INCENTIVES FOR CLEANER VEHICLES AND FUEL ECONOMY FOR THE VEHICLE FLEET OF CHILE

Prepared by Centro Mario Molina Chile

Sponsored by

GLOBAL FUEL ECONOMY INITIATIVE

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Contents

Figures

Tables

Executive Summary

This proposal is part of the Chilean Pilot Project of the Global Fuel Economy Initiative (GFEI), promoted by the United Nations Environment Programme, along with the International Energy Agency, the International Transport Forum and the FIA Foundation. It has been prepared by Centro Mario Molina Chile with the support of the International Council on Clean Transportation (ICCT), the Chilean Undersecretary of Transport and the Ministry of Environment.

According to indicators developed as part of the Pilot Project of the Global Fuel Economy Initiative (GFEI) for Chile, Nitrogen dioxide and average Particulate Matter emissions, average CO_2 emissions and average fuel consumption for vehicles sold in Chile have not decreased since 2006.

Currently in Chile, there exists a wide range of emissions and vehicle standards (EUROIII, EUROIV, EUROV, EPA94 and EPA2007 Tier2); some are applied in the Santiago Metropolitan Region and others in the rest of the country. There are also differences depending on whether the vehicles are diesel or gasoline. In this standard diversity, larger vehicles have lower requirements and additionally have a discount incentive on VAT taxes when bought through companies. The clear consequence of this is that SUV and light duty truck sales have increased by 244%[1] in the last six years, compared to merely 42% in the case of sedan and hatchback vehicles, reaching beyond the 30% of total sales in the country. It is important to note that the average Nitrogen oxide emission from new diesel SUV and light duty trucks is 30 times higher than the average emission from new gasoline sedans and hatchbacks. These larger vehicles have less performance and higher CO_2 emissions, which will deeply impact the future oil demand, increasing the energy dependence of Chile. .

In order to make this vehicular fleet growth more sustainable, Centro Mario Molina Chile, responsible for the execution of the case study from GFEI for Chile, has proposed two complementary options:

- To immediately update emission standards to EURO V at a national level;
- To incorporate the best international experience on incentive policies for low emissions vehicles and fuel economy.

Regarding the second point, it is proposed that the purchase of low emissions vehicles be a source of credit at the moment of declaring taxes and that purchase of high emission vehicles has a specific tax as a pollutant vehicle. The amount of the credit or tax, whichever is applicable, will be determined by the government authority in relation to the emission standard that the model to which vehicle corresponds complies and to the CO_2 emission level, all of this according to the efficiency label defined by the authority in December, 2010.

This system has the advantage of being fiscally neutral and it produces a change towards cleaner vehicles in all segments of the vehicle fleet, as has been the case, for example, in France with the bonus/malus system, and in Denmark. This instrument is more efficient than the incentives for specific technologies, which have

[1] Environmental Tracking study from Chilean Automotive Market, Centro Mario Molina Chile, Ministry of Transport and Telecommunications, ICCT-2010.

only demonstrated being effective in supporting the development of a new technology, such as hybrid vehicles, but that have had a marginal impact on the vehicle fleet.

It is estimated that the incentive and disincentive system will imply a 5% reduction o CO_2 emissions from the total national vehicle fleet in 2014, obtaining a total CO_2reduction of 2.15 million tons during the next 5 years.

Global Fuel Economy Initiative

The Global Fuel Economy Initiative, launched in March 2009, has as an objective to create awareness about the potential fuel saving and the cost of the vehicles manufactured and sold worldwide. It also offers direction and support in the development of strategies to foment the introduction of low consume vehicles. Its activities include:

- Development of improved data and analysis on fuel economy around the world, monitoring trends and progress over time and assessing the potential for improvement.

- Work with governments to develop policies to encourage fuel economy improvement for vehicles produced or sold in their countries, and to improve the consistency and alignment in policies across regions in order to lower cost and maximize the benefits of improving vehicle fuel economy.

- Work with stakeholders including auto makers to better understand the potential for fuel economy improvement and to solicit their input and support in working toward improved fuel economy.

Support regional awareness initiatives to provide consumers and decision makers with the information they need to make informed choices .

This will include periodic reports by the initiative and support for the development of vehicle testing and consumer information systems in regions where these are not yet available

The average fuel economy (L/100 km) of new cars in OECD countries could be improved 30% by 2020 and 50% by 2030 at low or negative cost taking into account fuel savings. Improvements of the same order of magnitude appear possible in non-OECD countries where car fleets are growing fastest. Improving the efficiency of new cars at this rate would make possible at least a 50% improvement in the average fuel economy of all cars on the road worldwide by 2050 – thus, the 50:50 initiative.

Even if vehicle kilometers driven double by 2050, efficiency improvements on this scale worldwide would effectively cap emissions of CO2 from cars at current levels. It is estimated that CO2 savings would exceed 1 Gt CO2 annually by 2025 and 2 Gt CO2 annually by 2050. Additional vehicular pollutants that also impact on the environment and contribute to climate change, including black carbon, would also be significantly reduced.

Chilean automotive market diagnosis 2006-2010

The Chilean domestic vehicle fleet has shown an average growth rate of 13% between 2005 and 2010; except for 2008, where there was a stagnation as a consequence of the international financial crisis where sales decreased by 8%. The segment of larger vehicles, such as light duty trucks and SUV[2], has increased significantly, growing 242% in the 2005-2010 period, accounting for almost a third of automobile sales, which affects a larger size and average displacement market. This is a phenomenon previously observed in other economies; for example, in the United States, in the late 90's there was an increase in local and global pollution emissions and a deterioration in energy efficiency, with these low performance vehicles. The national legal framework also has an effect on this phenomenon, distortions such as tax rebate for the purchase of light duty trucks and four wheel drive vehicles.

In Chile, the vehicles approved under EURO emission standards have displaced those certified under EPA standards. Diesel technology vehicles have progressively gained a larger market share, reaching 21% of total sales in 2010. This has produced two effects: a reduction in average CO_2 emissions and a substantial increase in Nitrogen oxide emissions.

The average NOx emissions from all petrol EURO light duty vehicles sold in 2010 was 0.022 grams per kilometer, while diesel EURO light duty vehicles corresponds to 0.18 grams per kilometer, that is eight times higher. In the case of commercial vehicles[3] emissions were 22 times higher, as shown in Figure 1.

Average emissions from the 2006-2010 sales have remained relatively stable. The commercial diesel vehicles segment shows an important increase in its emissions in 2007 and 2008, possibly due to an extension in the supply of light duty trucks and SUV EURO III vehicles, since this standard is still accepted in the country, although it is over 10 years old.

[2] Sport Utility Vehicle; corresponds to a vehicle category produced from a commercial vehicle chassis, adapted as Station Wagon or similar for family use, often equipped with four wheel drive. Corresponding to its commercial category, environmental requirements are less than for regular vehicle, so its high growth has been a problem that has had to be faced at an international level through optimization of pollutants emission standards.

[3] For the purpose of this study, commercial vehicles correspond to Euro categories N1 II/III and N2. For EPA vehicles, commercial correspond to LDV commercial type 2 and MDV.

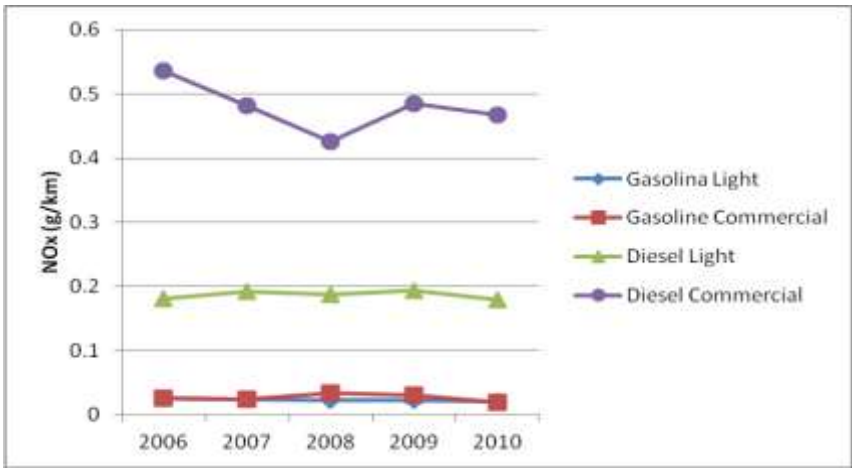

Figure 1. Average NOx emissions EURO models

In the case of particulate matter, there has been no improvement in the national vehicle fleet's average emissions, except for 2007 when the EURO IV standard took effect in the Metropolitan Region for light duty diesel vehicles.

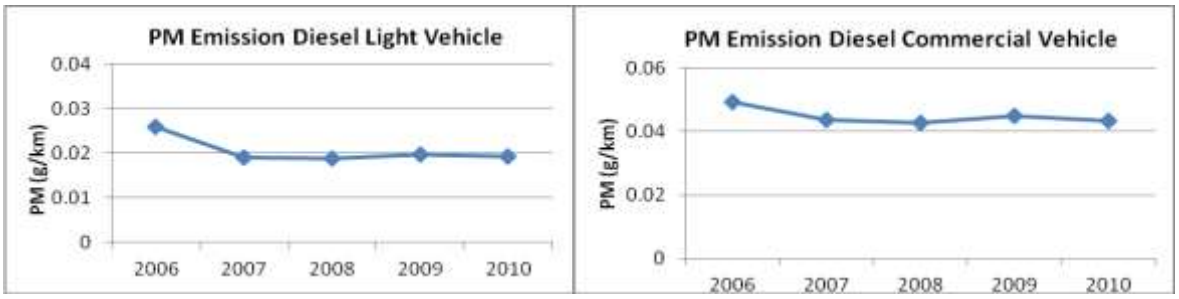

Figure 2. Average PM Emissions EURO models

The domestic fleet shows average CO_2 emissions similar to the ones observed in South Korea, and close to the ones from Australia and USA. In order to understand this phenomenon, it is necessary to consider that the domestic fleet composition is very particular, because it has important sales in the segment of light duty trucks and SUV's, typical of the U.S., with plenty of sales in the segment of city cars (class A vehicles), non-existent in the U.S. It is necessary to consider that the countries mentioned above, unlike Chile, have existing fuel economy standards, so the emissions difference is narrow.

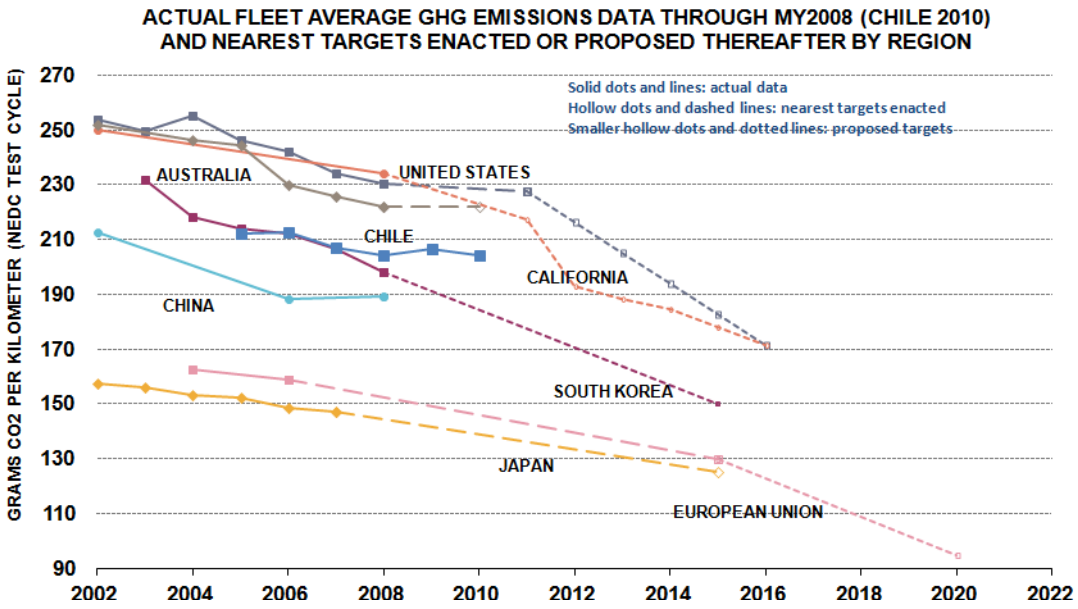

Figure 3. Average emission are compared in different vehicle markets.

With respect to the EU and Japan vehicle markets, Chile shows a significant lag, with 30% higher emissions. The reasons are that these countries show a smaller share of pick-up and SUV's purchases, and have existing or planned strong performance and CO_2 emissions regulations.

The high average emissions of vehicles sold in the country will mean a significant increase of greenhouse gas emissions, as the vehicle fleet continues to grow in this decade. Figure 4 presents an estimate of the total emissions of the national light and medium vehicles fleet, in an identical scenario to the one observed in 2010, considering the fleet growth according to BBVA[4]'s projections until 2012 and then based on projected growth rate over the past 5 years.

An increase of more than double in 10 years will mean a significant increase of greenhouse gases in the country, because transport is responsible for one third of these emissions

[4]Automotive situation in Chile, BBVA Research, December, 2010.

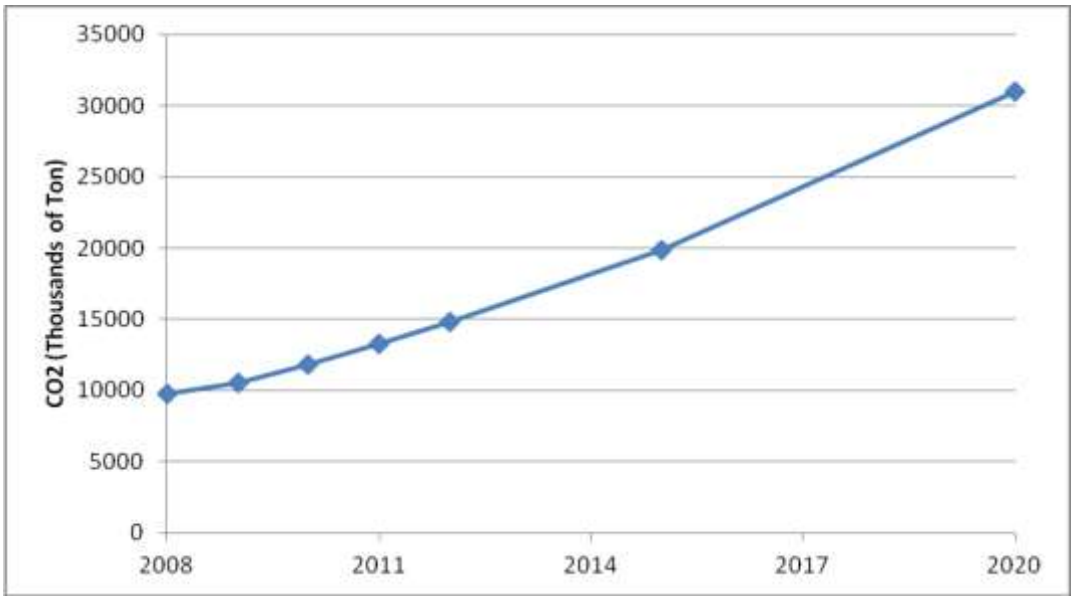

Figure 4. CO_2 emissions projection from Chilean national vehicular fleet.

Related to the growing international concern about the problem of climate change, is the need to reduce dependence on fossil fuels, area in which Chile is extremely sensitive. This was demonstrated during the last crisis in 2008, where the State had to supplement 1 billion US dollars from the Oil Prices Stabilization Fund, along with a significant loss of revenue resulting from the temporary reduction in the gasoline tax. It can be observed in an international comparison that the average performance of the national automotive market is low, corresponding to the year 2010 to 31.2 mpg, which has important implications for future oil demand.

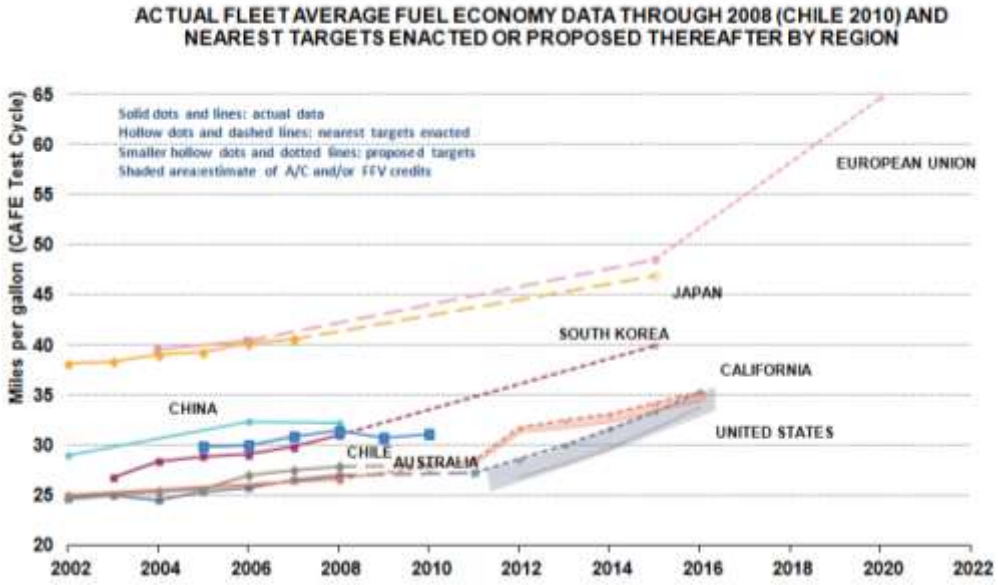

Figure 5. Average performance compared to different automotive markets

Incentive proposal

This proposes the establishment of a system of incentives for low emission and fuel efficient vehicles to promote a vehicle fleet transformation towards more efficient vehicles and that present less local and global pollutant emissions. This will advance compliance with air quality standards, especially in the case of PM2.5, along with reducing Chile's energy dependence and its CO_2 emissions.

To meet these objectives, the scheme provides correction of the vehicle market price based on compliant emission regulations and also on its level of CO_2 emissions (Figure6). CO_2 is considered because for conventional technology vehicles, this greenhouse gas emission is directly related to fuels consumption.

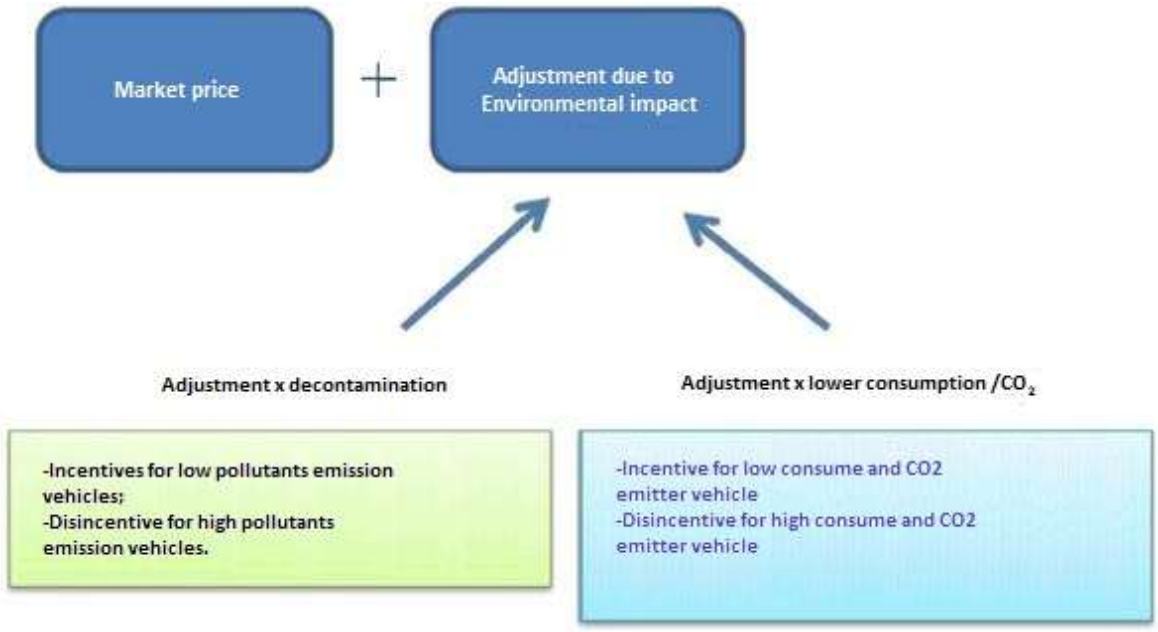

Figure 6. Price correction.

This system is proposed after a completed review of other developed countries' experiences in the promotion of cleaner, more efficient vehicles. These efforts relate to the interest of these countries to increase their energy security and mitigate climate change. For this research the following publication has been extremely useful: "A Review and Comparative Analysis of Fiscal Policies Associated with New Passenger Vehicle CO_2 Emissions-2011" from the International Council on Clean Transportation, as well as other publications provided by the institution. The main recommendations extracted from the aforementioned study are the following:

- Regulation should be directly linked to vehicle emissions.
- Regulation should apply to the entire vehicle fleet, not only to some segments.

- The regulation must establish the amount of incentives/disincentives which vary continuously across the spectrum of emissions, and there must be no emission ranges affected by the same amount, for example, avoiding regulations in steps.
- Bigger emissions reductions are obtained if incentives/disincentives are complemented at the moment of purchase with a similar regulation that applies during the vehicle's lifetime, for example, through annual registration certificates.
- Incentives for specific technologies, such as hybrid vehicles, must be related to emissions.

Cars price correction according to their pollution contribution

To this end, we propose six vehicle categories according to Nitrogen (NOx) emission limits, presented in Table 1 and 2, for EURO and EPA regulations respectively. In the case of EURO, in these six categories specific standards are classified for different types of vehicles, namely: light vehicles, called M1 and its commercial derivates (N1 class I), bigger size light duty vehicles, such as M1 class II and III and medium N2, according to the type of fuel used.

It has been considered that vehicles corresponding to approved models for EURO standards, with NOx emission limits lower than gasoline EURO IV M1 type vehicle, should receive an incentive. This corresponds to categories 5 and 6. It is proposed that the amount of the incentive corresponds to the average cost - estimated by the European Commission for the Environment - of the required technology to go from EURO IV to EURO V[5]. The incentive is progressive as the emissions are reduced. The category that receives the highest incentive is the one that considers vehicles without exhaust emissions.

For vehicles belonging to approved models for EURO standards with NOx emissions limit higher than gasoline M1 type vehicles, it is proposed that they receive a disincentive. This disincentive has been defined as an equivalent to the average cost of the required technology to go from EURO IV to EURO V, and progressive as it meets higher emissions levels.

In Figure 7 are shown 2010 sales classified according to the six proposed categories. It can be seen that most vehicles sold belong to category 3, due to use of the EURO III standard at national level, with exception of M1 diesel vehicles, which in the Metropolitan Region had to comply with EURO IV.

[5] EURO5 technologies and costs, for light duty vehicles, TNO/EuropeanComission,2005

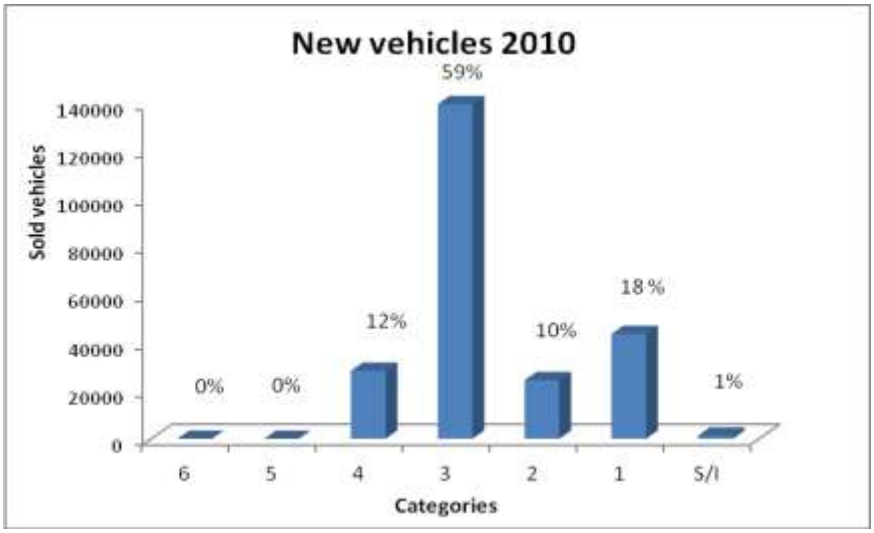

Figure 7. 2010 sales distribution according to proposed categories.

Table 1. Incentives and Disincentives, EURO Standard.

NOx	Category	Type	Standard	Incentive US$	Disincentive US$
Zero emission	6			1000	0
0.02 < NOx < 0.1	5	M1 Gasoline	EURO V / VI		
		Ml Diesel	EURO VI		
		N1 Diesel Class I	EURO VI		
		N1 Gasoline Class I	EURO V / VI		
		N1 Gasoline Class II	EURO V / VI		
		N1 Gasoline Class III	EURO V / VI		
		N2 Gasoline	EURO V / VI	500	0
0.1 < NOx < 0.2	4	M1 Gasoline	EURO IV		
		M1 Diesel	EURO V		
		N1 Gasoline Class I	EURO IV		
		N1 Gasoline Class II	EURO IV		
		N1 Gasoline Class III	EURO IV		
		N1 Diesel Class I	EURO V		
		N1 Diesel Class II	EURO VI		
		N1 Diesel Class III	EURO VI		
		N2 Gasoline	EURO IV		
		N2 Diesel	EURO VI	0	0
		M1 Gasoline	EURO III		
		M1 Diesel	EURO IV		

0.2 < NOx < 0.3	B	N1 Gasoline Class I	EURO III		
		N1 Gasoline Class II	EURO III		
		N1 Diesel Class I	EURO IV		
		N1 Diesel Class II	EURO V		
		N1 Diesel Class III	EURO V		
		N2 Diesel	EURO V	0	500
0.3 < NOx < 0.5	2	M1 Diesel	EURO III		
		N1 Gasoline Class III	EURO III		
		N1 Diesel Class I	EURO III		
		N1 Diesel Class II	EURO IV		
		N1 Diesel Class III	EURO IV	0	1000
0.5 < NOx < 0.8	1	N1 Diesel Class II	EURO III		
		N1 Diesel Class III	EURO III	0	1500

Since 2005 the domestic fleet has begun to be dominated approved vehicle models under EURO standard, moving progressively to those certified under the EPA standard, which until 2010 represented only 32% of sales. For this segment the categories shown in Table 2 are proposed. Similar to the EURO standards, there are 6 identified EPA categories based on the levels of NOx emissions.

It is suggested that vehicles to receive an incentive are those that are approved models for EPA standards with NOx emission limits equal to or lower than Tier 2 Bin5. In order to simplify the operation of this system, this amount is the same as the one defined for EURO categories, and progressive as it meets more stringent emission limits. In the case of EPA standard, Tier2 Bin1 and Bin2 type models belong to vehicles with zero or close to zero local pollutant emissions. For this reason, it is proposed that approved models under these standards receive the highest incentive.

Vehicles belonging to approved models for EPA standards with NOx emission limits higher than Tier2 Bin8 are proposed to receive a disincentive. This disincentive has been defined as the equivalent to the average cost of the technology to go from EURO IV to EURO V, and progressive as the emission levels increase.

Table 2. Incentives and Disincentives, EPA Standard

NOx	Category	Type	Incentive US$	Disincentive US$
NOx≤0.02	6	Tier 2 Bin 1 Tier 2 Bin 2	1000	
0.02 <NOx≤0.1	5	Tier 2 Bin 3 Tier 2 Bin 4 Tier 2 Bin 5	500	
0.1 <NOx≤0.2	4	Tier 2 Bin 6 Tier 2 Bin 7 Tier 2 Bin 8	0	0
0.2<NOx≤0.3	3	Tier 2 Bin 9 Tier 2 Bin 10 Tier 2 Bin 11 Tier 1 Passenger cars Tier 1 LLDT <3750 lbs		500
0.3<NOx≤0.5	2	3750 lbs Tier 1 LLDT Tier 1 HLDT≤5750 lbs		1000
0.5<NOx≤0.8	1	5750 lbs <Tier 1 HLDT		1500

An important aspect related to the implementation of this proposal, is related to correcting the actual imperfection in emission standards applied to the vehicle fleet, which restricts the approval only to the valid standard at national level or in the Metropolitan Region, regardless of whether a particular model is capable of complying with the higher standards at the international level. This problem is manifested, for example, for a European gasoline vehicle, which in its country of origin is certified EURO V (current standard in Europe since 2009) but in Chile can only be approved as EURO IV.

The way to resolve this imperfection is to dictate EURO V and EURO VI standards with voluntary compliance until the authority enact them as mandatory. In the same way it is necessary to proceed with the enactment of EPA standards Tier2 Bin 1, 2, 3 y 4.

Another important aspect is the need to remove the categories corresponding to emission standards that over the years have been abolished.

Price adjustment by Fuel Economy/CO_2 emission

In vehicles with internal combustion engines, the fuel economy is directly related to CO_2 emissions. For this reason, it is proposed a market price adjustment in relation to the grammes of CO_2 emission of the corresponding vehicle model, from the emissions reported according to the fuel economy labeling system agreed in December, 2010 between the Ministry of Environment, Energy, and Transports & Telecommunications, presented in Figure 8.

This label presents information on CO2 emissions determined using the driving cycle NEDC[6]. In the present proposal it is assumed that CO_2 assignation problems under NEDC cycle for approved vehicle models in the country under EPA standards will be resolved as part of the implementation of the fuel economy labeling system starting from July, 2011. For the impact assessment presented in the next chapter, NEDC's CO_2 emissions have been used. In the case of approved vehicle models under EPA standards, CO_2 emissions are expressed under the same driving cycle, the methodology used was from "Seguimiento Ambiental del Mercado Automotriz Chileno" ("Environmental Monitoring of the Chilean Automotive Market") elaborated by Centro Mario Molina Chile.

[6] NEDC:New European Driving Cycle.

Figure 8. National Fuel Economy Label

The CO_2 price adjustment has been defined from the adaptation mechanism of bonuses and penalties allocation used in France since January, 2008 (system Bonus/Malus). A constant CO_2 price has been adopted instead of step function, according to ICCT´s fiscal policies recommendations.

Since the value of the bonus is directly related to savings in fuels, because CO2 is a direct measure of the amount of fuel used in internal combustion vehicles, the French model has been adapted using the relation of gasoline litre prices in France and Chile (Metropolitan Region) observed in 2010. Along with fuel prices, it has also considered the relation between the Euro and the Chilean Peso.

CO_2 emissions with a price adjustment equal to zero, is called the pivot point. For vehicle models with lower emissions to the pivot point receive an incentive and those with high emissions to the pivot point receive disincentives, always in proportion to the emission. The pivot point was defined from the ratio between the pivot system used in the Bonus/Malus system in France (138.6 grams of CO_2/km) and the average CO_2 emission observed in the French market before the implementation of this system (149 grams of CO_2/km). The average observed in 2010 in the Chilean light duty vehicles fleet (185 grams of CO_2/km) was multiplied for this reason, obtaining a pivot of 171 grams of CO_2/km. Subsequently, the pivot point was adjusted to 175 grams to ensure fiscal neutrality of the system.

It is necessary to consider the large diversity of the domestic vehicle fleet, in which different vehicle models coexist, such as city cars with SUV's and large pick-ups. Some smaller models can have relatively high emissions in comparison to their segment, as well as other larger vehicles can have lower emissions than, for example, SUV's. This can be the case for vehicle models that incorporate hybrid engines, weight reduction or some other technology to make them more efficient.

According to international experience, it is possible to consider this factor by using the footprint, which corresponds to a size description of the vehicle model. The footprint corresponds to the multiplying the distance between the axes by distance between the centerline of the tires.

Based on the above the following market price adjustment equation is obtained as a function of CO_2 emissions:

$$\text{Market Price adjustment for a vehicle belonging to a certain model (Chilean \$)} = 10{,}835 \times \text{CO2 emission model i [grs/km]} - 1{,}903{,}155 \times \frac{\text{footprint model i}}{\text{footprint average}}$$

The factor 10.875 was obtained from a linear regression of step function of French Bonus/Malus system, adjusting the coefficient by the ratio between French and Chilean gasoline price for the year 2010.

For an average size model in the fleet, this equation corresponds to the line presented in Figure 9. According to this figure, vehicles of this size with emissions lower than 175 grams of CO2 per kilometer will receive an incentive up to a maximum of $ 1,848,000, in the case of a vehicle with zero CO_2 emission at its tailpipe.

In the opposite case, vehicles will receive a gradual disincentive, which can reach a total of $4,208,000 this corresponds to the model with the highest emissions sold in 2008 (557 grams of CO_2/km).

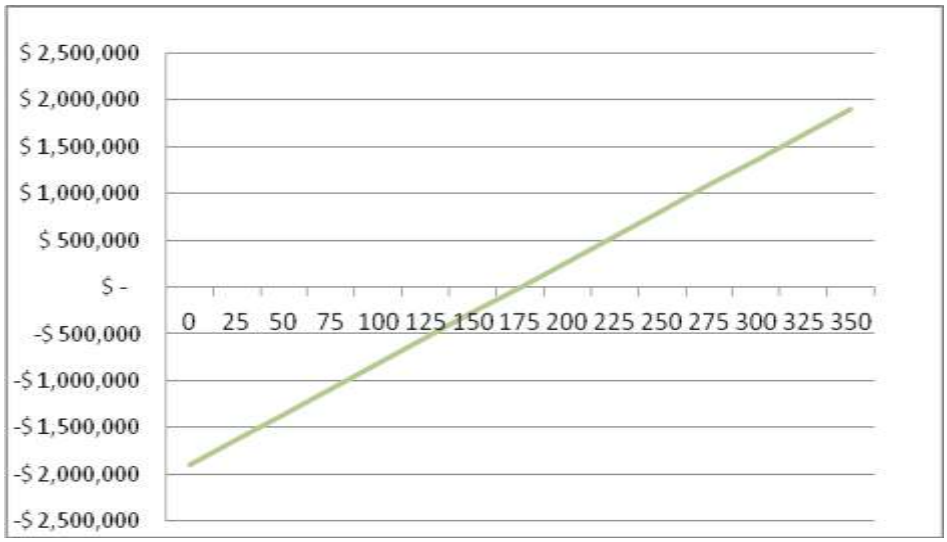

Figure 9. Price adjustment for CO_2 emissions for a model with footprint equal to the average in the vehicle fleet [Chilean $]

Final price adjustment

A vehicle corresponding to a given model will receive a price correction of its market price based on the sum of price correction due to pollution contribution and for fuel economy/CO_2. These price adjustments are determined by the emissions standards which have been approved for the corresponding model to CO_2 emissions and to relevant vehicle size.

An important aspect in the operation of the system is to promote a vehicle fleet transformation to more efficient and with less polluting vehicles, without imposing a cost on society. From this perspective, tax neutrality is an important objective for the system, so there should be a balance between amounts collected from disincentives and the amounts given as incentives.

The gradual improvement of the proposal with more efficient and with less polluting vehicle models must be accompanied by an adjustment of the categories requiring incentives from the point of view of its contribution to pollution, and a displacement of CO_2 pivot point to the left, according to Figure 9. This is in order to keep the system neutral from a taxation point, and to provide a dynamic that seeks to improve supply in the long run. As shown below, this proposed tax incentive is fiscally neutral within 5 years of implementation, resulting in a higher collection in the first years, which is reduced with the gradual improvement of vehicle technology, to the same extent that disbursements are increasing incentives.

Impact evaluation of the incentive system

Here follows an assessment of the impacts of the proposal on the promotion of cleaner vehicles in reducing CO2 emissions, together with an assessment of the balance of the system, in a scenario of five years.

Methodology

Figure 10 shows the general methodology used for the evaluation and adjustment of the system in its first 5 years of implementation.

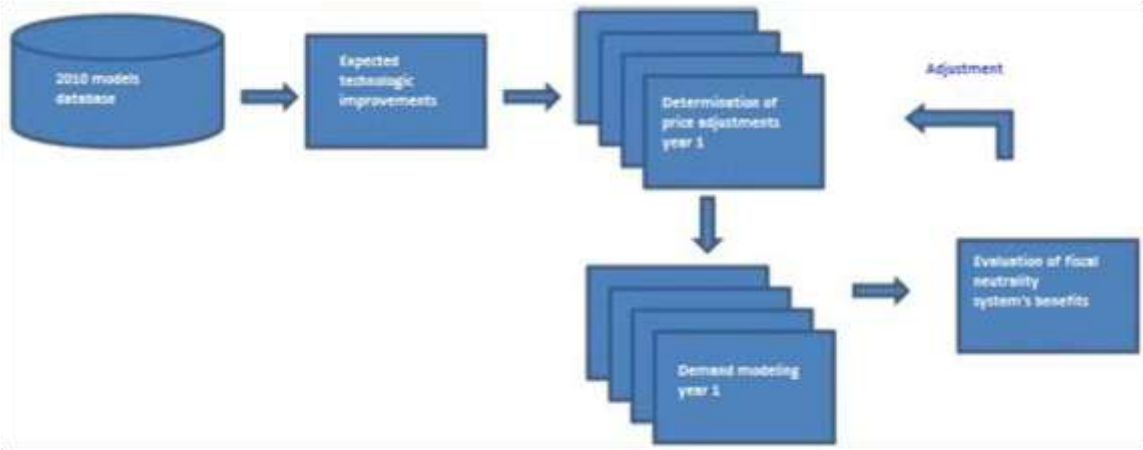

Figure 10. General representation of the evaluation methodology.

Due to the complexity of the vehicle fleet, which by 2010 has 885 models the impact evaluation was analyzed using a database with information from a sample of vehicle models and sales, developed from the information provided to the Under Secretary of Transport by car dealerships. The market segments were defined based on the most common body types (hatchback, sedan, station and pickup) subdivided into price segments by the National Vehicle Association of Chile (Asociación Nacional Automotriz de Chile (ANAC)). With this background, the Sales Matrix was populated, as shown in Annex 1. The matrix is composed of 63 models which represent 36% of total cars sold in 2010. The prices were obtained by direct communication and through the national dealership web sites, as well as historical valuations of new vehicles, according to information published by the Internal Tax Authority (Servicio de Impuestos Internos).

For the first year it was considered that the incentive system will affect the range of models supplied in the market in 2010. For this scenario it is assumed that the supply of models remains the same, but that the models eligible for re -certification under stricter standards have done so.

For subsequent years an improvement in the supply of a range of vehicle models, is estimated, in terms of CO2 emissions from the relationship between market segments and the emission standard for this pollutant as it begins to take effect in 2012 in Europe, and CO_2 trends observed in the French fleet in the period 2006 to 2009.

Figure 11 shows the average emission of CO_2 and the average weight of on road vehicles by segment of the vehicle fleet. Fleet segments are presented for each body style, as those indicated in Annex 1, assigning similar categories as those used in Europe.

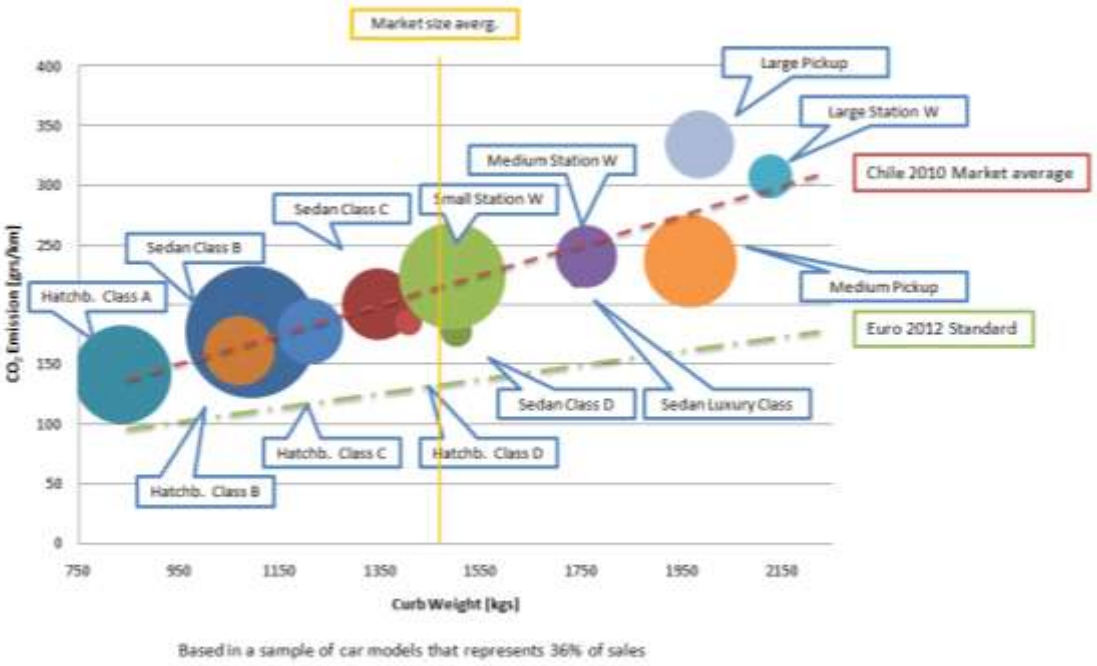

Figure 11. Comparison of the Emissions in the domestic fleet and the CO_2 standards of Europe, the size of the bubbles represent annual sales

Figure 11 shows which fleet segments have higher emissions than those required by the European standard, and this distance is greater the heavier the vehicle weight. The exception is the segment of sedans and hatchback classes D and luxury because the corresponding models are mostly products equivalent to those currently marketed in Europe.

It is expected that under an incentives system for more efficient vehicles with lower emissions the supply will improve faster in those segments furthest away from the European standard, because there is a growing alternative of vehicles that can meet these requirements and that can be imported into the domestic market. In the case of the segments and equivalent models to the European, the rates of emission reductions will be lower.

Under this approach, and considering the emissions reduction rates observed for each vehicle segment in France[7] in the period 2006 to 2009, it is estimated that emission reduction rates in the domestic fleet under a system of incentives will be the ones presented in Table 3.

[7] The French bonus/malus system: Objectives and achievements, Francoise Cuenot,IEA,2011

Table 3. CO_2 emissions reduction rate from 2010 expected by segment

Segments	2011	2012	2013	2014
Sedán 3a5MM$	2,5%	5,0%	7,5%	10,0%
Sedán 5a7MM$	3,7%	7,5%	11,2%	14,9%
Sedán 7a10MM$	4,1%	8,1%	12,2%	16,2%
Sedán 10a20MM$	2,8%	5,6%	8,3%	11,1%
Sedán ≥20MM$	3,9%	7,7%	11,6%	15,4%
Hatchback 3a5MM$	2,6%	5,1%	7,7%	10,3%
Hatchback 5a7MM$	3,7%	7,5%	11,2%	14,9%
Hatchback 7a10MM$	4,2%	8,5%	12,7%	16,9%
Hatchback 10a20MM$	2,8%	5,6%	8,3%	11,1%
Hatchback ≥20MM$	3,8%	7,7%	11,5%	15,4%
Station W7a10MM$	4,7%	9,3%	14,0%	18,6%
Station W10a20MM$	3,8%	7,7%	11,5%	15,4%
Station W≥20MM$	5,7%	11,5%	17,2%	22,9%
Pick Up 7a10MM$	3,8%	7,7%	11,5%	15,4%
Pick Up 10a20MM$	6,8%	13,5%	20,3%	27,1%

With the information from the sample of models and estimation of their improvement in the coming years, price adjustments were determined for each model included in the sample, according to their pollution contribution using categories presented in Tables 1 and 2, and to their CO_2 emission using equation presented in Page 23. From this, the average price adjustment per segment was obtained. In Table 4 and Table 5 price adjustments are presented for each market segment and their relationship with average price of a vehicle of the segment for the years 2010 and 2014. Price adjustments and percentages with a negative symbol correspond to incentives; those with a positive symbol correspond to disincentives.

Table 4. Price adjustments by segment in 2010 scenario [Chilean $]

Vehicle Price [MM Chilean $]	Sedán		Hatchback		Station W		Ligth Duty Trucks	
3 a 5			Price Adjusment	% vehicle price				
			$ 24,949	1%				
5 a 7	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price				
	$ 53,113	1%	$ 26,582	0%				
7 a 10	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price
	$ 16,534	0%	-$ 169,153	-2%	$ 403,217	5%	$ 756,518	7%
10 a 20	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price
	-$ 201,171	-2%	-$ 198,590	-2%	$ 863,412	7%	$ 917,608	8%
20 +	Price Adjusment	% vehicle price			Price Adjusment	% vehicle price		
	$ 46,976	0%			$ 1,154,876	5%		

Table 5. Price adjustments by segment in 2014 scenario [Chilean $]

Vehicle Price [MM Chilean $]	Sedán		hatchback		station		Ligth Duty Trucks	
3 a 5			Price Adjusment	% vehicle price				
			-$ 134,262	-4%				
5 a 7	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price				
	-$ 235,090	-4%	-$ 235,967	-4%				
7 a 10	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price
	-$ 312,219	-4%	-$ 479,456	-$ 0.06	-$ 64,376	-1%	$ 254,067	3%
10 a 20	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price
	-$ 434,537	-4%	-$ 422,705	-4%	$ 340,360	3%	$ 55,877	0%
20 +	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price	Price Adjusment	% vehicle price
	-$ 321,625	-1%	$ 2,212,516	7%	$ 306,324	1%	$ 3,216,390	15%

With these amounts of incentives and disincentives, the impact on annual demand was estimated. It is important to mention that there are no publications on national automotive market behavior, which is why it was necessary to build a simple demand model from the pricing and sales information used to build the sales matrix. For each segment we determined the elasticity of annual sales on average price observed since the year 2006 and the Gross Domestic Product (GDP). For segments with prices less than 10 million pesos, regressions explaining their behavior were obtained. Segments with prices over 10 million pesos are very inelastic, so if you assumed that those sales do not change with respect to a baseline scenario in which they grow with the rate observed in the last five years (6% annual growth in the vehicle fleet) but segments within each of these sales are distributed according to how the price corrections affect the relative prices of the models.

Estimated impacts

While the incentive system is at first a marginal effect on total annual vehicles sales, as shown in Figure 12, as the offer extends to vehicle models with lower emissions, the greater is the amount of incentives that are delivered. This is why there is a gradual increase in sales. A further increase in sales can compromise the expected emissions reductions as a result of the implementation of the incentive system. This is one reason, along with the need to maintain fiscal neutrality, to monitor and periodically adjust the pivot point of CO_2 and the proposed categories for the emissions standards.

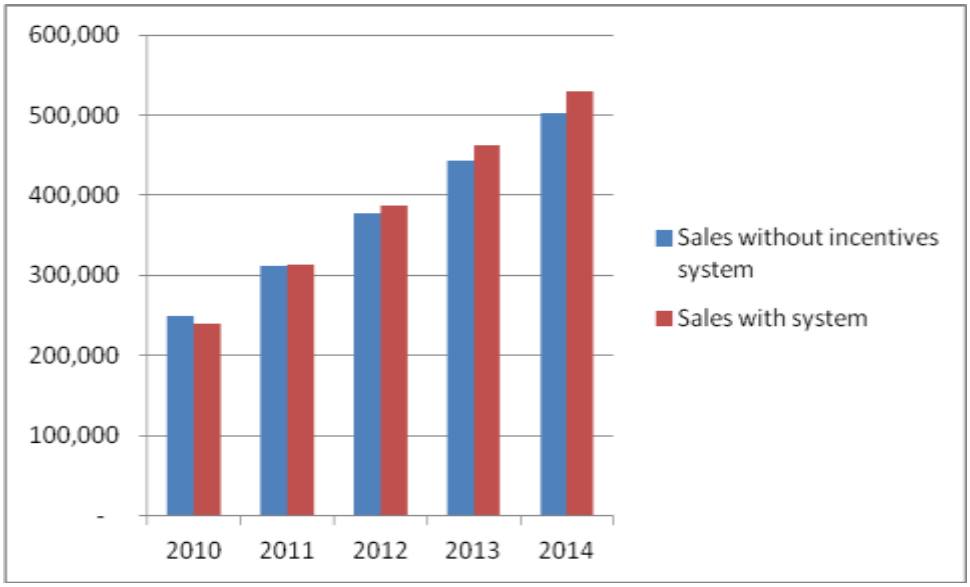

Figure 12. Incentives system effect in total sales

The system promotes improved technology of the vehicle models offered, and as emissions are lowered, it reduces the disincentives and increases revenue by spending on incentives. As shown in Figure 13, the system is fiscally neutral after 5 years.

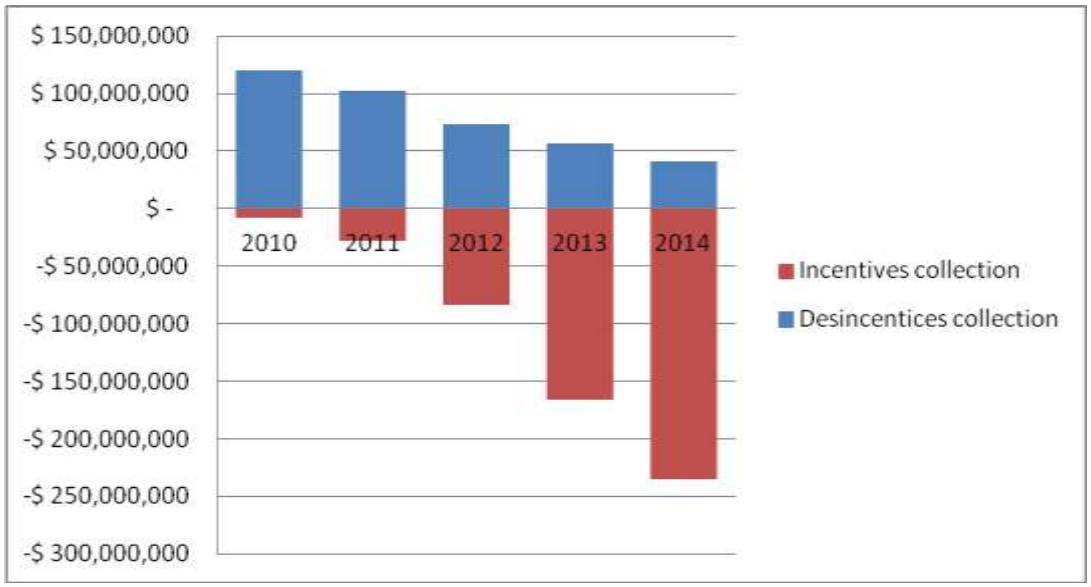

Figure 13. Fiscal neutrality evaluation of the system (values in US$/year)

Fleet segments that receive the highest incentives are sedans and hatchback with prices between 5 and 7 and between 7 and 10 million pesos (Figure 14). The segments with most disincentives payments are the pickups and station wagons (Figure 15). In this last category SUV's are included.

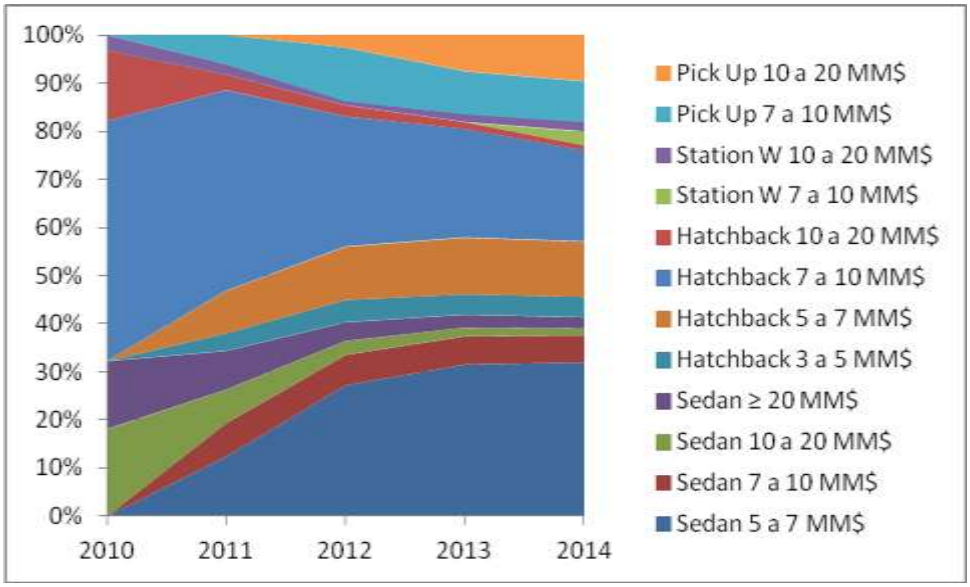

Figure 14. Segments with incentives.

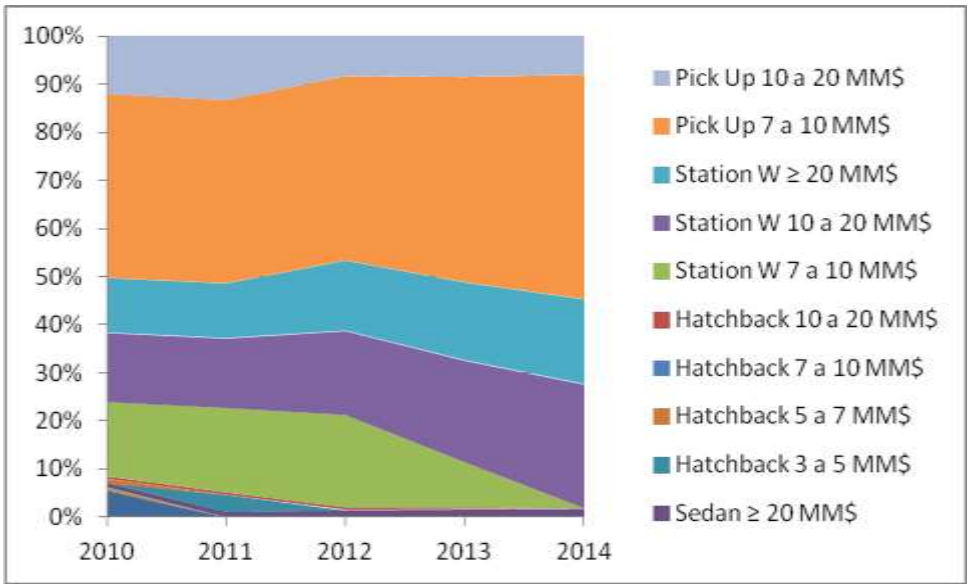

Figure 15. Segments with disincentives

By the application of the incentive system, there is a gradual improvement in the average emissions of the fleet, particularly in CO_2 emissions. This effect allows the domestic fleet to behave similar to other countries with regulation proposals of fuel consumption and CO_2 emissions, such as Korea, and reduces the gap between Chile and the more developed countries like Japan and the European Union, as shown in Figure 16.

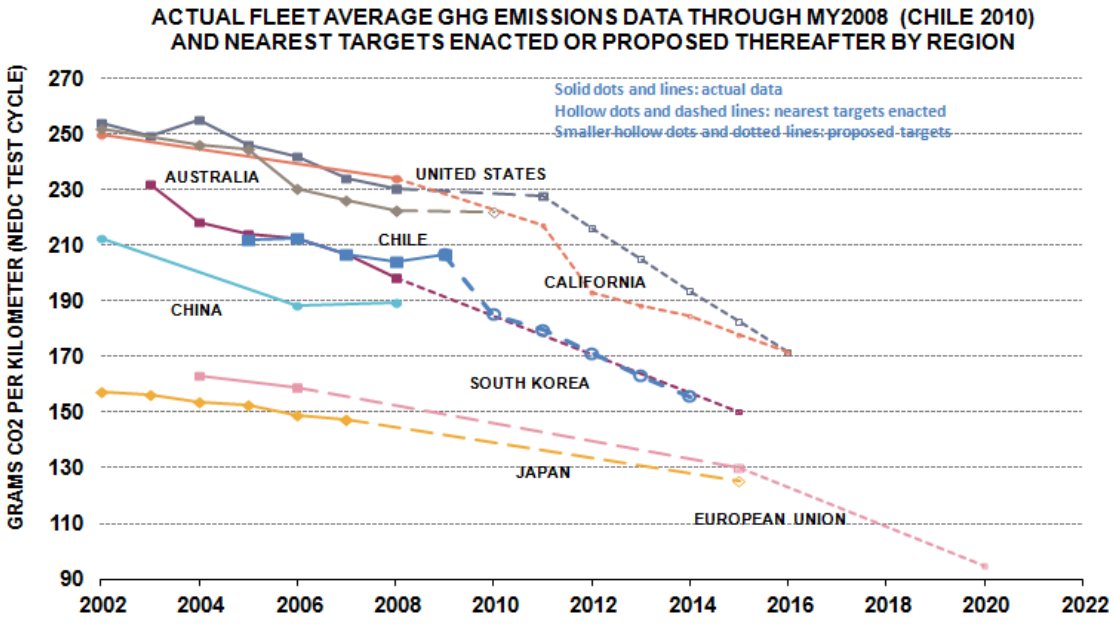

Figure 16. Estimated CO_2 average emission improvement in the national automotive market

The average emission reduction of the fleet means lower emissions of greenhouse gases. It is estimated that the fifth year of the incentive system, CO_2 emission of the total national fleet of cars is reduced by 5%, equivalent to 833 thousand tons per year. During the evaluation period of five years, a total reduction of 2.1 million tons is achieved (Figure 17).

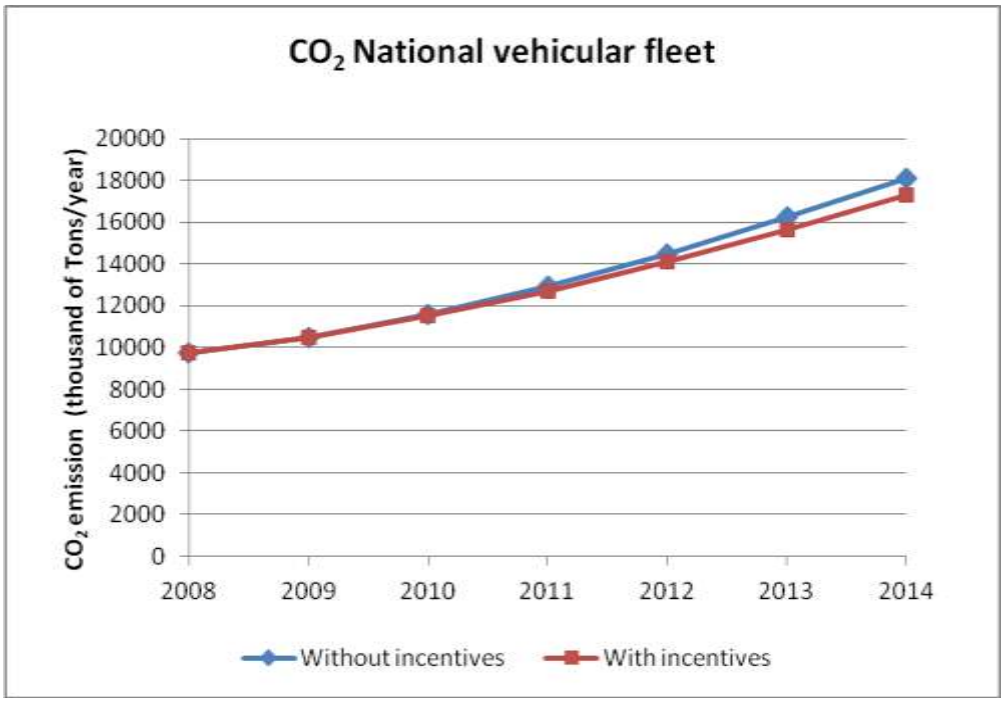

Figure 17. CO_2 emission estimate from the automotive fleet - with incentives.

In terms of fuel, it is estimated that the fifth year of implementation can achieve a national annual savings of $200 million pesos due to lower imports of gasoline and diesel. For car owners of a medium 5-door hatchback car it is estimated an average annual savings of $134,000 due to less fuel consumption. For owners of a double cab pick-up who use them as a work vehicle, these savings can be $ 400,000.

Recommendation for legal implementation

The fee-bate system implementation needs an analysis of the local legal conditions and practices for this kind of policy, without diminishing key aspects, as for example, the importance of clear signals in vehicle price at the moment of purchase of a new car. Some studies in the US suggest that customers discount rebates if they do not receive them immediately.

This chapter presents a first analysis and recommendation for fee bate system implementation under the Chilean legal framework, considering some similar experiences, for example, in the promotion of fuel efficiency in other fields.

Implementation options

The proposed incentive system seeks to provide benefits to those who purchase vehicles that are considered more efficient and with low emissions, and implement tax those who purchase vehicles that are considered highly polluting and have high fuel consumption.

The proper functioning of this system requires compliance of the following principles:

- Progressiveness: the benefits and penalties meet the pollutants emission levels of each particular vehicle, according to parameters previously established by the authority.
- Equivalence: the benefits provided must be equivalent to the fines or penalties, so that the effect of taxation is neutral.
- Final consumption: The model should be applied to the final consumer, so the reduction/penalty is applied directly and not indirectly through transfers or price adjustments by the intermediary depending on the elasticity of demand.

The legislative experience of recent years indicates that the road tax to encourage certain behaviors recognizes certain limits or conditions. In other words, it was decided to apply benefits within the following framework:

- No tariff: a tax could be considered a breach of trade tariff agreements between countries and thus are likely to object to their legality or constitutionality.
- Privileging the incentive more than the tax: the legal trend to generate consumer behaviors has been to establish incentives and benefits rather than applying taxes. This principle is expressly recognized in similar models as the law which created incentives for environmentally friendly vehicles.
- Limit regressive component: usually those measures that give tax incentives to investments or purchases are criticized during legislation discussions because they are considered of aggressive nature.
- Easy administration: for model as the one proposed to be easily administered requires the following basic conditions: i) the the purpose of the model approval is likely; ii) the purpose of the model is capable of integration into public records; iii) that the subject of the model can apply it simply and personally, iv) that the operation of the model is easily managed and of efficient control.

Table 6. Compliance with principles and limits of different benefit options and taxes

Option	Base principles		Limits				
	Progressiveness	Equivalence	Consumo Final	No Arancelario	Incentive Privilege	Limitar Regresividad	Facilidad Adm.y Fiscalización
Impuestos Importación							
Arancel	Complies	Complies	Fails	Fails	Fails	Fails	Complies
IVA y Adicionales							
Adicional IVA	Complies	Fails	Fails	Fails	Fails	Fails	Complies
Impuesto Renta							
PrimeraCategoría	Complies	Complies	Complies	Complies	Complies	Depends on the function	Complies
Global Complementario	Complies	Complies	Complies	Complies	Complies	Depends on The function	Complies

Where:

Impuestos de importación = importation tax,

IVA y adicionales = VAT,

Impuesto a la renta = Income tax.

Previous experiences

The law of income tax has been the mechanism most commonly used when it is needed to promote certain behaviors, particularly by way of granting credits against the tax or rebates of the tax base.

Table 7. Previous experiences

Incentive objective	Tax type	Mode
Fix assets investment	First class	Credit
Contracts I+D	First class	Credit
Training	First class	Credit
Thermal solar systems	First class	Credit
Investments savings	Complementary global	Debit Credit
Mortgage credit	Complementary global	Reduction
Pension savings	Complementary global	Reduction
Investments in capital market	First and global	Exention

Proposed model

The existing tax mechanism that most closely matches the desired model is now established in the Art. 57 bis of the Law on Income Tax, which promotes the acquisition of certain financial assets of savings by way of granting a tax credit equivalent to a percentage of the investments and discourages the liquidation of such assets by implementation of a debit tax.

Applying such a mechanism to the analyzed model, would imply that:

1. Taxpayers who buy a new pollutant vehicle will pay a specific tax on their declaration of income tax rent[8].

2. Taxpayers who purchase new lower-emission vehicles are entitled to a credit equal to a percentage of the value of the car.

3. When the taxpayer sells the car that gave the right to credit, he must replace as a debit the amount reduced by the purchase.

4. Then, if the taxpayer acquires a new car he will pay tax or will have the right to new credit as appropriate.

[8] Mechanism 57 does not have this first entry tax

Operations

The following table reflects the proposed tax model's operation and the participants.

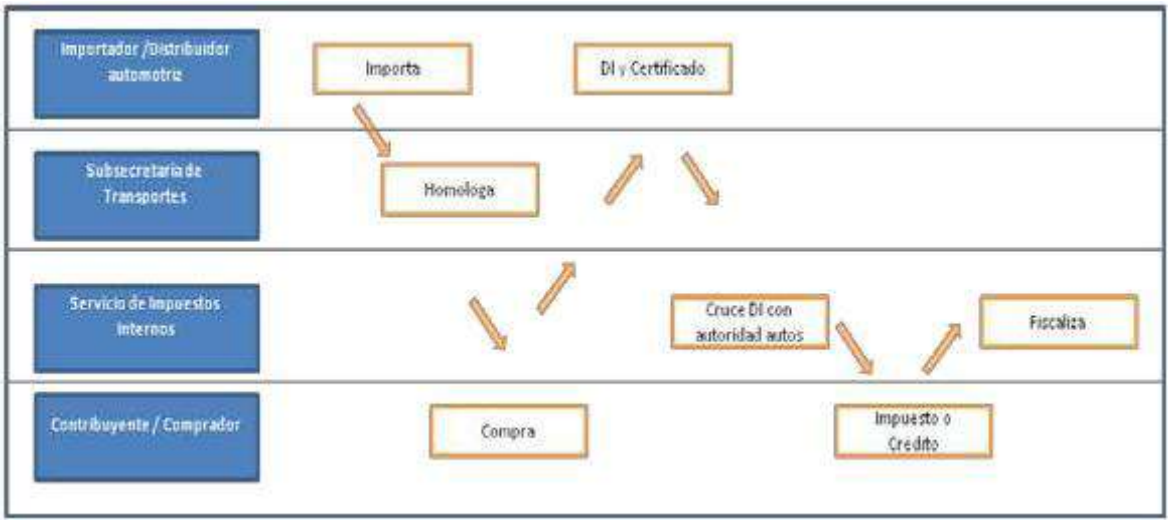

Figure 18. Operation of the system

The sequence of steps, responsibilities and activities is as follows:

1. Vehicle Importer/distributor imports vehicles
2. Authority approves vehicles and defines models and amounts
3. Taxpayer purchases vehicle
4. Vehicle Importer/distributor issues an Affidavit to the SII and informs specifically about polluting and nonpolluting cars sold.
5. Vehicle Importer/distributor issues certificates to taxpayer buyer with information about approval and amount of tax or credit.
6. SII makes link with Affidavit information issued by the Automotive
7. Taxpayer states in F22 using the certificate information
8. SII audits with linking algorithm

Annex 1 Sales Matrix

Body work	Price [MM$]	Model
sedan		Rio JB 1,4 DOHC Sedan 4P. T/M Motor Otto
		Accent MC 1,4 DOHC Sedan 4P. T/M Motor Otto
	5 to 7	Aveo LT NB AC 1,4 DOHC Sedan 4P. T/M Motor Otto
		Yaris 1,5 DOHC Sedan 4P. T/M Motor Otto
		Accent MC 1,6 DOHC Sedan 4P. T/M Motor Otto
		Mazda3 1,6 DOHC Sedan 4P. T/M Motor Otto
	7 to 10	Mazda3 1,6 DOHC Sedan 4P. T/A Motor Otto
		SM5 2,0 16v DOHC Sedan 4P. T/A Motor Otto
		Lancer 1,5 DOHC 16v Sedan 4P. T/M Motor Otto
		Elantra HD 1,6 DOHC Sedan 4P. T/A Motor Otto
		Mazda6 2,0 DOHC Sedan 4P. T/A Motor Otto
		Civix LXS 1,8 Lts., Sedán 4P T/A Motor Otto
	10 to 20	Accord EXL 2,4 DOHC Seadn 4P. T/A Motor Otto
		Avensis 2,0 DOHC Sedan 4P. T/A Motor Otto
		318i 2,0 DOHC Sedan 4P. T/A Motor Otto
		C 280 3,0 DOHC Sedan 4P. T/A Motor Otto
		C 350 3,5 DOHC Sedan 4P. V6 T/A Motor Otto
	20+	S 500 5,5 DOHC Sedan 4P. T/A Motor Otto
		E 200 K 1,8 DOHC Sedan 4P. T/A Motor Otto
hatchback		Alto 800 0,8 SOHC Hatch Back 5P. T/M Motor Otto
	3 to 5	Spark LT 1,0 SOHC Hatch Back 5P. T/M Motor Otto
		Morning 1,1 SOHC Hatch Back 5P. T/M Motor Otto
		Spark SE 0,8 Lts., HatchBack 5P T/M, Motor Otto
		Aveo LS 1,4 Lts., DOHC Hatchback 5P T/M, Motor Otto
	5 to 7	Getz F/L 1,4 DOHC Hatch Back 5P. T/M Motor Otto
		Yaris Sport 1,3 DOHC Hatch Back 5P. T/M Motor Otto
		Swift 1,3 DOHC Hatch Back 5P. T/M Motor Otto
		Swift 1,5 DOHC Hatch Back 5P. T/M Motor Otto
		Tiida 1,6 DOHC Hatch Back 5P. T/M Motor Otto
		C4 1,6 DOHC Hatch Back 5P. T/M Motor Otto
	7 to 10	308 1,6 Vti DOHC Hatch Back 5P. T/M Motor Otto
		XSara Picasso 1,6 HDI DOHC Hatch Back 5P. T/M Motor Diesel
		Caliber STX 2,0 16v DOHC Hatch Back 5P. T/A Motor Otto
		CR-V EX 2,4 16v DOHC iVTEC Hatch Back 5P. T/A 4x4 Motor Otto
		CR-V 2,4 DOHC Hatch Back 5P. T/A 4x2 Motor Otto
	10 to 20	A3 1,6 DOHC Hatch Back 3P. T/M Motor BSE Otto
		Cooper 1,6 16v DOHC Hatch Back 3P. T/M Motor Otto
		Mazda6 2,5 DOHC Hatch Back 5P. T/A Motor Otto
station		Rav4 2,4 DOHC Station Wagon 2WD 5P. T/A Motor Otto
		Rav4 2,4 DOHC Station Wagon 2WD 5P. T/M Motor Otto
	7 to 10	JB416 Grand Vitara 1,6 DOHC Station Wagon 4WD 3P. T/M Motor Otto
		EcoSport 1.6Lts., SOHC Station Wagon 5P T/M Motor Otto
		Sportage 2,0 Lts., DOHC Tipo Jeep 5P 4x4 T/M, Motor Otto
		Captiva LS SU 2,0 SOHC Station Wagon 5P. AWD T/M Motor Diesel
		Explorer II XLT 4,0 SOHC V6 Station Wagon 5P. 4x4 T/A Motor Otto
	10 to 20	Captiva LT SU 2,0 SOHC Station Wagon 5P. AWD T/A Motor Diesel
		CX-9 3,7 DOHC Wagon 5P. 4x4 T/A Motor Otto
		Impreza 2,0 R DOHC Wagon 5P. AWD T/A Motor Otto
		325i 2,5 DOHC Station Wagon 5P. T/A Motor Otto
		Suburban LT 5,3 DOHC Station Wagon 5P. 4WD T/A Motor Otto
	20+	ML 320 CDI 3,0 DOHC Station Wagon 5P. 4x4 T/A Motor Diesel
		ML 350 3,5 DOHC Station Wagon 5P. 4x4 T/A Motor Otto
		Expedition Eddie Bauer 5.4 Lts. SOHC V-8 Station Wagon 5P 4x4 T/A, Motor Otto.
pick up		Terrano D22 2,5 Look 4x4 Turbo DOHC Cabina Doble 4P. T/M Motor Diesel
		L200 Dakar CRS 2.5 CRDI 16v DOHC Pick Up D/C 4P. 4x4 T/M Motor Diesel
	7 to 10	Actyon Sport 2,0 DOHC Pick Up 4P. 4x4 T/M Motor Diesel
		S-10 2.4 Lts., OHC 2WD Pick Up Doble Cabina 4P. T/M, Motor Otto
		Terrano D22 2,5 Turbo DOHC Cabina Doble Pick Up 4P. 4x2 T/M Motor Diesel
		Hilux 2.5 Lts. DOHC Turbo Diesel Camioneta Cabina Simple 2P 4x4 T/M, Motor Diesel.
		Ranger XLT 2,5 DSL DOHC Pick Up Doble Cabina 4P. 4x4 T/M Motor Diesel
	10 to 20	Colorado CC 3,7 DOHC Pick Up 4P. 4WD T/A Motor Otto
		Dakota Quad Cab 3.7 Lts., V6 OHVC Pick Up D/C 4P. 4x4 T/A Motor Otto.
		Hilux (SR) 3,0 DOHC TDI Camioneta Cabina Doble 4P. 4x4 T/M Motor Diesel

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