
DRIVING RESTRICTIONS AND AIR QUALITY IN MEXICO CITY

Héctor G. Riveros

Instituto de Física. Universidad Nacional Autónoma de México, PO Box 20-364, Ciudad de México,

ABSTRACT. *Driving restrictions have been employed in Mexico trying to reduce the air pollution; but results have not been as expected. On November 1989, driving restrictions were applied for the first time in a mandatory fashion, removing 20% of the vehicles of the traffic from Monday to Friday, adding Saturdays in July 2008 and modified in 2014 and 2016. Nevertheless, reduction in the air pollution measured was not observed, neither in 1989, 2008, 2014 or 2016. In 1992 the reduction of sulphur in gasoline content (to 300-500 ppm) reduced the pollution, but in 2009 when the content of sulphur was reduced to 30 ppm the air not show the expected pollution reduction. Similar restrictions have been applied in 11 more cities around the world.*

KEYWORDS: air pollution, driving restrictions, sulphur.

INTRODUCTION

When the “Hoy no circula (HNC)” program was implemented (as a temporary measure) on November 20, 1989, it was done in order to remove 20 percent of private cars from the circulation on weekdays. If they consume 60 percent of the gasoline, we could expect a 12 percent reduction in pollution on weekdays. If gasoline consumption does not change on Saturdays and Sundays, we have a real 5/7 reduction of 12 percent; that is, 8.6 percent. This calculation implies that the population that uses this transport stays at home those days. If, on the contrary, they travel in some other private vehicle, or uses public transport, the consumption of gasoline increases by a percentage that is difficult to estimate. We can say that an action is a failure when the predicted results do not occur. The “HNC” program was implemented to reduce the air pollution measured in Mexico City, but in 1989, when it was first established 5 days a week, no reduction in air pollution was observed. The good thing that can be said is that it improved the car flow and reduced the consumption of gasoline by 5 percent (Riveros 2009). The bad thing is that part of the population that used new cars with low pollution was forced to use highly polluting public transport, which caused the total emissions to be practically the same. Other studies (Eskeland, & Feyzioglu. 1997; Davis. 2008), reach the same conclusion that pollution was not reduced.

Many cities have similar programs and the start year: Athens, Greece 1982, Mexico City, Mexico 1989, Santiago, Chile 1990, São Paulo, Brazil 1995, Bogotá, Colombia 1998, Manila, Philippines 2003, La Paz, Bolivia 2003, San Jose, Costa Rica 2005, Beijing, China 2008, Tianjin, China 2008, Quito, Ecuador 2010, Delhi, India 2016.

A review (Molina et al. 2019) says about Mexico: “The “No Driving Day” (Hoy No Circula or HNC) program has its roots back in 1987 as a citizen initiative to participate voluntarily

to avoid using cars once a week. The program became mandatory in 1989 as part of a short-term emergency program for the winter months. Based on the last digit of the license plate, around 20% of all private vehicles were banned to circulate one weekday per week between 05:00 and 22:00, with the aim of reducing pollution, vehicular traffic, and fuel consumption. HNC became permanent in 1990 and was tied to the PVVO. In 1991, taxis and public transport vehicles were included in the HNC program. In 1992, vehicles using CNG or LPG were excluded from the circulation restrictions. An undesirable consequence of the obligatory nature of the HNC was that families acquired an additional vehicle, usually older, increasing the vehicular fleet during the first years of the program. Despite this, a dramatic reduction in traffic-related pollution was observed in the following years promoted by the technological controls of exhaust emissions and improved vehicle maintenance.”. PVVO comes from Programa de Verificación Vehicular Obligatoria.-Marking in yellow doubtful statements

LPG vehicles excluded from HNC program

Figure 1 the shows the remote sensor data measured in 2005 in Mexico City.

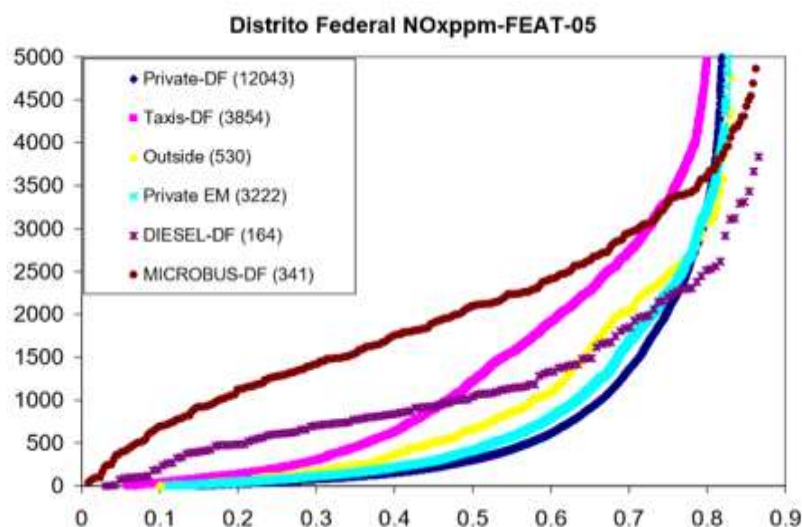


Fig.1. Normalized NOx emissions measured, minibuses (microbuses) and taxis emit much more than private cars.

In 2005, 30% of Microbuses used LPG, without anti-pollution devices. There is no difference with those of gasoline, being public transport can circulate despite its high emissions. These vehicles should not be exempt from the HNC and be verified more rigorously because they are of continuous use.

HNC does not reduce polluting emissions.

2.1 In 1989, given that HNC is a step signal in emissions, these should be better observed by analysing the data four weeks before and after applying the program. Averaging per day of the week, the effects must be shown from Monday to Friday, and Saturday and Sunday data serve as a control since they should not be affected. On the horizontal scale, Monday appears from 1 to 24 hours, Tuesday from 25 to 48, and Sunday from 144 to 168 hours in figure 2.

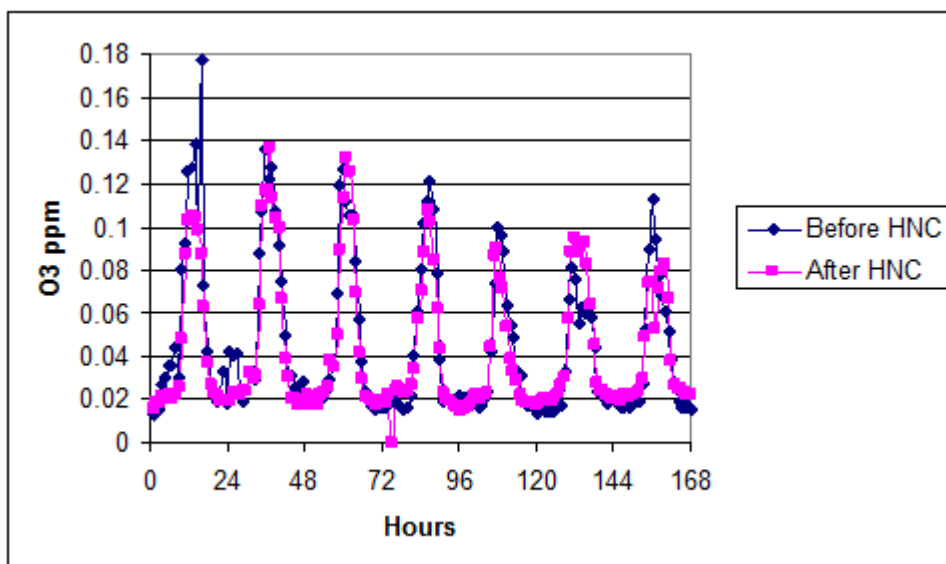


Fig. 2.- Average Ozone O₃ concentrations measured hourly in the 5 main stations of SMA of GDF (Secretary of the Environment of the Federal District Government), from Monday to Sunday. Data from 4 weeks before and after DWC implementation in 1989. Figures 2 do not show significant changes from Monday to Friday in comparison to data from Saturday and Sunday. These data show that there was no reduction in emissions, the air remains equally polluted

Including Saturday in HNC 2008.

To propose HNC for Saturdays, the Clean Air Institute CAI (2007) was consulted, which evaluated the original proposal which proposed removing from traffic all vehicles regardless of their hologram sticker number. The Secretary of the Environment of the Federal District Government affirms in its proposal of extending the DWC program to Saturdays, that the atmospheric pollution is greater on the weekends. The CAI calculated the reduction in emissions from cars that stopped driving but did not include the increase in public transport emissions that had much more passengers. CAI recommended something that did not reduce total emissions.

To study the effect by day of the week, data were measured every hour from June 2 to July 30, 2008, starting Mondays at 1:00 A.M. ending on the 168th hour on Sunday at 12:00 A.M. With the measured concentrations, an average of the 5 main stations was obtained, for each hour of the week. Mondays have the 1st to 24th hour, Tuesday the 25th to 48th hour, until reaching Sunday from 144th to 168th hour.

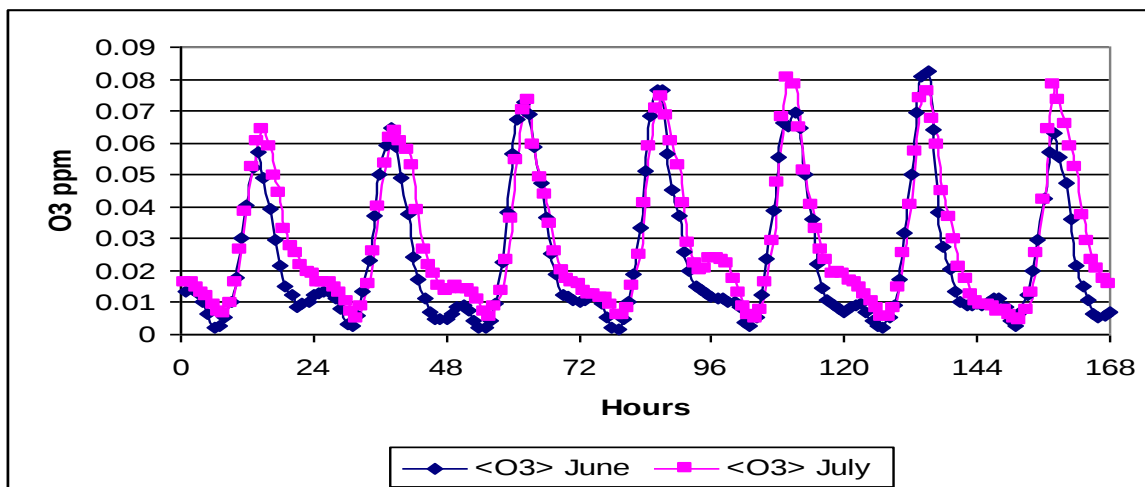


Fig. 3.- Data on ozone shows no significant changes on Saturdays 2008. Maximum values coincide with how it should be.

But no significant reduction is observed on ozone on Saturdays. The change is within the values observed as fluctuation for other weekdays.

Strengthening the HNC Saturdays 2014

From this date the cars from 9 to 15 years old can circulate only 2 Saturdays per month, and the cars older than 15 years can't circulate in Saturdays. According with Mexico City government the new provisions of the HNC is to protect the health of the population. They estimated an 11% annual reduction in emission of pollutants, but air pollution measured denied it. An 11% annual needs an 11% daily, but the reduction works only on Saturday, so the Saturday reduction needs to be 77%. Health may not improve if the values measured in the air are not diminished. The values measured in average hours per week (Sunday to Saturday) of Tlalnepantla, Xalostoc, Merced, Iztapalapa and Pedregal stations in the month of June are virtually identical to the of the month of July of 2014. The average of the 4 Saturdays of June is lower than that of the 4 Saturdays of July 2014. The pollution did not decrease as expected by the government (Davis 2017). No HNC has reduced pollution.

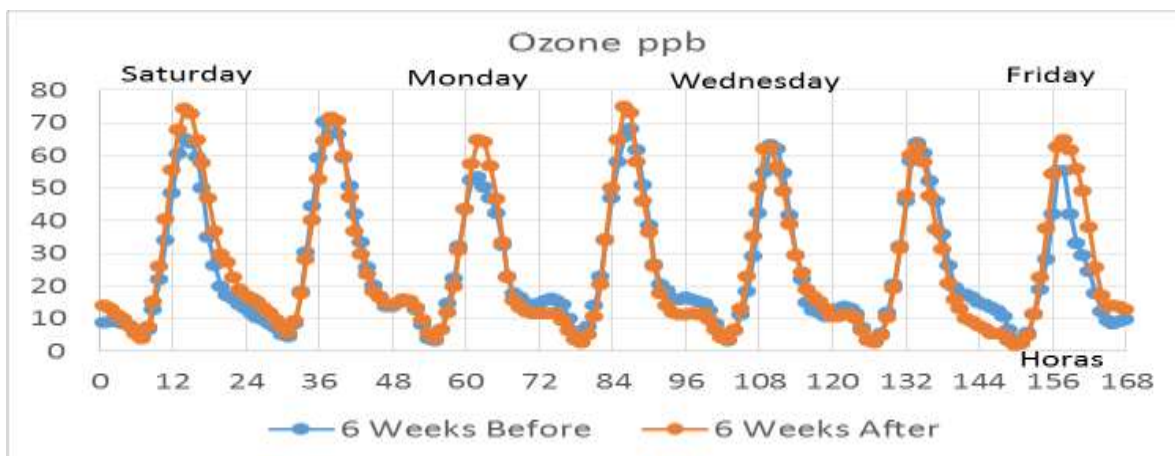


Fig. 4.- Average hourly data of the 37 stations, from May 24 to July 4 (before) and from July 5 to August 15 (after) 2014. Data from Sunday to Friday serve as control and to measure the effect of emissions and meteorological changes. It cannot be said that the new HNC lowered the concentration of ozone

Contingency in March 2016

The same review (Molina et al. 2019) says: “In 2016, after an extreme O_3 episode during March, the environmental authorities implemented changes in the program and mandated the installation of on-board diagnostics system (OBD II) in addition to exhaust emissions and visual inspection tests. The lack of OBD II in older vehicles prevented them from complying with the new requirements for the “0” sticker, reversing to some extent the impact of the previous court decision on the vehicle age requirements. In the second trimester of 2016, the HNC was also temporarily modified in response to the extreme O_3 episode: In addition to the regular restrictions, all vehicles were banned to circulate one weekday per week and one Saturday per month during Phase I Contingency, in addition to the regular restrictions”.

In March 2016 there were two days with very strong winds that brought down trees and advertisements. Then came minor winds. Figure 5 shows the hourly winds measured from March 10 to 18 and it was done using the data of the page of the Secretary of the Environment of the city of Mexico

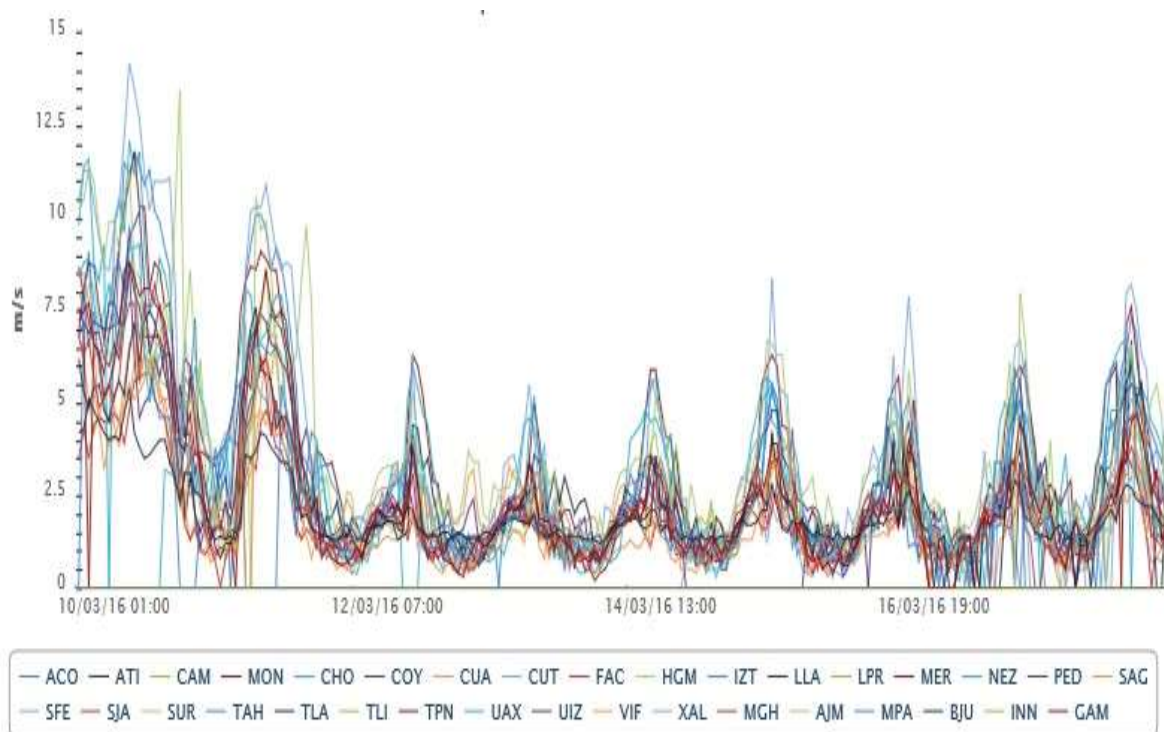


Fig. 5. Wind speed from March 10 to 18, data from all Mexico City stations. On days 10 and 11 the wind was very strong, from 12 to 14 they were weak and from 15 to 18 stronger. Figure 6 shows the hourly Ozone measured from March 10 to 18. On day 15 they declared effective contingency on day 16.

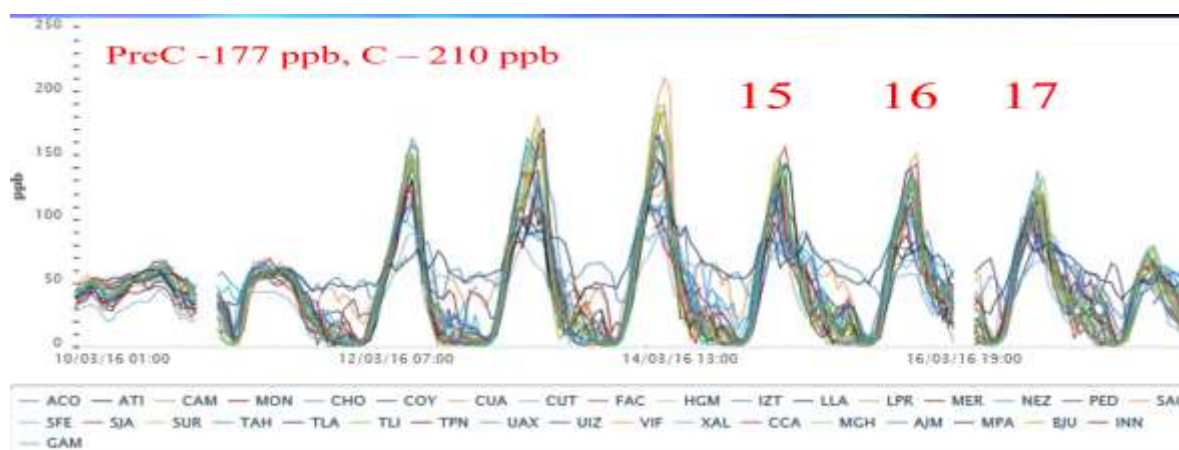


Fig. 6. Ozone measured from March 10 to 18. On the 15th they declared contingency from the 16th.

The Limits of Precontingency are 117 ppb and of Contingency 210 ppb of ozone. The CAME Metropolitan Environmental Commission made the decision to remove 20% of all cars from March 16 and lasted three months. The exemption to vehicles 0 and 00 was removed, sending

the message that it was better to have two old cars, to be able to drive every day. The most serious thing is that the pollution on day 16 was the same as on day 15, with equal winds. They demonstrated that the HNC does not reduce pollution but CAME did not understand it and kept the measure for three months.

1. Sulfur content in gasoline.

Studies (Pemex 2006) predicted that lowering sulfur to 30 ppm would reduce pollution between 20% and 40%, according to the contaminant. Graphing the moving average 30 days for maximum hours, reduces the noise that allow you to see the trends. Figure 7 shows the data from 2006 to 2017.

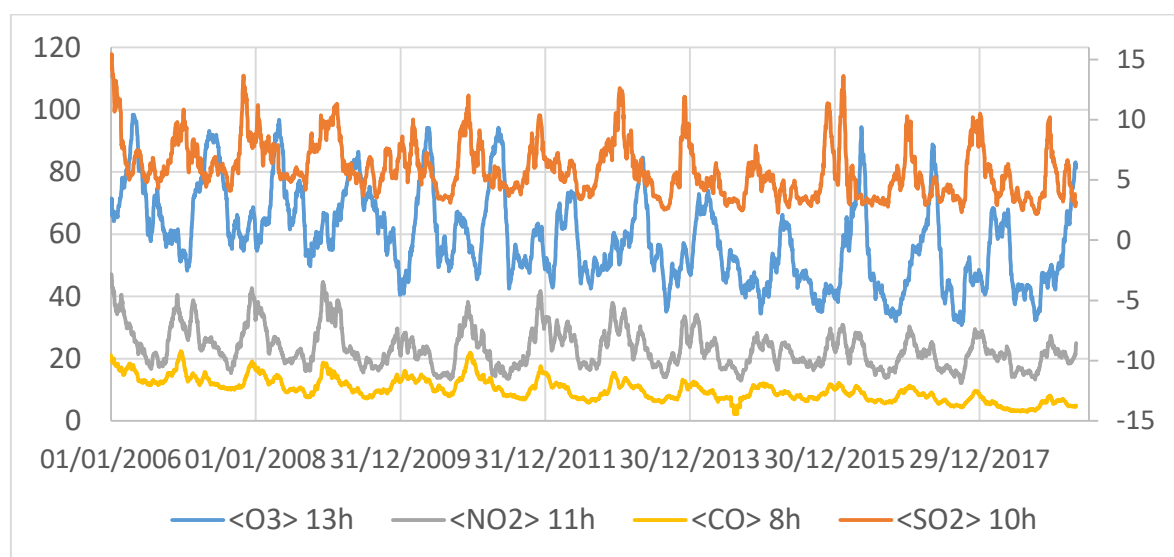


Fig. 7. 30-day moving average of the hourly values of pollutants in 5 stations in Mexico City Pemex says it sells fuels with 30 ppm of sulfur. No simultaneous reduction of the 4 contaminants is observed, as their studies predict. Several countries use 10 ppm sulfur fuels, which greatly reduces pollution. The reduction in sulfur costs much less than the costs of the health sector healing affected by pollution. Pollution falls slowly, despite the continuous increase in the consumption of gasoline and the vehicle fleet, showing that new cars travel more km / liter and emit less pollutants,

2. Ozone production It is produced by the reaction of volatile organic compounds VOC with nitrogen oxides NO_x and sunlight. Davis (2017) said:

“First, drop the double driving restrictions on high ozone days. There is no evidence that this has any impact on ozone levels. And, more generally, driving restrictions have been widely shown to be an expensive and ineffective approach to addressing air quality. If you want to reduce ozone in Mexico City, you have to reduce VOCs. VOCs come from all kinds of things. Paints. Solvents. Adhesives. Cleaning Products. Cosmetics. Even dog poop” This contributes to the zero effectiveness of the HNC in Mexico City, it is necessary to quantify both contributions to pollution.

CONCLUSIONS

The HNC does not work in Mexico because intensive public transport can circulate with its anti-pollution systems in poor condition and the VOCs controlled ozone production. To reduce pollution, it is necessary to increase the number of metro and metrobus convoys, to meet the demand during peak hours. Mexico needs fuels of 10 ppm maximum sulfur, which for now, Pemex cannot produce.

References

- Clean Air Institute 2007. Critical Review of Information on the Implementation of Driving Restrictions on Saturdays, in www.sma.df.gob.mx (accessed January 2008)
- Eskeland, G. & Feyzioglu, T. 1997. Rationing Can Backfire: The Day Without a Car in Mexico City. *World Bank Economic Review* 11–3, 383–408. Clean Air Institute.
- (2007), Davis, L. W., 2008. The Effect of Driving Restrictions on Air Quality in Mexico City. *Journal of Political Economy* 116(1), 38–81.
- Davis, L.W. 2017 Saturday Driving Restrictions Fail to Improve Air Quality in Mexico City, *Scientific Reports* | 7:41652 | DOI: 10.1038/srep41652
- Davis, Lucas. 2017. Stop Blaming Drivers for Mexico City's Smog, *Energy Institute Blog*, UC Berkeley, June 5, <https://energyathaas.wordpress.com/2017/06/05/stop-blaming-drivers-for-mexico-citys-smog/>
- Molina, L. & Velasco, Erik & Retama, Armando & Zavala, Miguel. (2019). Experience from Integrated Air Quality Management in the Mexico City Metropolitan Area and Singapore. *Atmosphere*. 10. 512. 10.3390/atmos10090512.
- Pemex. 2006. Estudio de evaluación socioeconómica de calidad de los combustibles, <https://docplayer.es/17092040-Estudio-de-evaluacion-socioeconomica-del-proyecto-integral-de-calidad-de-combustibles.html>
- Riveros, H.G.(2009) “Análisis del Programa Hoy No Circula”, *Ciencia*, 60,1(2009)76-83