

**Air Quality Management Technical Assistance for Central America
Grant X4-83387601-0**

**Clean Fuels and Vehicles Recommendations
for Central America and the Dominican Republic**

Submitted to:

**Mr. Orlando Gonzalez
Office of International Affairs
U.S. Environmental Protection Agency
Washington, DC**

Submitted by:

**Erica Zell, Glynis Lough, and Michael Murphy
Battelle
505 King Avenue
Columbus, Ohio 43201-2693**

11 November 2009

Executive Summary

Vehicle fleets in Central America and the Dominican Republic are a major source of air pollution, particularly in densely populated urban centers where health impacts are the greatest. This study, which provides assistance to the region on options for cleaner fuels and vehicles, was performed by Battelle under a grant from the U.S. Environmental Protection Agency. Fuels and vehicles must be considered as a system. Improvements in fuels and vehicles should proceed in parallel if significant reductions in emissions of air pollutants from vehicles are to occur. To maximize the likelihood of success, a dual focus on mitigation of climate change (CO₂) and air pollution reduction (particulate matter and ozone) should be adopted. Based on information from surveys completed by national governments in the region (Appendix A) and relevant studies, countries in the region have varying degrees of laws, regulations, and programs targeting the reduction of vehicular air pollution. Drawing from lessons learned in the region and worldwide, four priority actions are recommended:

Priority 1: Reduce sulfur in fuels.

Reduction of sulfur in fuels is a cost-effective means of addressing health impacts due to air pollution. Reduction of fuel sulfur allows immediate reduction in sulfur dioxide (SO₂) and sulfate particulate matter (PM), with no changes to the vehicle fleet. Sulfur in gasoline and diesel should be reduced to a maximum of 500 ppm as soon as possible, and eventually to 10 to 15 ppm in diesel, and 30 ppm in gasoline.

Priority 2: Establish reliable, clean public transport like Bus Rapid Transit.

The introduction of Bus Rapid Transit (BRT) eases traffic congestion and reduces carbon dioxide (CO₂) and other air pollutant emissions, by removing old, high-emitting buses from the streets and replacing them with modern buses in dedicated bus lanes. BRT is cost-effective to implement, and can be established in a relatively short timeframe.

Priority 3: Implement inspection and maintenance (I/M) programs.

Vehicle I/M programs encourage the compliance of the fleet with emission limits, resulting in gradual emission reductions. I/M programs are initially costly to implement and enforce, but provide long-term benefits, as the highest-emitting vehicles can be identified and repaired or replaced. Centralized I/M programs, overseen by the government at a few locations in an urban area, are likely to be the most effective.

Priority 4: Improve air quality information and source apportionment.

Air quality monitoring efforts in the region have been increasing recently, offering an opportunity to better quantify ambient air quality and health impacts. The adoption of country and regional air quality indices for conveying information to the public, and emissions inventory and health studies are recommended.

Further study is needed on a country-level basis for implementation of these recommendations, accompanied by regional collaboration to improve the likelihood of success in reducing vehicular air pollution.

Table of Contents

1.	INTRODUCTION	1
1.1.	Why address this issue?	2
1.2.	Who should address this issue?	3
1.3.	What are the options?	3
2.	STATE OF AFFAIRS AND OPTIONS	4
2.1.	Fuel Standards	5
2.1.1.	Low-sulfur Fuels	6
2.1.2.	Biofuels	10
2.2.	Vehicle Standards	14
2.2.1.	Age limits on imports	15
2.2.2.	Inspection and Maintenance Programs	16
2.2.3.	Fuel Efficiency Standards	18
2.2.4.	Fleet Programs	19
2.2.5.	Diesel Retrofits	19
2.3.	Voluntary/Incentive Programs	20
2.4.	Problem Quantification	21
2.5.	Alternative Transportation Systems	26
3.	SUMMARY OF RECOMMENDATIONS	27
Appendix A	Country Surveys	A-1
Appendix B	Bodies Regulating Fuels in Various Countries	B-1

1. Introduction

The transportation sector is a major emitter of air pollutants and greenhouse gases around the world. In Central America, the vehicle fleet in urban areas contributes up to 80% of urban air pollution.¹ As vehicle fleets in most Central American countries are growing rapidly, a focus on reducing vehicle emissions is critical to improve air quality, mitigate carbon emissions, and protect public health.

In order to effectively reduce emissions of carbon dioxide (CO₂) and pollutants that cause poor air quality, it is necessary to consider options to address the full, integrated system of fuels and vehicles. Emissions of CO₂ and non-CO₂ pollutants are a function of many factors, including fuel quality, fuel type, vehicle technology, vehicle fleet composition, and transportation patterns. A wide variety of stakeholders may be involved in efforts to reduce vehicle emissions, including the general public; vehicle importers and maintenance personnel; fuel importers and refiners; public and goods transportation operators; academic and non-governmental organization (NGO) researchers; and government agencies focused on transportation, commerce, energy, environment, and health. The challenges for Central America and the Dominican Republic are to understand the true costs of the current system of fuels and vehicles, and to identify solutions that minimize costs and consider all stakeholders.

The U.S. Environmental Protection Agency (USEPA) issued an “Urban Air Quality Program in Central America” grant to Battelle, a research institution, to consider ways to address air pollution issues in the region. This document was prepared by Battelle to provide assistance to the region regarding options for cleaner fuels and vehicles. The authors relied upon past studies in the region,² input from NGOs, and surveys completed by government representatives in Costa Rica, the Dominican Republic, Guatemala, Honduras, and Panama (Appendix A).

This document is designed to serve as a foundation for new or continued action to reduce air pollution and CO₂ emissions from fuels and vehicles. Recommended actions may be conducted by individual countries, regional coalitions, or groups working in the region such as the Partnership for Clean Fuels and Vehicles (PCFV), and its implementing partner the Mario Molina Center Chile. The target audience is officials at relevant ministries (e.g., Environment, Health, Transportation, Energy, Economy), legislators working to address this issue, and project implementers at NGOs. The document addresses the current state of affairs in Central America and the Dominican Republic with respect to fuels and vehicles, analyzes options to address the issue, and makes recommendations for next steps. The analysis and recommendations included in this overview will likely require further study by national and regional workgroups prior to implementation.

¹ “Reducing Fuel Sulfur Content in Central America: A Guide to Estimating Costs and Benefits.” November 2006, Draft Final Report, International Council on Clean Transportation.

² For example, Central America Commission on Environment and Development, Diagnóstico de la Normativa Técnica sobre Calidad del Aire en Centroamérica, 2007.

1.1. Why address this issue?

Emissions from motor vehicles are a major source of air pollution, especially in urban areas. Motor vehicles directly emit CO₂, sulfur dioxide (SO₂), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and particulate matter (PM), including organic compounds and heavy metals. VOCs, SO₂, and NO_x, in turn, contribute to formation of ozone (O₃), secondary organic PM, sulfate PM, and nitrate PM. Motor vehicle CO₂ emissions contribute to climate change, as does the greenhouse gas O₃, formed by vehicle emissions. Particulate black carbon emitted from diesel and gasoline vehicles is also a major contributor to climate warming. Reducing emissions from motor vehicles is clearly necessary as part of a strategy to mitigate climate change, improve air quality, and protect public health.

Gaseous and particulate pollutants emitted by motor vehicles are associated with a range of health impacts, including elevated risk of asthma, cardiopulmonary disease, upper respiratory infections, and chronic respiratory disease. Diesel exhaust is also a likely human carcinogen. It has been estimated that more than 60% of cases of diseases associated with respiratory infections worldwide are related to air pollution.³ Children and the elderly are most susceptible to the acute impacts of air pollution. The World Health Organization (WHO) reported in 2000 that up to 30% of children in Central America suffer from symptoms of asthma,⁴ a condition that is exacerbated by traffic-related pollutants. According to WHO, air pollution in Latin America has been blamed for more than 35,000 premature deaths, approximately 4.5 million total healthy years lost, and productivity losses of up to 2% of national gross domestic products (GDPs).

To protect public health, it is vital to reduce exposure to air pollution. Because air pollution is linked to both acute and chronic conditions, there are both short- and long-term aspects to exposure reduction. First, reductions in acute effects can be achieved through efforts to protect sensitive groups from increased risks during periods of poor air quality. Second, reductions in air pollution in the long term, accomplished through integrated planning across economic sectors, will reduce exposures and protect the health of the entire population.

Protecting public health in the long term also will require mitigating climate change and adapting to the impacts of climate change. According to recent IPCC predictions, the Central American region is expected to become warmer and drier due to climate change⁵. Expected climate change impacts in the region include altered precipitation patterns, decreased agricultural productivity, increased storm strength, reduced water supplies, degraded water quality, and expanded ranges and impacts of pests and disease. Strategies to address climate change must include both measures to adapt to potential changes and measures to mitigate emissions of CO₂ and other climate-warming species. Reducing

³ Kirk R. Smith et al., "How Much Global Ill Health Is Attributable to Environmental Factors?" *Epidemiology* 10, 5 (1999): 573-84

⁴ WHO, "Bronchial Asthma: Fact Sheet.

⁵ IPCC (Intergovernmental Panel on Climate Change) (2007). *Climate Change; The Physical Science Basis. Summary for Policymakers Contribution of Working Group I to the Fourth Assessment Report*, 21 pp.

emissions from the system of fuels and vehicles will be necessary to meet future goals to limit carbon emissions.

The importance of cleaning up fuels and vehicles in Central America and the Dominican Republic has been acknowledged by environmental ministerial representatives⁶ and other groups in the region. Translating acknowledgments and commitments into concrete action will require consensus and coordination among many groups of stakeholders, including government and industry groups for both fuels and vehicles. Effective action will also require serious consideration of the economic, environmental, and health costs of vehicular emissions of both CO₂ and non-CO₂ pollutants.

1.2. Who should address this issue?

Stakeholder groups have distinct roles in addressing the issue of air pollution from fuels and vehicles, and there is a need for broad cooperation among these stakeholders. Effective action will require political will, agreement between government and industry, and public support. The public needs information to understand the impacts of the current system of fuels and vehicles; governments and NGOs are responsible for establishing regulations and managing programs and resources on local and national levels; the business community can contribute experience and work to comply with new programs; and researchers can contribute valuable insights to support effective actions. To succeed, efforts at cleaning up fuels and vehicles in the region must engage the appropriate stakeholders. The importance of matching the actions considered to the agencies and groups with jurisdiction over the issue, and focusing on the appropriate geographic scale (local vs. municipal vs. national) cannot be overemphasized.

At the advice of experts in the region, this document focuses primarily on providing high-quality information at the appropriate “semi-technical” level for the relevant government agencies and NGOs. This document does not provide all the necessary information to move forward, but presents an assessment of available options, potential challenges to their success, and possibilities for implementation.

1.3. What are the options?

The goal of this document is to explore ways in which the impact of vehicles on air quality can be diminished in Central America and the Dominican Republic, particularly in heavily polluted urban areas. The region has become increasingly interested in recent years in reducing the health impacts of poor air quality, as well as mitigating CO₂ emissions and the impacts of climate change. All of the countries participating in the U.S.-Central America-Dominican Republic Free Trade Agreement (CAFTA-DR) now have monitors for PM, and several also monitor O₃ and other pollutants. Recently,

⁶ Final Report of the Sixteenth Meeting of the Forum of Ministers of the Environment of Latin America and the Caribbean, Santo Domingo, Dominican Republic; 27th January to 1st February 2008, available online at <http://www.pnuma.org/forumofministers/16-dominicanrep/html/documents.htm>.

countries in the region have begun discussions about adoption of an Air Quality Index (AQI) for the region, which will assist in coordination of air quality information, development of air quality controls, and dissemination of public health information across the region.

The likelihood of success for options to reduce emissions from the system of fuels and vehicles in the region depends largely on current status, past experience, stakeholder involvement, and economic factors. Implementation of any option must consider the potential impacts on - and requirements of - the full set of potential stakeholders. These factors are considered for the options discussed in this document, which are related to fuels, vehicles, voluntary programs, problem quantification, and transportation system alternatives.

Each country in the region faces some unique issues, but some commonalities also unite the region. To incorporate perspectives from each country, Battelle distributed a survey to the environmental ministry of each country. Participants provided information on the current state of affairs, fuel standards and quality, vehicle emissions, import regulations, and a range of programs (participant responses are provided in Appendix A).

2. State of Affairs and Options

The potential success of actions to address CO₂ and pollutant emissions from the system of fuels and vehicles will depend in part on the current status of the system. For each category of options, this report discusses the existing information obtained from country surveys and other relevant sources, anticipated challenges, and implementation options, including information gaps to be filled before such an option could be implemented. In cases where options, challenges, and implementation paths have many similarities, the discussion has been shortened.

While a range of options are treated in separate categories here for organizational purposes, fuels and vehicles need to be considered as an integrated system in order to maximize emission reductions and benefits. The vehicle-fuel system determines the quality and amount of emissions, as well as the extent to which emission control technologies will be able to reduce the emissions. The vehicle-fuel system also affects vehicle performance and general operation, which in turn affects consumer satisfaction and public support for emission reduction options. Understanding this “systems approach” is key to developing effective methods for emissions reductions⁷.

⁷ UNEP Partnership for Clean Fuels and Vehicles *Opening the Door to Cleaner Vehicles in Developing and Transition Countries: The Role of Lower Sulphur Fuels*

2.1. Fuel Standards

Use of cleaner vehicle fuels directly lowers pollutant emissions from the existing motor vehicle fleet. Cleaner fuels and improved fuel quality can also enable the use of exhaust after-treatment technologies to reduce pollutant emissions even further. Adoption of cleaner fuels requires the development of standards and programs to regulate the composition of vehicle fuels. The phase-out of leaded gasoline provides an example, as it allowed wide adoption of catalytic converters to reduce NO_x, CO, and VOCs in gasoline vehicle exhaust. Similarly, fuels with low sulfur content will allow adoption of advanced exhaust treatment technologies for diesel and gasoline vehicles.

Currently, interest in fuel composition and quality in Central America and the Dominican Republic is centered on sulfur content and biofuels. Representatives of environmental ministries in the region decided in 2008 to build on their experience with phase-out of leaded gasoline to promote the reduction of sulfur in fuels to a maximum of 50 ppm.⁸ Many of the countries in the region have begun to establish standards and timelines for reduction of sulfur content in fuels, as discussed below. There is also a great deal of interest in the region in biofuels, primarily for economic reasons. As discussed below, biofuels might be a successful aspect of a comprehensive program to reduce carbon emissions and pollutant emissions from vehicles.

Fossil fuels used for transportation in Central America and the Dominican Republic are mostly imported, either in the form of crude or refined products. While the breakdown of sources varies by importing country, a majority of the fuel for the region is imported from Venezuela, which has high-sulfur crude oil (sour crude). Other important sources of fuel for the region include Mexico, the United States, France, Colombia, Ecuador, Chile, and the Caribbean region (including Cuba). In the region, refineries are located in Costa Rica, Nicaragua, and the Dominican Republic. Information on domestic crude oil production, petroleum consumption, and refinery capacity is provided in Table 1.

Fuel quality specifications are under the jurisdiction of different governing bodies in different countries, as listed in Appendix B. In addition to the national bodies governing fuel quality specifications, five countries in the region (Guatemala, Nicaragua, El Salvador, Honduras, and Costa Rica) participate in the Central American Customs Integration Process, through which Central American Technical Regulations are issued and reviewed on standards for fossil fuels in the region. Each participating country has sent representatives to the Subgroup on Hydrocarbons to agree on regulations for fuel quality. The regulations are binding for members, but each country must determine how to incorporate them into its own regulatory framework. A mechanism exists to resolve controversies and promote compliance, but the Subgroup itself is not responsible for

⁸ Decision 8, Better Fuels for Better Air Quality, contained in the “Final Report of the Sixteenth Meeting of the Forum of Ministers of the Environment of Latin America and the Caribbean, Santo Domingo, Dominican Republic; 27th January to 1st February 2008,” available online at: <http://www.pnuma.org/forumofministers/16-dominicanrep/html/documents.htm>.

monitoring or compliance. The Subgroup has worked on a set of 17 regulations⁹, of which two were put into force.

Table 1. Crude oil production, petroleum consumption, and refinery capacity in Central America and the Dominican Republic in 2008 (Thousand Barrels per Day).*

Country	Crude Oil Production	Petroleum Consumption	Refinery Capacity
Belize	3.5	7	0
Costa Rica	0	45	24
Dominican Republic	0	119	47
Guatemala	15.5	76	0
Honduras	0	52	0
Nicaragua	0	29	20
Panama	0	94	0

Source: Energy Information Administration of the U.S. Department of Energy.

(<http://tonto.eia.doe.gov/country/index.cfm>)

*Consumption includes consumption of petroleum products and direct combustion of crude oil. Refinery capacity is crude oil distillation capacity.

2.1.1. Low-sulfur Fuels

Sulfur is naturally found in crude oil, from which both diesel and gasoline fuels are derived. Upon combustion, sulfur in fuel is emitted as sulfur dioxide (SO₂), which forms sulfate particles in the atmosphere. Sulfur in the atmosphere contributes to air pollution, adverse health effects, and acid rain. Because of the negative impacts of sulfur on air quality and health, many countries worldwide¹⁰ have set standards to limit sulfur concentrations in diesel fuel and gasoline. For diesel fuel, limits on sulfur content are typically less than 50 parts per million (ppm) in developed countries, and often less than 15 ppm. However, the currently allowed maximum level of sulfur in diesel for most countries in Central America and the Dominican Republic is 5,000 ppm. For gasoline, sulfur levels are mandated to be below 30 ppm in most developed countries, while the currently allowed maximum level in Central America and the Dominican Republic ranges from 1,000 to 1,500 ppm (see Table 2).

Current Status

The maximum sulfur levels allowed in diesel fuel and gasoline in Central America and the Dominican Republic, as well as known plans for future standards, are listed in Table 2. Ministerial representatives from the region agreed in 2008 to promote lowering the

⁹ The Subgroup has been inactive for the past 2 years, but could be reinstated by participating ministries. A list of the regulations of the Subgroup on Hydrocarbons can be found at:

<http://www.comex.go.cr/acuerdos/centroamerica/Paginas/Subgrupo%20Hidrocarburos.aspx>

¹⁰ For example, see the Worldwide Fuel Charter, available at <http://www.autoalliance.org/>

sulfur content in fuels to a maximum of 50 ppm,¹¹ but plans for reductions in fuel sulfur limits vary by country. Some countries (e.g., Honduras) report that their standards will defer to the Central American Technical Regulations. The Dominican Republic reports the highest level of sulfur currently allowed in diesel of the countries in this report (7,500 ppm), but is working towards an aggressive reduction in sulfur levels (to 50 ppm).

Table 2. Currently Allowed Maximum Levels of Sulfur in Fuel

Country	Currently Allowed Maximum Sulfur Level (ppm)		Plans for Future Standards
	Diesel	Gasoline	
Belize	Unknown	Unknown	Unknown
Costa Rica	500	1000 for Super; 1500 for Regular	Required gradual reduction of diesel sulfur content from 2003 - 2008 (from 4500 ppm to 500 ppm); diesel is now 500 ppm countrywide.
Dominican Republic	7500	1500	Preliminary work has been done on a proposal for 50 ppm limit in diesel and gasoline.
El Salvador	5000	1500	Unknown
Guatemala	5000	1000	None
Honduras	5000	1000	Defers to Central America Technical Regulations.
Nicaragua	5000	1000	None
Panama	5000*	1000	Diesel: required 3000 ppm by June 2009, and 1000 ppm by June 2010. Gasoline: required 800 ppm by October 2008, and 500 ppm by October 2009. Implementation status uncertain.

*Panama also has Diesel Liviano Grado 2D (S500) with a maximum sulfur content of 500 ppm

Challenges and Options

Mandating lower sulfur levels in fuels would require importing fuels in which sulfur has been removed in the refining process, and/or making modifications to the few refineries in the region to add the capability to produce lower sulfur fuels. The refinery capacity in the region is not enough to meet demand (Table 1), so a phase-in of low-sulfur fuel would require changes in fuel imports. For countries with refineries, changes to the refinery and/or imported crude oil would be needed to produce lower sulfur fuels, depending on the target level of sulfur. Alone, a switch to import low-sulfur crude oil could attain levels of sulfur of 1000 to 2000 ppm¹² (crude oil from Mexico and Venezuela, the current major suppliers of fuel for Central America, naturally has very high sulfur levels). To attain sulfur levels below 1000 ppm, technical changes would need to be made to refineries to implement desulfurization in the refining process.

¹¹ Decision 8, Better Fuels for Better Air Quality, contained in the “Final Report of the Sixteenth Meeting of the Forum of Ministers of the Environment of Latin America and the Caribbean, Santo Domingo, Dominican Republic; 27th January to 1st February 2008,” available online at: <http://www.pnuma.org/forumofministers/16-dominicanrep/html/documents.htm>.

¹² International Petroleum Industry Environmental Conservation Association, Fuel sulphur: Strategies and options for enabling clean fuels and vehicles, FUELS AND VEHICLES WORKING GROUP REPORT SERIES: VOLUME III, 2006. Available online at: <http://www.ipieca.org/activities/fuels/downloads/publications/sulphur.pdf>.

The introduction of diesel fuels with lower sulfur levels (500 ppm or less) would present opportunities for additional exhaust after-treatment technologies (e.g., particulate traps and NO_x controls) to further reduce diesel vehicle emissions.¹³ The sulfur content should be reduced to a maximum of 500 ppm to enable widespread deployment of diesel oxidation catalysts. For further technological improvements and even deeper reductions in SO₂, NO_x, and PM, the maximum should be 10 to 15 ppm sulfur in diesel. More information on diesel exhaust after-treatment technology is given in section 2.2.5.

The introduction of gasoline with lower sulfur levels (maximum of 30 ppm) would also allow for improved functioning of advanced catalytic converter systems.¹⁴ Advanced, low-emissions engines operate with an excess amount of air. The excess oxygen can oxidize SO₂ to SO₃, which coats the catalytic converter and reduces efficiency. Reduced levels of sulfur in gasoline would limit sulfur oxidation and permit improved catalyst function, thus decreasing emissions of co-pollutants (NO_x, CO, VOCs).¹⁵ Catalyst technology is also emerging for 2-3 wheeled vehicles, which will also allow emissions reductions for those vehicles with low-sulfur gasoline.

Based on past efforts in the region, economic factors can hinder efforts to reduce sulfur levels in fuels. For example, any increase in fuel costs to consumers directly affects public transportation fleets and drivers, resulting in potential public and political resistance. However, research has shown that the costs of implementing low-sulfur fuels are lower than typical price variations in the fuels market.¹⁶ Similar research has shown that actual implementation costs for introducing fuels with reduced sulfur levels are generally much lower than projected. The positive health benefits of reduced public exposure to sulfur and air pollution more than compensate for the costs of sulfur reduction. Without the corrosive effects of sulfur, vehicle maintenance costs can also be lower. Altogether, despite the widespread perceptions of high costs of switching to low-sulfur fuels, studies have overwhelmingly shown a favorable cost-benefit ratio.¹⁷

Economic analyses should be conducted in each country to determine whether gradual phase-in or a coordinated, countrywide switch to low-sulfur fuels would be more effective. Phase-in of fuels may be focused on different geographic areas (i.e., urban or rural), or may include a series of reductions in allowed sulfur levels. Experience in other countries has shown that a single, coordinated step to a lower level of sulfur in fuels can

¹³ Partnership for Clean Fuels and Vehicles, Opening the Door to Cleaner Vehicles in Developing and Transition Countries: The Role of Low Sulphur Fuels, Report of the Sulphur Working Group of the Partnership for Clean Fuels and Vehicles (PCFV), February 2007, Available online at: <http://www.unep.org/pcfV/PDF/SulphurReport.pdf>.

¹⁴ Partnership for Clean Fuels and Vehicles, Opening the Door to Cleaner Vehicles in Developing and Transition Countries: The Role of Low Sulphur Fuels, Report of the Sulphur Working Group of the Partnership for Clean Fuels and Vehicles (PCFV), Undated, Available online at: <http://www.unep.org/pcfV/PDF/SulphurReport.pdf>.

¹⁵ Partnership for Clean Fuels and Vehicles, U.S. Environmental Protection Agency, Clean Air Guide for Central America, Undated, Available Online at <http://www.unep.org/pcfV/PDF/GuiaCalidaddelAire-EN.pdf>, Accessed June 1, 2009.

¹⁶ "Low-Sulfur Gasoline & Diesel: The Key to Lower Vehicle Emissions," International Council on Clean Transportation report, May 2003.

¹⁷ "Reducing Fuel Sulfur Content in Central America: A Guide to Estimating Costs and Benefits," International Council on Clean Transportation report, Nov 2006.

be more cost-effective than a multi-step reduction.¹⁸ However, it has been noted that gradual changes in fuel standards may be more appropriate in some countries, especially where the required infrastructure and government regulatory authority is not in place to implement and enforce new regulations.¹⁹

If gradual phase-in of cleaner fuels is determined to be the best option, a focus on urban areas or transportation corridors is recommended. Urban areas have the highest vehicle density, the highest concentration of fuel distribution points, and the most significant air quality problems, and therefore offer potential for rapid reductions in sulfur emissions even with gradual phase-in.²⁰ Fleets such as buses and taxis, which are usually driven far more miles per day than privately-owned vehicles, are also a good option for selected phase-in of cleaner fuels. A program for educating the public about available fuel grades would also be necessary for gradual phase-in to ensure that the public understands the available grades of fuel and recommended applications.

The International Petroleum Industry Environmental Conservation Association (IPIECA) noted that the implications of any proposed fuel specification changes may include security of fuel supplies, economic competitiveness, opening of new markets, and employment changes. A detailed implementation strategy should be developed for each country to address these issues, as well as crude oil sources and security of long-term supply; capital requirements to modify refineries; and any necessary infrastructure improvements to separately transport products with lower sulfur.²¹

Changing fuel quality in the region will require attention to fuel prices, taxes, and subsidies. Subsidies for domestic fuels may impede the importation of cleaner fuels and low-sulfur crudes. Several countries also have tax incentives for diesel fuel because of its lower CO₂ emissions, but use of diesel over gasoline results in increased emissions of particulate matter. To ensure the effective adoption of low-sulfur fuels and achieve maximum reduction of sulfur emissions, the potential effects of such economic factors in the country and region will require further analysis.

To ensure that fuel quality specifications are achieved, a system of fuel testing and verification is required. Country surveys (Appendix A) indicate that fuel testing is already conducted to some degree in most countries in the region. As advanced vehicle technologies are phased in, fuel testing and verification will ensure that sensitive new technologies are not damaged from fuels with sulfur levels that are too high.

¹⁸ “Reducing Fuel Sulfur Content in Central America: A Guide to Estimating Costs and Benefits,” International Council on Clean Transportation report, Nov 2006.

¹⁹ International Petroleum Industry Environmental Conservation Association, Fuel sulphur: Strategies and options for enabling clean fuels and vehicles, FUELS AND VEHICLES WORKING GROUP REPORT SERIES: VOLUME III, 2006. Available online at: <http://www.ipieca.org/activities/fuels/downloads/publications/sulphur.pdf>.

²⁰ Partnership for Clean Fuels and Vehicles, Opening the Door to Cleaner Vehicles in Developing and Transition Countries: The Role of Low Sulphur Fuels, Report of the Sulphur Working Group of the Partnership for Clean Fuels and Vehicles (PCFV), Undated, Available online at: <http://www.unep.org/pcfV/PDF/SulphurReport.pdf>.

²¹ International Petroleum Industry Environmental Conservation Association, Fuel sulphur: Strategies and options for enabling clean fuels and vehicles, FUELS AND VEHICLES WORKING GROUP REPORT SERIES: VOLUME III, 2006. Available online at: <http://www.ipieca.org/activities/fuels/downloads/publications/sulphur.pdf>.

In addition to sulfur reductions, attention should be given to controlling the amount of heavy compounds with very high boiling points in diesel fuel. The heaviest compounds contribute much of the soot (PM) in the exhaust. The fraction of heavy compounds in diesel fuel could be reduced by placing a more stringent upper limit on fuel density or specifying the maximum allowable percentage of heavy hydrocarbons with high boiling points. Diesel fuels reformulated to limit heavy compounds emit less PM and less black carbon.

Overall, efforts to introduce low-sulfur fuels must consider the entire system of fuels and vehicles to ensure success. The impacts of new fuels on stakeholders, the public, technologies, and prices must be considered in order to ensure effective implementation in a country. Taxes and subsidies must be adjusted to stabilize fuel prices, encourage adoption of the new fuels, and minimize negative impacts of price changes. To maximize emissions reductions and prevent damage to new equipment from high-sulfur fuels, vehicles with new exhaust after-treatment technology or retrofits should be introduced simultaneously with low-sulfur fuels.

Recommendations

- Conduct country-specific economic analysis to understand the full range of potential issues with adoption of low-sulfur fuels, and develop a detailed implementation plan.
- Switch to gasoline and diesel fuels with a maximum of 500 ppm sulfur as soon as possible.
- Plan for future reductions to a maximum of 10 to 15 ppm sulfur in diesel and 30 ppm sulfur in gasoline, in combination with implementation of advanced vehicle exhaust after-treatment technologies.

2.1.2. Biofuels

Biofuels are fuels derived from biological materials. The two most common biofuels for transportation are ethanol (ethyl alcohol), produced from crops or crop waste, and biodiesel, produced primarily from plant oil or animal fat. There is currently a high level of interest in the Central American region in biofuels, driven by two factors: the economic value of local biofuel production, and the perceived lower emissions of CO₂ and other pollutants from biofuels. Economically, biofuels are attractive because of the local availability of raw materials, ability to reduce reliance on imported oil, creation of jobs in agriculture and biofuels processing, and potential for export of biofuels. However, biofuels have both environmental costs and benefits as detailed in this section.

The potential for CO₂ emission reductions from the substitution of biofuels for fossil fuels depends upon the raw material source of the biofuels. For mitigation of carbon emissions, biofuels are perceived as a low-carbon energy source because their emissions are part of the terrestrial carbon cycle. However, when changes in land use or energy-intensive agricultural practices are considered, biofuels can actually result in a large net

increase in carbon emissions compared to fossil fuels. Many studies have calculated that conversion of land from forest or grassland to agriculture for biofuel production is a major source of carbon emissions. Conversion of rainforests, wetlands, or grasslands to agriculture to grow food crops for ethanol production can create an enormous carbon debt through destruction of carbon stocks (forests), releases of carbon from soil, and use of energy for plowing, harvesting, watering, fertilizing, and processing the crops. Land change and intensive agriculture can release much more CO₂ than could be saved by replacing the equivalent amount of fossil fuels with biofuels (estimates for different scenarios and locations range from 17 to 420 times more CO₂ emitted from biofuels than from fossil fuels).²² To make biofuels a viable option for CO₂ reductions, the full cycle of biofuel production must be considered, and low-intensity agricultural practices must be applied. Low-intensity agricultural methods include production of biofuels from waste biomass, from perennial plants that require little care, or from plants grown on poor quality agricultural lands. Using low-impact agricultural and production practices, biofuels can have the potential to achieve low total carbon emissions. Lifecycle analyses of sustainably-produced biofuels with no negative land change impacts can show a significant carbon savings over fossil fuels, particularly on longer time horizons (e.g., 30 years in the future).²³ Detailed analysis of the location, crop type, crop yield, agricultural practices, land change, and net expected carbon emissions and savings must therefore be undertaken to evaluate the carbon impact of every proposed biofuel production strategy.

The impacts of biofuels on non-CO₂ air pollutants (e.g., PM and O₃-forming species such as VOCs) are mixed. Biodiesel reduces emissions up to 50% (compared to petroleum diesel) from the existing fleet, without engine or vehicle modifications. Unlike biodiesel, ethanol is expected to degrade air quality compared to gasoline. Ethanol and blends increase emissions of formaldehyde and acetaldehyde, toxic VOCs which contribute to O₃ formation. Ethanol and blends are also more volatile than gasoline, resulting in increased total evaporative emissions of VOCs. Therefore, models suggest that ethanol and blends can significantly increase O₃ formation compared to gasoline, contributing to an increase in adverse health effects.²⁴

Current Status

In Central America and the Dominican Republic, attention on biofuels has been focused on establishing fuel research and pilot implementation programs, both in the public and private sectors. Activities range from local and national projects to regional and broader multilateral partnerships. Several countries have laws and regulations related to biofuels. The following are highlights:

²² Fargione, J., J. Hill, D. Tilman, S. Polasky, and P. Hawthorne. *Land Clearing and the Biofuel Carbon Debt*. Science 29, February 2008. Vol. 319. no. 5867, pp. 1235 - 1238

²³ An example of an emissions analysis was published by the U.S. EPA Office of Transportation Air Quality in July 2009: *Lifecycle Greenhouse Gas Emissions due to Increased Biofuel Production: Methods and Approaches to Account for Lifecycle Greenhouse Gas Emissions from Biofuels Production Over Time*. <http://www.epa.gov/OMS/renewablefuels/rfs2-peer-review-emissions.pdf>

²⁴ Jacobson, M.Z., (2007). *Effects of Ethanol (E85) versus Gasoline Vehicles on Cancer and Mortality in the United States*. Environmental Science and Technology, 41, 4150-4157.

Costa Rica: The government has set goals of 10% ethanol mix and 20% biodiesel mix by 2010. The state-owned enterprise Costa Rican Petroleum Refining Institute (RECOPE) has a strategic plan and implementation projects on sugar cane ethanol and biodiesel, including feasibility analysis for RECOPE-owned biofuel plants. There are currently two ethanol production plants in the country associated with the Cane Sugar Agro-Industrial League and several smaller biodiesel plants. Plans are also underway for additional biodiesel facilities.

Dominican Republic: Currently there is a law that promotes the use of biofuel, and a program to blend 10% ethanol in gasoline to reduce petroleum imports. The National Commission of Energy also is studying the use of biofuel from the castor-oil plant, a common crop in the country.

El Salvador: As of 2007, El Salvador did not have any biofuel laws or regulations. However, the country has two private, small-scale biodiesel production plants.²⁵

Guatemala: Several laws and regulations on biofuels have been established, including initiatives to recycle vegetable oils for use in diesel engines and derive biofuel from sugar cane. Several small biofuel producers are operating in the country.²⁶ Regionally, in 2007 Guatemala and Colombia signed an agreement on technical exchanges on biofuels. Also, within the framework of the Energy and Environment Alliance Project with Central America, Finland, and Austria, there are several private-sector initiatives for production of biodiesel from *Jatropha* seed oil.

Honduras: A Biofuels Production and Consumption Act was passed, as were several related regulations: Technical Biodiesel Regulations, Technical Regulations for Anhydrous Ethanol Fuel. Technical Regulations for Hydrated Ethanol Fuel have been proposed.

Panama: The introduction of biofuels is currently under study in Panama, including potential plans to permit fuel blends containing 5% or less of biofuels, though no regulations have been established to date.

Regional: The Central American Technical Regulations define technical specifications for biodiesel, based on a composite of U.S. and European standards.²⁷

²⁵ United Nations Economic Commission for Latin America and the Caribbean (ECLAC/CEPAL), *Perspectivas para el Biodiesel en Centroamérica: Costa Rica, El Salvador, Guatemala y Honduras*, LC/MEX/L.791 (2007). Available online at: <http://www.eclac.cl/publicaciones/xml/3/29423/L791-1.pdf>, <http://www.eclac.cl/publicaciones/xml/3/29423/L791-2.pdf>, and <http://www.eclac.cl/publicaciones/xml/3/29423/L791-3.pdf>.

²⁶ United Nations Economic Commission for Latin America and the Caribbean (ECLAC/CEPAL), *Perspectivas para el Biodiesel en Centroamérica: Costa Rica, El Salvador, Guatemala y Honduras*, LC/MEX/L.791 (2007). Available online at: <http://www.eclac.cl/publicaciones/xml/3/29423/L791-1.pdf>, <http://www.eclac.cl/publicaciones/xml/3/29423/L791-2.pdf>, and <http://www.eclac.cl/publicaciones/xml/3/29423/L791-3.pdf>.

²⁷ Reglamento Técnico Centroamericano, Biocombustibles. Biodiesel y Sus Mezclas Con Aceite Con Combustibles Diesel. Especificaciones. Noviembre 2006. Available online at: <http://www.temasactuales.com/assets/pdf/gratis/RTCA75.02.43.06%20BiodieselCRnov06.pdf>

Challenges and Implementation Options

Biofuels offer only marginal opportunities to reduce emissions of CO₂ and other air pollutants. There are many drawbacks to biofuels, including potential fuel cost increases, the need to develop a biofuel supply infrastructure, competition with agricultural uses of cropland, the need to comply with engine manufacturer requirements, and increased volatility of gasoline-ethanol blends. Potential environmental impacts associated with biofuel production include land use change, lost forest land, decreased biodiversity, soil degradation, increased use of pesticides and herbicides, degraded water quality, and increased O₃ pollution due to increased emissions of formaldehyde and acetaldehyde.²⁸

Other implementation issues include lack of public knowledge about biofuels, and a need for testing and verification programs. In a Costa Rica pilot project, some consumers avoided purchase of biofuel blends for fear of engine damage or misperceptions that engine adjustments are needed prior to utilization of biofuels. Biofuel implementation may require a campaign of public outreach to overcome such misperceptions and gain support. Biofuels must also be of consistent and reliable quality to gain consumer confidence. Testing and quality verification programs for biofuels will be required to enforce biofuel specifications. For ethanol blends, quality verification is needed for ethanol, the gasoline with which it is mixed, and the end-use blended product.²⁹ One option to promote consistency of biofuel quality is the use of bio-based feed stocks in existing refineries, a strategy pioneered by some private oil companies.

Despite the range of potential difficulties, the availability of raw agricultural materials for biofuel production makes them an intriguing option in the Central American region, and many countries in the region have moved to promote biofuel development. However, availability of land for biofuel crops and competition with food crops and export crops may be an issue in the region. One study³⁰ concluded that Central American countries should explore innovative raw materials, such as fish oil or recycled cooking oils, when planning biofuel development. Other options being examined in the region include castor seed in El Salvador, and sugar cane, corn, and yucca in Costa Rica.

For countries in the region continuing to explore biofuel options, the United Nations Economic Commission for Latin America and the Caribbean has performed several studies that would be a useful reference. The analyses include economic assessment of ethanol, including costs of local production, and a feasibility evaluation of crops by country, including potential agricultural impacts.³¹ The analyses also explored existing

²⁸ United Nations Economic Commission for Latin America and the Caribbean (ECLAC/CEPAL), *Perspectivas para el Biodiesel en Centroamérica: Costa Rica, El Salvador, Guatemala y Honduras*, LC/MEX/L.791 (2007). Available online at: <http://www.eclac.cl/publicaciones/xml/3/29423/L791-1.pdf>, <http://www.eclac.cl/publicaciones/xml/3/29423/L791-2.pdf>, and <http://www.eclac.cl/publicaciones/xml/3/29423/L791-3.pdf>.

²⁹ United Nations Economic Commission for Latin America and the Caribbean (ECLAC/CEPAL), *Especificaciones de la calidad del etanol carburante y del gasohol (mezcla de gasolina y etano) y normas técnicas para la infraestructura*, September 2006. Available online at: <http://www.eclac.cl/publicaciones/xml/6/26436/L741-1.pdf>

³⁰ United Nations Economic Commission for Latin America and the Caribbean (ECLAC/CEPAL), *Perspectivas para el Biodiesel en Centroamérica: Costa Rica, El Salvador, Guatemala y Honduras*, LC/MEX/L.791 (2007).

³¹ United Nations Economic Commission for Latin America and the Caribbean (ECLAC/CEPAL), *Análisis económico de precios del bioetanol para mezclas con gasolinas*, September 2006. Available online at: <http://www.eclac.cl/publicaciones/xml/7/26587/L746.pdf>

legal frameworks, necessary fuel quality technical standards, development capacity, and conditions required for economically competitive production.³² In addition to environmental, legal, and economic factors, a full assessment must consider whether the vehicle fleet is modern enough to be broadly compatible with biofuels.

Fleet-targeted applications may be appropriate uses of biofuel. For example, in Costa Rica, a bus fleet of over 130 buses is operating on a biodiesel blend. Fleet programs for biofuels are attractive, as they limit the required fuel supply infrastructure and provide a stable maintenance system that allows for any necessary engine tuning.

Whether undertaken for economic reasons or in the hopes of reducing CO₂ and pollutant emissions, programs to develop and promote biofuels must consider the full range of potential impacts on local, national, and international scales. If full consideration is given to lifecycle carbon emissions, and if biofuels are accompanied by other fuel and vehicle measures, it may be possible to partially address reduction of CO₂ and pollutant emissions in Central America and the Dominican Republic through biofuels.

Recommendations:

- Study the environmental costs and benefits of biofuels carefully.
- Explore innovative raw materials, such as fish oil or recycled cooking oils, when planning biofuel development.
- Conduct regional coordination for disseminating experiences with biofuel planning and production.
- Biodiesel in targeted bus fleets may be an appropriate starting point for testing implementation of biofuels.

2.2. Vehicle Standards

Emissions from vehicles are dependent upon a number of vehicle-specific parameters, including vehicle type, age, weight class, and maintenance condition. In Central America and the Dominican Republic, the characteristics that are most important to understanding emissions are the relative age and maintenance condition of vehicles. It is common for 50% or more of the total fleet to be registered in urban areas, where both vehicle emissions and impacts on air quality are greatest. Most fleets in the region have a large percentage of older vehicles, with vehicles that are 10 years old or older comprising more than 80% of the fleet in some countries. As maintenance condition generally declines with vehicle age, older vehicles are normally the major emitters in a fleet. Gasoline vehicles are dominant in the region, with diesel vehicles of all types often constituting less than 15% of fleets. Though diesel vehicles are present in smaller numbers, they can have a disproportionate impact on air quality, as they tend to be older trucks and buses that are driven more miles, use more fuel, and have higher PM emissions than gasoline-fueled vehicles.

³² United Nations Economic Commission for Latin America and the Caribbean (ECLAC/CEPAL), *Perspectivas para el Biodiesel en Centroamérica: Costa Rica, El Salvador, Guatemala y Honduras*, LC/MEX/L.791 (2007). Available online at: <http://www.eclac.cl/publicaciones/xml/3/29423/L791-1.pdf>.

Options for reducing emissions from vehicle fleets are centered on age limits for imported vehicles, programs for inspection and maintenance, fuel efficiency standards, programs for publicly and privately owned fleets, and diesel retrofits. A number of programs to address the condition and function of the overall vehicle fleet have been proposed in Central American countries, and several have been implemented. Existing and proposed programs and options for the future are discussed below.

2.2.1. Age limits on imports

Throughout the region, economic factors make older vehicles desirable to the majority of users. The combination of vehicle price, consumer purchasing power, import duties, vehicle use and other taxes, maintenance cost, and availability of parts favors older vehicles. Establishing age limits for imported vehicles is one method to discourage the import of large numbers of older, high-emitting vehicles. A number of countries have established such age limits, as reported by country representatives (Appendix A) and listed in Table 3.

Table 3. Age Limits on Imported Vehicles.

Country	Import Age Limits	Notes
Belize		No information
Costa Rica	no	Several proposals have been made to restrict the import of used vehicles, but they have not been successful. >80% of the fleet is estimated to be >10 yr old.
Dominican Republic	yes	Cars <5 years only allowed. Engines >2000cc and more than 6 cylinders are subject to high luxury car tax.
El Salvador	no	Used vehicles must be inspected at the time of import, import tax is collected.
Guatemala	no	Imported new vehicles have a higher tax rate.
Honduras	yes	Buses and public transport vehicles must <10 years old, all other vehicles <7 years old. Emission limits for imports are more stringent than for existing vehicles.
Nicaragua	no	Used vehicles must be inspected at the time of import.
Panama	no	Used vehicles must have a certificate of emissions from the country of export, but there are no age limits. A variety of policies address emissions from imported vehicles, such as Bill 157 (Used Vehicle Import Standards)

Challenges and Implementation Options

In countries where age limits on imports have been implemented, few data exist on the effectiveness of the rules. Enforcement of age limits on imported vehicles may increase illegal “leakage” of older cars across borders and cause owners to retain older, poorly-performing vehicles longer because of the higher cost of newer vehicles. Any option that

eliminates the oldest, lowest-cost vehicles will result in demand for more low cost vehicles, including high-emitting domestic vehicles and illegal imports.

Implementing effective limits on imports may require new regulations or updates to existing rules. Additional restructuring of import duties and taxes can be applied to encourage import of newer vehicles (lower taxes for newer vehicles), though high duties for older vehicles may foster noncompliance. As age is only one indicator of the potential for high emissions, establishing emissions testing or requirements for imported vehicles may more effectively limit import of high-emitting vehicles. Finally, because importation of vehicles is generally conducted by private companies, building consensus and establishing agreements among them has been effective to encourage compliance. Guatemala, for example, has had some success gaining support from the association of vehicle importers for proposed regulations.

Recommendations

- Efforts to directly address import of older, high-emitting vehicles should consider creating financial incentives for newer vehicles, conducting emissions testing rather than strictly limiting age, and establishing working agreements with vehicle importers.

2.2.2. Inspection and Maintenance Programs

Requirements for inspection and maintenance (I/M) programs encourage the compliance of the overall fleet with emission limits and safety requirements. I/M programs are initially costly to implement and enforce, but provide long-term benefits, as the highest-emitting vehicles can be identified and repaired or replaced. Countries in the region have begun to work with versions of I/M programs.

Honduras: I/M is not being implemented, though implementation of an I/M system³³ is mandated for the existing vehicle fleet and a pilot program is being studied. Though emission limits by age and vehicle type have been established, the laws are not specific about application of limits. Further, the limits are not very restrictive, and any vehicle with an emission control system can meet them. Recent regulations³⁴ require annual emissions checks for all vehicles and issuance of a Contaminant Gas and Smoke Emission Control Certificate.

Costa Rica: All vehicles that circulate in the country are subject to technical inspection to verify that they “comply with the mechanical, safety, and other conditions required.”³⁵ The law requires annual inspection for vehicles more than 5 years old, inspection every 2 years for vehicles up to 5 years old, and inspection every 6 months for public transport vehicles. Some agricultural vehicles and older vehicles (pre-1997 models without catalytic converters) are

³³ SERNA Resolution (719-1999)

³⁴ Transit Regulations (2006)

³⁵ Articles 19 and 20 of the Public Roadway Transit Act (<http://www.poder-judicial.go.cr/transito/ley/indice.htm>)

exempted. The centralized program is operated by a company called RTV and overseen by the Ministry of Public Works and Transportation (MOPT).

Guatemala: There is no I/M program at this time, though the Ministry of Environment and Natural Resources is developing a proposal for emissions limits. While emission control standards do not currently exist, it is expected that they will be implemented in the future and will require catalytic converters.

Dominican Republic: There is no I/M program at this time, but there are plans to implement a program by 2012. The program will be implemented gradually and include installation of car inspection systems and creation of standards. The status of implementation is unknown.

Panama: A preliminary rule requiring emissions testing is currently awaiting presidential approval. Implementation of the system is expected to begin in 2010. The system will include equipment, facilities, and training needed to monitor vehicle emissions. Emission control systems are currently required for gasoline vehicles, with catalytic converters required for model year 1998 and later.

Challenges and Implementation Options

The highest-emitting vehicles are often owned by people without the financial means to participate in an I/M program or pay for required repairs. I/M programs will miss unregistered vehicles and may prompt a decrease in individual vehicle registrations, both of which will be problems in areas with low registration. Moreover, there may be public resistance to a new I/M program, which can be seen as government interference in private lives (public resistance was a problem with a pilot I/M program in Costa Rica, in the areas outside of San José). Testing equipment also must be calibrated regularly, which would be a challenge in many countries.

Capturing the highest-emitting vehicles through incentive programs could be part of a program to decrease total vehicle emissions relatively quickly (within a few years). Incentive programs may require governments to pay for repairs or replacement of the worst-emitting vehicles, but the incentive could induce vehicle owners to participate in the system and could increase vehicle registration. To make overall program management easier, I/M programs can be focused in urban areas, which have the majority of air quality problems. In urban areas, population and vehicle density also allow for easier enforcement. Allowing exemptions for new vehicles (up to 5 years old) can also promote adoption of new technology and reduce the total number of vehicles to be managed in the program.

Establishing and operating effective programs requires significant regulatory oversight, and effective management of locally distributed I/M programs can be difficult to maintain. Centralized systems are implemented by the relevant government agency, and are located at facilities operated by the agency. Decentralized systems are easier to implement, as they allow existing repair stations to conduct the testing. However, decentralized systems are also subject to greater abuse, because testing stations compete

for the I/M business, and customers tend to prefer stations with lax inspections and fewer required repairs.³⁶ Centralized systems should be the focus in the region, as centralized systems in developing countries have been much more effective at reducing high-emitting vehicles and improving vehicle safety. Most of the programs in development in the region (see above) are centralized systems, focused on operation of a small number of government-run facilities.

Recommendations

- Implementation of centralized I/M programs in urban areas is likely to be an effective method to reduce pollutant emissions from motor vehicles.
- To encourage public trust and participation, operation of the testing centers by an independent body should be considered.
- Grants or subsidies should be considered to repair the vehicles with the worst emissions. Alternatively, high-emitting vehicles could be purchased from the owners to remove them from operation.

2.2.3. Fuel Efficiency Standards

Fuel efficiency standards generally mandate an overall average fuel efficiency required to be achieved for a vehicle manufacturer, importer, or sales group. Institution of fuel efficiency standards has the potential for the combined effects of limiting CO₂ and pollutant emissions and encouraging technological upgrades throughout the fleet. None of the countries investigated has implemented fuel efficiency standards, though Costa Rica has established reduced tax rates for import of electric and hybrid vehicles.

There are several implementation challenges that can be associated with fuel efficiency standards. Like all standards, fuel efficiency requirements can be difficult to enforce in practice. Unlike vehicle repairs possible in I/M programs, poor fuel efficiency cannot be easily be modified, meaning that changes to the existing fleet fuel efficiency will take place gradually as newer vehicles are phased in to the fleet. Also, because vehicles with small engines such as two-stroke motorcycle engines can have high pollutant emissions, it is necessary to accompany fuel efficiency standards with emissions limits.

Fuel efficiency would be best approached as part of climate change and CO₂ mitigation programs. Climate change has received a great deal of attention in the region, and the public may be receptive to this approach. Fuel efficiency standards could also be instituted for new or imported vehicles, which would require new regulations separately or in conjunction with rules on imported vehicles. To promote a shift to more fuel efficient vehicles without the need to establish emission standards or limits, tax incentives for importers or owners could be made available for hybrid, electric, or alternative fuel vehicles, as in Costa Rica.

³⁶ Hemenway, D. and Solnick, S.J. (2008) *"You Better Shop Around": The Market for Motor Vehicle Inspection*. Law & Policy, v.12, no. 4, pp. 317 - 329

Recommendations

- Fuel efficiency standards encourage gradual change as the vehicle fleet is updated. They should be considered as part of a comprehensive approach to improving the system of fuels and vehicles.

2.2.4. Fleet Programs

Addressing emissions from publicly and privately owned fleets of vehicles (buses, public transport, taxis, police and municipal vehicles, delivery fleets) is often logistically easier than setting requirements for individually owned vehicles. Fleet vehicles also generally account for a larger percentage of total vehicle miles traveled than individual vehicles, meaning that programs aimed at reducing fleet emissions can have a relatively greater impact on reducing total vehicle emissions.

A number of fleet programs have been established or proposed in the region, mainly focused on buses and public transportation. Fleet programs include establishment of routine inspection and maintenance schedules, use of alternative fuels like hydrogen or biofuels, and phase-in of low-emitting hybrid or electric vehicles. Fleet programs can be mandated (e.g., inspection schedules), but are also effectively encouraged by financial or tax incentives (e.g., adoption of hybrid or electric vehicles). The visibility of fleet vehicles in an urban area can also help to raise public awareness of alternative fuels and technologies.

Determining the best options for a particular area will require consideration of the types of fleets, types of vehicles, and the needs of the fleet owners. UNEP has developed a Clean Fleet Toolkit³⁷ that can help fleet owners or regulators to estimate current fleet emissions and evaluate options and costs for improvement.

Recommendations

- Fleet programs should be considered as part of a comprehensive approach to improving the system of fuels and vehicles.

2.2.5. Diesel Retrofits

A range of technologies exists for diesel exhaust system retrofits, which can dramatically reduce the emissions of NO_x, VOCs, PM, and carbon monoxide (CO) from diesel vehicles. Most of these advanced technologies require clean fuels, and should be considered in conjunction with adoption of low-sulfur fuels. While diesel retrofit programs have been effectively implemented in many countries, including Mexico and Chile, the ultra-low levels of sulfur required for these technologies (5 to 50 ppm) make them incompatible with current fuels in Central America. A steady supply of low-sulfur fuels will be required before retrofits can be implemented.

³⁷ <http://www.unep.org/tnt-unep/toolkit/index.html>

There are two main technologies for the control of PM emissions. Diesel oxidation catalysts (DOCs) reduce the heavy, semi-volatile hydrocarbons in diesel exhaust, thereby reducing emissions of PM by at least 20%, as well as reducing emissions of lighter hydrocarbons and CO. While DOCs can be used with diesel fuel with maximum sulfur of 500 ppm, they are more effective when used with diesel with ultra-low sulfur (maximum 15 ppm). Diesel particulate filters (DPFs) are much more effective than DOCs; they reduce PM emissions by 60 to 90%. DPFs also require fuel with very low sulfur (maximum 50 ppm, preferably 15 ppm or less) for effective and reliable operation.

NO_x may be controlled through the use of exhaust after-treatment by selective catalytic reduction (SCR) or NO_x adsorber technology. The use of NO_x adsorber technology requires very low sulfur fuel (15 ppm sulfur or less). The use of SCR for NO_x control does not require the use of low-sulfur fuel and works well when installed as original equipment. SCR has not, however, been proven to be as effective when installed as a retrofit.

As low-sulfur fuels are phased in, installing diesel retrofits could allow relatively quick co-benefits of reductions in PM, NO_x, and CO emissions. To phase in diesel retrofit technology will require a coordinated plan for supplying low-sulfur fuel. If low-sulfur diesel fuel is phased-in in certain areas, installation of diesel retrofits should be conducted in the same areas. For technologies that may be damaged by high-sulfur fuel, it is important to consider education of owners and drivers about using only low-sulfur fuel.

Urban areas are expected to be the first to achieve a steady supply of low-sulfur fuel, making them ideal for retrofit programs. Programs to promote diesel retrofits in public and private fleets in urban areas could allow rapid adoption of the technology and reductions in emissions. Buses, for example, could be fitted with DPFs and refueled at central locations, where a steady supply of low-sulfur fuel would be available.

The cost of retrofit technology is currently prohibitive to the average consumer, but installation of retrofits for public or private vehicle fleets is likely to be cost-effective. Due to the cost, achieving broad implementation would require subsidies or other financial incentives.

Recommendations

- Diesel retrofits should be considered for areas after low-sulfur fuel is available. Once this has occurred, diesel retrofits should first be tested and demonstrated on selected fleets before broader implementation.

2.3. Voluntary and Incentive Programs

Many changes to the overall system of fuels and vehicles would require new regulations and substantial political and financial investment. However, a range of options could be implemented in the short term with limited resources. Voluntary programs include any options that allow the public, vehicle owners, and business to become more informed about air quality issues and take voluntary steps to reduce their contribution to emissions.

Incentive programs may include tax changes, monetary incentives, or recognition for reducing emissions. Voluntary and incentive programs can take a wide variety of forms, and can be initiated and administered by public or private groups.

As interest in climate change mitigation and pollution reduction increases, public perception provides an incentive to businesses to reduce emissions. Public awareness of the good environmental deeds of a business can improve attitudes about an environmentally friendly business. Certification programs such as “green star” programs for environmentally friendly businesses have been effective in many countries. El Salvador, Costa Rica, and Nicaragua have versions of these programs that require mandatory energy efficiency standards. Green star programs allow a company to use a logo indicating environmentally friendly behavior if it meets certain standards. A basic example of such a program is allowing vehicle fleets to advertise their use of alternative fuels with logos on the vehicles.

The effectiveness of programs such as green star programs relies upon the public having a basic knowledge of air quality and its health impacts. In some countries in the region, including the Dominican Republic, Costa Rica, and Panama, public outreach has been effective in warning the public about the health impacts of air pollution and emissions from vehicles. Public outreach can take many forms, including media (newspapers, radio, television, and advertisements), public events, school programs, and electronic billboards with daily air quality information. Newer methods might use electronic resources to warn sensitive groups on days with bad air quality, through text alerts, email notification, or even social internet media. Providing air quality information to the public could include, on a large scale, efforts to publish validated data from monitoring networks on a daily basis. On a smaller scale, it might include supporting inexpensive monitoring methods that allow school students to estimate pollution levels and learn about air quality. Informing the public about the hazards of air pollution increases public support for measures to reduce emissions. In turn, public support elevates air quality as an issue for political action and gains the support of businesses.

Recommendations

- Couple implementation of voluntary and incentive programs with basic public outreach on the programs and environmental health impacts.

2.4. Problem Quantification/Cost – Benefit Analysis

Quantification of the costs of air pollution from vehicles and the costs of various mitigation options is necessary to understand the issue, evaluate options, and perform ongoing evaluation of the success of any options being implemented. This process involves understanding air pollution levels, health and social costs associated with those levels, and costs for mitigation options. Taken together, evaluation of these issues amounts to a cost-benefit analysis. The groundwork has been laid for such analyses on a country-level basis by past studies such as “Reducing Fuel Sulfur Content in Central

America: A Guide to Estimating Costs and Benefits” by the International Council on Clean Transportation in 2006.³⁸

To develop a country-level cost-benefit analysis, information is needed on:

- Ambient air pollution levels
- Contribution of vehicle emissions to ambient levels
- Health effects associated with vehicle pollution
- Costs of pollution mitigation options.

Each of these topics is detailed below. While problem quantification and cost-benefit analysis are vitally important, it is difficult to gather the complete, detailed information necessary to perform a detailed analysis. However, basic information can be used to develop understanding of the problems and take steps to address them. More detailed information can be pursued on an ongoing basis, both to demonstrate progress and to inform future actions.

Ambient Air Pollution Levels: To understand ambient air pollution levels and their potential impacts, the most pressing questions are:

- What are the average and peak ambient air pollution levels of PM_{2.5}, PM₁₀, O₃, CO, NO_x, and SO₂ in urban areas?
- How do ambient air pollution levels relate to health-based standards such as those of the WHO, U.S. EPA, or in-country standards?
- Do ambient air pollution levels peak in certain parts of the city (e.g., near bus stations with idling buses, near certain corridors or elementary schools)?

To answer these questions, air quality monitoring networks have been established in some areas, though the status of networks in urban centers of Central America and the Dominican Republic varies. All countries with the exception of Belize have some level of air quality monitoring in the capital city, and progress is being made with regard to data consistency and quality assurance. Table 4 summarizes each country’s monitoring network and provides some program highlights.

Economic limitations and management capacity are generally cited as the largest impediments to consistent, routine monitoring over an extended geographic area. Several countries, such as Guatemala, have proposed new national programs to provide regulatory support and financing for improved monitoring networks. Recent progress towards regional coordination on air quality issues and acceptance of a regional AQI will also improve availability of air quality information, development of air quality controls, and dissemination of public health information across the region.

³⁸ “Reducing Fuel Sulfur Content in Central America: A Guide to Estimating Costs and Benefits.” November 2006, Draft Final Report, International Council on Clean Transportation.

Table 4. Current Status of Monitoring Networks.*³⁹

Country	Highlights of Program
Costa Rica	Has several-year historical record of speciated PM ₁₀ data from 7+ monitors. Acquiring real-time PM capabilities in early 2010.
Dominican Republic	Has 2 filter-based PM ₁₀ monitors operational since August 2008.
El Salvador	Has 3 continuous and 2 filter-based PM _{2.5} monitors, and 4 continuous and 1 filter-based PM ₁₀ monitor.
Guatemala	Has 6 filter-based PM ₁₀ and TSP monitors, and is expecting additional equipment in 2010 (including a continuous PM _{2.5} monitor).
Honduras	Has 3 continuous PM ₁₀ monitors, though equipment has not been used for several years; currently, efforts are underway to get equipment running.
Nicaragua	Has 3 filter-based PM ₁₀ monitors, though no ambient air monitoring is currently being performed.
Panama	Has been operating a continuous (real-time) PM _{2.5} monitor on the campus of the University of Panama since August 2008, and has had 8 other filter-based PM _{2.5} and PM ₁₀ monitors operational for many years.

*Belize does not currently own or operate any air quality monitors.

Contribution of Vehicle Emissions: While it is known that vehicles contribute on the order of 80% of urban air pollution in Central America, more specific information would be useful to address the problem and track solutions. To understand the contribution of vehicle emissions to the total ambient concentrations of pollutants, it is most desirable to have a “bottom-up” emissions inventory built on detailed vehicle emissions data, vehicle driving cycle data, and vehicle usage data, all supported by detailed air quality data. Because these data are very difficult to obtain with any level of certainty, alternative estimation methods for inventories are generally applied. El Salvador is the only country in the region that has a detailed emission inventory. Establishing and improving inventories is recognized as a priority in the region.

Some methods for estimating vehicle emissions inventories apply factors related to fuel sales, measurements of vehicle exhaust, study of ambient concentrations under special situations, and measurement of trace species in ambient PM. Fuel factors may be used if there is a detailed system for recording fuel sales or taxes. The amount of fuel sold (gasoline and diesel) can be used to estimate the pollutants that would be emitted from burning that amount of fuel. Because the amount and composition of emissions vary widely among individual vehicles, estimates from fuel sales are regarded as the least accurate method for inventory construction (though fuel sales are an effective method for calculating CO₂ emissions). Measurement of vehicle exhaust from a range of vehicle types, weights, and ages can be used to estimate total fleet emissions, if records on the composition of the general fleet are available. Constructing emission inventories in this way can be very expensive, as obtaining a representative sample of vehicles is difficult and requires testing a large number of vehicles. Extrapolating the results to the entire

³⁹ Battelle, for U.S. Environmental Protection Agency, Central America and Dominican Republic Ambient Air Monitoring Capabilities Technical Scoping Mission Report, April 3, 2009.

fleet also requires specific knowledge about the types of vehicles in the fleet and the distance traveled by each vehicle class.

Emission inventories constructed from fuel and vehicle data are “bottom-up” estimates, but “top-down” estimates based on ambient measurements can also be applied. For example, ambient air quality measurements from weekdays and weekends, upwind and downwind of major thoroughfares, during and after incidents (such as labor or transportation strikes) can be analyzed to discern the relative contributions of vehicles to total pollution in an area. Statistical source apportionment methods, such as factor analysis or chemical mass balance modeling, can also be applied to ambient PM data to determine the contribution of vehicle emissions to total pollution levels based on vehicle-specific pollutant species (trace elements and organic compounds). Statistical methods require a large number of ambient PM samples and analyses. Because source apportionment methods reflect what is actually present in the ambient atmosphere in an area, they are considered to be the most reliable representation of the contributions of various sources to total PM concentrations.

Overall, there is a need in the region to use available data to understand the specific causes of air quality problems. Efforts to increase the collection of relevant data to improve emission inventories and source apportionment studies should be implemented. The air quality networks being implemented in the region (Table 4) will provide important ambient data for source apportionment studies.

Health Effects: The costs associated with health effects due to short-term and long-term exposure to air pollution are recognized to be high in Central America and the Dominican Republic, as they are in many countries. Few direct studies on the health impacts of air pollution are available in the Central America region, though a number of countries have recognized the need for such information to inform decisions. Initial estimates of the magnitude of health effects due to air pollution in the region can be based on air quality data and published studies from the WHO or other regions.

Estimating health effects related to air pollution can be based on some combination of actual patient data (e.g., asthma attacks, hospital admissions) and information on ambient pollution levels. Typically, a connection needs to be made between episodes of poor air quality and increased health impacts to the population during those episodes. Longer-term impacts of elevated pollution levels also need to be considered. For example, a country-level study in Costa Rica evaluated the total costs of health impacts related to PM₁₀ from motor vehicles. The study included both the direct costs of illnesses and costs associated with premature mortality, resulting in a total cost of over \$190 million for the San José metropolitan area in 2001, or about US\$120 per city resident.⁴⁰ Cost-benefit analyses should consider the benefits from reduction of both short-term exposure to air pollution episodes and long-term exposure to existing air pollution levels.

⁴⁰ Allen, P., Vargas, C., Araya, M., Navarro, L., and Salas, R. 2005. Costos en salud por la contaminación del aire: Costa Rica 2001 reporte técnico. Ministerio de Salud, San José, Costa Rica.

Costs of Pollution Mitigation: There is often opposition to proposals for pollution mitigation based on anticipated costs. To foster acceptance, the challenges are to develop credible estimates of costs to the private and public sector, to avoid unfair costs to particular businesses or individuals, and to frame the costs in terms of the true savings to be made in health and environmental impacts.

It is difficult for governments, businesses, and individuals to estimate in advance the costs of compliance with pollution mitigation options. While few estimates are perfect, it is often true that more detailed analyses provide more credible results. As an example, when the production of ultra-low sulfur diesel fuel was proposed as a requirement in the United States, concerns about cost increases led the U.S. EPA to model costs of low-sulfur fuel production for individual refineries. The level of detail associated with the analysis greatly increased both the accuracy and the credibility of the cost estimates, and earned support from the refineries.

To avoid financial disparity in implementing new compliance programs, gradual phase-in policies that apply to entire industries or sectors often work best. In some situations, systems of pollution credit trading may be appropriate to allow businesses to delay adoption of new technology by paying a fee. If properly implemented, credit trading systems provide flexibility for businesses. Under credit trading systems, a business that cannot afford equipment upgrades to meet emission standards may have the opportunity to purchase credits and delay major equipment expenditures.

The costs of pollution mitigation options should be considered in terms of the true costs of the current system. If air pollution due to the current system of fuels and vehicles is effectively costing millions of dollars per year in health costs in an urban area, investment in capital equipment, technology, or infrastructure changes are easily justified. An example of a cost analysis undertaken by Mexico for efforts to improve air quality showed that the expected benefit in health costs was 10 to 20 times greater than expected implementation costs countrywide, and up 40 times greater for polluted urban areas.⁴¹ In a similar study, the U.S. EPA calculated that the benefits to human health and the environment were 10 times greater than the costs of actions to reduce sulfur in fuels in the U.S. Framing the costs in such a way requires credible information on the air quality problem, contribution of vehicles to the problem, and impacts on health in the area. With full consideration of the environmental, health, and economic impacts of the current system of fuels and vehicles, and with rational estimates of the expected costs for improvement, the motivation for change is clear.

Recommendations:

- Continue to invest in air quality monitoring, and develop emission inventories to better quantify the problem to be addressed.
- Create partnerships between health departments and universities to study health impacts of air pollution.

⁴¹ Molina, M., et al., 2004. *Air Quality in México: Toward Clean Air in a Decade – A Report from México Air Pollution Workshop*. http://www.theicct.org/documents/Molina_Mexico_Strategy_2004.pdf

2.5. Transportation System Alternatives

In their survey responses, many countries emphasized the need for redesign of existing transportation patterns. Options to change transportation patterns generally focus on reducing the vehicle fleet, expanding public transportation, providing alternative methods of transportation, and reducing traffic congestion in urban centers. While these options require considerable planning, they can be effective and relatively low in cost, and are solutions worth considering.

Bus Rapid Transit: Separate, express bus lanes have been developed in some cities, allowing bus transportation to be faster than private vehicles, increasing bus ridership, and decreasing the emissions per bus rider. Bus Rapid Transit (BRT) is generally considered to be the most cost-effective system to reduce traffic congestion, air pollution, and CO₂ emissions, as it replaces dirty buses with clean technology and reduces traffic congestion. BRT can also be implemented in a relatively short timeframe, as it requires, at a minimum, only dedicated bus lanes. To be effective and achieve maximum ridership and emissions reductions, BRT systems must be based on existing bus routes and extensive research on passenger destinations and travel times.

An example of a large and successful BRT system is TransMileneo in Bogotá, Colombia⁴². Since 2001, TransMileneo has expanded rapidly, removed over 7000 small, private buses from circulation, and reduced bus emissions by an estimated 59%. TransMileneo is now permitted by the United Nations to sell carbon credits, which have earned Bogotá an estimated US\$100 million to US\$300 million. The system is administered publicly, but operation of the buses is contracted to private vendors who are paid according to the number of miles their buses travel.

In the region, Guatemala and Panama have considered BRT. Guatemala City's Transmetro opened in 2007 and is expanding with new lines. Panama City is also considering implementation of BRT, though the status of the project is unknown.

Light Rail: Subways, ground-level trains, and elevated trains, typically powered by electricity, can ease pollution and traffic congestion in urban and suburban areas. The Dominican Republic recently implemented a light-rail system that transports more than 100,000 people daily with 17 rail cars. Costa Rica also has a new Inter-Urban Light Rail system.

Road System Planning: Actions could range from re-routing traffic or buses on existing roads, to a complete overhaul and new construction of an expressway system to ease congestion and resolve inefficient traffic routing patterns. Road system planning would be complementary to addition of BRT or light-rail corridors.

City Planning: With a long-term plan, the distances between where people live, work, attend school, and shop can be minimized, thereby reducing the need for all types of

⁴² <http://www.transmilenio.gov.co/>

transportation. This option would be most easily implemented in the early planning stages of a city (or, more likely, an expanding suburb). However, examples of “retrofit” options for older areas are development of bike corridors or express bus lanes to minimize everyday private vehicle travel.

Recommendations:

- Establishment of clean, reliable public transport should be assessed for individual urban areas.
- Bus Rapid Transit is recommended as a cost-effective system that is relatively easy to implement and has been successful in the Central American region.

3. Summary of Recommendations

There are several general recommendations for methods to reduce emissions from fuels and vehicles in Central America and the Dominican Republic. First, focus on climate impacts and mitigation of CO₂ emissions rather than solely on air pollution impacts of fuels and vehicles. While both climate change and air quality are recognized in the region as serious problems, climate change has greater international interest. Achieving CO₂ reductions will necessarily produce improvement in air quality. Moreover, CO₂ reductions can also allow sale of carbon credits on the international market (e.g., TransMileneo in Colombia earns income from carbon credits).

Second, fuels and vehicles must be considered as a system. Taking actions to address or change one part of the system will have consequences for many stakeholders and users. The potential impacts of an action throughout the system of fuels and vehicles must be anticipated. The treatment of fuels and vehicles as a system is one of the most important lessons learned from vehicle pollution control efforts worldwide. Improvements in vehicles and fuels must proceed in parallel if significant reductions in emissions of air pollutants from vehicles are to occur. A program that focuses on vehicles alone is doomed to failure; conversely, a program designed to improve fuel quality alone also will not be successful.

Third, regional collaboration and consensus will be necessary for effective change on fuels and vehicles. Regional consensus has been effective in the past. In the system of fuels and vehicles, cooperation in the region would simplify adoption of a timeline and intermediate steps for phase-in of low-sulfur fuels, establishment of vehicle standards, and continued collaboration on ambient air quality monitoring.

The priorities for technical actions to reduce air pollution from vehicles in the region depend on costs, likelihood of success, and potential benefits. The priorities identified through this analysis are to reduce fuel sulfur, establish clean public transport, implement inspection and maintenance programs, and improve information about air quality.

Priority 1: Reduce sulfur in fuels.

Reduction of sulfur in fuels has been shown in other countries to have large benefits for air quality, to be cost effective as a means of addressing health impacts, and to be less expensive to implement than anticipated. Reduction of fuel sulfur allows immediate reduction in SO₂ and sulfate PM, with no changes to the existing vehicle fleet. Adoption of a schedule for low-sulfur fuels must be preceded by consideration of the full range of economic factors, including any existing subsidies and taxes, regional suppliers and sales volumes, and costs to consumers.

Sulfur in gasoline and diesel should be reduced to a maximum of 500 ppm as soon as possible. In the future, once preparations can be made for adoption of advanced after-treatment control of diesel and gasoline exhaust, diesel sulfur should be limited to 10 to 15 ppm, and gasoline sulfur to 30 ppm.

Priority 2: Establish reliable, clean public transport like Bus Rapid Transit.

Bus Rapid Transit (BRT) is a solution to traffic congestion, air pollution, and carbon emissions. BRT is cost-effective to implement, and can be established on a relatively short timeframe. BRT systems remove old, high-emitting buses from the streets, replacing them with efficient new equipment that reduces CO₂ and non-CO₂ pollutant emissions. Dedicated bus lanes make bus travel faster than private vehicle travel, reduce traffic congestion, and improve safety for riders. Implementation of BRT should consider existing bus routes to maximize passenger participation and emissions reductions.

Priority 3: Implement inspection and maintenance programs.

I/M programs offer emission reductions over a period of a few years, as they encourage the compliance of the overall fleet with emission limits. I/M programs are initially costly to implement and enforce, but provide long-term benefits, as the highest-emitting vehicles can be identified and repaired or replaced. Several countries in the region have begun to work with versions of I/M programs, which should be continued, and other countries should follow suit. Beyond operation of the inspection centers, funding may be needed to pay for repairs or replacement of the highest emitting vehicles. Centralized I/M programs, overseen by the government at a few locations in an urban area, are likely to be the most effective. To encourage public trust and participation, operation of the testing centers by an independent body should be considered.

Priority 4: Improve air quality information and source apportionment.

Recent efforts have led to improved information about air quality in the region. The number of ambient monitoring stations has been increased, establishment of an AQI has begun, and regional cooperation on air quality information has expanded. The major sources of air pollution in the region are known, but efforts to improve air quality must include investigation of the specific sources and impacts of air pollution in the region, and associated public education campaigns.

Acknowledgements

The authors would like to thank those who provided input and review of this document, particularly Elisa Dumitrescu and Veronica Ruiz Stannah of the United Nations Partnership for Clean Fuels and Vehicles, Gianni Lopez of the Molina Center, and Michael Walsh (independent consultant). We would also like to thank USEPA for funding this effort.

Appendix A
Country Surveys

ATTACHMENT

Fuels and Vehicles Information Summary for Costa Rica

Name: José Bolaños

Affiliation: Ministry of the Environment, Energy and Telecommunications (MINAET)

E-mail: <jbolanos@minaet.go.cr>

- ✦ In the questions below, we have included some information that was previously gathered.
- ✦ Please make changes, corrections, and updates as needed.
- ✦ Please try to provide the source and date of all information.

Fuels Information

1. Current Fuel Sulfur Limits, by law

- a. For diesel fuel, ppm?** In Costa Rica fuel specifications are established by way of Executive Decrees such as regulations. The law stipulates a gradual reduction of sulfur content between 2003 and 2008 (from 4500 ppm to 500 ppm), although it appears that this schedule has been somewhat delayed.

The Central American Technical Regulations establish diesel fuel specifications in Standard 75.02.17.06. For Costa Rica, said Standard was published in the *Official Gazette* No. 64 on 3/30/2007, as Decree No.33664-COMEX-MINAE-MEIC. This Standard, which indicates that it represents an adaptation of ASTM D 975-06 (Grade 2-D), can be downloaded from:

http://www.recope.go.cr/nuestra_actividad/calidad_empresarial/normas_combustibles/RTCA_75_02_17_06_Diesel.doc

The Standard defines the sulfur limit for diesel fuel as the total sulfur content as defined in ASTM D-129, which is a maximum of 0.50 % (% mass), with the following footnote:

- (d) **Note for all countries.** With respect to sulfur content, each country shall apply the parameter established in its respective national legislation. The maximum allowable value is 0.50 mass fraction (% mass), unless the domestic legislation in effect stipulates lower limits.

- b. For gasoline, ppm?** 1000 ppm max. for Super; 1500 ppm max. for Regular.

In Costa Rica reference is commonly made to three types of gasoline: Regular (minimum octane of 88.0); Superior (minimum octane of 95.0), with both being included in the Central American Technical Regulations; and Plus 91 (minimum octane of 91.0). The latter was introduced by RECOPE in 2002 as a substitute for

Regular gasoline. See:

http://www.recope.go.cr/centro_informativo/sala_prensa/boletines/Presentacion_conf_rencia_prensa.pdf

The official web page of the Costa Rican Petroleum Refining Institute (RECOPE) shows the technical specifications for Plus 91 Gasoline).

Regular Gasoline. The Central American Technical Regulations establish Regular Gasoline specifications in Standard 75.01.19.06. For Costa Rica, said Standard was published in the *Official Gazette* No. 225 on 11/23/2006, as Decree No. 33428-COMEX-MINAE-MEIC. This Standard, which indicates that it represents an adaptation of ASTM D 4814-01a (Class B), can be downloaded from:
http://www.recope.go.cr/nuestra_actividad/calidad_empresarial/normas_combustibles/RTCA_75_01_19_06_Gasolina_Regular.doc

The Standard defines the sulfur limit for Regular Gasoline as the total sulfur content as defined in ASTM D-2622, which is a maximum of 0.10 % (% mass).

Superior Gasoline. The Central American Technical Regulations establish Superior Gasoline specifications in Standard 75.01.20.04. For Costa Rica, said Standard was published in the *Official Gazette* No. 245 on 12/20/2005, as Decree No. 32812-COMEX-MINAE-MEIC. This Standard, which indicates that it represents an adaptation of ASTM D 4814-00 (Class B), can be downloaded from:

http://www.recope.go.cr/nuestra_actividad/calidad_empresarial/normas_combustibles/RTCA_75_01_20_04_Gasolina_Superior.doc

The Standard defines the sulfur limit for Superior Gasoline as the total sulfur content as defined in ASTM D-2622, which is a maximum of 0.10 % (% mass).

Plus 91 Gasoline. The specifications for this gasoline can be found at:

http://www.recope.go.cr/nuestra_actividad/calidad_empresarial/normas_combustibles/Especificaciones_Gasolina%20Plus_91.doc

Said specifications define the sulfur limit for Plus 91 Gasoline as the total sulfur content as defined in ASTM D-2622, which is a maximum of 0.10 % (% mass).

It is interesting to note that the RON value (octane number) must be at least 91, but there appears an asterisk which refers to a note that indicates: “In the case of Puntarenas and Guanacaste, Plus 91 Gasoline contains 3% ethanol.”

2. What are the recent or future plans to mandate lower sulfur content of fuels?

No public announcement has been made regarding short-term plans to lower the sulfur limits established by law.

Regarding medium- and long-term plans, due to the fact that the refinery does not supply all of the fuels consumed in Costa Rica (the shortfall is imported in the form of refined fuels), there has been commentary for some time now concerning the need to expand and modernize the refinery. It has been publicly stated that such a

modernization project would be accompanied by a substantial improvement in fuel quality.

http://www.nacion.com/ln_ee/2007/enero/05/economia949206.html

http://www.nacion.com/ln_ee/2007/diciembre/09/economia1344650.html

http://www.nacion.com/ln_ee/2007/enero/12/pais957400.html

In reviewing RECOPE's Strategic Plan for 2009-2013, which can be found at: http://www.recope.go.cr/acerca/vision_corporativa/Plan_Estrategico_2009_2013.pdf, the word 'sulfur' is not mentioned.

3. What plans, if any, are there for introduction of biofuels?

There has been a lot of talk about biofuels, many proposals, several individual actors, and extensive government involvement.

Legislation

Decree No. 35091 MAG-MINAET, published on 3/17/2009, contains the Biofuel Regulations. It can be seen at:

<http://www.hacienda.go.cr/centro/datos/Decreto/Decretos%2035091-MAG-MINAET-Reglamento%20de%20Biocombustibles-La%20Gaceta%2053-17%20MAR-2009.doc>

Prior to the publication of said Decree, the Executive Branch Directive No. 041-MP-H-MOPT-MINAE was issued. Article 12 of the Directive covers biofuels:

<http://www.hacienda.go.cr/centro/datos/Directrices/Directriz%20041-MP-H-MOPT-MINAE-Directriz%20dirigida%20a%20los%20jerarcas%20de%20ministerios-%20instituciones%20aut%C3%B3nomas-%20empresas%20p%C3%ABAblicas%20y%20dem%C3%A1s%20%C3%B3rganos%20del%20Estado-La%20Gaceta%20134-12JUL-2005.pdf>

and refers to Decree No. 31087-MAG-MINAE regarding anhydrous ethanol:

<http://www.reglatec.go.cr/decretos/31087.pdf>

and Decree No. 31818 MINAE-MAG regarding biodiesel:

http://www.sica.int/busqueda/busqueda_archivo.aspx?Archivo=reso_26865_1_08082008.pdf

RECOPE

The state-owned fuel monopoly, RECOPE (<http://www.recope.go.cr/>) is responsible for undertaking various actions concerning the implementation of biofuel programs on a national level. Some examples are described below.

RECOPE's Strategic Plan includes the following objectives:

http://www.recope.go.cr/acerca/vision_corporativa/Plan_Estrategico_2009_2013.pdf

- 3.2.7 Implementation of an active research and development program to monitor and consider the standards observed by successful companies with respect to alternative fuels.

- 3.2.8 Operationalization of a program to promote sustainable domestic biofuel production practices in order to ensure raw materials of reliable quality.
- 3.2.9 Appraisal of the feasibility of installing a biodiesel plant wholly owned by RECOPE or in partnership with a third party, and the possible vertical integration thereof.
- 3.2.10 Appraisal of the feasibility of installing an ethanol plant wholly owned by RECOPE or in partnership with a third party, and the possible vertical integration thereof.
- 3.2.11 Establishment of research agreements focusing on alternative energies and services with research centers, universities, and other public or private institutions.

Implementation of biofuels by RECOPE

Information sources:

http://www.recope.go.cr/nuestra_actividad/proyectos/Biocombustibles.htm

http://www.recope.go.cr/nuestra_actividad/proyectos/etanol/Biocombustibles.gif

Implementation of the use of ethanol in gasoline required, at minimum, the following:

- Construction of a storage tank for anhydrous ethanol.
- Acquisition of anhydrous ethanol (this time it was imported).
- Have and operate all the equipment needed to prepare the mixture of both fuels.
- Design the respective distribution lines.
- Establish quality control systems.

The pilot project consisted of introducing Plus 91 Gasoline in the Province of Guanacaste and in the Central Pacific region of the Province of Puntarenas. In both areas a mixture with 3% ethanol content was required, but the program allowed evaluation of the performance of both. More information at:

http://www.recope.go.cr/nuestra_actividad/proyectos/etanol/etanol.htm

The public perception concerning the nationwide launching of the biofuel program is summarized in the following articles:

http://www.nacion.com/ln_ee/2009/marzo/17/economia1908677.html

http://www.nacion.com/ln_ee/2009/marzo/29/economia1919475.html

Cane Sugar Ethanol

The Cane Sugar Agro-Industrial League (LAICA) is an association of all cane growers and sugar processing plants in the country. Currently at least two plants have the capacity to produce ethanol. LAICA also owns a pier that can receive ships up to 35,000 DWT, with the respective warehouses and equipment. LAICA operates a refinery where, besides producing anhydrous alcohol for the domestic market, it also provides the same service under contract. Its annual fuel alcohol production capacity will be two million liters/year.

http://www.nacion.com/ln_ee/2008/abril/07/economia1354739.html

Biodiesel

Domestic biodiesel production is dispersed amongst various actors, some of which are also consumers. There is no clear structure of producers or consumers nor any organization that provides quality control services. The academic experts have stated that current production is inconsistent and quality varies widely.

http://www.nacion.com/ln_ee/2006/septiembre/18/economia828807.html

http://www.nacion.com/ln_ee/2007/septiembre/07/economia1230879.html

http://www.nacion.com/ln_ee/2006/mayo/01/economia0.html

http://www.nacion.com/ln_ee/2007/septiembre/07/aldea1230981.html

http://www.nacion.com/ln_ee/2008/agosto/21/economia1669181.html

http://www.nacion.com/ln_ee/2008/mayo/25/pais1549146.html

http://www.nacion.com/ln_ee/2008/noviembre/18/aldea1780665.html

http://www.nacion.com/ln_ee/2007/marzo/03/economia1016086.html

http://www.nacion.com/ln_ee/2008/junio/29/opinion1597686.html

[http://www.bioenergywiki.net/index.php/Costa_Rica_\(Espa%C3%B1ol\)](http://www.bioenergywiki.net/index.php/Costa_Rica_(Espa%C3%B1ol))

4. Is there a fuel testing program in place to verify sulfur levels?

In Costa Rica the Public Utility Regulatory Agency (ARESEP) was created:

http://www.aresep.go.cr/docs/01-2003-ML_Ley_%20Autoridad_Regul.pdf. This agency's Charter Act states that, among other functions, the ARESEP is responsible for maintaining a "fuel quality evaluation program." For further information, see:

<http://www.aresep.go.cr/cgi-bin/index.fwx?area=09&cmd=servicios&id=5140&sub=6219>

RECOPE is responsible for quality control of fuels, ranging from verifying raw material specification compliance (whether crude to be distilled or refined products) to finished products distributed nationwide. For more information, see:

http://www.recope.go.cr/nuestra_actividad/calidad_empresarial/index.htm

The recorded sulfur values can be found at:

http://www.recope.go.cr/nuestra_actividad/calidad_empresarial/Estad_Espec_Descrip_Combustibles.xls

5. (a) Do you have domestic refineries, or is most refined fuel imported?

RECOPE has a refinery (for separating front-end gasolines and diesel) with a current capacity of 25,000 BPD of reconstituted crude. Plans exist to expand capacity to 40,000 BPD, with the corresponding public bid process already underway.

Since the refinery is part of a state-run enterprise (Costa Rica has a state-owned fuel production monopoly), all of the distribution infrastructure is part of said enterprise. More information can be found at: <http://www.recope.go.cr/mapas/>. Retail fuel sales

(to individual clients) is handled by private companies, including both domestic and international (Shell, Texaco, Elf) companies.

(b) If imported, from where?

Costa Rica imports all of its hydrocarbons, whether in the form of crude or refined products. A breakdown of said products for 2007 can be found at:

http://www.recope.go.cr/comercio_internacional/estadisticas_Importaciones_Exportaciones_2007.pps

(c) Are there current or planned programs to use natural gas as a vehicle fuel?

Government policy maintains a significant difference between retail prices for LPG and gasoline. As a result, several companies import and install devices to convert vehicle engines to dual LPG/gasoline consumption.

As of today's date, the ARESEP website (<http://www.aresp.go.cr>) indicates gas station prices of 250 colons/liter versus 484 colons/liter, meaning that the price of LPG is only 51.7% of the price of Superior Gasoline. See cells 100*G215/K215 of the gas station price sheet at:

<http://www.aresp.go.cr/docs/PAGINA%20WEB%20COMBUSTIBLES.xls>.

The conversion industry has flourished nationwide since the companies coined the slogan "Save up to 40% by switching to LPG."

6. What agency is responsible for fuel quality standards? Please list name and contact information (email and/or phone)

In Costa Rica, the Costa Rican Petroleum Refining Institute (RECOPE) is the governing entity regarding fuels. RECOPE is a state-owned enterprise with a monopoly on the importation, refining, and marketing of petroleum products. RECOPE operates under the supervision of the Ministry of the Environment, Energy and Telecommunications (MINAET).

Fuel quality specifications are established by the Executive Branch through Executive Decrees (see the answer to Question 1) issued by the MINAET. Any modification of the quality standards requires the formal issuance of an Executive Decree by the Executive Branch.

On a routine basis, RECOPE tests the quality of domestically distributed fuels (as one of its normal functions), while the ARESEP contracts independent laboratories to monitor RECOPE's performance.

7. Other comments on fuels?

Note that all gas stations are required to have vapor recovery systems per Article 32 of Executive Decree 30131-MINAE-S. The Hydrocarbon Storage and Marketing System Regulations, which were issued as Decree No. 30131-MINAE-S, can be consulted at:

www.dse.go.cr/es/02ServiciosInfo/Legislacion/PDF/Hidrocarburos/Transporte%20y%20Comercializacion/30131-MINAE-S.pdf

Vehicle Fleet Information

8. Approximately how big is the country’s vehicle fleet? What is the breakdown by type of vehicle, approximate age, and diesel vs. gasoline?

In the San José metropolitan area, there are 725,450 vehicles, 21,000 trucks, and 13,000 buses. The Transit Act (Law No. 7331) sets forth that all vehicles that use public roadways must carry a Circulation Card which, among other fees, includes Mandatory Automobile Insurance (SOA).

Prior to the approval of CAFTA, the National Insurance Institute (INS) had a monopoly on the insurance market in Costa Rica. More information on the SOA can be found at: <http://portal.ins-cr.com/General/Marchamo/SOA.htm>.

In order to simplify payment, the INS serves as collection agent for all of the items covered by auto license tabs (*marchamo*), including the SOA, the Vehicle Use Tax, and other charges.

Although the INS expected payment of license tabs for a million vehicles, some owners do not pay for various reasons (theft or destruction of the vehicle, irreparability, lack of funds, etc.). For 2009 it is estimated that approximately 875,000 vehicles are circulating legally in the country. (See: http://www.nacion.com/ln_ee/2009/abril/07/pais1929864.html.)

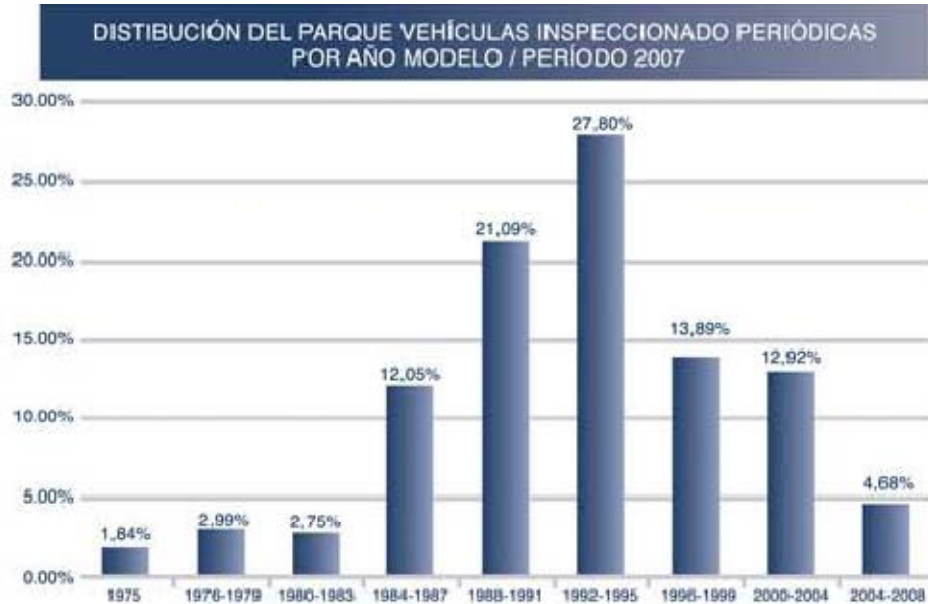
The Technical Vehicle Inspection (RTV) program (<http://www.rtv.co.cr>) is operated exclusively by a company that was awarded the contract after an international bidding process. All vehicles that circulate in the country are subject to technical inspection in order to verify that they “comply with the mechanical, safety, and other conditions required” by Articles 19 and 20 of the Public Roadway Transit Act (<http://www.poder-judicial.go.cr/transito/ley/indice.htm>).

Page 7 of the RTV 2007 Annual Report (<http://www.rtv.co.cr/docs/anuario2007.pdf>) shows the following information:

Periodic Initial Inspections According to Vehicle Type (2007)	
Vehicle Type	Total
Motorcycle	39,855
Automobile	449,688
Taxi	19,114
Cargo Vans (< 3,500 kg)	102,028
Cargo Vans (> 3,500 kg)	31,163
Public Transport Bus	13,368
Charter Transport	9,353
Trailer or Semi-Trailer	461
Agricultural	125
Public Works & Utility	809
Hazardous Transport	731
Other	8,084
TOTAL	674,779

On Page 8 of the same report the following information appears regarding the age of the vehicle fleet inspected:

**Age Distribution of the Vehicle Fleet Inspected in 2007
(by model year)**



9. Is there a policy on importing vehicles? How does it differ for new vs. used vehicles? How does it differ for gasoline vs. diesel vehicles?

New and used vehicles have to meet the standards listed below for the I/M program run by RTV (one sample vehicle out of every 20 new vehicles of the same type must be tested). A certificate of compliance must be presented for each imported new vehicle.

Vehicle importation into Costa Rica is carried out by various private companies. On Page 8 of the RTV 2007 Annual Report (<http://www.rtv.co.cr/docs/anuario2007.pdf>), the following information is shown:

Vehicle Age	Percentage
Earlier than 1984	7.6
Between 1985 and 1999	74.8
Between 2000 and 2004	12.9
Later than 2004	4.7

This data makes it clear that, for the final user, the set of economic factors regulated in the “State-limited free market” (Free Market: consumer purchasing power, CIF cost of the vehicle, importer/distributor/dealer profit, assumed maintenance cost, availability of parts, fuel consumption, etc.; and State: import duties, vehicle use tax, fuel taxes, etc.), cause the majority of users to prefer vehicles over ten years old.

10. Is there a law requiring vehicle inspection and maintenance (I/M) program for emissions?

Yes. The law requires annual inspection for vehicles more than 5 years old, inspection every 2 years for vehicles 5 years old or less, and inspection every 6 months for public transport vehicles. Exempts certain agricultural vehicles and vehicles not designed to work with catalytic converters (pre-1997 vehicles).

In Costa Rica, the Public Roadway Transit Act (Law 7331) (<http://www.poder-judicial.go.cr/transito/ley/indice.htm>) sets forth the mandatory nature of technical vehicle inspection, which was adjudicated to a Spanish company (RTV) (<http://www.rtv.co.cr>) based on an international bidding process. Additional legislation includes Decree No. 30184 (<http://www.rtv.co.cr/docs/30184.pdf>), which establishes the Technical Vehicle Inspection Regulations, Decree No. 17266 (<http://www.rtv.co.cr/docs/17266.pdf>), which sets forth the requirements for safety devices, and Decree No. 17373, which governs the use of taxi meters (<http://www.rtv.co.cr/docs/17373.pdf>).

a. If so, is the I/M program being implemented?

Yes, in the form of a centralized I/M system operated by RTV (<http://www.rtv.co.cr>). The emission control centers operated by a private company will be overseen by the Ministry of Public Works and Transportation (MOPT), which will also carry out random highway checks with help from the Transit Police.

The RTV website contains information on the location of the inspection stations, inspection frequencies, how to schedule appointments, basic maintenance requirements for passing the inspection, and annual results summary reports. A video showing the RTV inspection process can also be seen at: <http://www.rtv.co.cr/videoA.htm>.

b. If being implemented, what are the standards and results (e.g., ppm or grams/km, % failure rate)?

**Maximum Vehicle Emission Limits for the I/M System
Set by Law 7331 (1993) as Amended**

Gasoline Vehicles				
Contaminant	Unit	Emissions Limits for 4-Cycle Engines		
		Earlier than 1995	1995-1998	1999 and Later
Hydrocarbons (max)	ppm	-	350 (idle) 125 (high idle)	125 (idle) 100 (high idle)
Carbon monoxide (CO) (max)*	%	4.5	2.0 (idle) 0.5 (high idle)	0.5 (idle) 0.3 (high idle)
Carbon dioxide (CO ₂) (min)	%	-	-	10 (idle) 12 (high idle)
Contaminant	Unit	Emissions Limits for 2-Cycle Engines (all model years)		
Hydrocarbons (max)	ppm	2500		
Carbon monoxide (CO)(max)	%	4.5		
Mopeds and Motorcycles				
Contaminant	Unit	Emissions Limits for 4-Cycle Engines (all model years)		
Hydrocarbons (max)	ppm	2800		
Carbon monoxide (CO)(max)	%	4.5		
Contaminant	Unit	Emissions Limits for 2-Cycle Engines (all model years)		
Hydrocarbons (max)	ppm	12,500		
Carbon monoxide (CO)(max)	%	4.5		
Diesel Vehicles				
Vehicle Type		Emission Limit		
		Earlier than 1999	1999 and Later	
Weight ≤ 3.5 tons		< 70 % opacity	< 60 % opacity	
Weight > 3.5 tons		< 80 % opacity	< 70 % opacity	

* In addition to these limits, Executive Decree 31019-MOPT from 2002 stipulates that gasoline vehicles that were imported between 1995 and 2002 and that were not designed to use a three-way catalytic converter shall only be subject to the idle test with a CO limit ≤ 4.5%.

The compliance standards shown in the table above are set forth in Articles 33-36 of Law 7331 (<http://www.rtv.co.cr/docs/7331.pdf>).

The results of the vehicle fleet inspection, as tabulated based on various evaluation criteria and presented in various formats, can be seen in the Technical Vehicle Inspection 2007 Annual Report (<http://www.rtv.co.cr/docs/anuario2007.pdf>).

Important: On July 1, 2009, new Technical Vehicle Inspection Regulations are scheduled to take effect
<http://www.mopt.go.cr/ctp/Documentos/MRTVDEFINITIVO11DIC08.pdf>). Of special interest is Article 30, Chassis, Engine, and Transmission.

c. Are there plans to implement or expand the program in the near future?

By Executive Decree, the current Inspection and Maintenance Program is mandatory. After an international bidding process, the company RTV was awarded the contract to provide the service under concession at technical inspection stations around the country. Program development plans can be seen at:
<http://www.rtv.co.cr/proyectos.htm>.

d. Are there separate requirements for bus or other fleet maintenance?

Public transportation vehicles are subject to inspection twice a year. The inspection frequencies can be found at: <http://www.rtv.co.cr/cuando.htm>.

Specific vehicle maintenance is left to the discretion of vehicle owners (regardless of the vehicle type). All owners are required to ensure that their vehicle complies with technical inspection requirements.

11. (a) Are emission control systems required for cars?

Yes. Article 33 of the Public Roadway Transit Act (<http://www.rtv.co.cr/docs/7331.pdf>) states textually: "In addition, those vehicles that were imported on or after January 1, 1995, must have a closed-circulation emissions control system in proper working order. Vehicles with engines that use gasoline or similar fuels must have a three-way catalytic converter as part of said system."

(b) If catalytic converters are required, what was the first model year?

1995 (see the answer to the previous question).

(c) Are catalytic converters frequently removed?

If a vehicle is required to have a converter, there is no reason to remove it once the investment has been made.

In the case of vehicles that are imported almost at the end of their service life, and that due to their model year are not required to have a catalytic converter, the importers remove the converters in order to not increase the cost of the vehicle by installing a new unit.

12. What agency is responsible for vehicle standards? Please list name and contact information (email and/or phone)

The Ministry of Public Works and Transportation is responsible for vehicle standards. The Public Roadway Transit Act establishes the safety and environmental principles related to the technologies that vehicles are required to use.

Each vehicle is the result of the manufacturer's design oriented towards satisfying the demands of a given market. Costa Rica does not have a vehicle design industry, so we import vehicles with original standards in a supply-and-demand market.

13. Are there any incentives applied for cleaner vehicles (e.g. non-CO2 pollutants)?

By way of Executive Decree, the Selective Consumption Tax is applied at a reduced rate for the importation of electric and/or hybrid vehicles.

14. What is the average fuel efficiency (in L/100 km) for all light duty vehicles? Are there policies to promote more fuel efficient vehicles?

There are no accurate data available regarding average energy efficiency. The main policy for the acquisition of more efficient vehicles continues to be the cost-benefit analysis between: (a) proper maintenance; and (b) substitution of low-efficiency vehicles for more efficient units.

15. Other comments on vehicles?

Several proposals have been made to restrict the importation of used vehicles, but they have not met with success, primarily due to fiscal issues.

Program Information

16. Local Programs: Please list local agencies/communities that are actively engaged in vehicle pollution control programs.

Groups of residents in highly contaminated areas are taking individual measures in an attempt to improve the quality of their environment. In some cases they have convinced the government to change heavy vehicle routes or bus stop locations.

Institutions like the National Autonomous University (UNA) have performed studies on contamination in urban areas (like Heredia) which have served as input for purposes of proposing traffic flow modifications in downtown areas.

17. National Programs: Please list recent or current national programs or initiatives that target vehicle pollution control. What has been their focus?

There exists an air quality monitoring and control program in Costa Rica. The program is of a general nature, and thus does not focus exclusively on vehicle contamination. The actors involved in air pollution programs in the Greater Metropolitan Area (GAM) include the Ministry of the Environment, Energy, and Telecommunications, the Department of Health, the Labor Department (Occupational

Health Office), the National Autonomous University (Air Quality Laboratory), and various local governments.

http://www.vueltaenu.co.cr/index.php?option=com_content&task=view&id=6602

a. Which programs have been successful, and why?

The Technical Vehicle Inspection Program has been successful and consistent. Fuels have been improved, also. Then there is the air quality monitoring carried out by the UNA and the Health Department and now with expanded participation including MINAET and MOPT.

b. Which programs have not been successful, and why not?

The air quality monitoring program has not been consistent due to lack of financing.

c. Are there any relevant reports that you can share with USEPA?

Regarding general air pollution, see:

http://www.nacion.com/ln_ee/2007/febrero/14/aire.ppt

http://www.nacion.com/ln_ee/2007/enero/28/aldea973039.html

http://www.nacion.com/ln_ee/2007/febrero/13/ultima-sr995089.html

http://www.nacion.com/ln_ee/2007/febrero/14/pais995234.html

http://www.nacion.com/ln_ee/2007/noviembre/01/pais1298864.html

http://www.nacion.com/ln_ee/2007/noviembre/02/pais1300246.html

http://www.nacion.com/ln_ee/2008/junio/07/opinion1568157.html

http://www.nacion.com/ln_ee/2008/mayo/21/pais1544915.html

http://www.nacion.com/ln_ee/2008/octubre/03/aldea1723490.html

18. NGOs: Are there any non-governmental organizations or universities engaged in vehicle pollution control activities or research? Please list name and contact information (email and/or phone).

The UNA Environmental Sciences School (specifically the Environmental Control Laboratory) is in charge of the technical aspects involved in the implementation of the Air Pollution Control Program in Costa Rica. The head of the program is Jorge Herrera, M.S.

The ONG Wildlife Preservation Society (APREFLOFAS) has kept an active watch on the issue of air pollution, especially with respect to the importation of used vehicles, even to the extent of filing stays of injunction.

19. Business Involvement: Have there been past or current efforts to work with fuels and vehicles business organizations? (e.g., transportation unions, fuel importers and refiners, vehicle maintenance shops, and vehicle importers)? Were these successful? Why or why not?

In the current context, three major actors should be considered:

Industrial Sector. Any industry that considers itself to be on the cutting edge seeks to optimize fuel and energy usage in order to maximize profits. The substitution of older and low-efficiency vehicles for more modern units can be seen everywhere on the highways (for example, concrete and asphalt transport, milk trucks, heavy transport, etc.).

Commercial Sector. Many companies are introducing and marketing a variety of devices that allegedly increase vehicle efficiency and performance (devices to increase combustion efficiency, fuel catalyzers, exhaust catalyzers). Other companies promote vehicle conversion from gasoline to LPG.

Public Transport. Three types of actions are seen in this sector:

- Actions implemented by transport companies that seek to improve their profit margin by updating their bus fleets and using biodiesel.
- Governmental actions, such as the new Inter-Urban Light Rail System, which implies a direct reduction in pollution by using a single locomotive to transport a large number of passengers, as well as indirect reduction by reducing the number of buses that currently contribute to traffic congestion.
- Another governmental action involves the Inter-Area Bus Routes, which propose to reduce the number of passengers who currently have to ride from one outlying area into downtown San José in order to transfer to a different bus route to another outlying area, thus reducing traffic congestion by moving buses out of the downtown area.

20. Studies: Can you share any studies on emission estimates of the vehicle fleet, health impacts of air pollution, or cost/benefits of reducing vehicle pollution?

There are plans to develop and apply protocols for evaluating and building an emissions inventory that includes mobile sources, in order to obtain information that will serve as a starting point for decision-making regarding medium- and long-term reduction goals. The Fourth GAM Air Quality Report is the most current official document concerning air pollution.

21. Public Outreach:

a. How would you characterize the public's level of knowledge and attitude about air pollution from vehicles?

In general, mass media have been used in Costa Rica to raise public awareness regarding the results of the air quality studies that have been carried out and the efforts of the actors involved.

Despite the absence of information campaigns that specifically encourage individual actions to reduce vehicle contamination, the general public seems to support efforts to reduce said contamination.

b. Are there any past or current public outreach campaigns on this topic?

There are no specifically allocated funds, but all available media are used to the extent possible, basically in the form of news reports, presentations, invitations, and other programs that publicize what is being done about environmental contamination.

22. Challenges: What do you think future challenges might be for reducing air pollution from vehicles?

Cleaner and more efficient vehicles. Vehicles that use alternative fuels. See the plans set out in the climate change strategy and the institutional plans established for MOPT, INCOFER, and PRUGAM.

**Thank you very much for your participation! Please email your completed survey to:
Ms. Erica Zell, Battelle
zelle@battelle.org**

ATTACHMENT

Fuels and Vehicles Information Summary for Dominican Republic

Name:	<u>Lic. José Andrés Rodríguez</u>
Affiliation:	<u>Secretary of Natural Resources and Environment</u>
E-mail:	<u><joseandres462@yahoo.com ></u>

- | |
|--|
| <ul style="list-style-type: none">✦ In the questions below, we have included some information that was previously gathered.✦ Please make changes, corrections, and updates as needed.✦ Please try to provide the source and date of all information. |
|--|

Fuels Information

23. Current fuel sulfur limits, by law

a. For diesel fuel, ppm?

- 0.75% sulfur (7500 ppm equivalent)

b. For gasoline, ppm?

0.75% sulfur (1500 ppm equivalent)

24. What are the recent or future plans to mandate lower sulfur content of fuels?

To work on a proposal of a regulation to reduce the sulfur level to 50 ppm. We've created a committee on combustibles that sits in the General Direction of Regulations and Quality System (DIGENOR). This committee is integrated by the production or commercial sectors, consumer sector, and technical sector. The coordinator is a technician from DIGENOR.

25. What plans, if any, are there for introduction of biofuels?

*There is a law that promotes the use of biofuel. There is as program to use 10% of ethanol in gasoline to reduce the petroleum imports. Also, the National Commission of Energy has a program working on the use of biofuel from the Castor-oil plant (*Ricinus communis*). (There are thousands of hectares of this plant)*

26. Is there a fuel testing program in place to verify sulfur levels?

No.

Fuel analysis are made by Refinería de Petróleo Dominicana, S. A. (Tel. 809-472-9833 with Lic. Pedro Telentino (REFIDOMSA). At this moment the state of Dominicano just bought the refinery from the Shell company where it had 50% of its stocks.

The Refinería is who commercializes the fuels. The monitoring of the fuels should be made by DIGENOR; but at this moment, DIGENOR is not doing so

27. Do you have domestic refineries, or is most refined fuel imported? If imported, from where? Are there current or planned programs to use natural gas as a vehicle fuel?

The country has two refineries: Refinería de Petróleo, S.A. and the refinery of the company Falcon Bridge. This last one only refines until diesel for use of the same company.

60% of fuels come from importation, and 40% are refined by REFIDOMSA. Come from: Venezuela, Colombia and México.

There is a program to use natural gas as fuel for cars, which had been started with one service station for the sale of natural gas. Now more than one hundred (100) service stations of this fuel had been planned, and since these stations require environmental licenses, these are already in processing

28. What agency is responsible for fuel quality standards? Please list name and contact information (email and/or phone)

Lic. Fulgencio Batista Coordinador del Comité de Combustible. Tel: 809-686-2205 ext 300, 320 Fax. 809-688-3843

digenor@digenor.gob.do, www.digenor.gob.do, digenor@gmail.com

29. Other comments on fuels?

No further comments.

Vehicle Fleet Information

30. Approximately how big is the country's vehicle fleet? What is the breakdown by type of vehicle, approximate age, and diesel vs. gasoline?

Tipo/kind	2003	2004	2005	Participación, %
Automóvil/automobile	555,364	543,334	568,104	25.60
Autobuses/bus	51,401	53,109	57,207	2.50
Jeep	96,617	104,913	126,225	4.94
Carga/Cargo	274,839	266,650	279,785	12.56
Motocicletas/motorcycles	1,325,979	1,116,509	1,317,415	582.60
Volteo/dump truck	14,506	13,473	14,191	0.63
Maquinas Pesadas/heavy machinery	14,632	13,918	14,471	0.66
Otros/Others	968	10,833	11,145	0.51
Total	2,334,306	2,122,739	2,388,543	100.00

Note: automobiles include: privates, public, urban and intercity

Source: General Direction of Internal Taxes

Others: Include trailer, ambulance, hearse and "motocarga" (cargo-motorcycle)

31. Is there a policy on importing vehicles? How does it differ for new vs. used vehicles? How does it differ for gasoline vs. diesel vehicles?

It's prohibited to import cars older than five years. The engines can't exceed 2000cc and can't have more than six-cylinders. It's allowed for luxury cars, with a high tax.

32. Is there a law requiring a vehicle inspection and maintenance (I/M) program for emissions?

A program like that doesn't exist. This program is planned to be implemented for the 2008-2012 quadrennium.

a. If so, is the I/M program being implemented?

No

b. If being implemented, what are the standards and results (e.g., ppm or grams/km, % failure rate)?

c. Are there plans to implement or expand the program in the near future?

There are plans to implement the program explained below:

Base Line: 32 provinces split up into four zones (North, South, East and West); Total number of cars by zones (Sto. Domingo : 585,861; Santiago: 74,385).

GOAL OF 2008-2012 QUADRENNIUM: 50% (Install three car inspection systems; two in the South zone and other one in the North zone)

INDICATORS: Pollution data of car regulation with environmental review in both the North and South Zones of the country (inspection systems installed and official repair shop, standardized fuel and authorized catalytic converter).

OPERATIONAL PROGRAM: 2009 – 20% (fuel regulations, catalytic converter design and tender of inspection system); 2010- 30% (an inspection system installed); 2011 – 40% (two inspection systems installed), 2012 – 50% (three inspection systems installed).

d. Are there separate requirements for bus or other fleet maintenance?

It has not been implemented.

e. Are emission control systems required for cars? No

If catalytic converters are required, what was the first model year?

Are catalytic converters frequently removed?

33. What agency is responsible for vehicle standards? Please list name and contact information (e-mail and/or phone).

State Secretary of Environmental and Natural Resources, through Direction of the Environment Regulations. Director: Simer González, Tel. 809-472-0626

34. Are there any incentives applied for cleaner vehicles (e.g. non-CO₂ pollutants)?

Not at this time.

**35. What is the average fuel efficiency (in L/100 km) for all light duty vehicles?
Are there policies to promote more fuel efficient vehicles?**

No.

36. Other comments on vehicles?

No.

Program Information

37. Local Programs: Please list local agencies/communities that are actively engaged in vehicle pollution control programs.

The companies with licenses or environmental permission report their own car emissions according to the standards of Dominican regulation.

38. National Programs: Please list recent or current national programs or initiatives that target vehicle pollution control. What has been their focus?

Regarding national vehicular pollutants control programs, they are all taking in account into the 2008-2012 quadrennium. The approaches of the plans are:

First: Review the rules of fuels regarding to the sulfur content,

Second: To install a car inspection system to control emissions levels set up by the regulation.

Third: To implement a car maintenance system for the cars that don't pass the test

Fourth: To implement an awareness campaign with the sectors involved.

Fifth: To establish a regulation for imported cars.

a. Which programs have not been successful, and why not? No

b. Are there any relevant reports that you can share with USEPA?

Air Quality Assessment done in 2002 and 2003, in the city of Santo Domingo, Haiana and Santiago. This study includes an inventory of emissions, pollution levels and a review about the mobile source.

39. NGOs: Are there any non-governmental organizations or universities engaged in vehicle pollution control activities or research? Please list name and contact information (email and/or phone).

Don't exist.

40. Business Involvement: Have there been past or current efforts to work with fuels and vehicles business organizations? (e.g., transportation unions, fuel importers and refiners, vehicle maintenance shops, and vehicle importers)? Were these successful? Why or why not?

The commercial sector takes part in the fuel standardization process as a member of the Fuel committee. This committee is managed by the General

Direction of Regulations and Quality Systems (DIGENOR). The rest of the members are: production or commercial sectors, consumers and technician (universities, professionals, scientific specialists and others)

41. Studies: Can you share any studies on emission estimates of the vehicle fleet, health impacts of air pollution, or cost/benefits of reducing vehicle pollution?

In the assessment done in 2002 and 2003, there are estimates of car emissions, also the impacts of the pollution on public health and costs

42. Public Outreach:

a. How would you characterize the public's level of knowledge and attitude about air pollution from vehicles?

There is an evident perception from the population about the knowledge of car pollution. The newspapers of the country in have written reviews as leading article innumerable times, and there is a demand from the population about this topic.

b. Are there any past or current public outreach campaigns on this topic?

There is a diffusion campaign through brochures, where they invite to save fuel and use low fuel consume cars, owing to the high cost of fuels. This campaign is implemented by the Subsecretary of Education and Communication of The Environmental Secretary

43. Challenges: What do you think future challenges might be for reducing air pollution from vehicles?

The main challenges are: Follow the implementation of public transportation as the Metro, which we just started and moves more than 100,000 people daily. The metro has 17 carriages with the capacity of 750 people

Thank you very much for your participation! Please email your completed survey to:

Ms. Erica Zell, Battelle

zelle@battelle.org

**Ministry of Environment and Natural Resources (MARN)
Ministry of Energy and Mining (MEM)**

Environmental Protection Agency (EPA)

ATTACHMENT

Fuels and Vehicles Information Summary for Guatemala

Name:	<u>Carlos Mansilla M., Abelardo Pérez Z., Julio Campos P.</u> <u>(MARN); César Corado (MEM)</u>
Affiliation:	<u>Ministry of Environment and Natural Resources (MARN)</u> <u>National Climate Change Program; Ministry of Energy and</u> <u>Mining (MEM) Hydrocarbon Department</u>
E-mail:	<u>MARN: climático@marn.gob.gt</u> <u>MEM : dirhidro@mem.gob.gt</u>

- | |
|--|
| <ul style="list-style-type: none">✦ In the questions below, we have included some information that was previously gathered.✦ Please make changes, corrections, and updates as needed.✦ Please try to provide the source and date of all information. |
|--|

Fuels Information

44. Current Fuel Sulfur Limits, by law

a. For diesel fuel, ppm?

0.5% mass (5000 ppm)

b. For gasoline, ppm?

Superior Gasoline: 0.10% mass (1000 ppm)

Regular Gasoline: 0.10% mass (1000 ppm)

Parameters established in the Petroleum Products Registry, along with the respective denominations, characteristics, and quality specifications, in accordance with Ministerial Resolution No. 265-2008 dated 11/25/2008.

45. What are the recent or future plans to mandate lower sulfur content of fuels?

At this time there are no plans for reducing fuel sulfur content in Guatemala.

46. What plans, if any, are there for introduction of biofuels?

Within the framework of the Energy and Environment Alliance Project with Central America, Finland, and Austria, there are some private-sector initiatives for domestic production of biodiesel by processing *Jathropa curcas* (pine nuts). There are also other initiatives on a national level to: 1) recycle vegetable oils for use in diesel engines; and 2) obtain biofuel from sugar cane.

In addition, a Memorandum of Understanding for Biofuels Technical Cooperation was signed in December 2007 between the Guatemalan Ministry of Agriculture, Livestock and Foods and the Columbian Ministry of Agriculture and Rural Development. The MoU covers: (i) training in the area of biofuels; (ii) organization of scientific and technological symposiums, conferences, and workshops focusing on the subject; and (iii) value-added processes, transport, and marketing of biofuels.

47. Is there a fuel testing program in place to verify sulfur levels?

The Technical Hydrocarbon Laboratory of the Ministry of Energy and Mining carries out fuel analysis procedures. The laboratory's current analytical capacity for verifying sulfur levels (based on ASTM Method D-129) in the imported petroleum derivatives that are marketed in the country covers only diesel, C-bunker, and crude. Gasolines are not tested due to the lack of equipment and certain supplies.

48. Do you have domestic refineries, or is most refined fuel imported? If imported, from where? Are there current or planned programs to use natural gas as a vehicle fuel?

There are no refineries in the country. All fuels are imported. All oil-based fuels come from the U.S., Trinidad and Tobago, Ecuador, and Chile. Currently there are no plans to use natural gas as a vehicle fuel. There is only one gas station that sells LPG for vehicles. LPG is also sold at the main distribution centers.

49. What agency is responsible for fuel quality standards? Please list name and contact information (email and/or phone)

The Hydrocarbon Department of the Ministry of Energy and Mining. The General Director is César Corado (dirhidro@mem.gob.gt). Within said Department is the Technical Supervision Office run by Daniel Armando Cortez Argueta (gastrans@mem.gob.gt).

50. Other comments on fuels?

Efforts to establish sulfur content limits have been made through the Central American Customs Integration Process. As a result, the Central American Technical Regulations were issued regarding standards for fossil fuels used in the region.

Vehicle Fleet Information

51. Approximately how big is the country's vehicle fleet? What is the breakdown by type of vehicle, approximate age, and diesel vs. gasoline?

As of January 2009, there were 1,775,706 vehicles registered in the country.

Of that number, 898,191 (50%) are registered in the capital city, 126,150 (7%) in the Department of Quetzaltenango, and 100,293 (5.6%) in the Department of Escuintla, which are the three principal urban areas in the country based on industrial activity and population. The Department with the smallest vehicle fleet is Sololá with 11,195 vehicles.

The vehicle fleet is comprised of 29% passenger cars, 23% pick-ups, 11% cargo vans, 6% semi-trailers and other large freight vehicles, 5% buses, and 26% motorcycles.

Approximately 30% of the vehicles are model year 2003 or later, another 30% are between 1991 and 2002, and the remainder are earlier than 1991.

84% of the vehicles use gasoline, 14% use diesel, and the remainder use LPG.

52. Is there a policy on importing vehicles? How does it differ for new vs. used vehicles? How does it differ for gasoline vs. diesel vehicles?

There are no vehicle import restrictions. The only differential treatment between new and used vehicles is the import tax rate (new vehicles pay a higher rate).

Vehicle Fleet Classified by Department

DEPARTMENT	Dec. 2005	Dec. 2006	Dec. 2007	Dec. 2008	Jan. 2009
GUATEMALA	608,961	708,267	817,175	893,097	898,191
EL PROGRESO	9,710	12,113	15,083	17,754	18,004
SACATEPEQUEZ	18,205	22,075	26,435	29,966	30,214
CHIMALTENANGO	21,815	27,691	35,151	41,613	42,074
ESCUINTLA	50,464	67,886	85,563	99,265	100,293
SANTA ROSA	18,657	23,339	29,362	35,019	35,528
SOLOLA	6,332	7,833	9,726	11,077	11,195
TOTONICAPAN	13,394	15,225	17,910	20,129	20,333
QUETZALTENANGO	75,774	90,969	109,737	124,892	126,150
SUCHITEPEQUEZ	22,049	27,350	34,351	40,277	40,789
RETALHULEU	18,078	22,834	29,007	34,756	35,253
SAN MARCOS	34,617	43,599	55,646	66,585	67,608
HUEHUETENANGO	28,683	37,270	46,626	54,237	54,850
QUICHE	13,982	18,123	23,573	28,067	28,453
BAJA VERAPAZ	6,958	9,176	12,022	14,683	14,910
ALTA VERAPAZ	12,276	14,872	17,935	20,779	20,962
PETEN	15,005	21,103	28,246	35,089	35,622
IZABAL	23,804	30,349	37,581	44,177	44,630
ZACAPA	22,165	27,937	34,476	40,439	40,963
CHIQUIMULA	20,799	25,730	31,474	36,363	36,850
JALAPA	12,994	16,195	20,311	23,436	23,750
JUTIAPA	25,346	32,336	40,755	48,313	49,084
TOTAL	1,080,068	1,302,272	1,558,145	1,760,013	1,775,706

Source: Fiscal Vehicle Registry, Superintendent of Tax Administration

53. Is there a law requiring vehicle inspection and maintenance (I/M) program for emissions?

There is no program in operation at this time.

a. If so, is the I/M program being implemented?

n/a

b. If being implemented, what are the standards and results (e.g., ppm or grams/km, % failure rate)?

n/a

c. Are there plans to implement or expand the program in the near future?

The Ministry of Environment and Natural Resources is developing a proposal for Automotive Vehicle Contaminant Emissions Regulations (emissions limits).

d. Are there separate requirements for bus or other fleet maintenance?

n/a

54. Are emission control systems required for cars?

Not at this time. It is expected that a system will be implemented in the future.

If catalytic converters are required, what was the first model year?

Converters are not required. They will be covered by the proposed Regulations.

Are catalytic converters frequently removed?

Yes, sometimes.

55. What agency is responsible for vehicle standards? Please list name and contact information (email and/or phone)

Several institutions have legal authority regarding vehicles. MARN is responsible for setting gaseous and particle emissions limits. Those efforts are currently being handled by MARN's National Climate Change Program (e-mail: cclimatico@marn.gob.gt; phone number: 2423-05000x2306 or 2305).

The National Civil Police and the Municipal Transit Police are responsible for enforcing the law with respect to seat belt usage, lights, brakes, ownership documentation, etc.

Public transport routes are authorized by the Transportation Department of the Ministry of Communications, Infrastructure and Housing.

56. Are there any incentives applied for cleaner vehicles (e.g. non-CO2 pollutants)?

Not at this time.

57. What is the average fuel efficiency (in L/100 km) for all light duty vehicles? Are there policies to promote more fuel efficient vehicles?

No measurements are currently made.

58. Other comments on vehicles?

None.

Program Information

59. Local Programs: Please list local agencies/communities that are actively engaged in vehicle pollution control programs.

The Ministry of Environment and Natural Resources is promoting regulatory frameworks to prevent contamination and coordinate with other institutions.

60. National Programs: Please list recent or current national programs or initiatives that target vehicle pollution control. What has been their focus?

- Methodological Analysis of Air Quality. Consists of a literature review of air quality studies, regulations, and standards on the national, regional, and international levels in order to perform a comparative analysis of atmospheric contaminant emissions that will form the basis for the development of standards and strategies for air quality management in Guatemala.
- Proposal for the creation of a National Air Quality Monitoring System. The idea is to create an inter-institutional platform for coordination and synergy among the institutions involved with air quality issues.
- Proposal for the creation of an Air Quality Unit. Focused on the formal establishment of a nationwide air quality management unit within MARN, the scope of which will include vehicle emissions.
- Proposal for Automotive Vehicle Contaminant Emissions Regulations. Designed to regulate mobile-source gas and particle emissions.
- Air Quality Monitoring Project. Focused on measuring a limited baseline of atmospheric contaminants emitted by fixed and mobile sources.
- Installation of an air quality monitoring station with support from the Government of Taiwan. Designed to monitor criteria contaminants (PM₁₀, O₃) and meteorological variables in real time at a site located in the capital city.

a. Which programs have been successful, and why?

Not applicable. Only proposed initiatives exist at this time.

b. Which programs have not been successful, and why not?

n/a

c. Are there any relevant reports that you can share with USEPA?

If requested, we could share the reports mentioned in the answer to Item 18. Please let us know.

61. NGOs: Are there any non-governmental organizations or universities engaged in vehicle pollution control activities or research? Please list name and contact information (email and/or phone).

The Air Laboratory at the University of San Carlos has a study based on air quality monitoring from 1996 to 2007. There are also graduate studies and research projects carried out by students from various universities around the country.

62. Business Involvement: Have there been past or current efforts to work with fuels and vehicles business organizations? (e.g., transportation unions, fuel importers and refiners, vehicle maintenance shops, and vehicle importers)? Were these successful? Why or why not?

There has been some contact with the Vehicle Importers Association and experts in the field with respect to the proposed Regulations. Consensus has been reached with some of them.

63. Studies: Can you share any studies on emission estimates of the vehicle fleet, health impacts of air pollution, or cost/benefits of reducing vehicle pollution?

Little information exists with respect to studies focusing on air pollution and vehicle emissions. Specific mention can be made of the report titled *Air Pollution Control* by José Toledo (1996).

64. Public Outreach:

a. How would you characterize the public's level of knowledge and attitude about air pollution from vehicles?

Intermediate level, since the only topic discussed is the smoke emitted by heavy vehicles (no mention is made of the other gases produced by fuel combustion).

b. Are there any past or current public outreach campaigns on this topic?

No formal campaign has been conducted, only scant information on the topic of air quality. It should be noted that formal reports do exist concerning climate change, greenhouse gases, and climate change scenarios.

65. Challenges: What do you think future challenges might be for reducing air pollution from vehicles?

- Inform, communicate, and educate on the topic of air quality.
- Raise public awareness regarding the impacts caused by air pollution.
- Follow up on proposals for standards, specifically the Automotive Vehicle Contaminant Emissions Regulations.
- Develop point-source air quality standards.
- Strengthen institutional and individual capacities (human resources).

ATTACHMENT

Fuels and Vehicles Information Summary for Honduras

Name:	Ing. Luisa Mariela Turcios Almendares Ing. Fernando Lobo, Comision Administradora del Petroleo (CAP) Ing. Manuel Bermudez, Secretaria de Obras Publicas y Transporte (SOPTRAVI) Ing. Marcia Lopez, Secretaria de Obras Publicas y Transporte (SOPTRAVI) Ing. Manuel Rey, Proyectos Especiales de la Presidencia (Actualmente trabaja en un proyecto para sustituir diesel por biodiesel en el transporte publico) Ing. Moises Starkman, Proyectos Especiales de la Presidencia
Affiliation:	Unidad de Contaminación Atmosférica Centro de Estudios y Control de Contaminantes (CESCCO). Tel. 00 504 2311006 (Ext. 109) Cel. 00 504 96662367
E-mail:	mariela.turcios@gmail.com flobo@sic.gob.hn mebermudez@yahoo.com marcia_lopez@yahoo.com mjrey@cablecolor.hn mstarkmanp@yahoo.com

- ✦ In the questions below, we have included some information that was previously gathered.
- ✦ Please make changes, corrections, and updates as needed.
- ✦ Please try to provide the source and date of all information.

Fuels Information

66. Current Fuel Sulfur Limits, by law

a. For diesel fuel, ppm?

5,000 ppm (max)

b. For gasoline, ppm?

1,000 ppm (max)

67. What are the recent or future plans to mandate lower sulfur content of fuels?

The Central American Technical Regulations are to be reviewed this year. If there is any request from any of the five countries regarding this point, the request will be considered and, if accepted, the Regulations will be amended accordingly.

68. What plans, if any, are there for introduction of biofuels?

Honduras has already established a policy regarding this topic, which has resulted in Technical Biodiesel Regulations, Technical Regulations for Anhydrous Ethanol Fuel, and proposed Technical Regulations for Hydrated Ethanol Fuel. In addition, a Biofuels Act has been passed, and the related Decree No. 144-2007 (Biofuels Production and Consumption Act) has been issued.

69. Is there a fuel testing program in place to verify sulfur levels?

The only verification measure consists of a review of the quality certificates that accompany the shipments of refined fuel that arrive in port.

70. Do you have domestic refineries, or is most refined fuel imported? If imported, from where? Are there current or planned programs to use natural gas as a vehicle fuel?

There are no refineries. Refined products are mostly imported from the U.S. Gulf Region, the Caribbean, and Venezuela. No specific plans exist for using natural gas on a national level, and thus neither for use as vehicle fuel.

71. What agency is responsible for fuel quality standards? Please list name and contact information (email and/or phone)

The Petroleum Administration Commission of the Department of Industry and Commerce (SIC).

72. Other comments on fuels?

The same Technical Regulations apply to the five Central American signatory countries.

Vehicle Fleet Information

73. Approximately how big is the country's vehicle fleet? What is the breakdown by type of vehicle, approximate age, and diesel vs. gasoline?

74. Is there a policy on importing vehicles? How does it differ for new vs. used vehicles? How does it differ for gasoline vs. diesel vehicles?

Imported buses and public transport vehicles greater than 10 years old are prohibited, and other vehicles greater than 7 years old are prohibited (Decree 194-2002). The

distinction between new and used imported vehicles is that new vehicles are required to have an Emissions Control Certificate issued by the manufacturer.

75. Is there a law requiring vehicle inspection and maintenance (I/M) program for emissions?

- SERNA Resolution 719-1999 regulates the implementation of an I/M System for the existing vehicle fleet.
- The new Transit Regulations (2006) mentions vehicle emissions control and verification. These regulations require annual emissions checks for all vehicles and issuance of a Contaminant Gas and Smoke Emission Control Certificate.

a. If so, is the I/M program being implemented?

b. If being implemented, what are the standards and results (e.g., ppm or grams/km, % failure rate)?

c. Are there plans to implement or expand the program in the near future?

Standards (although the I/M system is not being implemented, and the laws are not specific with regard to applicability of these requirements.)

**Maximum Vehicle Emission Limits for the I/M System
Established by SERNA Resolution 719-1999**

(Applicable to all vehicles that circulate in Honduras one year after the Resolution takes effect.)

Gasoline Vehicles				
Contaminant	Unit	Emission Limit		
		1973 and Earlier Models	1974-2001 Models	2002 and Later Models*
Hydrocarbons (max)	ppm	800	600	350
Carbon Monoxide (CO) (max)	%	6.0	4.5	2.5
Carbon Dioxide (CO ₂) (min)	%	8.0	10	10
Diesel Vehicles				
Vehicle Type				Emission Limit
Vehicle Weight ≤ 3.5 tons (without turbocharger)				< 70 % opacity
Vehicle Weight ≤ 3.5 tons (with turbocharger)				< 80 % opacity
Vehicle Weight > 3.5 tons				< 80 % opacity

*CCAD noted that these limits are not very restrictive, and that any vehicle with an emissions control system could meet stricter limits than these.

Maximum Vehicle Emission Limits Established by SERNA Resolution 719-1999

(Applicable to all vehicles imported into Honduras one year after the Resolution takes effect.)

Gasoline Vehicles		
Contaminant	Unit	Emission Limit
Hydrocarbons (max)	ppm	100
Carbon Monoxide (CO) (max)	%	1.0
Carbon Dioxide (CO ₂) (min)	%	12
Diesel Vehicles		
Vehicle Type	Emission Limit	
Weight ≤ 3.5 tons (without turbocharger)	< 60 % opacity	
Weight ≤ 3.5 tons (with turbocharger)	< 70 % opacity	
Weight > 3.5 tons	< 70 % opacity	

Results (e.g, % failure rate): Unknown

d. Are there separate requirements for bus or other fleet maintenance?

According to CCAD, one main reason why the I/M program has not been implemented is the limited resources of SERNA and the fact that the I/M program is to be implemented by SERNA rather than private-sector businesses.

76. Are emission control systems required for cars?

If catalytic converters are required, what was the first model year?

Are catalytic converters frequently removed?

Yes.

77. What agency is responsible for vehicle standards? Please list name and contact information (email and/or phone)

Mainly SERNA, along with the Health Department, the National Transit Department, and the Department of Public Works, Transportation and Housing.

78. Are there any incentives applied for cleaner vehicles (e.g. non-CO2 pollutants)?

79. What is the average fuel efficiency (in L/100 km) for all light duty vehicles?

Are there policies to promote more fuel efficient vehicles?

80. Other comments on vehicles?

Program Information

- 81. Local Programs:** Please list local agencies/communities that are actively engaged in vehicle pollution control programs.
- 82. National Programs:** Please list recent or current national programs or initiatives that target vehicle pollution control. What has been their focus?
- a. Which programs have been successful, and why?
 - b. Which programs have not been successful, and why not?
 - c. Are there any relevant reports that you can share with USEPA?
- 83. NGOs:** Are there any non-governmental organizations or universities engaged in vehicle pollution control activities or research? Please list name and contact information (email and/or phone).
- 84. Business Involvement:** Have there been past or current efforts to work with fuels and vehicles business organizations? (e.g., transportation unions, fuel importers and refiners, vehicle maintenance shops, and vehicle importers)? Were these successful? Why or why not?
- 85. Studies:** Can you share any studies on emission estimates of the vehicle fleet, health impacts of air pollution, or cost/benefits of reducing vehicle pollution?
- 86. Public Outreach:**
- a. How would you characterize the public's level of knowledge and attitude about air pollution from vehicles?
 - b. Are there any past or current public outreach campaigns on this topic?
- 87. Challenges:** What do you think future challenges might be for reducing air pollution from vehicles?

Thank you very much for your participation! Please email your completed survey

to:

Ms. Erica Zell, Battelle

zelle@battelle.org

ATTACHMENT

Fuels and Vehicles Information Summary for Panama

Name:	<u>Roberto Forte, P.E., and support staff</u>
Affiliation:	<u>National Environmental Authority</u> <u>(ANAM)</u>
E-mail:	<u><roberto.forte@anam.gob.pa></u>

- ✦ In the questions below, we have included some information that was previously gathered.
- ✦ Please make changes, corrections, and updates as needed.
- ✦ Please try to provide the source and date of all information.

Fuels Information

88. Current fuel sulfur limits, by law

a. For diesel fuel, ppm?

Technical Regulations DGNTI-COPANIT 73-2007 stipulate that only the following two denominations and specifications for diesel quality may be marketed in the country:

- Grade 2D Light Diesel (S5000): Currently maximum 5000 ppm sulfur content, to be reduced to 3000 ppm starting in June 2009 and 1000 ppm starting in June 2010.
- Grade 2D Light Diesel (S500): maximum 500 ppm sulfur content.

b. For gasoline, ppm?

Technical Regulations DGNTI-COPANIT 71-381-2008 (First Revision) require a maximum of 1000 ppm, reduced to 800 ppm starting in October 2008 and 500 ppm starting in October 2009 (this reduction has not been applied yet).

89. What are the recent or future plans to mandate lower sulfur content of fuels?

See the answers to the preceding question for the sulfur content reduction chronogram set forth in the Regulations.

90. What plans, if any, are there for introduction of biofuels?

The introduction of biofuels is currently being analyzed. There are plans to permit mixtures containing 5% or less, but no regulations have been established yet.

91. Is there a fuel testing program in place to verify sulfur levels?

Cabinet Decree No. 26 dated September 17, 2003 (as amended) requires that imported products comply with the product quality requirements set forth in the Technical Regulations issued by the Bureau of Standards and Industrial Technology (DGNTI).

In addition, the Hydrocarbons Bureau can carry out quality control inspections at any time without prior notice.

No fuel testing program exists for verifying sulfur levels at service stations. All products imported for the domestic market, however, are subject to approval based upon verification of the quality specifications established in the Technical Regulations.

92. Do you have domestic refineries, or is most refined fuel imported? If imported, from where? Are there current or planned programs to use natural gas as a vehicle fuel?

Panama has no refineries. All fuels are imported, mainly from Curacao, Venezuela, Argentina, Chile, the U.S., and Columbia.

There exists no current nor planned program to use natural gas in the vehicle fleet.

93. What agency is responsible for fuel quality standards? Please list name and contact information (email and/or phone)

The agency responsible for fuels regulation and oversight is the National Hydrocarbon Secretariat, a division of the Hydrocarbons Bureau.

According to Cabinet Decree No. 26 dated September 17, 2003 (as amended), the Hydrocarbons Bureau and the Bureau of Standards and Industrial Technology set the minimum quality requirements for products sold or distributed in the domestic market, at national and international airports, and to electricity generation companies.

94. Other comments on fuels?

No further comments.

Vehicle Fleet Information

95. Approximately how big is the country's vehicle fleet? What is the breakdown by type of vehicle, approximate age, and diesel vs. gasoline?

According to the results of a study carried out by the Statistics and Census Division of the Comptroller's Office, this edition of *Panamanian Statistics (Estadística Panameña)* contained figures for the transportation sector up through 2006. For that

year it was estimated that there were 365,000 vehicles in the country. The table below shows the breakdown of the figures by vehicle type.

Vehicle Type	Total
Total	365,758
Passenger Automobiles	285,322
Passenger Automobiles (13 persons)	268,301
Pickup Truck	68,514
Coupe	10,106
Jeep	7,622
Sedan (2)	182,059
Omnibus (5 or more persons)	17,021
Minibus (3)	10,117
Omnibus	6,904
<u>Freight Transport Vehicles</u>	80,264
Truck	15,319
'Mule'	3,616
Pickup	44,644
Trailer	6,744
Panel	9,941
Others	172

It is estimated that in 2008 between 400,000 and 450,000 vehicles were circulating just in Panama City. This is not an official figure, but as soon as we can obtain more current data we will forward them.

96. Is there a policy on importing vehicles? How does it differ for new vs. used vehicles? How does it differ for gasoline vs. diesel vehicles?

Yes. Imported new vehicles after 1998 must have a certificate of emissions compliance with Panama standards, and used vehicles must have a certificate of emissions compliance from the country of export.

There are various policies in the country that cover vehicle importation aspects and establish environmental protection measures regarding contamination produced by vehicle emissions.

One example is Preliminary Bill No. 157, which includes Bill 131 (Used Vehicle Import Standards), submitted on September 7, 2005.

Law 36 dated May 17, 1996 (Controls to Prevent Environmental Contamination Caused by Fuels and Lead), states in Article 9: Starting in 2002, only the sale of unleaded gas will be allowed (with the exception of aviation fuel).

97. Is there a law requiring a vehicle inspection and maintenance (I/M) program for emissions?

No. The Preliminary Bill for Vehicle Emissions Environmental Standards, however, which is currently awaiting Presidential signature prior to publication in the *Official Gazette*, includes annual vehicle emissions testing. The test results will be included in the Annual Vehicle Registration, which is used to evaluate the vehicles that circulate in the country and determine whether they comply with current standards.

a. If so, is the I/M program being implemented?

Once the Preliminary Bill for Vehicle Emissions Environmental Standards is approved, it is expected that in 2010 the Transit and Ground Transportation Authority will begin implementing the systems, equipment, facilities, and training need to monitor vehicle emissions.

b. If being implemented, what are the standards and results (e.g., ppm or grams/km, % failure rate)?

The Preliminary Bill for Vehicle Emissions Environmental Standards sets forth the following:

Vehicles that Use Gasoline or Alternative Fuels

Vehicle Type	Parameter	Allowed Limit	Testing Conditions
Model with pre-1999 engine	Carbon Monoxide (CO)	Max: 4.5% ^a	Idle (Low: 800-1000 rpm; High: 2500 ±300 rpm)
	Carbon Dioxide (CO ₂)	Min: 10.5%	
	Raw Hydrocarbons (HC)	Max: 500 ppm	
Model with 1999 or later engine (with catalytic converter)	Carbon Monoxide (CO)	Max: 0.5%	Idle (Low: 800-1000 rpm; High: 2500 ±300 rpm)
	Carbon Dioxide (CO ₂)	Min: 12.5%	
	Raw Hydrocarbons (HC)	Max: 125 ppm	

^a To convert percentage to ppm, divide the percentage by 0.0001.

^b To the convert ppm to percentage, multiply by 0.0001 (1 ppm = 0.0001%).

Vehicles that Use Diesel

Vehicle Type	Parameter	Allowed Limit	Testing Conditions
Gross weight < 3.5 tons	Opacity	60 UH (%)	Free acceleration
Gross weight ≥ 3.5 tons	Opacity	70 UH (%)	Free acceleration

1UH: 1%

c. Are there plans to implement or expand the program in the near future?

Implementation is expected to begin in 2010.

d. Are there separate requirements for bus or other fleet maintenance?

Executive Decree No. 273, dated August 25, 1993 (Regulations for granting administrative concessions to shops or companies for annual vehicle inspection; and Requirements for obtaining the Inspection Certificate or passing the Annual Vehicle Inspection). This decree specifies by vehicle type the requirements for passing Vehicle Inspection.

98. Are emission control systems required for cars? Yes. (Please describe.)

If catalytic converters are required, what was the first model year? 1998

Are catalytic converters frequently removed? No.

99. What agency is responsible for vehicle standards? Please list name and contact information (e-mail and/or phone).

In Panama, three institutions are responsible for dealing with vehicle emissions: the ANAM, the Department of Health, and the Transit and Ground Transportation Authority (ATTT).

100. Are there any incentives applied for cleaner vehicles (e.g. non-CO₂ pollutants)?

Not at this time.

101. What is the average fuel efficiency (in L/100 km) for all light duty vehicles? Are there policies to promote more fuel efficient vehicles?

This information could not be obtained.

102. Other comments on vehicles?

No.

Program Information

103. Local Programs: Please list local agencies/communities that are actively engaged in vehicle pollution control programs.

The National Environmental Authority, together with the Transit and Ground Transportation Authority, the Panamanian Association of Auto Shops, and the Panamanian Association of Automobile Distributors, launched the *Drive and Clean Up Your Environment* awareness campaign in September 2008. The campaign covers various activities for disseminating information and training people concerning the Preliminary Bill for Vehicle Emissions Environmental Standards. The campaign kicked off a series of dissemination and training activities starting in December 2008, when a training course was given to shop owners and institutional personnel regarding the provisions of the new legislation and the testing methodology to be applied. In addition, a six-month program was developed for offering free testing at shops located throughout the city, where vehicle owners would be given explanations concerning the status of their vehicles and whether the emission levels measured are within the limits that will subsequently take effect. During other activities, information brochures were handed out, sweaters were given away, etc.

The interactive link provided below was developed in order to present all information related to the campaign, the current trends based on tests performed by the Specialized Analysis Institute (SAI), and all necessary information regarding projects, institutions, and data related to air quality in Panama.

<http://www.anam.gob.pa/joomla/images/stories/emisiones/Emisiones.html>

http://www.anam.gob.pa/joomla/index.php?option=com_content&view=article&id=17&Itemid=90

104. National Programs: Please list recent or current national programs or initiatives that target vehicle pollution control. What has been their focus?

a. Which programs have been successful, and why?

See the answer to Item 16. It is worth mentioning that, besides the free monitoring activities beginning in 2008 and running through the first six months of 2009, there was also an event called Air Quality Management in Panama. The event was open to the private and public sectors and the community at large. Presentations were given by the National Environmental Authority, the Specialized Analysis Institute, and technicians specialized in monitoring equipment and methodologies.

b. Which programs have not been successful, and why not?

c. Are there any relevant reports that you can share with USEPA?

The following studies are available:

- Swiss Contact 2000 (analysis using data obtained from the SAI)

- Scientific-Technical Air Quality Study 2005
 - Republic of Panama Environmental Indicators 2006
 - Contamination Sources Location Registry
- http://www.anam.gob.pa/joomla/index.php?option=com_content&view=article&id=28&Itemid=399 (This link contains the Preliminary Bills for Fixed and Mobile Emissions Standards along with the respective Technical-Scientific Document.)

105. NGOs: Are there any non-governmental organizations or universities engaged in vehicle pollution control activities or research? Please list name and contact information (email and/or phone).

The Technological University of Panama, through the Specialized Analysis Institute (Vasco Duke, <vascoduke@cwpanama.net>).

106. Business Involvement: Have there been past or current efforts to work with fuels and vehicles business organizations? (e.g., transportation unions, fuel importers and refiners, vehicle maintenance shops, and vehicle importers)? Were these successful? Why or why not?

The National Environmental Authority signed an agreement with the Panamanian Association of Auto Shops to develop a free testing program for Semester I 2009. Next we will be developing the activity program for Semester II 2009. Likewise, the Transit and Ground Transportation Authority will be *(original text cut off)*

107. Studies: Can you share any studies on emission estimates of the vehicle fleet, health impacts of air pollution, or cost/benefits of reducing vehicle pollution?

The following studies are available:

- Swiss Contact 2000 (analysis using data obtained from the SAI)
 - Scientific-Technical Air Quality Study 2005
 - Republic of Panama Environmental Indicators 2006
 - Contamination Sources Location Registry
- http://www.anam.gob.pa/joomla/index.php?option=com_content&view=article&id=28&Itemid=399 (This link contains the Preliminary Bills for Fixed and Mobile Emissions Standards along with the respective Technical-Scientific Document.)

108. Public Outreach:

a. How would you characterize the public's level of knowledge and attitude about air pollution from vehicles?

We have no knowledge of studies in that sense, but public awareness campaigns are being developed. The investments being considered with respect to environmental issues include the development of an environmental management system covering plans, programs, and strategies for disseminating information and raising public awareness regarding air quality issues.

b. Are there any past or current public outreach campaigns on this topic?

We have seen some samples of public outreach materials in Panama that appear to address vehicles. Can you describe these campaigns and provide materials electronically?

109. Challenges: What do you think future challenges might be for reducing air pollution from vehicles?

1. Effective follow-up, control, and oversight of the requirements set forth in the new Preliminary Standards Bill once same has been approved.
2. Development of capacities and infrastructure for the institutions involved in air quality issues.
3. Development of an air quality management model that includes an updated emissions inventory, impact mitigation and prevention strategies, and an assessment of the number of monitoring stations needed nationwide and whether the current stations should be relocated in light of the changes that have occurred in the highway network and zoning codes in general.
4. Development of studies that link air quality status and respiratory illnesses. Such studies should also show the costs incurred by the government to provide public health care services.
5. Development of effective awareness systems and campaigns so that the public will stay informed and take the necessary measures to reduce vehicle emissions.

**Thank you very much for your participation! Please email your completed survey to:
Ms. Erica Zell, Battelle
zelle@battelle.org**

Appendix B

Bodies Regulating Fuels in Various Countries

Bodies Regulating Fuels in Various Countries

Costa Rica: Costa Rican Petroleum Refining Institute (RECOPE), a state-owned enterprise under the Ministry of the Environment, Energy and Telecommunications (MINAET)

Dominican Republic: Director General of Standards and Quality Systems (DIGENOR)

El Salvador: Ministry of Economy, Hydrocarbons and Mines, and Ministry of Natural Resources (MARN-SV), and Vice Minister of Transportation

Guatemala: Hydrocarbon Department of the Ministry of Energy and Mining

Honduras: Petroleum Administration Commission of the Department of Industry and Commerce (SIC).

Nicaragua: The Nicaragua Institute of Energy, in conjunction with MARENA

Panama: Ministry of Commerce and Industry (MICI), and Hydrocarbons and Alternative Energy, and Ministry of the Environment (ANAM)