 1,716 Mt CO2e fewer emissions in the whole 2009-2035 period.

- ISVs entering from 2009 to 2035 will cause 590,250 tons of NOx emissions by 2035. This is equivalent to 51% of the total 1,144,740 tons of NOx emissions caused by all LDVs in this year. The total NOx emissions of ISVs entering from 2009-2035 will be 16,895,649 in the whole period (41% of total LDV emission).

- PM2.5 from ISVs entering in 2009 and later will reach 3,476 tons by 2035. This is equivalent to 45% of the total 7,801 tons estimated for the whole LDV fleet in that year. In the whole period ISVs will be responsible for 40,967 tons of PM2.5 (35% of total LDVs emissions).

6 Public Policy Recommendations

6.1 Barriers to ISVs

Entrance barriers to ISVs aim to reduce the absolute number of imports of a category (i.e., all vehicles older than five years) of second-hand vehicles. Most entrance barriers are fast and cheap to implement, and in most cases relatively easy to apply for designated authorities. Well-designed entrance barriers will contribute to a significant reduction of high-emitting or dangerous passenger vehicles. Examples include border inspection, certificates (i.e., of origin), import taxes, import quotas and required mechanical standards. Two steps should be considered in the context of free markets:

- Border inspection.
- Environmental and safety certificate.

6.1.1 Policy focus on ISVs Regulation

If the aim of barriers is to regulate the emission and safety performance of ISVs, then a border inspection or an environmental certificate will have to focus on the following effects:

1. Prevent the entry of high-emitting and/or insecure ISVs
2. Reduce the total volume of second-hand vehicles entering the country

The policy settings and recommendations for entrance barriers rely on three different spheres, just as in the case of compulsory insurance or I&M programs. The first sphere consists of legal aspects and enforcement actions. This sphere is very relevant for all other command and control tools. Technical recommendations will also be included in this section. Finally, entrance barriers that are aimed at regulating ISVs should be implemented in combination with additional enforcement programs. Therefore, diverse combinations of these options are also encompassed in this section. It is important to note that for correct implementation of any of the options provided, recommendations in the other two spheres must be taken into account.

Programme design should consider the following elements:

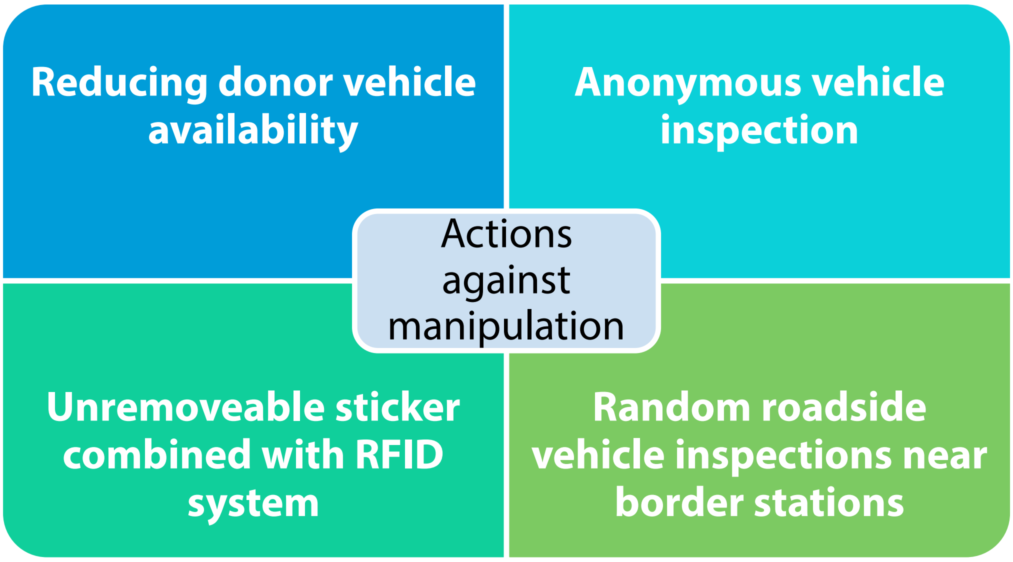
- **Legal requirements:** There are several methods that could be used, including the current national emission and safety standards for vehicles in use, set standards with the same characteristics as those recommended for I&M programs, or implement standards which the major country of origin uses. For example, in Mexico vehicle in use standards from California or Texas could be considered as a valid environmental import prerequisite. . This option would have the big advantage that failed vehicle from these states would not be able to enter Mexico.

- **Implementing entrance barriers**: Contrary to I&M programs, border inspection programs can be rapidly implemented and do not require lengthy preparations or early announcements for the public. If international treaties exist with a reference to the bilateral trade of ISVs, it would be advisable to consult with the affected trade partner. This consultation will be all the more important if the trade partners are closely integrated.

- **Institutional Design**: All control stations should be managed according to the same regulation, impose the same requirements, and use the same second hand vehicles' control methodology/technology. Border inspection stations should not offer maintenance function for failed vehicles. Failed vehicles should not be allowed to enter the country. Risks and costs should be borne by the motorist, and in cases where the authorities of the country of origin do not allow the return of the vehicle or the affected motorist (i.e. visa is expired, etc.) the vehicle shall be scrapped at the motorist expense.

- **Enforcement and Compliance Promotion:** Proof of border inspection or the environmental/safety certificate should be required before a vehicle license or license plate can be issued. Border stations should be also linked to each other. A rejected vehicle should be locked for a certain time (at least 3 days) to participate in another inspection to reduce possibilities of corruption, station-jumping, etc. The potential of fraud and corruption should also be addressed, and the following figure presents actions that can aid in manipulation prevention.

Figure 5 Border inspection: Actions against manipulation



The technical aspects of an import barrier programme include:

- **Location of border inspections:** Directly at border crossings and harbours.
- **Quantity and capacity of inspection centres.**
- **Adequate technology:** Technology should be able to prevent temporary tuning that enables test passing. Additionally, the roadworthiness test should be automatic. **Number of vehicles checked:** If possible, every ISV should be inspected, however, the main focus should be on older passenger vehicles (5 years and older), and light trucks. The road-safety inspection should be performed on all ISVs.
- **Staff training**.

6.1.2 Optional Elements for a border inspection program

1. **Mandatory three-way catalytic converter**: Will contribute significantly to reduce criteria pollutants. While performing a border inspection or during the inspection to receive the environment/safety certificate, converter malfunctions can be located and fixed.
2. **Combination with other entrance barriers:** For example the requirement of a catalytic converter, road safety requirements and import duties depending on the vehicle´s age and size. Each additional entrance barrier must be in conformity with international agreements.
3. **Follow-up program**: Basic road safety checks and a visual exhaust emission check for passenger vehicles older than 6 years should be performed twice per year. It is recommended to expand such a follow-up program to the whole passenger vehicle fleet to avoid discrimination.
4. **Combination with a public awareness campaign**: A smart campaign could even upturn the effect of border barriers, whereby the campaign has to focus on the regions most affected by ISVs. Potential importers should know that there are strict border controls and only clean vehicles are allowed entry into the country. This would increase the demand for clean vehicles in the country of origin, and prices would increase. The affected population should also be informed about the negative health impacts of highly polluting ISVs.

6.1.3 Emission mitigation and fuel-savings potential scenario

Assumptions

Border inspections and environmental/safety certificates indirectly regulate the efficiency of ISVs by requiring that they meet minimum environmental standards. The intervention for Mexico assumes the adoption of standards that would result in 15-20% of vehicles failing the test (as was recommended in this document for setting standards for this policy). The policy would start in 2013. In order to follow a conservative approach it was assumed that the standard set resulted in 15% of ISVs to fail the test and not be allowed to cross the border. Therefore it is assumed that the stringency of the standard required at the border would be revised by the Mexican government in such a way that this 15% failure rate is maintained throughout the 2013-2035 period.

To project program costs, it is assumed that stations are managed by private entities under government concessions. Therefore, the price charged reflects the investment in the station, equipment, salaries, training, and profit. We assumed the highest price found; that of the I&M Program in California ($40 USD per test).

Results

With respect to GHG mitigation, a border inspection program could potentially reduce a total of 240 Mt CO_{2e} between 2013-2035.This emission reduction is equivalent to a 6% reduction of GHG emissions of the total LDV GHG emissions from the whole LDV fleet from 2009 until 2035.

In terms of criteria pollutant emission reduction, the total NOx emission reduced would equal 548,570 tons. This reduction is equivalent to 3.25% of total BAU NOx emissions from LDVs between 2009-2035. The total $PM_{2.5}$ emission reduction would be equivalent to 3,978 tons; 3.41% of total LDV $PM_{2.5}$ emissions from 2009 to 2035.

The total cost of the program will be equal to $1.278 billion USD (NPV[80]). The monetary benefits of the program, in terms of fuel savings amount to $14.9 billion USD (NPV) which is 5% of total fuel expenditure of all LDVs in the BAU scenario. Calculating the net benefit of the program taking into account the fuel savings and the cost of the program yields $13.6 billion USD (NPV). This means an average cost of $5 USD (NPV) per reduced ton of CO_2, $2330 USD (NPV) per reduced NOx ton, and $321,357 USD (NPV) per $PM_{2.5}$ ton reduced.

6.2 Scrapping programme

A Scrapping Program Scheme has the objective of providing incentives to promote the early retirement of older vehicles and to replace them with other means of transportation. In this way, scrapping programs help reduce the average age of the national fleet by increasing the vehicle mortality rate and thus accelerating the rate at which the fleet is renewed.

Scrapping schemes have the dual effect of increasing mortality of older vehicles while also increasing demand for new vehicles. Therefore, this policy has been portrayed as an environmental policy that fosters growth of the automotive market. However, many scrapping schemes have produced much better results in boosting new automotive sales than in achieving environmental, health or fuel saving results. As will be seen throughout this section, an adequate design is crucial for promoting a scrapping program will achieve such impacts.

This offers an analysis of four policy actions that can be employed to regulate imported second-hand vehicles (ISVs): scrapping, barriers to ISVs, inspection and maintenance programmes and compulsory vehicle maintenance.

Each section includes a brief description of the policy action as well design recommendations. Finally, a scenario in which each policy was implemented in the Mexican context is provided. Results for the reduction of CO_2e, NOx and $PM_{2.5}$ emissions and costs are shown. Conclusions are presented in Chapter 8 of the study.

6.2.1 Policy Design

In the development of a scrapping program, there are five main decisions to be taken into account in the design. These decisions will assist the regulator in properly set a regulatory target and have success:

- **Main Objective of the Initiative:** The regulator needs to decide whether the resources are to be directed merely to promoting the scrapping of older vehicles or if the resources will be allocated only if there is replacement of the scrapped vehicles. The first option is called Cash-for-Scrapping and the latter is named Cash-for-Replacing.
- **Eligibility Conditions**: The program must set the minimum requirements for those vehicles that may be scrapped. These conditions might include minimum age, kilometres driven, emissions and fuel consumption maximums or minimums, date of registry and vehicle class.
- **Eligibility Conditions for Replacement**: The authority might place restrictions on how compensation might be spent. It might be limited to either new or national second-hand vehicles, vehicles with certain emissions, fuel efficiency and safety standards, or certain vehicle classes.

[80] Net present value with a 10% discount rate.

- **Characteristics of the Economic Incentive**: The relevant features of this demarcation include the source of funding and the amount of compensation for trade-in. The financing source will determine the total budget for the program. Considering different funding sources for programs is an important part of making a program's desired outreach possible. Possible sources for funding include public monies, manufacturers, drivers and any combination of these.
- **Trade-in Payments:** The key condition to ensuring participation of ISV users in a Cash-for-Replacing scheme is that their cost of participation has to be lower than their cost of not participating. The user's cost of not participating in the program is the cost of selling their current ISV and buying another ISV. The higher the price of the vehicle purchased through the program and the higher the price of the ISV the participant would sell, the higher the trade-in payment needed to incentivize participation of ISV users. In the cash-for-scrapping scheme, participation depends strongly on the price and accessibility of other modes of transportation.

  The structure of the trade-in payment refers to the possibility of the regulator to index the payment given to some characteristic of the scrapped and/or replacing vehicles. By indexing the trade-in payment, a regulator can shape how the fleet is renewed. For example, a regulator could incentivize the scrapping of the oldest or most polluting ISVs by indexing the trade-in payment to the age or level of emissions of the scrapped vehicle. The same can be done with the replacement vehicles.

6.2.2 International Experiences

While estimating benefits from scrapping schemes it helps to consider lessons learned from experiences in other countries. The following shows some of these lessons for CO2, NOx emissions and road safety in France, Germany and in the U.S.:

- **Impacts on CO_2**: All 3 schemes generated a net reduction of CO_2, not only to 2010, but also when the effects are accumulated to 2030 (~100, ~200 and ~265 thousand tons for the U.S., Germany and France respectively). However, the monetised value of that impact is quite small (<5 million Euro in the U.S., <10 M Euro in Germany and France) and the overall results suggest that CO_2 abatement should not be the main objective in implementing a scrapping program. The amount of CO_2 reduced varies with the class and age of the scrapped vehicles, but unfortunately, the analysis does not specify which vehicle age must be targeted to achieve particular outcomes. Replacing scrapped vehicles with younger vehicles delivers higher CO_2 reductions, but at higher societal and economic cost.
- **Impacts on NOx:** The monetised NOx impact is 1-2 orders of magnitude greater than the CO_2 impact (~500 million Euro in the U.S., ~300 million Euro in Germany, ~100 million Euro in France), and it does suggest which vehicles such a scheme ought to target: in general, vehicles older than ~15 years. The French scheme shows that increasing the share of diesel vehicles among those replaced erodes the NOx impact, and should thus be avoided.
- **Road Safety:** In the long run, it is estimated that the U.S. scheme prevented ~2800 serious injuries, of which ~40 were fatalities. Electronic Stability Control and the effect of general improvements in vehicle safety account for 70% of the impact. In Germany, an estimated 6100 injuries and ~60 fatalities were avoided. The conclusion here also seems to be that "older cars should be retired". The French scheme is estimated to have had a much more limited impact: only ~330 serious injuries were avoided, of which ~20 were fatalities (OECD, FIA Foundation, ITF, IEA, UNEP and GFEI, 2011).

6.2.3 Emission mitigation and fuel-savings potential scenario

Assumptions

A scrapping program implementation scenario was built for Mexico, considering a program that would be in effect from January 2013 until December 2013. It assumed that a trade-in payment was offered to users who traded an SUV, Van, or Pick-up that was 13 years or older and used it to replace the vehicle with a subcompact or compact car between 0 and 6 years old. The trade-in payment offered would be $2,000 USD.

Based on the results of the Mexican Scrapping program "PRODIAT C", CTS Mexico calculated that in the Mexican case, the price elasticity of private vehicles is about 0.125. This information was used to calculate that about 171,575 vehicles 13 years and older (SUVs, Pick-ups and Vans) would be scrapped. Of these, 20,296 would be replaced with a new subcompact or compact vehicle. Based on the conclusions of IHS Global Insight about the payback rate (sales during the next period due to the scrapping program), it was found that 25% (a medium payback rate) of new vehicles sales made through the program were drawn from sales that would have otherwise occurred in 2014.

Results

In terms of GHG mitigation, a scrapping program with the above characteristics would reduce a total of 5 Mt CO_2e in the period 2013-2035. This is equivalent to a 0.13% reduction from the total LDV GHG emissions from the year 2009 until 2035.

With respect to criteria pollutant emissions, the total NOx emissions reduced would equal 17,780 tons; equivalent to 0.1% of total BAU NOx emissions from LDVs between 2009 and 2035. The total $PM_{2.5}$ emission reduction would be equivalent to 97 tons, or 0.08% of total LDV $PM_{2.5}$ emissions from 2009-2035.

The total cost of the program would be equivalent to $286 million USD (NPV99). The monetary benefits of the program, in terms of fuel savings, amount to $787 million USD (NPV), which is about 0.3% of total fuel expenditures of all LDVs in the BAU scenario. Calculating the net benefit of the program taking into account the fuel savings and the cost of the program, this yields $500 million USD (NPV). Thus, there would be an average cost of $57 USD (NPV) per reduced ton of CO_2, $16,770 USD (NPV) per reduced NOx ton, and $2,952,000 USD (NPV) per $PM_{2.5}$ ton reduced. Table 13 summarizes the most important results.

Table 13 Scrapping Program and its possible results in Mexico

	Estimated Reductions (2013-2035) (tons)	Equivalent % LDV emissions reductions (2009-2035)	Average cost per ton reduced (USD)
CO_2e	5,000,000	0.13%	$57
No_x	17,780	0.10%	$16,770
$PM_{2.5}$	97	0.08%	$2,952,000
Programme Costs: $286 million USD			
Benefits from Fuel Savings: $787 million USD			

6.3 Inspection and Maintenance (I&M) Programs

I&M ensure that the regulated fleet is well maintained. In order to do so, authorities establish a desired performance standard. I&M programs are normally accompanied by sanctions to incentivize compliance to the standard. A well designed I&M program will significantly contribute to a reduction of high-emitting passenger vehicles and will reduce vehicle exhaust emissions. Additionally, implementation of I&M programs is recommended alongside safety checks. Roadworthiness testing (I&M + road safety checks) represents one of the best ways to improve road safety in developing countries.[81] Therefore, this should be considered when implementing I&M for ISVs.

6.3.1 Policy design

If the aim of I&M programs is to regulate the emissions, safety performance, and fuel efficiency of ISVs, so an I&M program will have to focus on four effects:

1. Improve the maintenance level of the ISV fleet
2. Increase the safety features present in ISVs
3. Reduce quantity of high emitting and insecure ISVs in the Fleet
4. Reduce the importation of high emitting and insecure ISVs

In many LICs and developing countries, ISVs are an important factor of motorization growth, contributing to high emissions and poor safety of the general fleet. Additionally, low levels of physical and mechanical maintenance during a vehicle's lifetime also significantly contribute to high emissions and road-safety casualties. Finally, in many LIC´s and developing countries, repairs to keep older vehicles functioning are relatively cheap. Therefore, these vehicles are part of the fleet for many years.

[81]See for example GTZ: Inspection & Maintenance and Roadworthiness, 2005.

Programme design should include the following elements:

- **Legal requirements:** Legislation should regulate the following: definition of the I&M requirements for motor vehicles, licensing and control of private sector vehicle testing stations, emission standards, qualifications of testing personal, characteristics and equipment of testing stations, vehicle testing fees, documentation, cases of withdrawal of both station and personnel licensing, actions of enforcement and penalties for breach of licensing conditions (stations, personnel).[82] The emissions standards should be based on statistics on the distribution of emission levels, analysis of what proper maintenance can achieve and how much it costs, and sensible judgment of what level of standards will command political support. Standards should be adopted so that the worst 15 – 25% of the tested vehicles fail and gradually tighten the standards as the service industry and maintenance practices improve. Regulated criteria pollutants will vary for gas and diesel engines.
- **Institutional Design:** I&M programs should ideally be regulated within a national framework. An I&M program should preferably be part of a larger policy framework that addresses vehicle emissions in an integrated manner. State and local governments should shape some program details within this framework to address specific conditions within regions or cities. I&M program elements should account for new vehicle emission standards, equipment warranties, and fuel standards, all of which are typically set at the national level. Good coordination improves the effectiveness of I&M significantly.
- Centralized inspection where the inspection function is separated from the maintenance function has produced the best results in terms of emission reduction. Additionally, centralized I&M programs have many advantages as discussed below. I&M should be compulsory, because effectiveness of voluntary programs is limited.[83] Private contractors should perform the actual inspections, though regulators should ensure that all actors in an I&M program have the capacity to carry out their roles. Finally, regulators should exert strong oversight and institute a quality assurance program for I&M programs.[84]
- **Implementation:** When implementing I&M programs, national and regional governments should proclaim well in advance (more than 1 year) the schedule for introducing an I&M program. I&M program should be implemented in a phased approach that allows learning, adaptation, and capacity building along the way. The I&M program in Mexico City serves as a good example for this approach.[85] Though I&M programs should focus on ISVs, they should also include other passenger vehicles in use. Hence, all passenger vehicles in use should be checked according to the same criteria (e.g. age of vehicle).
- **Enforcement**: Represents one of the keys to the success of any I&M program. It ensures that vehicles are tested, and then undergo repairs and retesting if they fail. Generally, quality assurance should focus on the contractor, I&M station, and motorists. Figure 6 offers a list of enforcement mechanisms that regulators recommend in order to assure effective compliance and therefore desired impacts of an I&M program.

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[82]See GTZ: Inspection & Maintenance and Roadworthiness, 2005.

[83]Mexico City started with a voluntary inspection program and ten years later, policy-makers introduced mandatory tests for all vehicles. See for example GTZ: Inspection & Maintenance and Roadworthiness, 2005.

[84]See United States Agency for international Development: Vehicle Inspection and Maintenance Programs: International Experience and Best Practices, 2004.

[85] The I&M programme is in force in the valley of Mexico and there are problems with programme implementation, particularly bribery and cheating.

Figure 6 Enforcement actions required for I&M programs

Station

- Fully automated test results: pass/fail.
- Monitoring of testing centers.
- Penalties for corrupt inspectors and testing centers.
- Equipment and station maintenance.
- Proper test design and protocol.
- Video-surveillance system.

Motorist

- Actions to avoid manipulation of data
- Easy identification of vehicles that have passed the test
- Random road-side vehicle inspection
- Smoky vehicles reported
- Combination of annual vehicle registration and I&M
- Penalties (financial and withdrawal of license)

Institutional

- Integral Data Management System
- Powers and duties of the regulatory organ
- Compliance Promotion
- Public awarness campaigns

Technical Settings and Recommendations: To implement properly functioning I&M programs implies consideration of numerous technical aspects (Figure 7). Technical aspects can be divided in two parts: 1) I&M station related factors (Elements of control, Staff training, Station characteristics and technology used) and 2) Vehicle related factors (Location of I&M, Quantity of I&M stations, Vehicle´s categorization of inspection and Frequency of inspection).

Figure 7 Technical aspects

Related to station	Related to vehicle
• Information collection • Emissions test • Safety test • Number, size and location of test centres • Technology used • Staff training	• Checked vehicles • Frequency of inspection

6.3.2 Optional Elements for an I&M program

1. **Circulation Restriction Program –** To limit the number of days a vehicle can be used each week, as is currently done in Mexico City.
2. **Compliance promotion –** Involves reducing the opportunities for corruption and fraud through making results automated, and tamper-proof.
3. **Reducing "donor vehicle" availability:** Cars in good conditions are used instead of the alleged polluting car. To reduce the inspection of good cars (i.e., due to age restrictions) reduces this risk.
4. **Mandatory use of a three-way catalytic converter.**
5. **Technical tools to support I&M**: Specifically, On-Board Diagnostic (OBD), and Remote Sensing represent two additional technical means to support an I&M system.

6.3.3 Emission mitigation and fuel saving potential scenario

Assumptions

An I&M implementation scenario was built for the Mexican case. This scenario assumes that I&M programs are put into place in 25 metropolitan zones[86] of Mexico, for all vehicles older than 3 years. From 2013 to 2017, a phased approach will be used, with 5 cities joining the programme each year.

[86] According to the National Council for Population (CONAPO) a metropolitan zone is defined as the group of two or more municipalities where a city with fifty thousand inhabitants or more is located. In the case of a metropolitan zone, functions and activities of the urban area exceed the limits of the municipality where it was originally located. The city has therefore incorporated neighbouring municipalities (generally urban municipalities) as part of its area of influence, and it maintains a close socioeconomic relation with them.

The scenario assumes that the I&M programs implemented are combined with a vehicle circulation restriction according to age (as in Mexico City). Therefore, all vehicles that are 8 years or older are restricted from being used once a week and one Saturday a month. This reduces their use-intensity by 20%. Added to this, vehicles that do not pass the I&M test do not have the right to circulate. Following the design recommendations in this section, the I&M test results in 16% of vehicles failing the first time they take the test. This means that 4% of 3 to 7 years-older vehicles fail, increasing to 25% in vehicles 8 years and older.

The projected costs of the program where calculated under the assumption that stations are managed by private entities under governmental concessions; the price of tests includes the investment in the stations, equipment, salaries and training of employees. The highest international price was used (I&M Program in California), which is 40 dollars every two years. Since the scenario is built with the assumption of annual testing, 20 dollars per test was considered.

Results

In terms of GHG emission mitigation, an I&M scheme with the above mentioned design has the potential to reduce a total of 100 Mt CO_2 in the period 2013-2035. J This means a net benefit in terms of fuel saving of $6.7 billion USD(NPV) and an average cost of $2.14 USD (NPV) per reduced ton of CO2 , $399 USD (NPV) per reduced ton of NOx and $80,452USD (NPV) per reduced ton of $PM_{2.5}$.

6.4 Compulsory Vehicle Insurance

Compulsory vehicle insurance refers to the existence of a minimum amount of vehicle liability insurance required by a state law. Financial responsibility laws require all motorists to show proof, after an accident, of their ability to pay damages to at least a minimum amount. This is usually in the form of an insurance policy.

The primary objective of compulsory vehicle insurance is to provide coverage for third party liability for death, injury, and third party vehicle damage. Optional extra insurance is for damage to the driver´s vehicle and sometimes for material damage to third party vehicles. It should be accompanied by sanctions to incentivize compliance. Compulsory insurance should include basically body injury liability and property damage liability for the third party.

6.4.1 Policy design

In a compulsory vehicle insurance program with focus on ISVs, minimum liability should be primarily seen as a direct answer to the specific condition is presented by the ISVs in a national fleet. These conditions are:

- Average age: Older vehicles have higher probability to be involved in traffic accidents (Source)
- Few or none safety features: Bigger physical damage for motorists
- Socio-economic level of ISV users: In many cases motorists of ISVs are not able to pay for the caused damage without liability insurance
- Low price of ISV: motorists do not consider valuable enough to spend on insurance of a vehicle with a low market value (Source)

Therefore, while the levels of compliance with compulsory third party vehicle insurance are very high in HICs, ranging from 90 – 99%, levels are fairly low in LICs ranging from 3 – 84%.[87] Specifically, motorists of older vehicles do not have vehicle insurance (Source).

The ultimate objective of this policy action is that all passenger vehicle users inside the country should have compulsory vehicle insurance. Compulsory vehicle insurance has the following two direct effects:

1. Reduce average distance travelled for vehicles in the fleet.
2. Reduce quantity of new entry ISVs.

Aspects to consider in the design and implementation of a compulsory insurance scheme include:

- **Implementation:** The programme should be implemented in combination with a basic public awareness program to explain why a certain level of vehicle insurance is needed, as well as the advantages[88] of the program. This awareness campaign should be financed by insurance companies.
- **Institutional Design:** The compulsory insurance may be implemented directly by a national authority, or by local institutions. In this last case homogenization may be an important challenge and could still depend on national leadership. Different national insurance providers and motorists representatives should be involved early in the design process.
- **Compliance Promotion:** Several options exist:
    1. **National Database:** Police officers can easily check a license plate to determine if the vehicle has insurance.
    2. **Periodic Revision:** Combine any type of periodic revision with the vehicle insurance verification, for example annual vehicle registration, or I&M programs. The risk with this configuration is that motorists get insurance only with the purpose of going through these periodic verifications. Afterwards they cancel their contract with the insurance companies. To avoid these abuses, a prepayment (6–12 month) for the basic insurance should be required for the first registration of the vehicle. Once a compulsory vehicle insurance system has been in place for a while (more than 1 year), a proof of insurance ownership for the last year of vehicle use in combination with a prepayment (3 month) should be required when registering the vehicle for the next year. For vehicles registering for the first time a longer prepayment (6 - 12 month) should be required.

[87]See Aeron-Thomas, A.: The Role of the Motor Insurance Industry in Preventing and Compensating Road Casualties, 2002.
[88]See more about the benefits of this policy action. In: Estimating Benefits (Chapter 5).

3. **Random road inspections**: Motorists should carry an insurance card to prove coverage
4. **Fines**: Essential to link control of vehicle insurance with punitive measures such as fines. The first offense of the motorist should not be extremely high[89], but should increase significantly with the second and third offense.

Figure 8 Features that determine the premium of vehicle insurance

Variables referring to the motorist

- Gender and age of insured(s)
- Marital status of insured(s)
- Prior driving record of insured(s)

Coverage

- Type of coverage
- Amount of liabilities

Variables referring to the vehicle

- Annual mileage driven
- Age and condition of vehicle
- Make and model of vehicle

6.4.2 Options of compulsory vehicle insurance combined with road-safety and vehicle use programs

1. **The Road Safety Cent**: A road safety cent approaches the most difficult problem in developing countries, which represents the funding for road safety projects. In the context of compulsory vehicle insurance a certain percentage (between 1 and 10%) of the paid basic premium would go to a road safety fund.
2. **Fostering active participation of insurance companies in road safety policy.**
3. **Fostering the existence and correct use of Safety Features.**
4. **Bonus malus insurance system**: The bonus malus system refers to the use of premium discounts for claim-free driving and extra charges for involvement in traffic accidents. The objective of a bonus malus system is to provide an incentive to the motorist to drive in a safe way and hence, to avoid causing damage. Every year without an accident claim moves the motorists to a lower level at which premiums are lower. The challenge of an effective bonus malus system must be to design it in a way that it contributes to safer driving rather than to non-reporting of claims.
5. **Odometer based system or pay-as-you-drive insurance**: After the insurance company´s risk factors have been applied and the customer has accepted the per-kilometre rate offered, customers purchase prepaid kilometres of insurance protection as needed (like buying litters of gasoline). Insurance automatically ends when the odometer limit (recorded on the car´s insurance ID card) is reached unless more kilometres are bought.

6.4.3 Emission mitigation and fuel saving potential scenario

Assumptions

A Compulsory Vehicle Insurance Scenario was built for the Mexico. It supposed that insurance will be made compulsory in the entire national territory by 2013. However, two important assumptions where made regarding the outreach of the policy:

1) Implementation can be expected to be strong in the urban zones but not in rural ones. Therefore, the policy is believed to reach the vehicles registered in the 56 metropolitan zones that exist in Mexico, rather than the whole fleet.
2) The acquisition of insurance is assumed to take place gradually during the first six years; it is until the sixth year that implementation on the fleet of the 56 metropolitan zones is believed to be completed.

Most of the data used was taken from the National Survey of Income and Expenditure database for 2010 (ENIGH 2010). According to this database about 84% of cars, 88% of SUVs, and 95% of Pick-ups are owned by a household that does not make any expenditure on vehicle insurance. Also, according to the survey, the average price for annual insurance paid by users of each segment is the following: 5706MXN (~455 USD) for cars, 6690 MXN (~534 USD) for SUVs, and 6280 MXN (~501 USD) for pick-ups.

With the information above and the average per capita income of those homes that have vehicles without insurance, it was calculated that paying insurance will reduce the income of an average user of a car without insurance by 10%, the income of an average user of an SUV without insurance by 13% and the income of an average user of a pick-up without insurance by 15%.

Therefore, it was assumed that all users of each type of vehicles without insurance that were in the proportion of the fleet reached by implementation in each year would have to pay the average price of the insurance according to their type of vehicle. The reduction in the income of the users of each type of vehicle will in turn cause a reduction on the vehicle stock of the corresponding vehicle stock. The projected costs were calculated as the average insurance cost paid by the users of vehicles without insurance and in the portion of the fleet that has reached implementation of the compulsory insurance policy in each year.

Results

Based on the above scenario, the potential reduction of a Compulsory Vehicle Insurance program is equivalent to 171 Mt CO_{2e} in the period 2013-2035. This is equivalent to a 4.5% reduction on total LDV emissions from 2009-2035.

In terms of criteria pollutant emissions, this scenario results in a potential reduction of 760,180 tons of NOx. This reduction is equal to 4.5% of total NOx emissions from LDVs between 2009 and 2035. In terms of $PM_{2.5}$ emissions, the policy has a potential to reduce 5329 tons, which is 4.6% of total $PM_{2.5}$ emissions from the LDV fleet during the period studied.

The costs of a compulsory vehicle insurance designed under the assumptions explained above would cost $4.5 billion USD (NPV), and would have a fuel saving potential equivalent to $11.9 billion USD (NPV) equivalent to 4% of fuel expenditure. This means a net benefit in terms of fuel saving of $7.4 billion USD (NPV) and an average cost of $26.13 USD (NPV) per reduced ton of CO_2, $5,878 USD (NPV) per reduced ton of NOx and $838,500 USD (NPV) per reduced ton of $PM_{2.5}$.

7 Conclusion – Comparison of Results

In 2009, Mexico´s passenger LDV fleet emitted 108 Mt CO_2e. By 2035, this will have increased to 207 Mt CO_2e. If ISV entry and use are not regulated, resulting ISV GHG-emissions will reach 60% of the total LDV fleet emissions. In absolute terms, this represents 124 Mt CO_2e. Because of these numbers, it is strongly recommended to set public policies to regulate ISVs, at the same time as, or even before introducing measures to regulate or otherwise influence the fuel economy of new vehicles. The following Table illustrates the emission reduction potential of the suggested policies in Mexico.

Table 14 Reduction of CO_2, $PM_{2.5}$, and NOx

Results	Total CO_2 emission reduction (Mt CO_2)	Total PM 2.5 Reduction (tons)	Total NOx reduction (tons)
Scrapping (1 year)	5	97	17,078
Insurance	171	5329	760,180
I & M	100	2666	538,120
Border Inspection	240	3978	548,570

Source: CTS EMBARQ Mexico, 2012.

A scrapping program designed for Mexico has the potential to mitigate a total of 5 Mt CO_2e (0.13% reduction from total LDV GHG-emissions from 2009 to 2035). Additionally, 17,780 tons of NOx and 97 tons of $PM_{2.5}$ can be reduced due to the program. Compared to other public policies this result is not very impressive; however, it must be considered that the program period is just one year.

Compulsory vehicle insurance has the potential to mitigate 171 Mt of GHG-emissions (4.5% reduction from total LDV GHG emissions from 2009 to 2035). In terms of criteria pollutant emissions, this scenario results in a potential reduction of 760,180 tons of NOx and 5,329 tons $PM_{2.5}$. These results are impressive, ranking second in GHG-emission mitigation and first in criteria pollutant emission reduction. That makes this policy highly recommendable in countries where participation in vehicle insurance is very low, such as Mexico.

In the case of Mexico, the results of an I&M program are disappointing. Reductions of 100 Mt CO_2, 538,120 tons of NOx and 2,666 tons of $PM_{2.5}$ are low compared to other policies. However, one reason for this poor result is that there is already an I&M program in place in the valley of Mexico, and more than 20% of Mexico´s LDV fleet circulates in this area. Additionally, there are hardly any ISVs in the valley of Mexico, which also proves how successful this program has been.

Border inspection shows the best results in GHG-emission mitigation, with a total of 240 Mt CO_2e (6% reduction from total LDV GHG emissions from 2009 to 2035). In terms of criteria pollutant emission, 548,570 tons of NOx and 3,978 tons of $PM_{2.5}$ reduced are also respectable numbers. This makes it the most recommended policy, especially because it is quick to implement.

Besides comparing mitigation results, it is also of interest to do a Cost-Benefit Analysis. The following Table shows the costs and benefits of public policy implementation in Mexico.

Table 15 Cost- Benefit Comparison for Public Policies

Results	Total Cost (in million USD)	Average Cost per reduced ton of CO2 (USD)	Total Fuel Savings (in million USD)	Net benefit in terms of fuel saving (in million USD)
Scrapping (1 year	286	57.28	786	500
Insurance	4,468	26.13	11,861	7,392
I & M	214	2.14	6,996	6,781
Border Inspection	1,278	5.32	14,946	13,668

Source: CTS EMBARQ Mexico, 2012.

Border inspection also performs well in terms of cost per reduced ton of CO_2 ($ 5.32 USD). Only the I&M program has lower costs. It should be less surprising that the scrapping program is the most expensive per reduced ton CO_2. Because of the high costs of a scrapping program, it should be seen more as an additional policy than as the ultimate solution to the problem. In terms of the net benefit of fuel savings, the border inspection is also the most attractive for policy makers, saving $ 13,668 million USD, which is roughly equivalent to the other three policies put together.

Finally, the decision regarding which policy best regulates ISVs depends on many country-specific factors. Most countries affected by ISVs have not implemented any of these policies, or have done so only poorly. New Zealand recently implemented a border inspection with the result that the volume of ISVs has decreased rapidly. However, the final decision of which policy to implement (Compulsory vehicles insurance, I&M, and border inspection) is not as important as the full commitment of policy makers and its enforcement.

Annex 1- Paragraphs 24 of Appendix 300A (2) NAFTA

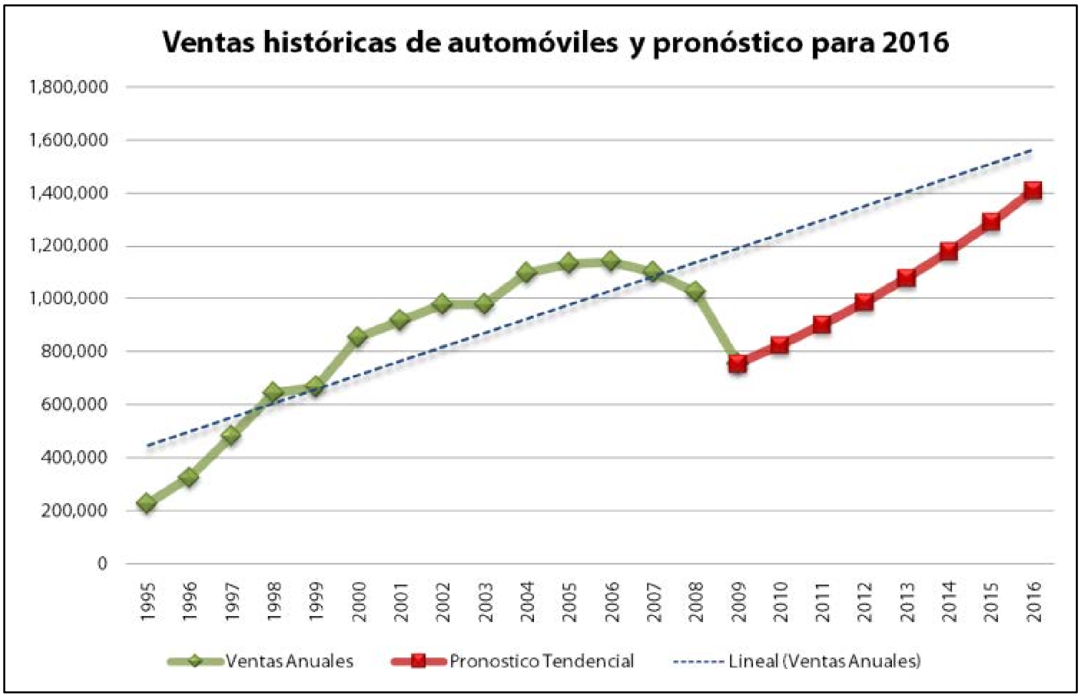
Paragraph 24 of the Appendix 300A (2) of the North American Free Trade Agreement reads as follows:

24. Mexico may adopt or maintain prohibitions or restrictions on imports of second-hand vehicles from the territory of another Party, except as follows:

a) beginning January 1, 2009, Mexico may not adopt or maintain a prohibition or restriction on imports from the territories of Canada or the United States of originating second-hand vehicles that are at least 10 years old;
b) beginning January 1, 2011, Mexico may not adopt or maintain a prohibition or restriction on imports from the territories of Canada or the United States of originating second-hand vehicles that are at least eight years old;
c) beginning January 1, 2013, Mexico may not adopt or maintain a prohibition or restriction on imports from the territories of Canada or the United States of originating second-hand vehicles that are at least six years old;
d) beginning January 1, 2015, Mexico may not adopt or maintain a prohibition or restriction on imports from the territories of Canada or the United States of originating second-hand vehicles that are at least four years old;
e) beginning January 1, 2017, Mexico may not adopt or maintain a prohibition or restriction on imports from the territories of Canada or the United States of originating second-hand vehicles that are at least two years old; and
f) Beginning January 1, 2019, Mexico may not adopt or maintain a prohibition or restriction on imports from the territories of Canada or the United States of originating second-hand vehicles.

Annex 2- Input data for BAU scenario

Projection of New Vehicle Sales



Source: CTS Mexico with information from AMIA

Survival Rates for different classes of gasoline vehicles

Survival Rate Gasoline Vehicles				
	Class			
AGE	Private Light Trucks	Private Compact Cars	Private Subcompact Cars	Private Luxury/Sport Cars
0	0.987	0.995	0.995	0.993
1	0.98	0.994	0.993	0.991
2	0.97	0.992	0.991	0.988
3	0.957	0.989	0.988	0.985
4	0.939	0.986	0.985	0.982
5	0.916	0.982	0.98	0.977
6	0.887	0.977	0.975	0.972
7	0.852	0.971	0.969	0.965
8	0.81	0.964	0.961	0.958
9	0.762	0.956	0.952	0.949
10	0.707	0.945	0.941	0.939
11	0.648	0.934	0.928	0.927
12	0.584	0.92	0.913	0.914
13	0.518	0.904	0.896	0.898
14	0.452	0.885	0.877	0.881
15	0.387	0.865	0.855	0.862
16	0.325	0.842	0.831	0.841
17	0.267	0.817	0.805	0.818
18	0.215	0.789	0.776	0.793
19	0.17	0.759	0.745	0.766
20	0.131	0.727	0.712	0.738
21	0.099	0.692	0.677	0.707
22	0.073	0.656	0.641	0.675
23	0.052	0.619	0.603	0.642
24	0.037	0.58	0.564	0.607
25	0.025	0.541	0.524	0.572
26	0.017	0.501	0.484	0.536
27	0.011	0.461	0.444	0.5
28	0.007	0.422	0.405	0.464
29	0.004	0.383	0.367	0.428
30	0.003	0.345	0.33	0.392
31	0.002	0.309	0.295	0.358

Source: Mexican Institute of Petroleum

Emission Factors

Emission Factors				
Gas	PM10	$PM_{2.5}$	NOx	Car CO_2e
Emission Factor	0.018	0.009	1.098	0.0693
Unit	g/km	g/km	g/km	Kg/MJ

Source: Mexico City´s Ministry of Environment, IPCC06- Vol 2.

Fuel Efficiency for Different Classes of Existing Vehicles (km/l)

	Existing Vehicles				
	Sub	Com	L&D	CUM	Cam 123
1980	6.62725043	5.14629228	5.00024946	4.13909564	4.13909564
1981	6.75979544	5.24921813	5.10025445	4.22187756	4.22187756
1982	6.89499135	5.35420249	5.20225954	4.30631511	4.30631511
1983	7.03289117	5.46128654	5.30630473	4.39244141	4.39244141
1984	7.173549	5.57051227	5.41243082	4.48029024	4.48029024
1985	7.31701998	5.68192251	5.52067944	4.56989604	4.56989604
1986	7.46336038	5.79556096	5.63109303	4.66129396	4.66129396
1987	7.61262758	5.91147218	5.74371489	4.75451984	4.75451984
1988	7.76488014	6.02970163	5.85858919	4.84961024	4.84961024
1989	7.92017774	6.15029566	5.97576097	4.94660244	4.94660244
1990	8.07858129	6.27330157	6.09527619	5.04553449	5.04553449
1991	8.24015292	6.3987676	6.21718171	5.14644518	5.14644518
1992	8.40495598	6.52674296	6.34152535	5.24937409	5.24937409
1993	8.5730551	6.65727782	6.46835585	5.35436157	5.35436157
1994	8.7445162	6.79042337	6.59772297	5.4614488	5.4614488
1995	8.91940652	6.92623184	6.72967743	5.57067778	5.57067778
1996	9.09779465	7.06475648	6.86427098	5.68209133	5.68209133
1997	9.27975055	7.20605161	7.0015564	5.79573316	5.79573316
1998	9.46534556	7.35017264	7.14158753	5.91164782	5.91164782
1999	9.65465247	7.49717609	7.28441928	6.02988078	6.02988078
2000	9.84774552	7.64711961	7.43010766	6.15047839	6.15047839
2001	10.0447004	7.800062	7.57870982	6.27348796	6.27348796
2002	10.2455944	7.95606324	7.73028401	6.39895772	6.39895772
2003	10.4505063	8.11518451	7.88488969	6.52693687	6.52693687
2004	10.6595165	8.2774882	8.04258749	6.65747561	6.65747561
2005	11.3163406	8.42672462	8.15564642	6.70459628	6.70459628
2006	11.806124	8.62110324	8.32987799	6.76228182	6.76228182
2007	12.2091017	8.84878662	8.50816292	6.8506246	6.8506246
2008	12.5369219	9.04080869	8.64285512	6.94530593	6.94530593
2009	12.8032074	9.22679201	8.75564785	7.04004794	7.04004794
2010	13.1739377	9.46679817	8.92983582	7.10585843	7.10585843
2011	14.2725212	10.6026182	9.37213028	8.00456813	8.00456813
2012	14.8401545	11.2277722	9.55344262	8.39215131	8.39215131
2013	15.3339663	11.8426887	9.68499882	8.79013001	8.79013001
2014	15.7572218	12.4208123	9.78460888	9.18502135	9.18502135
2015	16.1291795	12.9665157	9.86889323	9.58274507	9.58274507
2016	16.5107867	13.5124759	9.95357321	9.98657717	9.98657717
2017	16.9070788	14.0234422	10.0602671	10.4126658	10.4126658
2018	17.3627899	14.5614755	10.2126521	10.8773769	10.8773769
2019	17.8743055	15.1301954	10.413061	11.392052	11.392052
2020	18.4458796	15.7383158	10.6641644	11.9625871	11.9625871

2021	19.0789523	16.39099	10.9668351	12.592017	12.592017
2022	19.9086146	17.2485229	11.3664459	13.438731	13.438731
2023	20.5290551	17.8669778	11.7303068	14.0357892	14.0357892
2024	21.3419709	18.6840687	12.1921258	14.8463145	14.8463145
2025	22.2218705	19.5478903	12.7082243	15.7167787	15.7167787
2026	22.6663079	19.9388481	12.9623888	16.0311143	16.0311143
2027	23.1196341	20.3376251	13.2216366	16.3517365	16.3517365
2028	23.5820267	20.7443776	13.4860693	16.6787713	16.6787713
2029	24.0536673	21.1592651	13.7557907	17.0123467	17.0123467
2030	24.5347406	21.5824504	14.0309065	17.3525936	17.3525936
2031	25.0254354	22.0140994	14.3115247	17.6996455	17.6996455
2032	25.5259441	22.4543814	14.5977552	18.0536384	18.0536384
2033	26.036463	22.903469	14.8897103	18.4147112	18.4147112
2034	26.5571923	23.3615384	15.1875045	18.7830054	18.7830054
2035	27.0883361	23.8287692	15.4912546	19.1586655	19.1586655

Fuel Efficiency for Different Classes of New Vehicles (km/l)

	New Vehicles				
	Sub	**Com**	**L&D**	**CUM**	**Cam 123**
1980	9.17870384	6.16156217	5.79745478	4.30814682	4.30814682
1981	9.36227791	6.28479342	5.91340388	4.39430976	4.39430976
1982	9.54952347	6.41048928	6.03167195	4.48219595	4.48219595
1983	9.74051394	6.53869907	6.15230539	4.57183987	4.57183987
1984	9.93532422	6.66947305	6.2753515	4.66327667	4.66327667
1985	10.1340307	6.80286251	6.40085853	4.7565422	4.7565422
1986	10.3367113	6.93891976	6.5288757	4.85167304	4.85167304
1987	10.5434455	7.07769816	6.65945322	4.94870651	4.94870651
1988	10.7543145	7.21925212	6.79264228	5.04768064	5.04768064
1989	10.9694007	7.36363716	6.92849512	5.14863425	5.14863425
1990	11.1887888	7.51090991	7.06706503	5.25160693	5.25160693
1991	11.4125645	7.66112811	7.20840633	5.35663907	5.35663907
1992	11.6408158	7.81435067	7.35257445	5.46377185	5.46377185
1993	11.8736321	7.97063768	7.49962594	5.57304729	5.57304729
1994	12.1111048	8.13005043	7.64961846	5.68450824	5.68450824
1995	12.3533269	8.29265144	7.80261083	5.7981984	5.7981984
1996	12.6003934	8.45850447	7.95866305	5.91416237	5.91416237
1997	12.8524013	8.62767456	8.11783631	6.03244562	6.03244562
1998	13.1094493	8.80022805	8.28019304	6.15309453	6.15309453
1999	13.3716383	8.97623261	8.4457969	6.27615642	6.27615642
2000	13.6390711	9.15575727	8.61471283	6.40167955	6.40167955
2001	13.9118525	9.33887241	8.78700709	6.52971314	6.52971314
2002	14.1900895	9.52564986	8.96274723	6.6603074	6.6603074
2003	14.4738913	9.71616286	9.14200218	6.79351355	6.79351355
2004	14.7633692	9.91048611	9.32484222	6.92938382	6.92938382
2005	15.7078604	10.206286	9.79762989	7.15247812	7.15247812
2006	16.2134159	10.6525096	10.178668	7.36597055	7.36597055
2007	16.5407683	11.0852641	10.5713245	7.61856168	7.61856168
2008	16.6455913	11.3535009	10.4841337	8.02910334	8.02910334
2009	16.7571354	12.0071141	10.3980004	8.47313193	8.47313193
2010	16.8701358	12.6926858	10.3055246	8.93482121	8.93482121
2011	17.1117294	13.2128676	10.2539954	9.50270858	9.50270858

2012	17.3616037	14.2008185	10.2003698	10.1614996	10.1614996
2013	17.6372297	15.0834617	10.1951575	10.7915221	10.7915221
2014	17.8429107	15.5733545	10.1899453	11.3069419	11.3069419
2015	18.1135038	16.1587331	10.2662281	11.8119385	11.8119385
2016	18.475503	16.8440294	10.4271853	12.3030073	12.3030073
2017	19.0968736	17.351379	10.7828828	12.9050677	12.9050677
2018	20.0168698	18.1657367	11.3579833	13.6420808	13.6420808
2019	21.0965652	19.1255648	12.0473036	14.5332506	14.5332506
2020	22.2233729	20.1281062	12.7733672	15.4767951	15.4767951
2021	23.399348	21.1753502	13.5380013	16.4755333	16.4755333
2022	24.6270049	22.2686777	14.3431207	17.5309566	17.5309566
2023	25.9074864	23.4139559	15.1907311	18.6513545	18.6513545
2024	27.2444708	24.6090086	16.0829332	19.8357639	19.8357639
2025	28.6406675	25.856924	17.0219279	21.0895934	21.0895934
2026	29.2134809	26.3740624	17.3623665	21.5113852	21.5113852
2027	29.7977505	26.9015437	17.7096138	21.9416129	21.9416129
2028	30.3937055	27.4395746	18.0638061	22.3804452	22.3804452
2029	31.0015796	27.9883661	18.4250822	22.8280541	22.8280541
2030	31.6216112	28.5481334	18.7935838	23.2846152	23.2846152
2031	32.2540435	29.119096	19.1694555	23.7503075	23.7503075
2032	32.8991243	29.701478	19.5528446	24.2253136	24.2253136
2033	33.5571068	30.2955075	19.9439015	24.7098199	24.7098199
2034	34.2282489	30.9014177	20.3427796	25.2040163	25.2040163
2035	34.9128139	31.519446	20.7496351	25.7080966	25.7080966

Fuel Efficiency for Different Classes of ISVs (km/l)

	Imported Second-hand vehicles				
	Sub	Com	L&D	CUM	Cam 123
1980	6.22368632	5.14582783	5.35428736	4.15513302	4.15513302
1981	6.34816004	5.24874439	5.46137311	4.23823568	4.23823568
1982	6.47512324	5.35371927	5.57060057	4.32300039	4.32300039
1983	6.60462571	5.46079366	5.68201258	4.4094604	4.4094604
1984	6.73671822	5.57000953	5.79565284	4.49764961	4.49764961
1985	6.87145259	5.68140972	5.91156589	4.5876026	4.5876026
1986	7.00888164	5.79503792	6.02979721	4.67935465	4.67935465
1987	7.14905927	5.91093868	6.15039316	4.77294175	4.77294175
1988	7.29204046	6.02915745	6.27340102	4.86840058	4.86840058
1989	7.43788127	6.1497406	6.39886904	4.96576859	4.96576859
1990	7.58663889	6.27273541	6.52684642	5.06508397	5.06508397
1991	7.73837167	6.39819012	6.65738335	5.16638564	5.16638564
1992	7.8931391	6.52615392	6.79053101	5.26971336	5.26971336
1993	8.05100189	6.656677	6.92634164	5.37510762	5.37510762
1994	8.21202192	6.78981054	7.06486847	5.48260978	5.48260978
1995	8.37626236	6.92560675	7.20616584	5.59226197	5.59226197
1996	8.54378761	7.06411888	7.35028915	5.70410721	5.70410721
1997	8.71466336	7.20540126	7.49729494	5.81818936	5.81818936
1998	8.88895663	7.34950929	7.64724084	5.93455314	5.93455314
1999	9.06673576	7.49649947	7.80018565	6.05324421	6.05324421
2000	9.24807048	7.64642946	7.95618937	6.17430909	6.17430909
2001	9.43303189	7.79935805	8.11531315	6.29779527	6.29779527
2002	9.62169252	7.95534521	8.27761942	6.42375118	6.42375118
2003	9.81412637	8.11445212	8.4431718	6.5522262	6.5522262
2004	10.0104089	8.27674116	8.61203524	6.68327073	6.68327073

2005	10.0631042	8.22578343	8.56454146	6.68699931	6.68699931
2006	9.93069807	8.1372604	8.59076335	6.6780016	6.6780016
2007	9.78893883	8.05285158	8.6153024	6.65863173	6.65863173
2008	9.74180513	8.09288789	8.62549802	6.62324114	6.62324114
2009	9.6267044	8.05444143	8.63613272	6.58994066	6.58994066
2010	9.64994592	8.08736428	8.6387534	6.57077123	6.57077123
2011	9.59859772	7.92942378	8.73842936	6.54132654	6.54132654
2012	9.53719022	7.92820228	8.76448177	6.52220148	6.52220148
2013	9.47464705	7.95463834	8.74622925	6.50621508	6.50621508
2014	9.40188728	8.00500909	8.71465226	6.49315527	6.49315527
2015	9.35151143	8.07065547	8.65237207	6.48266646	6.48266646
2016	9.34636099	8.12734691	8.59467703	6.47273219	6.47273219
2017	9.42587461	8.18821544	8.53510241	6.46289862	6.46289862
2018	9.59168025	8.25428263	8.48178542	6.45873327	6.45873327
2019	9.85982798	8.32099757	8.42751475	6.46180751	6.46180751
2020	10.2201646	8.42212872	8.43174213	6.4715876	6.4715876
2021	10.6435611	8.5537976	8.48985707	6.49418638	6.49418638
2022	11.1642378	8.73002043	8.59661848	6.53452721	6.53452721
2023	11.5948829	8.87481869	8.74279022	6.58242513	6.58242513
2024	12.0280794	9.0290772	8.87776351	6.62789865	6.62789865
2025	12.4392355	9.17126469	9.00469791	6.67081331	6.67081331
2026	12.6880202	9.35468999	9.18479187	6.80422958	6.80422958
2027	12.9417806	9.54178379	9.3684877	6.94031417	6.94031417
2028	13.2006162	9.73261946	9.55585746	7.07912046	7.07912046
2029	13.4646285	9.92727185	9.74697461	7.22070287	7.22070287
2030	13.7339211	10.1258173	9.9419141	7.36511692	7.36511692
2031	14.0085995	10.3283336	10.1407524	7.51241926	7.51241926
2032	14.2887715	10.5349003	10.3435674	7.66266765	7.66266765
2033	14.574547	10.7455983	10.5504388	7.815921	7.815921
2034	14.8660379	10.9605103	10.7614476	7.97223942	7.97223942
2035	15.1633587	11.1797205	10.9766765	8.13168421	8.13168421

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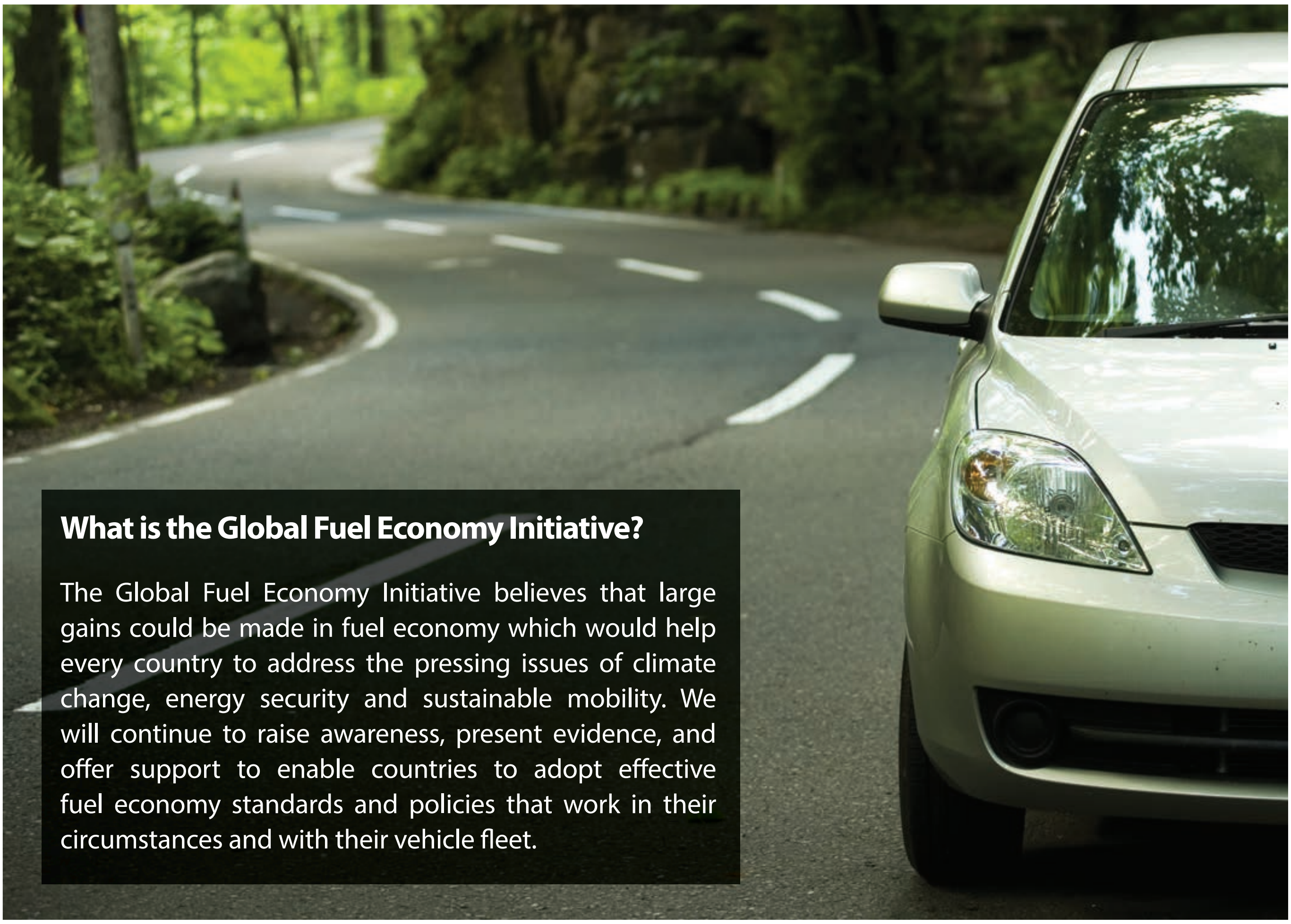

What is the Global Fuel Economy Initiative?

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.

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