An Assessment of Environmental Effects of the 2005 Mexican Automotive Decree

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Foreword

In today's world, global policymaking has become essential. From climate change and avian influenza to currency crises and nuclear proliferation, key policy problems refuse to be confined within the territorial jurisdiction of a single country or region of the world. No longer do policymakers or policy analysts have the luxury of approaching policy design and implementation one nation at a time.

This report addresses a key global policy challenge—the intersection of global trade and environmental degradation. The report's focus is on the U.S.-Mexico border and the dramatic increase in automobile imports into the Mexican border region as a result of recent changes in Mexico's import laws. The project is the result of collaboration between students in the La Follette School and the U.S. Environmental Protection Agency.

The Master of International Public Affairs program in the Robert M. La Follette School of Public Affairs at the University of Wisconsin–Madison prepares students for future careers addressing challenging problems such as this one. Students develop skills in policy analysis, public management, economic and statistical research, and data interpretation and presentation—as well as the knowledge and understanding to apply these skills to emerging transnational and global problems.

The authors of this report are enrolled in Public Affairs 860: Workshop in Public Affairs, International Issues, and the capstone course in the international public affairs program. The workshop provides students with practical experience applying the tools of analysis they have acquired in three semesters of coursework to examine real-world problems, to contribute useful knowledge and (where relevant) to propose feasible solutions to clients in the public, nongovernmental, or private sector.

Most of the semester is spent doing analysis in the form of projects that culminate in reports such as this one. While acquiring a set of analytical skills is important, it is no substitute for learning by doing. To be sure, the opinions and judgments presented in this report do not represent the views, official or unofficial, of either the La Follette School or of the client organization for which the report was prepared.

I am grateful to Wilbur R. Voigt whose generous gift to the La Follette School supports the school's workshop projects in which reports like this one are produced. With his support, we are able to finance the production of the final reports, plus other expenses associated with the projects.

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We are greatly appreciative for Professor Clark Miller's input throughout the project. His direction and support in shaping our final report was invaluable. We are also grateful to Karen Faster for her work in editing and formatting the report. Lastly, we would like to thank a handful of University of Wisconsin-Madison reference librarians for assisting us with the vast array of resources at their disposal.

Executive Summary

Mexican President Vicente Fox's August 2005 Automotive Decree opened the Mexican border to the importation of 10- to 15-year-old used vehicles from the United States. Concern exists that large influxes of these vehicles as a result of the Decree will increase air pollution in the U.S.-Mexican border region. This report assesses the impact of the incoming used vehicles on the size and emission levels of the Mexican border-state vehicle fleet in response to these concerns.

We develop best-case and worst-case scenarios that allow us to predict the environmental impact of vehicle emissions as a result of the Decree. We believe that a scenario closest to the worst case is most likely. In the worst-case scenario, we assume each vehicle that enters Mexico as a result of the Decree is added to the pre-Decree fleet without any retirement of older and problem vehicles. As a result, hydrocarbon emissions increase by 9 percent, carbon monoxide emissions increase by 9 percent, and nitrogen oxides emissions increase by 10 percent. In the best-case scenario, we assume each vehicle that enters Mexico as a result of the Decree replaces vehicles from the pre-Decree fleet that have the highest levels of emissions at a 1-to-1 ratio. In this scenario, hydrocarbon emissions decrease by 10 percent, carbon monoxide emissions decrease by 7 percent, and nitrogen oxides emissions decrease by 4 percent.

We then analyze slow-growth and a rapid-growth scenarios to predict the potential growth of the total vehicle fleet through December 2008. We believe that a scenario closest to rapid-growth is most likely because of rising population and vehicle registration rates. The rapid-growth scenario projects an initial spike in used vehicle imports from the United States to Mexico of 2 million vehicles followed by an annual vehicle growth rate of 3.91 percent for the population of vehicles legally imported into Mexico's border states. In this growth scenario, we find that tons of emissions increase by 40 percent per pollutant from 2005 to 2008. The slow-growth scenario projects an initial spike in used vehicle imports of 1 million vehicles followed by increases in used vehicle imports by an annual vehicle growth rate of 3.91 percent until December 2008. For the slow-growth scenario, we find that for hydrocarbon, carbon monoxide and nitrogen oxides, tons of emissions increase by 27 percent per pollutant.

We identify two policy options that could improve the environmental impact of the incoming fleet. We believe that the most effective solution would be to establish a scrapping program to eliminate older legal and problem vehicles in the border region. Further research must be done to determine which policy options would be the most effective in reducing emissions.

Problem Statement

On August 22, 2005, Mexican President Vicente Fox issued an Automotive Decree opening his country's borders to the importation of 10- to 15-year-old used vehicles from the United States and Canada. In the United States, approximately 100 million vehicles fall within the parameters of the Decree and may now be legally imported into Mexico (Dickerson & Enriquez, 2005). The Decree establishes a gradual phase-out of vehicle import restrictions, cuts duties on used vehicles by 40 percent and offers amnesty for approximately 1 million out of the estimated 2.5 million illegally imported or unregistered vehicles already in Mexico (Centro de Estudios Sociales y de Opinión Pública [CESOP], 2004). The elimination of trade barriers for 10- to 15-year-old used vehicles accelerates a process set in motion by the North American Free Trade Agreement (NAFTA). NAFTA requires Mexico to begin phasing out trade barriers on vehicles that are 10 years or older by January 1, 2009 (NAFTA Secretariat, n.d.).

Between September 2005 and March 2006 alone, more than 1 million used vehicles that fall within the parameters of the Decree were imported from the United States to Mexico. The central environmental question associated with the Decree is whether the incoming used vehicle fleet will worsen or improve air quality along the U.S.-Mexican border. A fundamental component in determining the net environmental impact of this trade is ascertaining at what rate incoming vehicles are replacing older, higher polluting vehicles.

Complicating the picture is the illicit trafficking of vehicles from the United States to Mexico. According to recent estimates, approximately 200,000 vehicles are stolen and exported from the United States each year, the vast majority of which are destined for Mexico and the rest of Latin America (Clarke & Brown, 2003). The total illegal vehicle fleet in Mexico includes these vehicles and many more unregistered vehicles. It remains unclear however, how much the illegal vehicle fleet contributes to air pollution in the Mexican border states since estimates of the total number in circulation vary greatly. In addition, many illegal vehicles have been stripped of catalytic converters or other emissions-reducing technologies, greatly increasing their emission levels.

As a result of the Decree, large increases in the number of vehicles imported into Mexico are anticipated. The U.S. Environmental Protection Agency (EPA) and Mexican state and national environmental authorities are interested in determining whether the greater volume of imported used vehicles will increase levels of harmful pollutants along the U.S.-Mexican border.

Background: The 2005 Automotive Decree, Trade Liberalization in the Mexican Automobile Sector

In the past, Mexico has maintained high levels of protection for its automobile industry. In 1962, the government adopted an Automotive Decree prohibiting all imports of finished automobiles. However, rather than isolating itself from all capital inputs needed to produce automobiles and achieve industrial goals, the Mexican government created incentives for multinational companies to establish factories for automobile production within the national territory. The government required all multinational corporations to adhere to strict requirements regarding the use of local content and labor with a goal of transferring foreign technological know-how to domestic producers. Despite government efforts, protection of the Mexican automobile industry did not result in competitive firms, but instead led to higher prices for domestically produced automobiles (Schechter, 2006). Following the debt crisis of the early 1980s and a subsequent wave of policies that privatized many state-owned enterprises, President Carlos Salinas issued an Automotive Decree in 1989 that sought to encourage greater competition in the automobile sector by limiting imports to 15 percent of the Mexican market for the first two years following the Decree and 20 percent beginning in 1993.

The North American Free Trade Agreement (NAFTA), signed on December 17, 1992, represented a further step toward the elimination of protectionist policies in the auto industry. NAFTA allows Mexico to retain the 1989 Automotive Decree until January 1, 2009, at which point Mexico will be required to begin the elimination of inconsistencies with the provisions of the Free Trade Agreement. This is an initial step toward the gradual elimination of import barriers in the Mexican automobile sector. NAFTA requires Mexico to begin opening its borders to vehicles that are at least 10 years old by January 1, 2009. Furthermore, NAFTA employs a successive phase-out process, removing import barriers on younger vehicles (newer model years) every two years. For example, in 2011, vehicles at least 8 years old may be imported, while in 2013 vehicles that are at least 6 years old are eligible for importation. In 2019, NAFTA allows all vehicles to be imported into Mexico from the United States. By the end of the 2019 transition period, all significant barriers to trade between the automotive sectors of Canada, the United States and Mexico will have been eliminated. Table 1 provides an outline of NAFTA’s gradual import barrier elimination process.

Table 1:
NAFTA Transition Phase

Start of Transition Period	Minimum Age of Used Vehicles for which Import Barrier is Eliminated
January 1, 2009	10 years old
January 1, 2011	8 years old
January 1, 2013	6 years old
January 1, 2015	4 years old
January 1, 2017	2 years old
January 1, 2019	May not have any restrictions on importation of used vehicles

Source: North American Free Trade Agreement Secretariat. n.d. Description of NAFTA Transition: Trade and Investment in Automotive Sector. Accessed 9 March 2006 from http://www.nafta-sec-alena.org/DefaultSite/index_e.aspx?DetailID=277.

The 2005 Automotive Decree accelerates the NAFTA process of eliminating import barriers by opening the Mexican market to U.S. and Canadian used vehicles aged 10 to 15 years beginning in September 2005. The rules established under the 2005 Decree maintain the 10- to 15-year-old age structure regime until December 31, 2008. After this date, the NAFTA transition phase begins allowing imports of vehicles that are at least 10 years old, an age range already introduced under the 2005 Decree. Table 2 provides an outline of the import barrier elimination process established under the Decree.

Table 2:
Breakdown of the 2005 Automotive Decree

This is the timeline the Decree has established for the introduction of 10 to 15 year old used vehicles imported from the United States to Mexico.	
Importation Period	**Model Years of Vehicles**
August 2005-October 31, 2005	1990-1995
November 1, 2005-October 31, 2006	1991-1996
November 1, 2006-October 31, 2007	1992-1997
November 1, 2007-October 31, 2008	1993-1998
November 1-December 31, 2008	1994-1999

Source: Administración General de Aduanas. 2005. Description of 22 August 2005 Automotive Decree. http://www.aduanas.sat.gob.mx/webadunet/ Descargas/ Importacion_ vehiculos_usados_19Octubre05.pdf. Accessed on February 28, 2006.

Research Design and Goals

This report assesses the environmental impact of Mexico's 2005 Automotive Decree. In the following analysis we

1) calculate the size and emissions for the pre-Decree fleet;
2) calculate the size and emissions of the incoming used vehicle fleet; and
3) analyze changes in fleet size expected under the Decree and project emissions in six Mexican border states.

The largest changes in the vehicle fleet size and emissions will occur in Mexico's six border states; therefore, we focus our analysis on these border states. We divide our analysis into three sections:

Pre-Decree Vehicle Fleet: In this section, we analyze the size and emission levels of the vehicle fleet circulating in the six Mexican border states prior to the influx of 10- to 15-year-old used vehicles. Emission levels are calculated using annual per-vehicle emission rates and estimates of the size, age structure and kilometers traveled per year of the pre-Decree vehicle fleet.

Decree Fleet: This section analyzes the size and emission levels of the incoming 10- to 15-year-old used vehicle fleet, which we identify as the "Decree fleet." In this section we offer the inventory of used vehicles that have crossed the border from the United States into Mexico between November 2005 and February 2006. Consistent with the pre-Decree vehicle fleet section, we calculate emission levels using annual per-vehicle emission rates and estimates of the size, age structure and annual kilometers traveled of the Decree vehicle fleet.

Post-Decree Scenarios: In this section, we construct four scenarios that assess different fleet size and emission changes to the pre-Decree vehicle fleet as a result of the influx of 10- to 15-year-old used vehicles. The first two scenarios analyze the size and emission levels of the post-Decree fleet from a worst-case and best-case perspective for 2006:

- **Worst-Case Scenario:** In this scenario, we assume that the incoming used vehicles are incorporated into the pre-Decree fleet without replacing the oldest and highest emitting pre-Decree fleet vehicles.

- **Best-Case Scenario:** In this scenario, we assume that the incoming used vehicles replace an equal number of the oldest and highest pollutant-emitting pre-Decree fleet vehicles.

To estimate the impact of the 2005 Automotive Decree on the vehicle fleet size and emission levels beyond 2006, we construct two hypothetical vehicle fleet growth scenarios. These scenarios apply an annual growth rate of the incoming used vehicle fleet following an initial spike in imports:

- **Slow-Growth Scenario:** In this scenario, we assume an initial spike in imports of 1 million used vehicles the United States to Mexico from August 2005 to March 2006. This adds 1 million vehicles to the pre-Decree legal fleet. This initial spike is followed by "steady state" growth based on the average annual vehicle ownership growth rate in the Mexican border states for 1980 to 2002. This annual growth rate is applied through December 2008.

- **Rapid-Growth Scenario:** In this scenario, we assume an initial spike in imports of 2 million used vehicles the United States to Mexico from August 2005 to December 2006, which adds 2 million vehicles to the pre-Decree population of vehicles legally imported into Mexico's border states, hereafter referred to as the pre-Decree legal fleet. This is followed by the same "steady state" growth rate applied in the Slow-Growth Scenario through December 2008.

Following the four scenarios we present our assessment of what outcomes are likely. We believe that a post-Decree scenario closer to that of our worst case of no replacement is the most likely outcome of the influx of used vehicles. In the short term, the incoming used vehicle fleet will contribute to consumer demand in the Mexican border states. While a demand saturation point may eventually be reached as the number of used vehicle imports that make up the Decree fleet continue to grow, the best-case post-Decree scenario of full replacement of older vehicles on the border is unlikely to occur.

After our assessment of the Automotive Decree, we conclude that without the removal of older, higher emitting vehicles from the border states, any improvements to air pollution due to the incoming vehicle fleet will be lost. We believe that rising population and vehicle ownership growth rates mean that demand for vehicles exceeds supply. Consequently, individuals will not remove higher polluting vehicles from the fleet without sufficient economic incentives. Based on these findings, we outline two measures that work to remove older and problem vehicles from the post-Decree fleet. These measures are: A) programs that encourage the scrapping of older and problem vehicles; and B) export tag requirements allowing for easier identification of vehicles that have passed emissions inspection.

Pre-Decree Vehicle Fleet

Our analysis of the pre-Decree vehicle fleet is limited to the six Mexican border states. We believe the most effective way of measuring the impacts of the 2005 Automotive Decree is by assessing changes in the vehicle fleet in these states. Most of the pollution resulting from the Decree is concentrated in the border states. Therefore, an analysis of pollution in these states will most accurately determine the impact on air quality as a consequence of the Decree. The border states are: Baja California, Chihuaha, Coahuila de Zaragoza, Nuevo Leon, Sonora and Tamaulipas. We estimate the number of vehicles in the Mexican border states, the age structure and average annual kilometers traveled of the fleet, and we calculate emissions for the fleet.

A. Size of the Pre-Decree Vehicle Fleet

The total vehicle fleet of the Mexican border states is made up of both legal and illegal fleets. We calculate the size of both in the following sections.

i. Size of the legal vehicle fleet

To estimate the total number of vehicles in circulation in the six Mexican border states,[1] we apply 2002 Mexican census data and multiply the population of each state by its vehicle registration rate. We estimate that approximately 5.7 million legal vehicles operate in the six border states.[2] Table 3 provides our estimate of the number of vehicles operating in each of the six border states.

[1] In the short-term, we assume that the vast majority of imported vehicles from the United States are destined for one of the six Mexican border states.

[2] We believe that Mexican government figures overstate the actual number of vehicles in circulation since they do not accurately account for vehicle retirement rates.

Table 3:
Population and the Number of Vehicles per 1,000 Inhabitants Registered in Circulation in the Six Mexican Border States

Border State	Total Population (2005)[1]	Percent of Population with Registered Vehicles	Estimate of Total Vehicles by Border States
Baja California	2,842,199	36.90%	1,048,771
Chihuahua	2,474,692	30.80%	762,205
Coahuila de Zaragoza	3,238,291	25.70%	832,241
Nuevo Leon	4,164,268	31.10%	1,295,087
Sonora	2,384,261	28.20%	672,362
Tamaulipas	3,020,225	37.30%	1,126,544
Total	18,123,936	--	5,737,210

[1] Source: Instituto Nacional de Estadística, Geografía e Informática. 2005. Población total, relación hombres-mujeres y tasa de crecimiento media anual por entidad federativa. Accessed 6 April 2006, from http://www.inegi.gob.mx/est/contenidos/espanol/rutinas/ept.asp?t=mpob106&c=6687.

ii. Size of the illegal vehicle fleet

The illegal vehicle fleet in the Mexican border states comprises illegally imported, stolen and unregistered vehicles. Mexican governmental estimates of the total illegal vehicle fleet circulating in Mexico range from 1.5 million to 5 million vehicles (See Appendix Table 1C). We believe higher-end estimates fail to account for vehicle deterioration rates, and thus we overestimate the number of illegal vehicles. As such, we have decided that a more conservative estimate of 2.5 million illegal vehicles is appropriate. Additionally, we believe that the number of illegal vehicles operating outside of the border region is negligible because of the large demand for cheap vehicles in the border states, especially among migrant and agricultural workers, as well as the lack of effective enforcement mechanisms in the border states.[3] Based on these assumptions, we estimate that all 2.5 million illegal vehicles operate in the Mexican border states. Table 4 lists the localities in five of the border states with substantial illegal vehicle populations.

[3] Along the border zone, hundreds of thousands of agricultural workers require cheap vehicles to tend to their land or migrate to the United States for work (CESOP, 2004). For example, an agricultural worker looking to purchase a Mexican light-duty truck will pay 60,000 pesos in 2000 currency. An equivalent American model truck costs around 10,000 pesos, also in 2000 currency (Martínez, 2000). Coupled with the absence of any strong enforcement of stolen vehicles crossing the U.S. border, the market for illegally imported vehicles has continued to flourish.

Table 4:
Mexican States and Localities or Districts with the Largest Number of Illegal Vehicles[4]

Mexican State	Locality/District
Baja California	Tijuana, Tecate, Mexicali.
Chihuahua	Ojinaga, Ciudad Juárez
Coahuila	Ciudad Acuña, Piedras Negras
Sonora	San Luis Río Colorado, Nogales, Naco, Sonoíta, Aguaprieta.
Tamaulipas	Matamoros, Reynosa, Miguel Alemán, Camargo.

Source: Martínez, Marco Antonio. 2000. "Vehiculos chocolates: autos, votos y corrupción" Published in *Periódico Reforma*, 7 May 2000. Reprinted in *Los vehículos de procedencia extranjera ilegales en México*, Centro de Estudios Sociales y de Opinión Pública (CESOP). 2004.

iii. Total pre-Decree fleet

Based on our estimates of the legal and illegal vehicle fleets, the ratio of legal to illegal vehicles is roughly 3 to 1. When we combine our legal and illegal vehicle estimates, the total pre-Decree vehicle fleet in the Mexican border states is estimated to be 8.2 million vehicles.

B. Age Structure and Annual Kilometers Traveled of the Pre-Decree Fleet

The next step is to estimate the age structure of the pre-Decree fleet in the six border states. Comprehensive data on the vehicle fleet age structure are only available for Ciudad Juárez, a city in the border state of Chihuahua. However, we believe the age structure of the Ciudad Juárez vehicle fleet is representative of all the six border states because the general socio-economic characteristics of Ciudad Juárez are similar to other border cities. Given that most vehicles in Ciudad Juárez are older imports from the United States, vehicle and emissions data from this city are useful when examining the environmental effects that widespread importation of used vehicles could have on other cities throughout Mexico, particularly in the interior and south where importation of used vehicles is less prevalent. Thus, due to the general absence of vehicle data in most border states, we use the well-documented experience of Ciudad Juárez to estimate the age structure and the average annual kilometers traveled of the Mexican border states vehicle fleet.

[4] The study from which we draw this list does not include Nuevo Leon, the sixth border state.

As outlined in Table 5, the Ciudad Juárez vehicle fleet comprises mainly older vehicles.[5] The age composition of the fleet is as follows: 6 percent of the vehicle fleet is 3 years old or younger; 32 percent of the vehicle fleet is 4 to 10 years old; 46 percent of the fleet is 11 to 17 years old; and 16 percent is 18 years or older (Instituto Nacional de Ecología, 1997).

Table 5:
Age Structure of the
Ciudad Juárez Vehicle Fleet

Vehicle Age	Percent of Vehicle Fleet
0 to 3 years	6%
4 to 10 years	32%
11 to 17 years	46%
18+ years	16%

Source: Dirección General de Finanzas del Gobierno del Estado de Chihuahua, 1997. Instituto Nacional de Ecología. Programa de gestión de la calidad del aire de Ciudad Juárez 1998-2002. Accessed 20 March 2006 from http://www.ine.gob.mx/ueajei /publicaciones/consultaPublicacion.html?id_pub=233 &id_tema=6&dir=Consultas%3E%3Cimg%20src=.

Table 6 details the average annual kilometers traveled of vehicles in Ciudad Juárez. We apply the average annual kilometers traveled of the private vehicle fleet in Ciudad Juárez to the entire pre-Decree legal Mexican border fleet of 5.7 million vehicles.

Table 6:
Average Annual Kilometers Traveled
of the Ciudad Juárez Vehicle Fleet

Number of Vehicles	Percentage of Total Ciudad Juárez	Kilometers per Vehicle per Day	Annual Kilometers
348,214	94.95	68.5	25,000

Source: Dirección General de Finanzas del Gobierno del Estado de Chihuahua, 1997. Instituto Nacional de Ecología. Programa de gestión de la calidad del aire de Ciudad Juárez 1998-2002. Accessed 20 March 2006 from http://www.ine.gob.mx/ueajei/ publicaciones/consultaPublicacion.html?id_pub=233&id_tema=6&dir=Consultas %3E%3Cimg%20src=.

[5] Approximately 87 percent of the privately owned vehicles in Ciudad Juárez are of U.S. origin (Instituto Nacional de Ecología, 1997).

C. Emissions Calculations for the Pre-Decree Fleet

After determining average annual kilometers traveled by the pre-Decree Mexican border states legal fleet, we calculate annual emissions per pollutant for this fleet. Considering that the vast majority of vehicles along the border are imports from the United States, we make projections using U.S vehicle emissions data from U.S. sources. Specifically, we use the national average per-vehicle, per-pollutant emission rates for vehicle model years 1990 to 2004.

Given that a significant number of vehicles in the Ciudad Juárez fleet are more than 15 years old, we project U.S. per vehicle emission rates backward from 1990 to 1986. In addition, U.S. emissions data collected for this report did not account for 2005 and 2006 emissions per vehicle per pollutant. Thus, we also project emission rates from 2004 to 2006.[6] This gives us a range of emissions data for a 21-year span, from 1986 to 2006. Because we assume that the age structure of the Ciudad Juárez vehicle fleet is representative of the total legal vehicle fleet in the six border states of 5.7 million vehicles, we calculate total tons of emissions per pollutant by applying tons of emissions per vehicle model year using U.S. emissions data (as illustrated in Table 7). The border states' legal vehicle fleet is disaggregated by age and tons of emissions per pollutant in Table 8.

Table 7:
Annual Tons of Emissions per Pollutant
of the Legal Border States Fleet
Prior to the 2005 Automotive Decree

Pollutant	Annual Tons of Emissions per Pollutant
Hydrocarbon	716,733
Carbon monoxide	7,566,065
Nitrogen oxides	487,534

Source: Authors' calculations.

[6] Data on emissions as a function of age is provided in Table 2A in Appendix A.

Table 8:
Annual Tons of Emissions per Pollutant
by Model Year of the Legal Border States Fleet
Prior to the 2005 Automotive Decree

Vehicle Fleet Model Years	Total Hydrocarbon Emissions	Total Carbon Monoxide Emissions	Total Nitrogen Oxides Emissions
2003-2006	18,516	188,904	13,711
1996-2002	148,825	1,480,618	102,788
1989-1995	362,212	3,832,326	245,138
1988 and older	187,181	2,064,217	125,897

Source: Authors' calculations.

In Tables 7 and 8, we did not include the illegal border fleet because we could not obtain the age structure and annual kilometers traveled for the illegal fleet. However, because we believe it is important to show the impact these vehicles could have on air pollution levels in the border states, we incorporate illegal vehicles into the total pre-Decree fleet in our post-Decree scenarios to illustrate their effect on total emission levels.

Based on interviews with individuals familiar with the illicit trafficking of vehicles from the United States to Mexico, we conclude that a significant number of vehicles in circulation in Mexico have been stripped of their catalytic converters or other emissions-reducing mechanisms, usually to extract platinum, palladium and rhodium. As a result, we believe that official estimates presented in Table 9 below showing the total annual tons of emissions per pollutant drastically underestimate actual emission levels of the illegal vehicle fleet. However, we were unable to find reliable data on emission levels per pollutant for vehicles that have been stripped of their catalytic converters. Vehicles that do not have catalytic converters can emit up to 30 times the amount of pollutants of new model vehicles with catalytic converters (Breathe Easier Campaign State of California, 2005). To account for the impact these problem vehicles have on increasing total emissions of the pre-Decree vehicle fleet, we double the annual emission rates per pollutant. Although we apply a conservative multiplier, a substantial increase in overall pollutant levels still results. Table 9 displays the Mexican government estimates of emission levels by pollutant as well as estimates after we double the emissions by pollutant for the illegal vehicle fleet.

Table 9:
Estimate of Annual Tons of Emissions per Pollutant of the Illegal Border States Vehicle Fleet

Illegal Vehicle Fleet Size	Tons per Year of Hydrocarbon Emissions	Tons per Year of Carbon Monoxide Emissions	Tons per Year of Nitrogen Oxides Emissions
2,500,000	318,313	2,688,351	139,778
2,500,000[7]	636,626	5,376,702	279,556

Source: Secretaria de Medio Ambiente Recursos Naturales (SEMARNAT) and Instituto Nacional Ecología (INE) Joint Study. 2002. Estimacion de emisiones pollutantes de vehiculos de procedencia extranjera en Mexico. Reprinted in *Los vehículos de procedencia extranjera ilegales en México*, Centro de Estudios Sociales y de Opinión Pública (CESOP). 2004.

In Table 10 we combine the legal and illegal pre-Decree vehicle fleets to determine the total size of the fleet and total tons of emission per pollutant.

Table 10:
Fleet Size and Annual Tons of Emissions per Pollutant for the Pre-Decree Vehicle Fleet

	Size of Vehicle Fleet	Tons per Year of Hydrocarbon Emissions	Tons per Year of Carbon Monoxide Emissions	Tons per Year of Nitrogen Oxides Emissions
Legal Pre-Decree Fleet	5,737,210	716,733	7,566,065	487,534
Illegal Pre-Decree Fleet	2,500,000	636,626	5,376,702	279,556
Total Pre-Decree Fleet	8,237,210	1,353,359	12,942,767	767,090

Source: Authors' calculations

[7] These estimates include our doubling of emissions per pollutant to account for higher polluting vehicles that lack catalytic converters and other emissions-reducing mechanisms. In states like California that export used vehicles to Mexico, the mean retirement age of problem vehicles is 18 to 20 years old. While these vehicles represent only 10 percent of the vehicle population, they account for more than 50 percent of total vehicle pollution and emit up to 30 times more emissions than newer vehicles (Breathe Easier Campaign State of California, 2005).

Decree Fleet

The Decree fleet is defined as the 10- to 15-year-old used vehicle fleet crossing the border as a result of the Automotive Decree. The Decree has resulted in the influx of a large number of vehicles in a short period of time. This section examines the number of these vehicles that crossed the border since the Decree's implementation, the Decree fleet age structure and resulting changes in annual emission levels.

A. Size of the Decree Fleet

Overall, an estimated 1 million vehicles crossed the border from November 2005 to February 2006 (Lacy Tamayo, 2006). These vehicles make up the Decree fleet.

B. Age Structure and Average Kilometers Traveled of the Decree Fleet

Based on data from a sample of 500,000 vehicles from the Decree fleet, Table 11 estimates the age structure of the vehicles imported under the Decree from late August 2005 to March 2006.[8] This random sample reflects roughly half of the vehicles that have crossed the border and is therefore a sound estimate of the overall age structure. Nearly 46 percent of vehicles that have crossed the border as a result of the Decree are 1995 and 1996 model year used vehicles. Older model years, such as vehicles manufactured in 1990 and 1991, accounted for approximately 2 and 8 percent of the Decree fleet, respectively. Thus, although the Decree indiscriminately allows for the importation of 10- to 15-year-old used vehicles, newer model years are imported more than older model years.

Table 11:
Model Year of Imported U.S. Vehicles to Mexico
Under the 2005 Automotive Decree

Model Year of Import	1990	1991	1992	1993	1994	1995	1996
Percent of Total	2.26%	8.51%	10.61%	15.22%	17.47%	23.83%	22.09%

Source: Aduana Mexico. 2006. Información de pedimentos con clave de documento VU. Accessed 28 March 2006, from http://www.aduanas.sat.gob.mx/aduana_mexico/A_Vehiculos_3_pedimentos_VU.htm.

[8] For specific monthly data on the number of imported vehicles see Appendix Table 1A. Table 11 represents the most comprehensive data available regarding the importation of 10- to 15-year-old used vehicles into Mexico as a result of the 2005 Automotive Decree. While data are missing from August to November 2005 and a number of weeks between November 2005 and February 2006, we account for more than a half million vehicles that have crossed the border. We use this sample to project to 1 million, our estimate for the total number of vehicles that have crossed the border from August 2005 to March 2006.

C. Emissions Calculation for the Decree Fleet

Import data show the number of imports of specific model years that make up the Decree fleet. We apply per-vehicle annual emissions characteristics of vehicles from 1990 to 1996 to the model year data. We assume that the average kilometers traveled per year of the Decree fleet is 25,000 kilometers because these vehicles will likely be used for purposes similar to those already in the border states. These calculations assume 1 million used vehicles have been imported into Mexico from the United States as of March 2006. Based on the data compiled, we believe that the vast majority of vehicles that have crossed the border can be classified as light-duty vehicles.[9] The tons of emissions measured in Table 12 represent the total tons of emissions by pollutant type of the 1 million imported used vehicles.[10]

Table 12:
Annual Tons of Emissions per Pollutant for the Incoming Vehicle Fleet

Pollutant Type	Tons of Emissions per Pollutant
Hydrocarbon	115,846
Carbon Monoxide	1,198,682
Nitrogen Oxides	78,645

Source: Authors' calculations.

[9] Light-duty vehicles are defined as vehicles not exceeding 6,000 pounds (U.S. Environmental Protection Agency National Vehicle and Fuel Emissions Laboratory, 2005). We do not include a light-duty truck (exceeding 8,500 pounds) scenario in the body of our report. However, we acknowledge that these higher emitting vehicles may make up a small percentage of the total number of used vehicles crossing the border as a result of the Decree. To be safe, we conducted a 50-50 scenario that assumed 50 percent light-duty vehicles and 50 percent light-duty trucks. Using the same methodology as described in Appendix A, we found annual tons of emissions per pollutant per year to be slightly higher than in our light-duty vehicle scenario incorporated in this report.

[10] For a complete breakdown of all of our emissions calculations, refer to Table 1A in Appendix A.

Post-Decree Scenarios

Based on the data developed in the previous two sections, this section analyzes the air pollution impacts under worst-case and best-case scenarios. The key variable in each scenario is the degree to which new imports under the Decree are simply added to the pre-Decree fleet or whether new imports replace pre-Decree vehicles.[11]

We develop two hypothetical best- and worst-case scenarios to consider cases where the 1 million vehicles imported from the United States replace the oldest and worse polluters of the pre-Decree border fleet or simply add to the pre-Decree border fleet. Following those analyses, we make two longer-term projections of the Decree fleet that take into account large initial influxes of used vehicles from the United States. Following these large influxes, an average growth rate is applied to the Decree fleet to account for the inflow of used vehicles until the NAFTA transition process is launched in January 2009.

A. Worst-Case Post-Decree Scenario

This worst-case scenario assumes there is no replacement of the existing fleet. We assume that there is no scrapping of the legal and illegal vehicles in the border fleet. Therefore, we add the Decree fleet to the current border fleet of 8.2 million vehicles for a new total of 9.2 million vehicles, resulting in an increase of 12 percent in the total border-state vehicle fleet population. With a scrapping rate of zero, the additional 1 million vehicles increase emission rates by about 10 percent per pollutant. Table 13 below details our calculations.

Table 13:
Worst-Case Post-Decree Scenario

	Total Vehicles	Tons per Year of Hydrocarbon Emissions	Tons per Year of Carbon Monoxide Emissions	Tons per Year of Nitrogen Oxides Emissions
Pre-Decree Border-States Fleet	8,237,210	1,353,359	12,942,767	767,090
Decree Fleet	1,000,000	115,846	1,198,682	78,645
Post-Decree Fleet	9,237,210	1,469,205	14,141,449	845,735
Fleet Size and Emissions Increase from the Decree Fleet	12%	9%	9%	10%

Source: Authors' calculations.

[11] We assume replaced vehicles move to areas of Mexico outside of the border states or are scrapped.

B. Best-Case Post-Decree Scenario

This scenario assumes that the Decree fleet replaces the oldest and worse polluting vehicles in the existing pre-Decree fleet. That is, for every 10- to 15-year-old used vehicle imported into the Mexican border states, a pre-Decree vehicle is scrapped or removed from circulation.[12] The resulting effect is that the border-state fleet population remains the same at 8.2 million vehicles, but emission levels of the post-Decree fleet are lower for each pollutant. Table 14 illustrates this replacement of vehicles and emissions by subtracting the emission levels of the worse polluting 1 million vehicles per pollutant from the total vehicle fleet. Reductions in fleet size and tons of emissions following the influx of the Decree fleet are represented by the row of numbers within parentheses. Overall, we find that the emission levels for hydrocarbons, carbon monoxide and nitrogen oxides fall by 10, 7 and 4 percent, respectively, as a result of the Decree Fleet.

Table 14: Best-Case Post-Decree Scenario

Category of Vehicle Fleet	Total Vehicles	Hydrocarbon Emissions (tons per year)	Carbon Monoxide Emissions (tons per year)	Nitrogen Oxides Emissions (tons per year)
Pre-Decree Fleet	8,237,210	1,353,359	12,942,767	767,090
Decree Fleet Replacement	1,000,000	115,846	1,198,682	78,645
Reduction of Emissions via Removal of Worse Polluters	(1,000,000)	(254,650)	(2,150,681)	(111,822)
Post-Decree Fleet	8,237,210	1,214,555	11,990,768	733,913
Percentage Emissions Decrease from the Decree Fleet	--	-10%	-7%	-4%

Source: Authors' calculations.

C. Projections of Vehicle Fleet Growth from August 2005 to December 2008

Based on the best- and worst-case scenarios developed above, we conclude that the worst air pollution impacts from the Decree fleet occur when imports are simply added to the existing pre-Decree fleet. This point is further supported by our longer-term import projections from March 2006 to December 2008.

Using documented Mexican vehicle ownership rates in the six border states from 1980 to 2002, we determine an average vehicle ownership growth rate. This rate

[12] Considering our calculations of the illegal vehicle fleet in the pre-Decree section, the worse polluting vehicles are considered illegal vehicles.

then allows us to find the percentage growth of future incoming used vehicles following an initial spike of imported vehicles (See Appendix D for Mexican Vehicle Ownership Rates). The following projections exclude illegal Mexican vehicles used in the earlier post-Decree scenarios because we were unable to find reliable data to predict their growth rates.

Table 15, our slow-growth scenario, projects an initial spike in used vehicle imports from the United States to Mexico of 1 million vehicles from August 2005 to March 2006 followed by the annual vehicle growth rate of 3.91 percent for the vehicle population of the border states. Used vehicles imported from the United States are assumed to encounter additional consumer demand, thus the replacement rate is zero.[13] We find that increases in tons of emissions as a result of the Decree are substantial. Emissions for hydrocarbon, carbon monoxide and nitrogen oxides increase by 27 percent per pollutant.

[13] Calculations:

1) To estimate Mexican border vehicle population growth from March 2006 to December 2008 annual growth rates were forecasted using vehicle registration rate data. The growth in vehicle registration rates in the six border states from 1980 to 2002 was averaged annually using a compound annual growth rate estimate.
2) The average vehicle registration growth rate was then applied to estimate the post-Decree Mexican border vehicle fleet "steady state" growth rate (from March 2006 to December 2008). The average growth rate for the border-states fleet following the initial importation spike of 1 million vehicles was determined at 3.91 percent.
3) The growth of the border fleet was then projected until December 2008 using a supposed annual growth rate of 3.91 percent.
4) Emissions characteristic of 10- to 15-year-old U.S. vehicles from the estimated national average vehicle emission rates per vehicle by type using gasoline were applied assuming all vehicles imported were light-duty vehicles. Next, we applied U.S. emissions data to the vehicle fleet operating in the Mexican border states since a very large percentage of these vehicles were imported from the United States.

Table 15:
Slow-Growth Scenario from August 2005 to December 2008[14]

Total Vehicles and Cumulative Tons of Emission per Pollutant	July 2005	August 2005 to March 2006	March to December 2006	January to December 2007	January to December 2008	Percent Increase 2005-08
Total Vehicles	5,737,210	6,737,210	6,935,183	7,206,902	7,489,268	31%
Hydrocarbons	716,733	832,579	855,454	884,432	912,359	27%
Carbon Monoxide	7,566,065	8,764,747	9,001,380	9,297,355	9,579,157	27%
Nitrogen Oxides	487,534	566,179	581,707	601,450	620,538	27%

Source: Authors' calculations.

Table 16, our rapid-growth scenario, projects an initial spike in imports of 2 million used vehicles from August 2005 to December 2006 followed by the annual growth rate of 3.91 percent for the legal vehicle population of the border states. Once again, the vehicles imported from the United States are assumed to encounter additional consumer demand, thus the replacement rate is zero. In this growth scenario, we find that tons of emissions for hydrocarbon, carbon monoxide and nitrogen oxides in 2008 are greater than in the slow-growth scenario described above. For all three pollutants, tons of emissions increase by 40 to 41 percent from 2005 to 2008 as a result of the influx of used vehicles.

Table 16:
Rapid-Growth Scenario from August 2005 to December 2008

Total Vehicles and Cumulative Tons of Emission per Pollutant	July 2005	August 2005 to March 2006	March to December 2006	January to December 2007	January to December 2008	Percent Increase 2005-08
Total Vehicles	5,737,210	6,737,210	7,737,210	8,040,354	8,355,375	46%
Hydrocarbon	716,733	832,579	948,425	980,754	1,011,911	41%
Carbon Monoxide	7,566,065	8,764,747	9,963,429	10,293,632	10,608,024	40%
Nitrogen Oxides	487,534	566,179	644,824	666,850	688,146	41%

Source: Authors' calculations

[14] The numbers for July 2005 represent the legal pre-Decree vehicle size and cumulative tons of emissions.

D. Post-Decree Scenario Assessment

Due to rising population and vehicle-ownership growth rates, we believe that a scenario closer to the worst case is the most probable outcome following the introduction of the Decree fleet. While owners may scrap some older vehicles in favor of newer ones, we do not believe the Decree fleet will replace 1 for 1 older legal vehicles or problem vehicles. Thus, we assume that the flow of incoming used vehicles will add to the pre-Decree fleet at an unknown rate until the market for vehicles in the border states is saturated. The point at which this demand saturation will take place is uncertain.

Assuming a scenario close to the worst-case scenario of no replacement, we have identified the removal of older legal and problem vehicles from the Mexican border fleet as the most important policy option to reduce the negative environmental impact of the Decree fleet. If our assumptions are correct, the Mexican government must act quickly to avoid an increase in air pollution in the border states. Potential options to mitigate the negative environmental impacts are mentioned below.

Potential Policy Options

Our paper lays the initial groundwork for future research into policy options that may reduce emission levels in the border states. We provide two potential policy options that have been implemented elsewhere as a starting point for further research. These measures include: (A) scrapping programs for older and/or problem vehicles and (B) export tag requirements. Any decision to implement these programs should be accompanied by substantial research into: (1) the measure's positive impact on air pollution; (2) the amount of resources necessary to enforce the measure; (3) whether the measure complies with federal and state laws, as well as treaties; and (4) the political feasibility of the suggested measure.

A. Programs to Scrap Older and Problem Vehicles

As our scenarios indicate, if the Decree fleet replaces rather than adds to the pre-Decree fleet, air pollution would improve in the border region. From our perspective, the best policy option is to scrap high-polluting pre-Decree vehicles, specifically older model vehicles that tend to pollute more than newer vehicles because of vehicle deterioration and problem vehicles that lack catalytic converters and other emissions-reducing mechanisms. Simple measures exist that create economic incentives for scrapping these high-polluting vehicles.

The Bureau of Automotive Repair's Consumer Assistance Program in California offers motorists up to $500 in smog-related repairs or $1,000 to scrap problem vehicles. The bureau's goal is to retire 15,000 high polluting vehicles by the end of 2006, thereby reducing smog-forming pollutants by more than 900 tons. To

increase support for the program, the state of California has implemented a public awareness campaign to increase knowledge of the harmful health effects of these vehicles. The state advertises that air pollution as a result of vehicle emissions has been linked to a series of health concerns, including asthma, cancer, reduced lung capacity and premature death (Zettel, 2005).

Sponsoring a similar scrapping/repair program in Mexico that incorporates a public awareness campaign is an immediate step that the Mexican government could take to retire high-polluting problem vehicles and thereby improve air quality. In its early phases, the program could target major Mexican metropolitan areas and regions with the poorest air quality. Partnerships between cities like San Diego and Tijuana on the U.S.-Mexican border could be formed to coordinate scrapping efforts and smog-related repairs.

The eventual costs of such a program depend on the magnitude and multitude of cash rewards. The program could be financed through federal and state funds, as well as through fund-raising efforts by local community groups. Several Canadian provinces, for example, offer incentives other than cash rewards, such as transit or bus passes, and rebates for purchases of newer vehicles, bicycles and helmets.

B. Environmental Export Tag Requirement for Imported Used Vehicles

Mexican law requires that all imports comply with state of origin emission standards. In the United States, the Clean Air Act of 1990 sets federal emission standards (42 U.S. Code §§ 7401-31). However, federal law allows states to adopt emission standards that are at least as protective of the public health and welfare as applicable federal standards. (42 U.S. Code §§ 7543).

A second policy option requires that at the time of importation into Mexico, vehicles must be certified as meeting U.S. state-of-origin emission standards. Currently, Mexican enforcement of state-of-origin emission standards when a vehicle is imported is lax. Requiring an environmental export tag could lead to better air quality overall because it would increase the ease of emission standards enforcement. The tag could be issued by Inspection and Maintenance (I&M) stations in the United States or at the border.[15]

[15] In a 2006 interview, John Rogers stated that emissions testing programs would be feasible at border points. Environmental testing equipment in the border region is sometimes tampered with so the parameters of allowable emissions are increased to allow more vehicles to pass emissions tests. Rogers said accurate instruments ensuring that parameters are not tampered with could be designed based on a similar environmental testing program in Mexico City where inspection equipment has built-in checks.

The environmental export tag would signal to authorities in an efficient manner that the vehicle complies with the state-of-origin requirement. Compliance with the environmental tag could be monitored by:

i. U.S. customs officials at the border at the time of exportation,
ii. Mexican officials at the border at the time of importation, or
iii. distribution of incentives for the inspection of imported vehicles by local inspection and maintenance programs within some time period following the date of importation.

i. Enforcement by U.S. customs officials at the time of exportation

U.S. customs officials at the border could check export tags to determine when vehicles were permanently exported. The tag would have been obtained by an I&M station in the United States or at the border. I&M stations are not allowed to put emissions stickers on all vehicles. For example, Texas I&M station inspectors/operators can only put Texas I&M stickers on vehicles registered in counties that require I&M, or on vehicles registered to military service members who are residents of another state and stationed in counties that require I&M (Currey, 2006b). Thus, to allow inspection station operators to put I&M stickers on all vehicles being exported to Mexico, municipal, state and federal law may have to be amended.

ii. Enforcement by Mexican officials at the time of importation

In contrast to option (i), this option would require Mexican border authorities rather than U.S. border authorities to enforce U.S. environmental export tags. The environmental export tag could be obtained from I&M stations in the United States or at border points. This program, along with its potential obstacles, would be similar to subsection (i) above.

iii. Enforcement after importation in conjunction with local inspection and maintenance programs

This option would work best as a financial incentive to obtain a U.S. export tag rather than a check to ensure that vehicles have export tags. Certain Mexican cities and regions have I&M programs that require regular emissions tests for vehicles.[16] A potential policy option would be to allow vehicle owners to exchange their U.S. export tags for cash or free emissions inspections. This

[16] Border region enforcement contrasts with that of Mexico City, which provides an example of efficient emission sticker enforcement. All vehicles that circulate in Mexico City have to pass an emissions test every six months. Upon passing the emissions test, the vehicle is issued a holographic window sticker. Unlike in other cities or regions where enforcement of such "sticker requirements" is lax, enforcement in Mexico City seems to be working well. This has partly to do with the fact that any police officer has the authority to impound vehicles without the sticker. The cost of getting the vehicle back is higher than the cost of having the sticker (Rogers, 2006).

measure would require an increased number of I&M programs throughout Mexico and, in particular, in the border region.

A possible obstacle to the effectiveness and desirability of this option is that under current export laws and practices, it is difficult for border officials to determine if a vehicle is being temporarily or permanently exported. Vehicles are allowed to operate in the border zone (the area 100 kilometers or 62.5 miles on either side of the inland boundaries between the U.S. and Mexico) on a temporary basis without meeting state-of-origin export requirements. Therefore, to avoid emission requirements for permanent exportation, drivers often do not reveal their true intentions when crossing the border. The export tag option standing alone does nothing to solve this problem. Therefore, without increased capacity to determine if vehicles are crossing the border on a temporary or permanent basis, the export tag may have limited effectiveness.

Further, the removal of catalytic converters and other emissions-reducing technologies may decrease the positive environmental impact that an export tag program could have. Vehicles that have the tag and are legally exported may be stripped of emissions-reducing technology upon arrival in Mexico.

Conclusion

In this report, we develop best and worst-case scenarios that allow us to estimate the emission contributions or reductions of the Decree fleet. We conclude that a scenario closer to the worst-case scenario of no replacement of pre-Decree older and problem vehicles is the most probable. This scenario yields increases in tons of emissions of roughly 10 percent per pollutant (hydrocarbon, carbon monoxide and nitrogen oxides) as the incoming vehicles are simply added to the pre-Decree border-states fleet. We conclude that a best-case scenario of 1 for 1 replacement of the highest-polluting vehicles from the pre-Decree fleet is unlikely. With rising population and vehicle registration rates in the border states, we believe demand for vehicles outweighs supply, thus incentives to remove operational older or problem vehicles are weak.

Due to the existing high demand for vehicles in the border states, we believe that a rapid-growth scenario is more likely to occur. In our rapid-growth scenario, we project that high demand will contribute to an initial spike in used vehicle imports of 2 million vehicles. This period is followed by a steady state growth rate of 3.91 percent for used vehicle imports. We determine that total tons of emissions will increase by 40 percent per pollutant from 2005 to 2008. In our slow-growth scenario, we project a smaller initial spike in used vehicle imports from the United States to Mexico of 1 million vehicles. Again, this period is followed by the steady state growth rate. We find that total tons of emissions per pollutant increase by 27 percent. The slow-growth scenario does not take into account existing demand measured by increasing vehicle registration and population growth rates in the border states.

Overall, we believe the 2005 Automotive Decree will have a negative impact on air pollution in the border states because of the presence of high-polluting older and problem vehicles that are not being replaced by the younger Decree fleet. We have identified several policy options that could be implemented to improve the Decree fleet's environmental impact. We think that the most effective solution would be to implement measures, such as a scrapping or export tag program, that will eliminate high-polluting older and problem vehicles from the border region.

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Appendix A: Decree Fleet Size and Emissions Calculations

We created Table 1A using import data from the Mexican Customs online database Aduana Mexico. We summed used vehicle imports based on model year for the available data on 500,738 imported used vehicles from November 2005 to February 2006. Table 1A includes data on 10- to 15-year-old vehicles imported from the United States that are covered under the 2005 Automotive Decree. After sorting the data by model year for each importation date our group determined that the Decree fleet thus far consists of the following age composition: 2.26 percent were model year 1990; 8.51 percent were model year 1991; 10.61 percent were model year 1992; 15.22 percent were model year 1993; 17.47 percent were model year 1994; 23.83 percent were model year 1995; and 22.09 percent were model year 1996 (Aduana Mexico, 2006).

According to estimates by the Centro Mario Molina in Mexico City, 1 million used vehicles falling within the parameters of the Decree have crossed the border from the United States since November 2005 (Lacy Tamayo, 2006).

Table 1A:
Number of U.S. Vehicles Imported to Mexico
by Model Year (Covered under the 2005 Automotive Decree)

Date of Import	1990	1991	1992	1993	1994	1995	1996	1990-96
22-Nov	210	730	614	949	1,062	1,389	1,054	6,008
23-Nov	142	424	538	778	897	1,301	964	5,044
24-Nov	266	696	809	1,178	1,248	1,868	1,217	7,282
25-Nov	278	625	826	1,200	1,331	1,812	1,220	7,292
26-Nov to 27-Nov	119	221	329	458	513	729	394	2,763
28-Nov	147	570	772	1,173	1,465	1,892	1,517	7,536
29-Nov	246	622	798	1,112	1,279	1,770	1,288	7,115
30-Nov	223	545	664	981	1,170	1,534	1,032	6,149
1-Dec to 8-Dec	1,373	3,053	3,554	5,289	5,962	7,929	5,814	32,974
9-Dec to 12-Dec	795	1,877	2,494	3,509	4,101	5,543	4,079	22,398
13-Dec to 19-Dec	2,436	5,295	6,577	9,340	10,670	14,351	10,034	58,703
20-Dec to 21-Dec	863	1,748	2,148	2,979	3,589	4,923	3,566	19,816
22-Dec to 27-Dec	2,287	3,260	3,944	5,567	6,333	8,504	5,947	35,842
6-Jan to 10-Jan	1,820	7,493	10,161	14,842	18,893	25,717	22,389	101,315
11-Jan to 18-Jan	40	4,233	5,179	7,583	8,222	11,551	15,362	52,170
19-Jan	19	580	751	1,096	1,178	1,645	2,033	7,302
20-Jan to 22-Jan	18	894	1,110	1,567	1,826	2,539	3,089	11,043
23-Jan	4	548	765	1,054	1,233	1,677	2,151	7,432
24-Jan to 8-Feb	42	4,437	5,404	7,427	7,492	10,210	13,477	48,489
9-Feb to 15-Feb	7	4,652	5,530	7,951	8,827	12,244	13,823	53,034
16-Feb to 28-Feb	0	125	140	203	193	199	171	1,031
Total	11,335	42,628	53,107	76,236	87,484	119,327	110,621	500,738
Percent of Total	2.26%	8.51%	10.61%	15.22%	17.47%	23.83%	22.09%	100%

Source: Author's calculations

To calculate the emissions characteristics of the vehicle fleet entering as a result of the Automotive Decree, the number of vehicles aged 10 to 15 years that legally crossed the border from November 2005 to February 2006 were sorted by importation date provided by Aduana Mexico data.[17] We analyzed the number of vehicles that crossed the border by their average vehicle emission rates per pollutant (hydrocarbons, carbon monoxide and nitrogen oxides) per vehicle according to vehicle type (light-duty truck or light-duty vehicle) for 1990-1996.[18] Ideally, applying both model year and make of vehicles crossing the border would yield the most accurate emission levels. However, the descriptions of vehicles crossing the border from November 2005 through February 2006 are inconsistent.

Table 2A contains the results of our backward and forward projections of emission rates (grams per kilometer) per pollutant using U.S. emissions data for 1990 through 2004. To accurately reflect the age structures of the Decree fleet and the Ciudad Juárez fleet, we first calculated the percentage annual increase in emissions from 1995 to 1990. We then found the average percentage increase during this period and multiplied 1990 emission rates for each pollutant by this average. This product was added to 1990 emission rates to find 1989 emission rates per pollutant. We continued this process through 1986. To complete our range and fully capture the age structure of the Ciudad Juárez fleet, we calculated the percentage decrease in emissions per year from 1999 to 2004. Next, we found the average percent decrease during this period and multiplied 2004 emission rates for each pollutant by this average. The product was then added to 2004 emission rates to find 2005 and 2006 emission rates per pollutant.

[17] While the Decree only incorporates the importation of 1990 vehicles from August 23-October 31, 2005, we included these used vehicles in the report because a significant number were imported from November 2005 through February 2006. By late February 2006 however, 1990 vehicles had been phased out.

[18] The U.S. Environmental Protection Agency's National Vehicle and Fuel Emissions Laboratory defines light-duty trucks as vehicles weighing as much as 8,500 pounds. Light-duty vehicles are defined as vehicles weighing as much as 6,000 pounds. The vast majority of vehicles crossing the border as a result of the Decree have been light-duty vehicles.

Table 2A:
Emission Rates per Vehicle per Pollutant of U.S. Vehicles for Model Years 1986-2006 (grams/ per kilometer)

Year	Hydrocarbons	Carbon Monoxide	Nitrogen Oxides
1986	8.80	97.90	5.91
1987	8.14	89.72	5.47
1988	7.53	82.22	5.07
1989	6.96	75.36	4.69
1990	6.44	69.06	4.35
1991	5.90	63.04	3.97
1992	5.40	57.23	3.65
1993	4.95	51.90	3.36
1994	4.57	47.20	3.12
1995	4.21	42.82	2.86
1996	3.88	38.92	2.64
1997	3.63	36.02	2.50
1998	3.41	33.58	2.35
1999	3.22	31.46	2.18
2000	3.03	29.83	2.08
2001	2.85	28.66	2.01
2002	2.66	27.34	1.92
2003	2.48	25.99	1.84
2004	2.21	22.19	1.61
2005	2.04	20.57	1.51
2006	1.88	19.06	1.41

Source: U.S. Environmental Protection Agency National Vehicle and Fuel Emissions Laboratory. 2005. Accessed through the Bureau of Transportation Statistics on 18 March 2006, from http://www.bts.gov/publications/national_transportation_statistics/2006/html/table_04_38.html.

Appendix B: Trafficking of Stolen Vehicles from the United States to Mexico

Public policy in Mexico has been greatly influenced by the trafficking of stolen vehicles across the U.S.-Mexico border. From 1978 to 2001, the Mexican government implemented 14 regularization programs that sought to incorporate these vehicles into the main vehicle fleet via vehicle registration and inspection (CESOP, 2004). The incentive for Mexican drivers of illegally imported vehicles to comply with regularization programs was to avoid payment of expensive bribes to corrupt traffic officers who could easily identify illegal or unregistered vehicles by the lack of identifying stickers (Rogers, 2006).

While the 14 regularization programs resulted in the legalization of 2.8 million vehicles between 1978 and 2001, the current total illegal vehicle population is estimated at 2.5 million (CESOP, 2004). Despite policies aimed at providing disincentives to those illegally importing vehicles, the illicit traffic of vehicles continues.

The way in which the 2005 Automotive Decree will affect trafficking in stolen vehicles across the U.S.-Mexico border remains unclear. According to recent estimates, approximately 200,000 vehicles are stolen and exported from the United States each year. In Mexico, the models that are in most demand are those manufactured in the United States and manufactured or marketed in Mexico (Clarke & Brown, 2003). Many of the vehicles taken illegally to Mexico are vehicles for which individuals can easily get replacement parts (Currey, 2006a).

In Texas, older model sedans and pickup trucks like the Ford F-150 are cited as common targets for theft on the border (Currey, 2006a). The National Insurance Crime Bureau's "Top Ten Stolen Vehicles by State" 2004 study confirms that non-exotic vehicles are targeted in the border states of California, Arizona, New Mexico and Texas. Common vehicles targeted for theft in the border states include the Honda Accord, Honda Civic, Dodge Ram pickup, Chevrolet full-size C/K pickup, Oldsmobile Cutlass/ Supreme/Ciera and Ford and Toyota pickup trucks (National Insurance Crime Bureau, 2006).Table 1B lists the top 10 stolen vehicles by U.S border state. Despite contacting the National Insurance Crime Bureau's office on multiple occasions, our group was unable to obtain additional information on stolen vehicles recovered from Mexico, making it difficult to estimate the characteristics of the stolen used vehicles that are taken to Mexico.

Table 1B: Top Ten Stolen Vehicles by U.S. Border State

California	**New Mexico**
1. Toyota Camry	1. Ford F150 pickup
2. Honda Accord	2. Honda Accord
3. Honda Civic	3. Chevrolet full-size C/K pickup
4. Toyota pickup	4. Oldsmobile Cutlass/Supreme/Ciera
5. Toyota Corolla	5. Jeep Cherokee/Grand Cherokee
6. Nissan Sentra	6. Ford Ranger
7. Acura Integra	7. Chevrolet full-size extended-cab pickup
8. Ford Mustang	8. Dodge Ram pickup
9. Oldsmobile Cutlass/Supreme/Ciera	9. Pontiac Grand Am
10. Toyota van	10. Ford F250 pickup
Arizona	**Texas**
1. Chevrolet full-size C/K pickup	1. Chevrolet full-size C/K pickup
2. Honda Accord	2. Honda Accord
3. Dodge Ram pickup	3. Chevrolet full-size extended-cab pickup
4. Ford F150 pickup	4. Ford F150 pickup
5. Chevrolet full-size extended-cab pickup	5. Chevrolet/GMC Suburban
6. Nissan standard body pickup	6. Toyota Camry
7. Nissan Sentra	7. Oldsmobile Cutlass/Supreme/Ciera
8. Oldsmobile Cutlass/Supreme/Ciera	8. Dodge Ram pickup
9. Honda Civic	9. Honda Civic
10. Jeep Cherokee/Grand Cherokee	10. Ford Mustang

Source: National Insurance Crime Bureau. 2006. *Top Ten Stolen Vehicles by State*. Accessed 7 March 2006, from http://www.nicb.org/rootlinks/top10bystate.cfm#tx.

Experts have identified several factors that facilitate the exportation of stolen vehicles. These factors include difficulty of spotting stolen vehicles among the large numbers of vehicles crossing and a high likelihood of a large stolen vehicle market if officials are unable to prevent an illegal market for imports that were purchased legally in another country (Clarke & Brown, 2003). A study of the methods used in trafficking vehicles between the United States and Mexico finds that auto theft begins with the targeting of a desired vehicle. The thief then breaks into the vehicle and engages the ignition system, a process that can take anywhere from 15 to 90 seconds. The thief or an accomplice drives the vehicle across a bridge into Mexico. To cross, a vehicle must pass two checkpoints. If no police officers challenge the stolen vehicle, the first toll is simply paid. If there is a challenge, the driver ignores the toll. If police block the bridge, the driver does not stop, but continues driving until the police officers remove themselves. The driver must pass a second toll, where if the thief is signaled for inspection, the thief again drives through the toll to avoid Mexican officials, a process that can end in a high-speed chase. Generally, thieves prefer to steal vehicles and cross the international bridges between midnight and 5 a.m. when traffic is at its lightest (Resindez & Neal, 2000).

Appendix C: Range of Illegal Vehicle Size and Emission Levels in Mexico

Recent estimates from a number of Mexican automobile and government sources range from 1.5 million to 5 million total illegal vehicles nationwide. Prior to the Decree, of an estimated 700,000 total vehicles entering the country annually, approximately 200,000 are illegal and remain in Mexico (CESOP, 2004).

Table 1C:
Range of Estimates of Illegal Vehicles in Mexico

Number of Vehicles	Sources of Estimates
1,500,000	Asociacion Mexicana de la Industria Automotriz
2,500,000	Asociacion Mexicana de la Industria Automotriz, Asociacion Mexicana de Distribuidores de Automotores
3,500,000	Comisión de Economía
5,000,000	Secretaria de Hacienda y Credito Publico

Source: Secretaria de Medio Ambiente Recursos Naturales (SEMARNAT) and Instituto Nacional Ecología (INE) Joint Study. 2002. "Estimacion de emisiones pollutantes de vehiculos de procedencia extranjera en Mexico." Accessed from "Los vehículos de procedencia extranjera ilegales en México." Centro de Estudios Sociales y de Opinión Pública (CESOP). 2004.

Estimates of total tons of emission also vary based on the estimates of the number of illegal vehicles. Table 2C details each one of the estimates of total tons of emissions according to the number of vehicles believed to be in circulation above. The sources for the estimates of the total tons of emissions correspond with those in Table 1C.

Table 2C:
Range of Estimates of the Total Tons of Emissions of Illegal Vehicles per Pollutant in Mexico as of 1997

Number of Vehicles	Cumulative Hydrocarbons	Cumulative Carbon Monoxide	Cumulative Nitrogen Oxides
1,500,000	190,988	1,613,010	83,867
2,500,000	318,313	2,688,351	139,778
3,500,000	445,638	3,763,691	195,689
5,000,000	636,626	5,376,702	279,556

Source: Secretaria de Medio Ambiente Recursos Naturales (SEMARNAT) and Instituto Nacional Ecología (INE) Joint Study. 2002. "Estimacion de emisiones pollutantes de vehiculos de procedencia extranjera en Mexico." Accessed from "Los vehículos de procedencia extranjera ilegales en México." Centro de Estudios Sociales y de Opinión Pública (CESOP). 2004.

Appendix D: Vehicle Ownership in the Mexican Border States

Another important effect to consider is the potential impact incoming vehicles could have on vehicle ownership rates in the Mexican border states. The table below details the number of registered vehicles in circulation in the six Mexican border states from 1980-2002. As illustrated in Table 1D, the number of vehicles registered in the border states has risen substantially since 1980. With increasing registration rates, we hypothesize that the majority of the vehicles imported under the Automotive Decree would contribute to additional consumer demand rather than replace much of the existing border vehicle fleet.

Table 1D:
Number of Vehicles Registered per 1,000 Inhabitants and in Circulation in the Six Mexican Border States

Mexican State	1980	1990	1995	2000	2001	2002
Baja California	295	327	300	303	337	369
Coahuila de Zaragoza	96	179	150	145	205	257
Chihuahua	136	227	233	266	304	308
Nuevo León	105	153	187	249	288	311
Sonora	117	164	70	232	246	282
Tamaulipas	128	196	190	267	297	373

Source: Instituto Nacional de Estadística, Geografia e Informática. 2005. Vehículos de motor registrados en circulación. Accessed: 27 February 2006 from http://www.inegi.gob.mx/est/contenidos/espanol/rutinas/ept.asp?t=mamb137&c=5885