CEGESTI

Centro Mario Molina Chile

Report

CO_2 emissions and fuel economy baseline for imported new vehicles in Costa Rica during the period 2008-2014.

PNUMA

Alianza para Combustibles y Vehículos Limpios

GFEI
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Hacia la Sostenibilidad - Towards Sustainability

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Elaborated by CEGESTI

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1. CONTEXT

Costa Rica has had multiple challenges in the transport sector that currently require an immediate solution. The poor transport infrastructure and public transportation and citizen mobility situation further reinforce the urgency to solve these problems. The difficulty to implement previous plans or projects designed have had different causes: political, economic and technical factors. Nonetheless, the impact that this lack of action has had in the public treasure, health and well-being of the citizens, and the environment obliges measures that come to solve this national problem.

The country is looking for measures that allow it to reduce its fossil fuel consumption and at the same time reduce the impact that the transport sector is causing on the environment. This sector is responsible for almost all of the fuels imported into the country that during 2014 represented an expenditure of $2 100 million USD. It is the largest CO_2 emitter in the energy sector with 66% (IMN, 2010). The impact on public health, environment, and socioeconomic aspects makes it mandatory to improve the sector's efficiency and result in positive impacts in all of the areas mentioned.

In a deeper analysis of the CO_2 emission share, it is noted that 41% come from light passenger vehicles (SUV, pickups, vans included), 22% from small cargo and heavy duty vehicles (buses excluded), and 16% from motorcycles (idem). Figure 1 shows the fleet age, with particular attention that the largest percentage is located between 21-30 years old, with data provided by the technical inspection entity (Riteve, 2014). Vehicles as old as these ones don't have the best emission control technologies available nor the best fuel economy, ergo, don't contribute with the emission and fuel consumption reductions sought by the country and also cause pollution that affects public health and the environment.

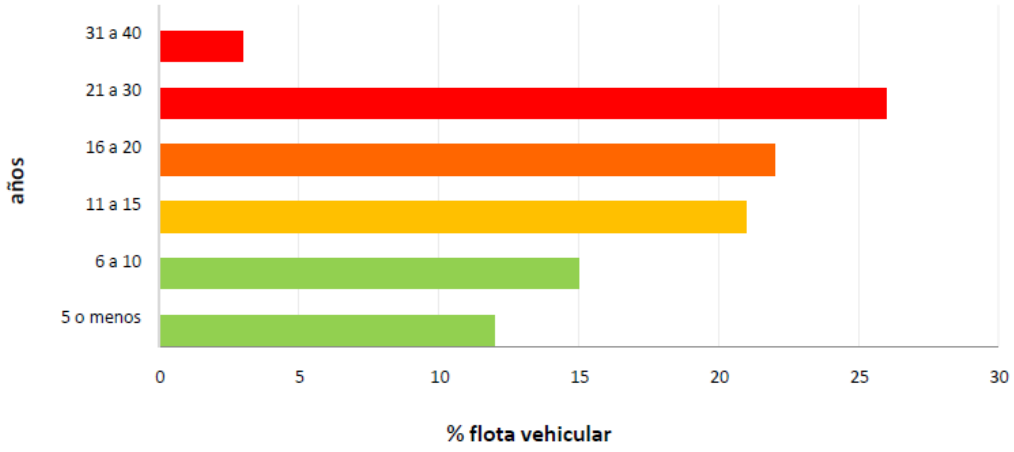


Figure 1. Fleet age in Costa Rica.

From 2005 the vehicle imports started to incline towards the new vehicles instead of the second hand due to fiscal adjustments. In 2014 the new vehicle imports reached more than 80%, mainly for motorcycles (more than 90%), according to data facilitated by the Customs Agency (Figure 2).

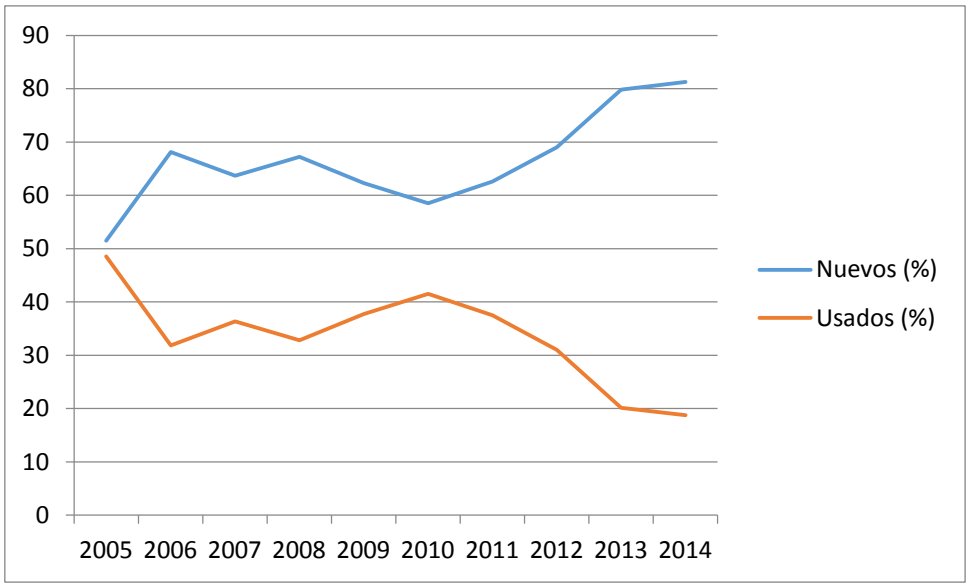


Figure 2. New and used vehicles import tendency from 2005-2014.

In this context the project "Promoting cleaner fuels and more efficient vehicles in Costa Rica" comes into place. Part of the project includes a baseline study on the new vehicle market trend for CO_2 emissions and fuel economy, during the period 2008-2014. This study was elaborated according to the methodology developed by the Global Fuel Economy Initiative (GFEI), in order that its results might be compared with other baselines worldwide.

The results are expected to be taken into account by policy makers for the definition and evaluation instruments that allow them to set their goals for emission reductions and fuel economy, therefore contributing to the proposed country goal to be carbon-neutral by 2021.

2. OBJECTIVE

Determine the trends in fuel economy and CO_2 emissions for the new vehicles in Costa Rica during the period 2008-2014 in order to establish policies that contribute to reach the national goal to become a carbon-neutral country by 2021.

3. METHODOLOGY

The used methodology was developed by the Global Fuel Economy Initiative (GFEI) and was supplied to CEGESTI by the United Nations Environmental Program (UNEP). For the development of the present study, CEGESTI had technical assistance from the Centro Mario Molina Chile (CMMCh) who facilitated the emission factor data gathered by the Centro de Control y Certificación Vehicular (3CV), from the Ministry of Transport and Communications of Chile.

3.1 METHODOLOGICAL GENERALITIES

The results to attain with the proposed methodology are: the annual harmonic average for fuel economy expressed in miles per gallon (under the CAFE cycle) and the annual weighted average for emissions expressed in grams of CO_2 per kilometer (under the NEDC cycle).

These values were calculated according to the following formulas:

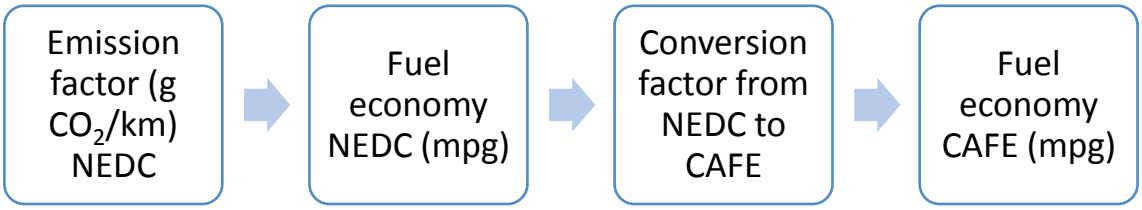
$$\text{Promedio anual de emisión} = \frac{\sum_1^n ventas\ modelo\ i * emisión\ modelo\ i}{\text{Total de ventas en el año}}$$

$$\text{Promedio armónico anual del rendimiento} = \frac{Total\ de\ ventas\ en\ el\ año}{\sum_1^n \frac{ventas\ modelo\ i}{rendimiento\ de\ modelo\ i}}$$

The information corresponding to the fuel economy and the emissions, reference vehicles standardized under the norms EURO or EPA. To determine the emissions (EURO norm) the New European Driving Cycle is used (NEDC), while the CAFE is used for the EPA norm. Due to this difference, an adjustment has to be made in order so the data can be compared. The conversion was done using a tool developed by the International Council on Clean Transportation (ICCT).

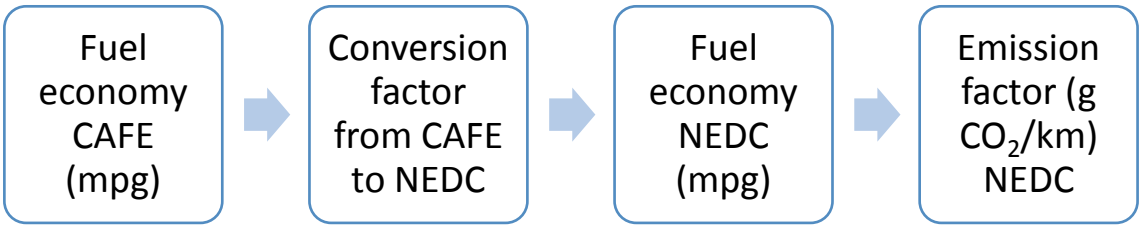
The procedure to adjust the data from one cycle to the other was:

- From the European cycle (NEDC) to the North American cycle (CAFE)



To determine the annual harmonic average for fuel economy all data must be presented in miles per gallon under the North American driving cycle (CAFE). In that case, all of the information that is gathered using the emission factor under the European Cycle (g CO_2/km NEDC) must be transformed first to fuel economy under the NEDC cycle. This conversion depends on the type of fuel used by the vehicle, as it varies depending on the content of carbon present. This step was made using the tool available from the ICCT. After the data is in fuel economy in mpg under the NEDC cycle a conversion factor must be used in order to pass from that cycle to the CAFE cycle. Once the data is in mpg under the CAFE then all the information can be put into the formula mentioned above to obtain the annual harmonic average for fuel economy.

- From the North American cycle (CAFE) to the European cycle (NEDC)



To determine the annual weighted average all of the emissions data must be in grams of CO_2 per kilometer under the European driving cycle (NEDC). For the vehicles in which the data available was only in fuel economy a conversion must be made in order to pass from mpg under the CAFE to g CO_2/km under the NEDC driving cycle. For this conversion, first the data must be converted from mpg under the CAFE to mpg under the NEDC. The ICCT tool provided the conversion factor for this step. Once the information is in mpg under the NEDC cycle then it must be converted into g CO_2/km under the NEDC cycle. The conversion depends on the type of fuel the vehicle runs on, as the carbon content in each fuel is different. After this conversion the value obtained should be in g CO_2/km under the NEDC and the information ready to be used in the formula established above for emissions.

3.2 DATA PROCUREMENT AND PROCESSING

The data used to elaborate the baseline study were the vehicle imports during the period 2005-2014, facilitated by the Customs Agency. CEGESTI opted to use this data because there are no official sales data on vehicles for the country. According to the market conditions, the approximation of vehicles imported vs. vehicles sold is very realistic. The only stakeholder that has the information on sales available is the Association of Vehicle and Machinery Importers (AIVEMA).

The effort to obtain this information was made but the information was not supplied. Also, this information is not considered official since it belongs to an association.

On the other hand, another consideration was with the National Property Registry; nonetheless, those data had a cost that the project couldn't cover.

The data was processed with a metadata tool called Tableau Public. Once the information was organized, data on emissions and fuel economy was added.

3.3 EMISSION AND FUEL ECONOMY DATA

The information sources used, in order of priority, were the following:

- Database from Chile: supplied by the CMMCh with data generated by the 3CV.
- Database from the United States of America: Taken from the www.fueleconomy.gov website to obtain the fuel economy from the vehicles.
- Database from Europe: due to the differences between the Costa Rican and European markets, the use of these databases was minimal. They were consulted from: http://www.eea.europa.eu/data-and-maps/data/co2-cars-emission-8.
- Information from the dealers/manufacturers: if none of the other sources had the information on fuel economy or emissions, the data contained on the specifications sheets was used.

The priorization of the information was decided because the Chilean database presents the information detailed by emission standard (Euro 3, Euro 4). Most of the information taken came out of this database (around 85%). The remaining information was consulted in the United States, European and manufacturers' databases in their respective order of priority.

3.4 METHODOLOGICAL CRITERIA

During the data processing to develop the baseline there were some criteria taken for the development of the calculations. Shown next are the criteria used:

- The 2005, 2006 and 2007 databases were discarded because of the lack of data. Data for more than 30% of the new vehicles wasn't available, a considerable part of what came into the country during those years, so the decisión was made to omit these years.
- The data used had to be based on new vehicle imports due to the inexistence of the sales data.
- For the baseline only new cars were taken into account. This for two main reasons: most of the vehicles imported into the country during the period of time studied were new and there is no proven methodology for the used vehicles (unknown operating conditions or if they were subject to any modification).
- During the search for emission factors, the value for the worst emission standard was taken. For example if there was a Toyota Hilux and there were values for Euro III, Euro IV and Euro V, then the Euro III value was the one taken. No Euro V values were considered for the study.
- In the worksheets, the model consulted for the values used were referenced, also de database consulted and the emission standard with which the vehicle complied, in order to establish a better traceability.
- In case that there was more than one value for the emission standard, the most updated value was the one preferred. For example if there was a Nissan Sentra that complies with the Euro IV standard, and there was a value from 2009 and another one from 2012, the one taken was the one from 2012.
- Several models are commercialized under different names worldwide. Some of the models in Costa Rica have a different name than in Chile, USA or Europe. For these models the reference was made in order to be able to trace the value used.
- In the worksheets, the data were handled in a way that allowed to be filtered by emission standard and thus consider several scenarios for the final results.

4. RESULTS

The results obtained after the data processing are presented in figures 3 and 4.

- Annual weighted average for the emissions in grams of CO_2 per kilometer under the NEDC.

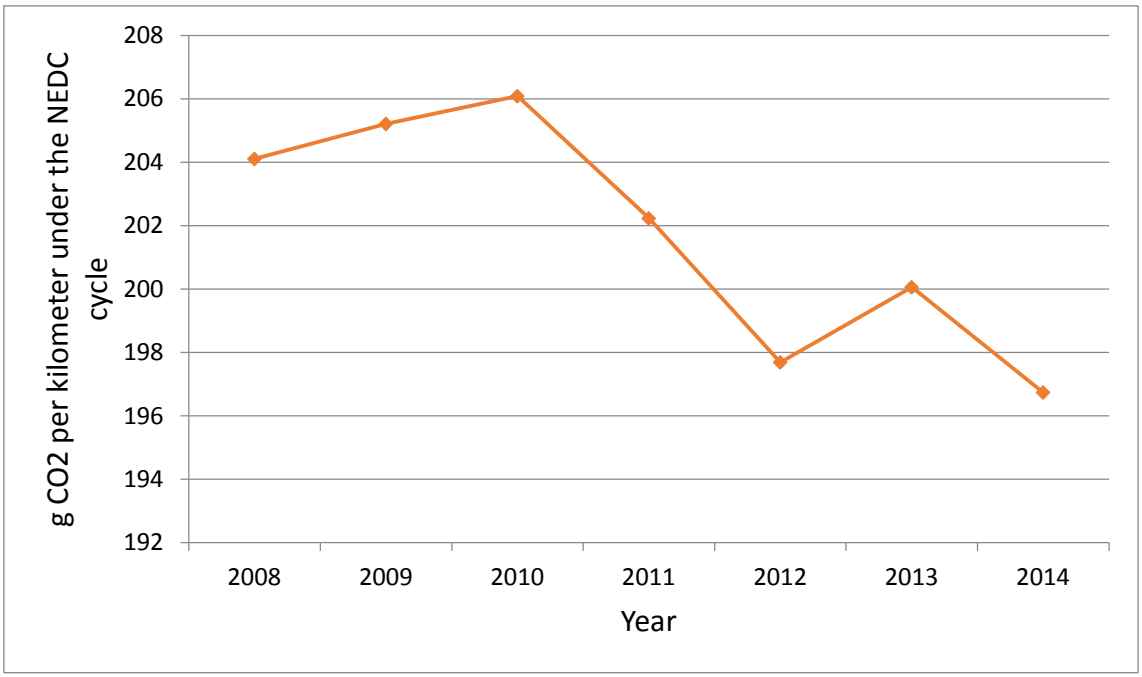


Figure 3. Emissions trend in g CO_2/km under the NEDC cycle during the period 2008-2014.

- Annual harmonic average for fuel economy in miles per gallon under the CAFE cycle.

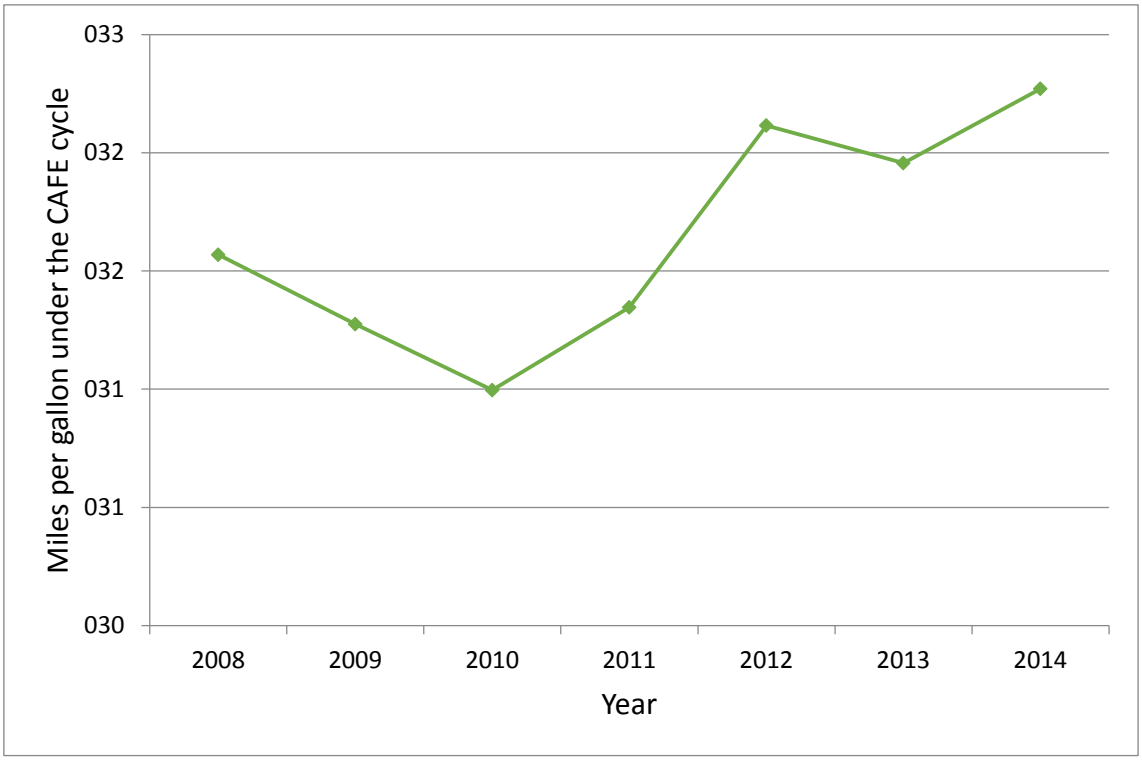


Figure 4. Fuel economy trend in miles per gallon under the CAFE cycle during the period 2008-2014.

5. ANALYSIS

According to the results obtained and the national context, it is observed that Costa Rica has a lot of options to improve in the transport sector, especially with light passenger vehicles. These constitute 41% of the emissions generated by the transport sector, as mentioned before. The vehicle market is currently unregulated. Importation of second-hand vehicle, even when it has declined it isn't negligible, is still allowed and every year a considerable amount of them enter the market. On the other hand, the new vehicles coming in aren't necessarily equipped with the best technologies available.

Costa Rica doesn't have any regulation that demands vehicles to comply with any emission standard or fuel economy value. Figures 3 and 4 exemplify that the trend varies year by year because of the lack of a specific goal. Without a proposed target, no improvements are mandatory, and to make it worse if second-hand or inefficient vehicles are allowed in, none of both are due to get any better.

For the 2008-2014 period it is observed in Figures 5 and 6 that Costa Rica is way behind in fuel economy and CO_2 emissions aspects. For 2013 the average fuel economy was almost 32 mpg, while all of the countries present were above this value during that same year (ICCT, 2015). For 2014, the average CO_2 emissions for Costa Rica were around 197 g CO_2 per kilometer. As shown in Figure 6, this leaves Costa Rica lots of room to improve in comparison with the other countries shown.

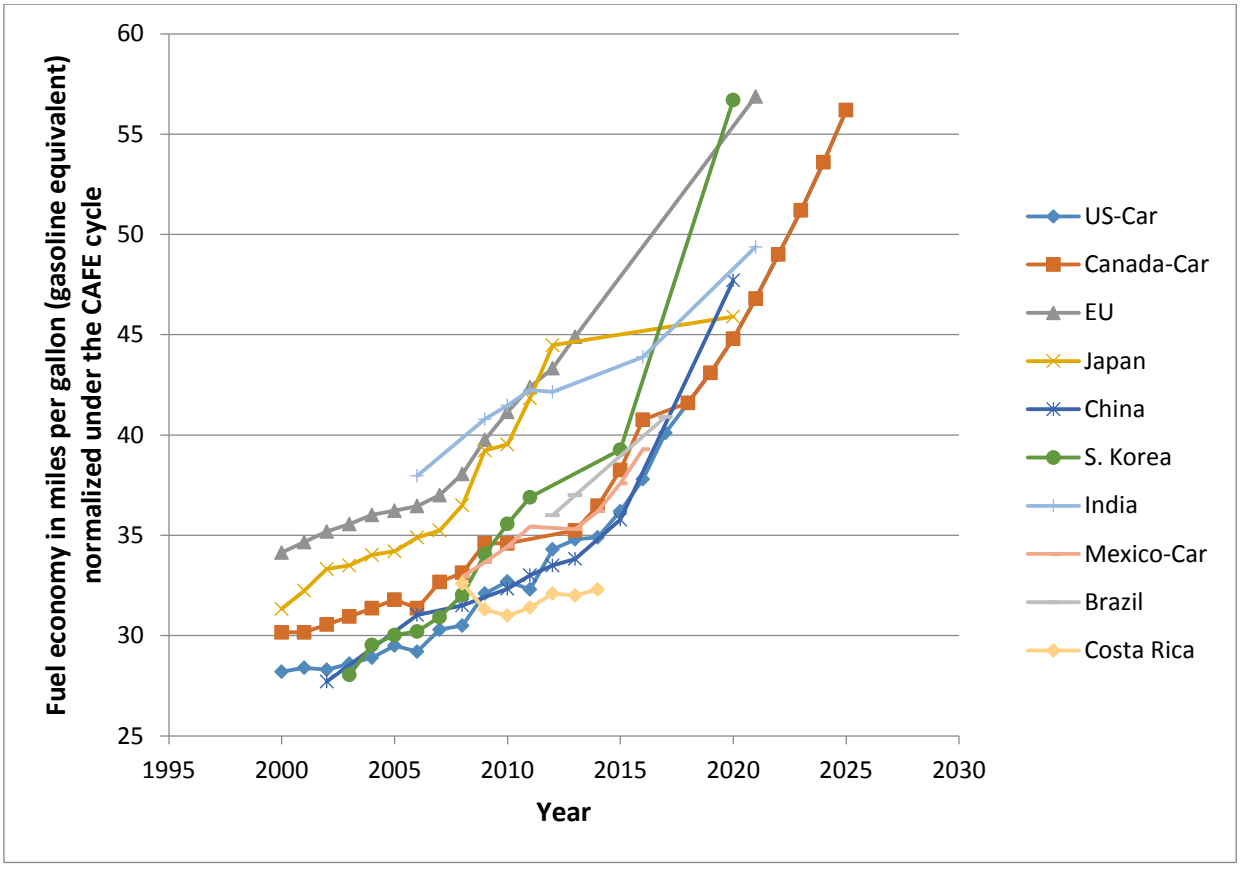


Figure 5. Fuel economy trend in miles per gallon under the CAFE cycle for several countries.

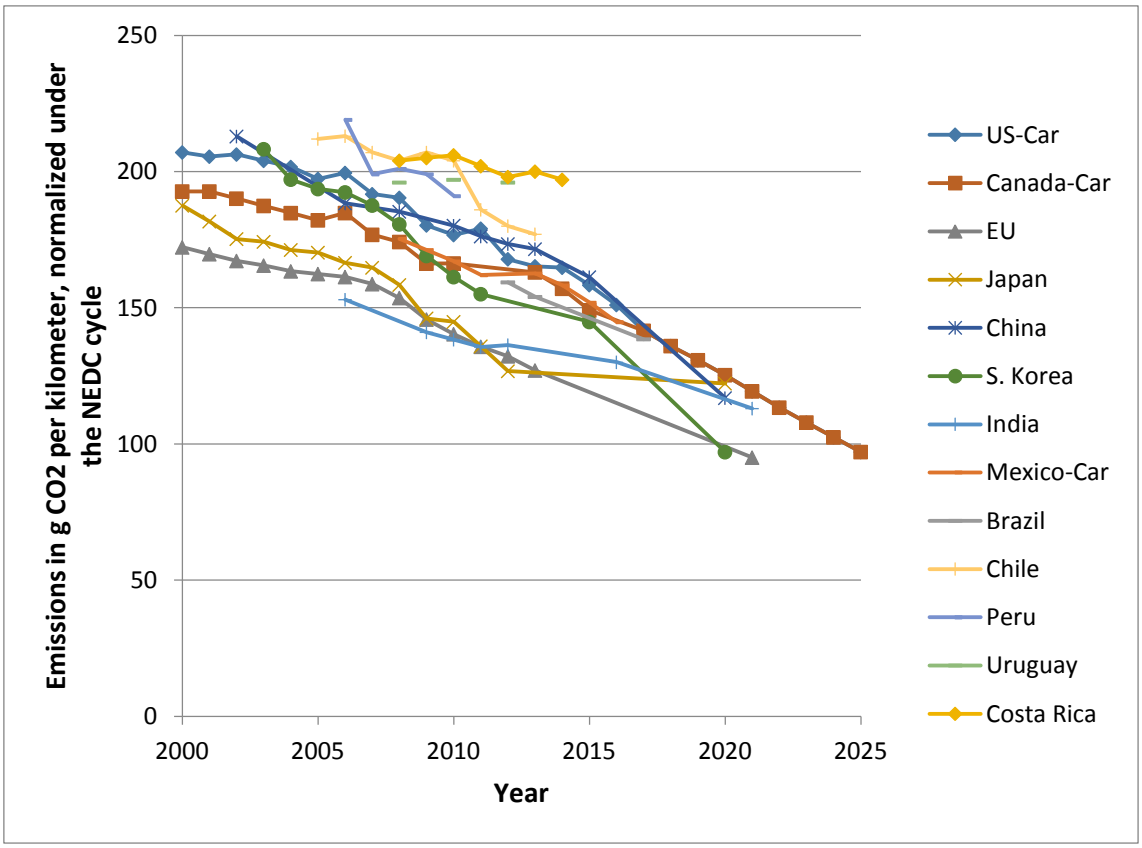


Figure 6. Emission of grams of CO_2 per kilometer trend normalized under the NEDC cycle for various countries

On the consumers perspective, it has no information whatsoever during its purchase process. Consumers aren't informed on fuel economy or emissions when they go shopping for a car. There's no culture around considering these aspects when they acquire vehicles. During 2015 the Energy and Environment Ministry launched an Efficient Vehicle Acquisition Program (PAVE in Spanish) that incentivized citizens to buy more efficient vehicles (the limit was established in 200 g CO_2/km as an approximation due to lack of information). The purpose of the program is to accelerate the fleet renewal and promote more efficient technologies.

Costa Rica currently has a very good fuel quality that would allow the introduction of more efficient technologies that could increase the fuel economy and lower the emissions of pollutants. Even though the Central American Technical Regulations state that the limit for sulfur content is 1000 and 500 ppm for gasoline and diesel respectively, Costa Rica has imported fuels with an average of 50 ppm S for gasoline and 30 ppm S for diesel (ARESEP, 2015). This potential has been wasted with the introduction of vehicles with obsolete technologies, resulting in a sub-utilization of the fuel quality.

The countries presented in Figure 5 have established clear policies on where they want to go in terms of fuel economy or emissions several years ago. The regulations that they have established have allowed them to gradually raise the fuel economy of the vehicles and consequently reduce the emissions from the vehicles that enter their fleets annually.

The adoption of emission standards or goals to improve the fuel economy would have positive impacts for the country in various flanks. On the economic side it would represent less volume of fuels needed, since the vehicles would improve their fuel economy. On the environmental subject the CO_2 reductions will help the country achieve the national proposed goal of becoming carbon-neutral by 2021. Introducing vehicles with new emission control technologies will also have an impact on the urban air quality, which will result in

less respiratory and cardiovascular diseases caused by air pollution and less missed workdays from disease.

6. CONCLUSIONS AND RECOMMENDATIONS

The transport sector is of great importance for the country under several optics. On one hand, it is one of the largest energy consumers, especially fossil fuels. On the other it is the largest emitter in the energy sector. Costa Rica has set a goal to become carbon-neutral by 2021. If it wants to effectively accomplish this goal and become a low emission economy, it is vital to intervene this sector. Due to the magnitude of the challenge, a multiple front approach must be taken simultaneously: best vehicular technologies, improvements in public transportation, adequate maintenance and inspection, and fuel quality

The quality of the fuels and the vehicular technologies must be seen under an integrated approach. The best technologies require top quality fuels, especially with ultra-low sulfur content. Fuel quality must be guaranteed to be able to take advantage of these new technologies that the market is offering. Moving fuel quality and emission standards hand in hand will allow to maximize the obtainable benefits.

Due to the countries circumstances, the following recommendations are issued:

- Adopt a labelling policy that provides the user with information on fuel economy and CO_2 emissions, so a more conscious purchase can be made.
- Prohibit or restrict all type of second-hand heavy duty vehicles, and advance towards the prohibition or restriction of second hand light and medium duty vehicles.
- Define a policy for emission reduction or fuel economy for vehicles to contribute to achieve the national goal of being carbon-neutral by 2021.
- Establish regulations for new vehicles that incorporate a broader look, with emissions and efficiency standards, in order to contribute to protect the citizens' health and the country's carbon neutrality goal.
- Introduce ultra low sulfur fuels (15 ppm S or less) that allow the best technologies available to enter the Costa Rican market.
- Elaborate a vehicle sales information registry to have a better perspective on the local market. This information will be useful to update the baseline, evaluate the regulations adopted and to estimate the fleet growth. Among the data that this registry must contain are: make, model, transmission, engine capacity, model year, technology, emissions standard, and others considered relevant.
- Follow up the baseline study in order to evaluate the policies adopted and to measure the impact that these have.
- Define a norm that sets the required information that will be mandatory for the vehicle importers/dealerships/manufacturers to deliver to the competent authority.
- Create an information platform for the consumers with the fuel economy and emissions data that will help them take a more informed decision on the vehicles commercialized in the country.