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Cleaning Up Latin America's Air: Reducing Black Carbon Emissions Can Benefit the Climate and Public Health Quickly

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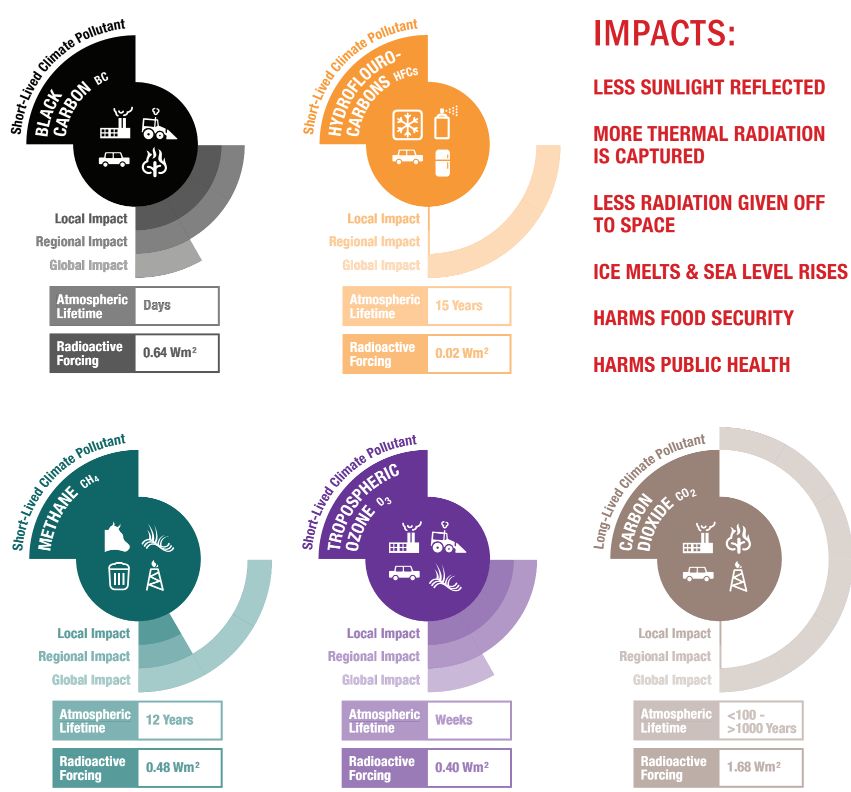
Black carbon is one of four major short-lived climate pollutants (SLCPs) that remain in the atmosphere for a relatively short period of time compared to other greenhouse gases, such as CO_2 (see Figure 1). Among SLCPs, black carbon has the shortest lifetime—staying in the atmosphere for only days or weeks. Thus, reducing black carbon emissions provides benefits almost immediately.[1] Recent studies have shown that black carbon is the second most powerful climate warming pollutant after CO_2[2,3] and international experts have linked it to cancer and other serious health problems[4]—providing an even stronger incentive to prioritize reducing these emissions.

Black carbon is released from a wide variety of combustion sources including open biomass burning (e.g., wildfires), domestic stoves and industry. In Latin America, however, the transportation sector is the largest source of human-generated black carbon emissions.[5, 6] Within the transportation sector, high-emitting diesel vehicles emit the most black carbon. This is a function of two factors: (1) the high concentration of black carbon within the carbon core of a typical diesel particle and (2) the increasing number of diesel vehicles in the region.

Without strong policies to reduce black carbon emissions, Latin America's transportation sector will continue to exacerbate global climate change and threaten local public health. Fortunately, those policies have already been proven in other countries, and have reduced black carbon emissions

Figure 1: Explanation of short-lived climate pollutants (SLCPs)



Source: Climate and Clean Air Coalition and the IPCC Fifth Assessment Report up to 99 percent.[7] In their new report, *Dumping Dirty Diesels in Latin America: Reducing Black Carbon and Air Pollution from Diesel Engines in Latin America*, Gladstein, Neandross and Associates (GNA) and NRDC take a closer look at the current black carbon situation in 15 Latin American countries and outline policies that can help clean up the region's air.

BLACK CARBON'S CLIMATE IMPACTS

As research into the impacts of black carbon emissions continues, consensus is emerging that, globally, black carbon emissions accelerate the melting of glaciers, snow and ice as well as impact temperature and weather patterns in the Arctic and many alpine regions. In addition, black carbon emissions may also affect photosynthesis, reduce the quantity or quality of water for agriculture, and reduce visibility.[8, 9, 10]

Research about the local climate impacts of black carbon emissions in Latin America reflects the global trends. For example, the surface area of the Andean glaciers has diminished significantly over the past three decades. Compared to 1964–1975, the loss of glacial surface area has nearly quadrupled in scale through 2010.[11,12] This drastic decline impacts the 85 million people who live in the Andean regions of Argentina, Bolivia, Chile, Colombia, Ecuador, Peru, and Venezuela.[13] Of these people, 20 million rely on Andean glaciers for drinking water and agriculture.[14] Shrinking glaciers are also a major concern for the region's hydroelectric power generation. In addition, black carbon emissions have reduced evaporation rates and atmospheric moisture, continually decreasing rainfall throughout the Amazon Basin and surrounding areas.[15, 16, 17]

BLACK CARBON'S PUBLIC HEALTH IMPACTS

Black carbon is a component of particulate matter (often referred to simply as PM), a complex mixture of extremely small particles and liquid droplets in the atmosphere. The most common source of transportation-related particulate matter is diesel engine combustion.[18] Because the core of a diesel particle is typically comprised of black carbon, diesel engine combustion is *also* the most common source of transportation-related black carbon. Thus, reducing black carbon also means reducing particulate matter.[i]

Both black carbon and particulate matter pose serious health threats. Experts have found links between black carbon exposure and decreased vascular and respiratory function, including thrombosis, acute respiratory symptoms, aggravated asthma symptoms, and lung inflammation.[19] Moreover, the World Health Organization (WHO) has determined that exposure to outdoor air pollution, diesel exhaust, and particulate matter cause cancer.[20, 21]

Although some studies have been conducted (e.g., in Santiago, Chile), there is a lack of sufficient information and data regarding black carbon's specific health impacts in Latin America. This research should be a priority for policy makers, since the expanding use of diesel fuels and vehicles in Latin America as a whole, coupled with the incredibly high rates of urbanization in the region mean that increasing numbers of people there are being exposed to fumes that harm their health, damage their local environments and aggravate the global problem of climate change. One study has shown that, by implementing specific measures to reduce black carbon and methane emissions, the Andean region could avoid 27,000 premature deaths annually.[22]

Although more focused and localized studies about the full extent and implications of black carbon emissions in Latin America are clearly still needed, we do know that the problem is serious. We also know that cost-effective solutions exist and that governments can implement those solutions now. Policy efforts to reduce diesel emissions—and therefore black carbon emissions—to very low levels have been highly successful where implemented, such as in the United States and Europe, demonstrating the potential to combat climate change and a range of public health threats.

i Some particulate matter reduction strategies will reduce black carbon, but not all. For example, limiting sulfur levels in diesel fuel to no more than 50 ppm and installing diesel particulate matter filters will reduce both particulate matter and black carbon. In contrast, reducing sulfur levels in diesel fuel from 5,000 ppm to 500 ppm will reduce particulate matter levels, but will not affect black carbon.

A "SYSTEMS APPROACH" TO REDUCING BLACK CARBON EMISSIONS FROM TRANSPORTATION

In Latin America, evidence shows that black carbon contributes to glacial melting in the Andes and Patagonia, declining moisture in the Amazon Basin, and illness and premature deaths from outdoor air pollution. Because the largest source of human-generated black carbon in Latin America is transportation—particularly diesel fuels and vehicles—minimizing emissions from that sector with vehicle and fuel regulations is the most direct way to address those impacts. We recommend a "systems approach" that has successfully reduced diesel particulate matter and black carbon emissions in the United States, Canada, Europe, and elsewhere. There are three main components of this systems approach, as follows:

- **Clean fuels:** Latin America's top priority is to widely adopt fuel standards to reduce sulfur levels to ultra-low levels, that is, below 50 ppm and ideally below 15 ppm. Reaching ultra-low sulfur levels will reduce particulate matter emissions from all vehicles and enable the use of advanced vehicle emission control technologies that can eliminate more than 90 percent of black carbon emissions. Currently, Chile is the only country to both adopt and implement ultra-low sulfur diesel standards below 15 ppm. Mexico, despite adoption in 2009, has yet to implement its standards, though it has signaled an intention to revise fuel regulations in 2014 and to implement an ultra-low sulfur requirement in the near future. Colombia and Uruguay have 50 ppm sulfur standards.

- **Stringent emissions standards for new vehicles:** Once ultra-low sulfur fuel standards are in place, nations can mandate installation of diesel particulate filters or comparably effective emerging alternative fuels or advanced vehicle technologies (e.g., vehicles powered by natural gas, hybrid-electric or electric power). Diesel particulate filters and other advanced emission controls are damaged or destroyed by high-sulfur fuels, so ultra-low sulfur diesel fuels represent a critical first step. By holding urban buses to the U.S. Environmental Protection Agency's (EPA) 2007 standards, Chile is leading the way. As it adopts new standards, Mexico is likely to join Chile's ranks.

- **Complementary programs to reduce in-use emissions from existing vehicles:** Because so many older, high-emitting vehicles will remain on the road for years to come, countries should consider complementary programs to reduce in-use emissions from their existing diesel fleets. The most successful of these programs has targeted urban fleets, which focus on high-emitting, centrally fueled fleets. For example, in Santiago, Chile, more than 2,000 city buses have been *retrofitted* with diesel particulate filters.[23] Low-Emissions Zones, which restrict vehicle access to urban centers according to emission levels, have proven successful in Europe.[24] Small *scrappage programs* are being implemented in Mexico, Colombia, and Chile, under which owners of the oldest, dirtiest trucks receive financial incentives to replace them with cleaner, more fuel-efficient models.[25] More than 45 Latin American cities have implemented new *Bus Rapid Transit* routes that use clean buses to replace aging, high-emitting buses.[26] Finally, in-use *emissions monitoring* helps ensure and improve fuel quality and support in-use emissions maintenance programs.

Figure 2: Map of Latin American countries surveyed with corresponding fuel sulfur levels

Source: Map adapted from the UNEP's Partnership for Clean Fuels and Vehicles

Table 1: Summary table of key indicators for the countries surveyed in this report

COUNTRY	National Annual PM_{10} and $PM_{2.5}$ Standards[27*]	Maximum Sulfur Level in Diesel Fuel	Road Sector Diesel Use (kilotons of oil equivalent by year)	Number of Registered Vehicles[28]	Emissions Standards for New Vehicles[29*]
ARGENTINA[30]	PM_{10}: None $PM_{2.5}$: None	1,500 ppm (500 in Buenos Aires, Rosario, Mar del Plata, and Bahía Blanca)	7,212 (2008)	11 MM (2011)	LDV, HDV, and Buses: Euro V[31]
BOLIVIA[32]	PM_{10}: 50 μg/m^3 $PM_{2.5}$: None	5,000 ppm	1,058 (2010)	1.1 MM (2011)	Buses: Euro III (La Paz)[33]
BRAZIL	PM_{10}: 50 μg/m^3 $PM_{2.5}$: None	1,800 ppm (Between 50 and 500 in major cities) [34]	28,732 (2009)[35]	64.8 MM (2010)[36]	LDV: Euro IV HDV: Euro V
CHILE	PM_{10}: 50 μg/m^3 $PM_{2.5}$: 20 μg/m^3	15 ppm[37]	3,534 (2010)[38]	3.4 MM (2010)[39]	LDV and MDV: Euro V HDV: Euro V (from Sept. 2014) Buses: U.S. 2004 NO_x / U.S. 2007 PM[40]
COLOMBIA[41]	PM_{10}: 50 μg/m^3 $PM_{2.5}$: 25 μg/m^3	50 ppm[42]	3,754 (2010)	7.2 MM (2011)	LDV: Euro IV HDV: Euro IV (from 2015) Buses: Euro II
ECUADOR[43]	PM_{10}: 50 μg/m^3 $PM_{2.5}$: 15 μg/m^3	5,000 ppm (500 in Quito and Cuenca)[44]	2,415 (2010)	1.4 MM (2011)	LDV: Euro I / U.S. 1987 HDV: Euro II / U.S. 1994
EL SALVADOR[45]	PM_{10}: 50 μg/m^3 $PM_{2.5}$: 15 μg/m^3	5,000 ppm	Levels unknown	0.7 MM (2012)	LDV: Euro I / U.S. 1987
GUATEMALA[46]	PM_{10}: None $PM_{2.5}$: None	5,000 ppm	Levels unknown	2.1 MM (2010)	None
HONDURAS[47]	PM_{10}: None $PM_{2.5}$: None	5,000 ppm	Levels unknown	1.2MM (2012)	None
MEXICO	PM_{10}: 50 μg/m^3 $PM_{2.5}$: 15 μg/m^3	15 ppm, but most diesel is 300 ppm[48]	13,767 (2009)[49]	30.2 MM (2011)	All: Euro IV / U.S. 2004
NICARAGUA[50]	PM_{10}: 50 μg/m^3 $PM_{2.5}$: None	5,000 ppm	Levels unknown	0.6 MM (2012)	None
PARAGUAY[51]	PM_{10}: None $PM_{2.5}$: None	2,500 ppm	1,039 (2010)	1.15 MM (2013)	None enforced
PERU[54]	PM_{10}: 50 μg/m^3 $PM_{2.5}$: 25 μg/m^3	5,000 ppm (15 in Lima and Callao)	3,426 (2010)	2.6 MM (2011)	LDV and HDV: Euro III Buses: Euro IV (Lima)
URUGUAY[52]	PM_{10}: None $PM_{2.5}$: None	50 ppm[53]	582 (2010)	1.6MM (2011)	All: Euro III
VENEZUELA	PM_{10}: 50 μg/m^3 $PM_{2.5}$: None	2,000 ppm[54]	2,909 (2010)[55]	4.4 MM (2011)	HDV: Euro I / U.S. 1991[56]

*This column lists the types of regulations—using the U.S. or European systems—that are already in place for light duty vehicles (LDV), heavy duty vehicles (HDV) and/or buses in each country. For further information, see Appendix 3: U.S. and E.U. Heavy-Duty Diesel Engines Emission Standards" in the full report, *Dumping Dirty Diesels in Latin America*.

Some countries have adopted more stringent PM_{10} and/or $PM_{2.5}$ standards for their major cities. For example, La Paz, Bolivia, has adopted WHO-equivalent annual PM_{10} and $PM_{2.5}$ standards of 20 and 10 μg/m^3, respectively. Also, Montevideo, Uruguay has adopted an annual PM10 standard of 60 μg/m^3.

In addition to these policy recommendations, Latin America will benefit from more extensive air quality monitoring. Currently, half of the 16 countries reached for this analysis monitor for fine particulate matter ($PM_{2.5}$)—and then mainly only in major cities. Because black carbon is a component of fine particulate matter, monitoring for the latter is a critical step towards understanding the scope of the problem and the need for solutions. With improved air quality monitoring, public education and communications campaigns can educate the public about the link between diesel pollution, public health and climate change, and thereby help to catalyze progress towards better government policies.

Dumping Dirty Diesels in Latin America: Reducing Black Carbon and Air Pollution from Diesel Engines in Latin America summarizes the latest research on black carbon and its role in global warming, and consolidates research NRDC and GNA conducted over the past year. Some of the most pertinent information about the 15 countries we researched is summarized in Table 1 above.

If policymakers follow the systems approach—relying on proven fuels, technologies, and strategies—black carbon emissions will be significantly reduced in Latin America, providing important climate, public health, and other environmental benefits to hundreds of millions of people locally and globally.

Endnotes

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