

## BRIEFING

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SERIES: GLOBAL TRANSPORTATION ROADMAP

OCTOBER 2013

# The Impact of Stringent Fuel and Vehicle Standards on Premature Mortality and Emissions: Brazil in the Global Context

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Brazil accounts for 3.5 percent of all early deaths worldwide from exposure to urban vehicle particle emissions and approximately 31 percent of early deaths in Latin America. Brazil has moved quickly to control vehicle emissions, with the result that early deaths from exposure to vehicle emissions are projected to decline by 50 percent in 2030, relative to current levels. In contrast, significant increases in early deaths are expected in the rest of the Latin American region.<sup>1</sup> If Brazil were to go one step further and adopt the best available controls on vehicles and fuels, it could cut health impacts by an additional two-thirds, avoiding 2,400 early deaths in 2030 alone and adding 260,000 years of life cumulatively through 2030.

A forthcoming ICCT report, *The Impact of Stringent Fuel and Vehicle Standards on Premature Mortality and Emissions* (scheduled for release in November 2013) describes urban particle emissions and health impacts in the transportation sector through the year 2030.<sup>2</sup> The study finds that on a global scale, the health impacts from exposure to urban vehicle particle emissions will increase 150 percent by 2030 unless new policies are adopted. The report presents a global policy roadmap for cleaner vehicles and fuels and finds that aggressive actions to limit vehicle emissions throughout the world could reduce health impacts to two-thirds below current levels, adding 25 million years of life cumulatively.<sup>3</sup>

Brazil implemented Proconve's P-7 standards for heavy-duty vehicles (HDVs) in 2012 and is in the process of implementing L-6 standards for light-duty vehicles (LDVs) between 2013 and 2015. In parallel with these new vehicle emission regulations, Brazil has adopted a timeline for lower sulfur fuels. Major metropolitan areas and select stations nationwide will receive 10 ppm diesel starting in 2013 to supply new P-7 trucks

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1 Under baseline policies, the share of health impacts in Brazil will decrease from 31 percent of the total for Latin America in 2010 to 11 percent in 2030.

2 This is part of the ICCT's roadmap series of global analyses of the impacts of clean transportation policies on health, energy, and climate; see <http://www.theicct.org/transportation-roadmap>.

3 New policies would reduce health impacts worldwide by 67 percent below 2013 levels and 77 percent compared to a 2030 baseline.

and buses. All other regions will reduce diesel fuel sulfur levels from 1,800 ppm to 500 ppm by 2014. Gasoline fuel sulfur levels will decline as well, from 1,000 ppm to 50 ppm in 2014 when L-6 standards come into force.

Brazil is a leader among Latin American countries and among emerging economies in adopting limits on vehicle emissions. Despite its efforts thus far, however, Brazil still suffers serious health impacts from vehicle emissions. A move toward the best available vehicle emission and fuel quality standards would produce dramatic additional benefits for air quality and human health. Based on these findings, Brazil needs to immediately advance to the next set of standards for commercial diesel vehicles. Proconve’s P-8 standards, which are equivalent to Euro VI standards adopted in Europe, should require the latest emission control technologies for particulate matter and nitrogen oxides. Moving toward Euro 6-equivalent standards for LDVs and replacing 500 ppm with 10 ppm diesel nationwide would ensure additional health benefits.

## STUDY APPROACH

*The Impact of Stringent Fuel and Vehicle Standards on Premature Mortality and Emissions* assesses the benefits of worldwide adoption of tighter limits on vehicle emissions and fuel sulfur content in sixteen regions. This regional perspective enables comparisons of trends in vehicle activity, emissions, and related health outcomes under various scenarios, including a baseline scenario assuming no new policies and an accelerated policy scenario assuming aggressive but pragmatic adoption of the best available control technologies worldwide. The report presents a global policy roadmap that informs the accelerated policy scenario and that is sensitive to the administrative and technical barriers in each region. Table 1 gives details of the policy scenarios developed for Brazil.

**Table 1.** Baseline versus accelerated policies for controlling vehicle emissions in Brazil

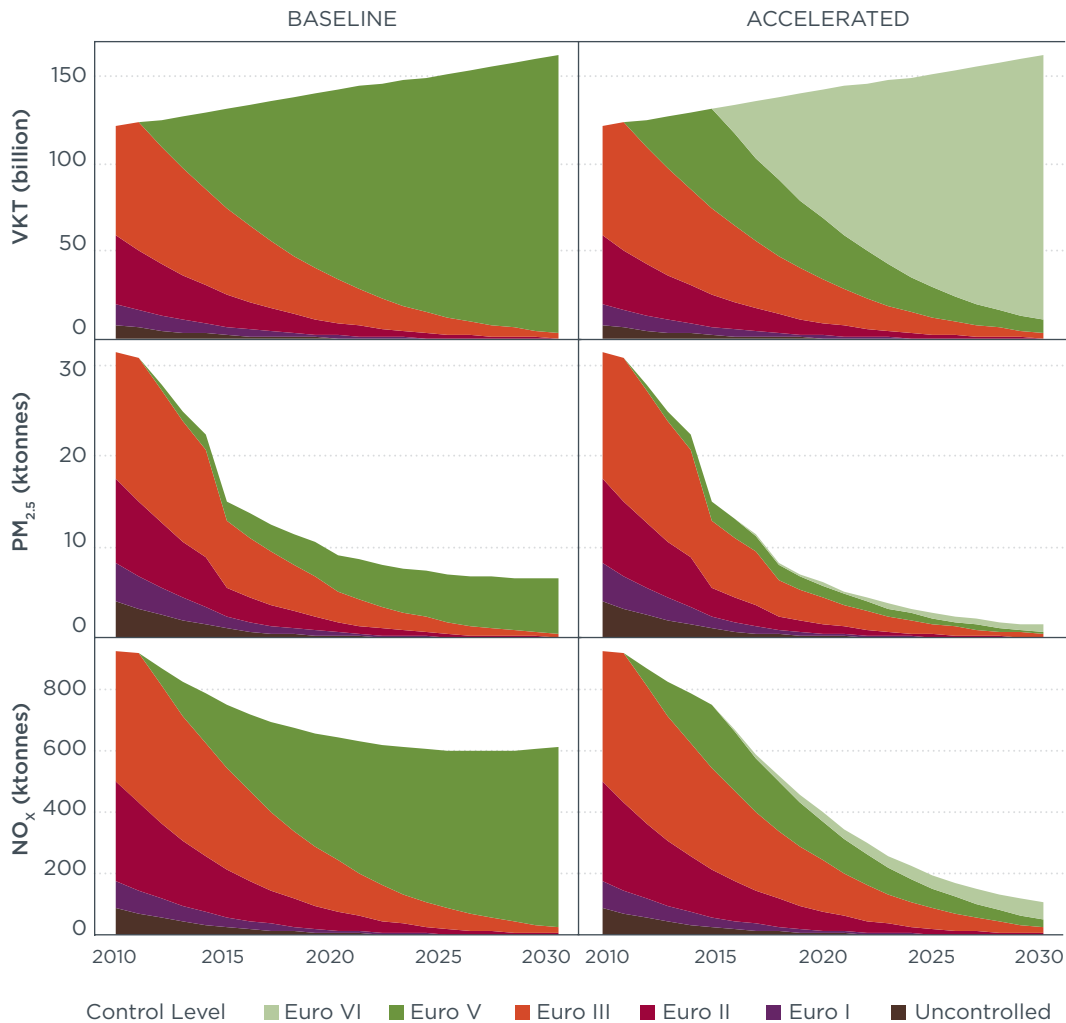
SCENARIOS	EMISSION STANDARDS	FUEL STANDARDS	VEHICLES WITH MINIMAL EMISSION CONTROLS <sup>4</sup>
<b>Baseline</b>	P-7/Euro V in 2012 (HDVs); L-6/Euro 5 in 2013-2015 (LDVs) <sup>1</sup>	Ultra-low sulfur diesel (10 ppm) in major metropolitan areas and select stations by 2013; 500 ppm sulfur diesel in rest of Brazil by 2014.	25% of vehicle fleet have minimal or no emission controls in 2010; less than 2% by 2020 due to turnover
<b>Accelerated</b>	Euro VI-equivalent in 2016 (HDVs); Euro 6-equivalent in 2017 and Tier 3 in 2025 (LDVs)	Ultra-low sulfur diesel (10 ppm) nationwide by 2018	No change from baseline

1 Brazil’s standards for light-duty vehicles do not follow the European system of vehicle standards, and L-6 standards are equivalent to Euro 4 or 5, depending on the pollutant.

4 Gross emitters are defined as vehicles with minimal (Euro I) or no emission controls. The share of gross emitters is estimated based on the historical progression of emission standards.

## TRENDS IN VEHICLE EMISSIONS

Diesel vehicles, primarily heavy-duty trucks and buses in most regions, are major sources of fine particulate pollution and therefore prime targets for reducing  $PM_{2.5}$ .<sup>5</sup> In 2010, diesel HDVs accounted for over 80 percent of emissions of  $PM_{2.5}$  from vehicles worldwide, and over 90 percent of  $PM_{2.5}$  emissions in Brazil. The 2012 implementation of P-7 standards (equivalent to Euro V) goes a long way toward reducing emissions of fine particles from HDVs, with new vehicles emitting about one-quarter the  $PM_{2.5}$  of vehicles under the previous standard. Moving to Euro VI-equivalent standards (P-8), however, could further cut  $PM_{2.5}$  from new diesel HDVs by 90 percent. Doing so would reduce  $PM_{2.5}$  from diesel HDVs by 80 percent, and on-road  $PM_{2.5}$  by 70 percent, compared to the 2030 baseline (see Figure 1).

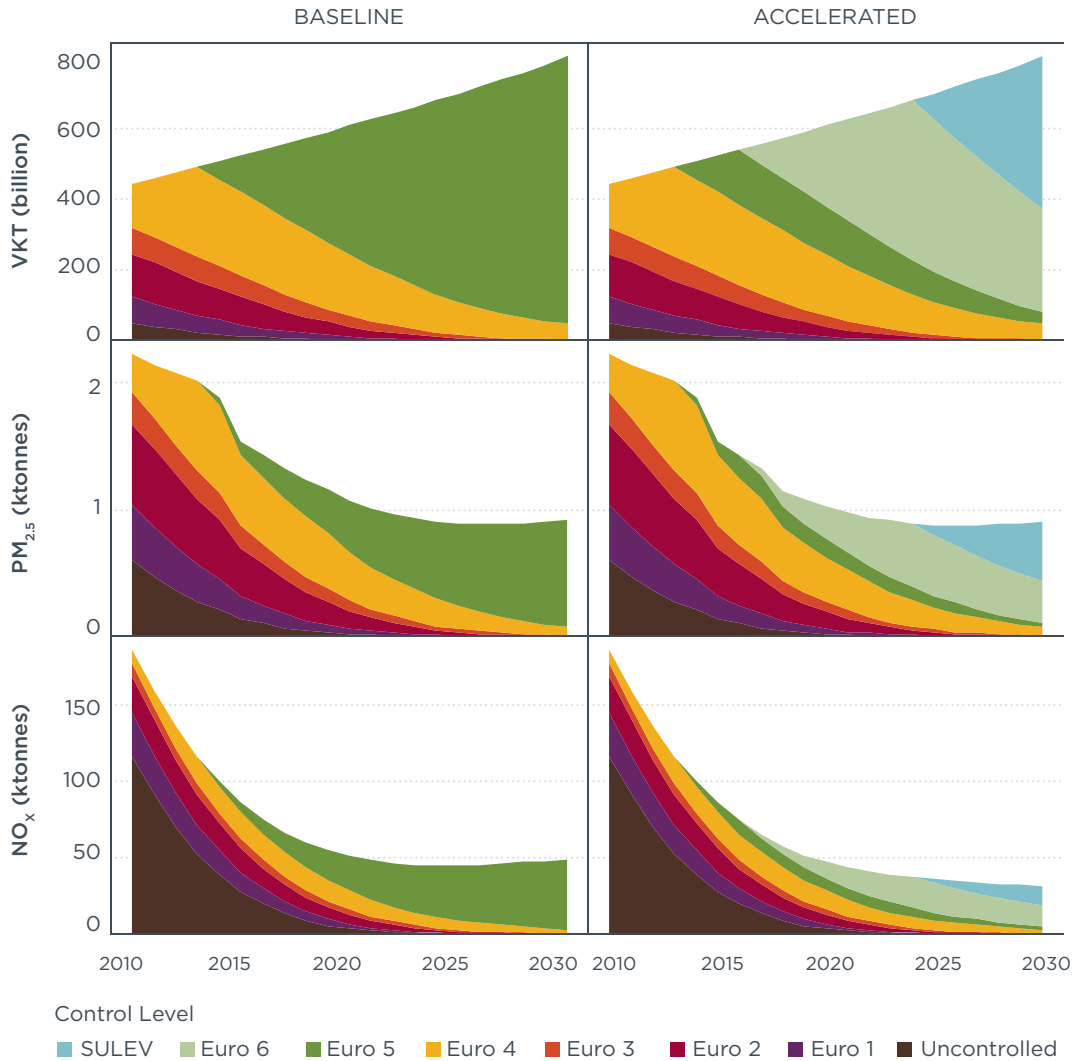


**Figure 1.** Vehicle-kilometers traveled (VKT) and emissions from heavy-duty vehicles

Tighter emission limits for LDVs are increasingly important as demand for personal mobility grows in Brazil (see Figure 2). For LDVs, next-generation standards (labeled “SULEV” in figures) are based on proposed US Tier 3 standards and California’s LEV III standards.

5 Particulate matter with diameter less than 2.5 microns.

These require significant reductions in NO<sub>x</sub> and HC from Euro 6 levels, as well as a further tightening of PM<sub>2.5</sub> emission limits. The new limits for light-duty PM<sub>2.5</sub> are not likely to require new technology for diesel vehicles; however, these could prevent an increase in emissions from fuel-efficient gasoline direct injection vehicles, which can have higher PM<sub>2.5</sub> emissions than conventional gasoline engines even under Euro 6 limits.<sup>6</sup> Introducing Euro 6 in 2017 followed by next-generation standards in 2025 could reduce LDV NO<sub>x</sub> emissions by 36 percent in 2030. Reductions would be greater with more rapid adoption.



**Figure 2.** Vehicle-kilometers traveled (VKT) and emissions from light-duty vehicles

Baseline estimates of on-road emissions in Brazil are well understood. *The Impact of Stringent Fuel and Vehicle Standards on Premature Mortality and Emissions* estimates that on-road vehicles in Brazil emitted 1.1 million tonnes of NO<sub>x</sub> and 35,000 tonnes of PM<sub>2.5</sub> in 2010. These values are within about 10 percent of estimates from Brazil’s official inventory

<sup>6</sup> Vehicles fitted with diesel particulate filters (DPFs) currently overcomply with Euro 6 PM<sub>2.5</sub> limits, testing at less than 1mg/km. Euro 5 and 6 introduced gasoline PM2 limits in reaction to an increased market share of gas direct injection (GDI) vehicles, which can have significantly higher PM emissions than traditional gasoline vehicles. GDI vehicles may be able to meet the Euro 6 PM standard through in-cylinder technology, but a tightening of PM limits and the addition of a particle number limit may require that GDI vehicles be equipped with particulate filters (Borken-Kleefeld and Ntziachristos 2012).

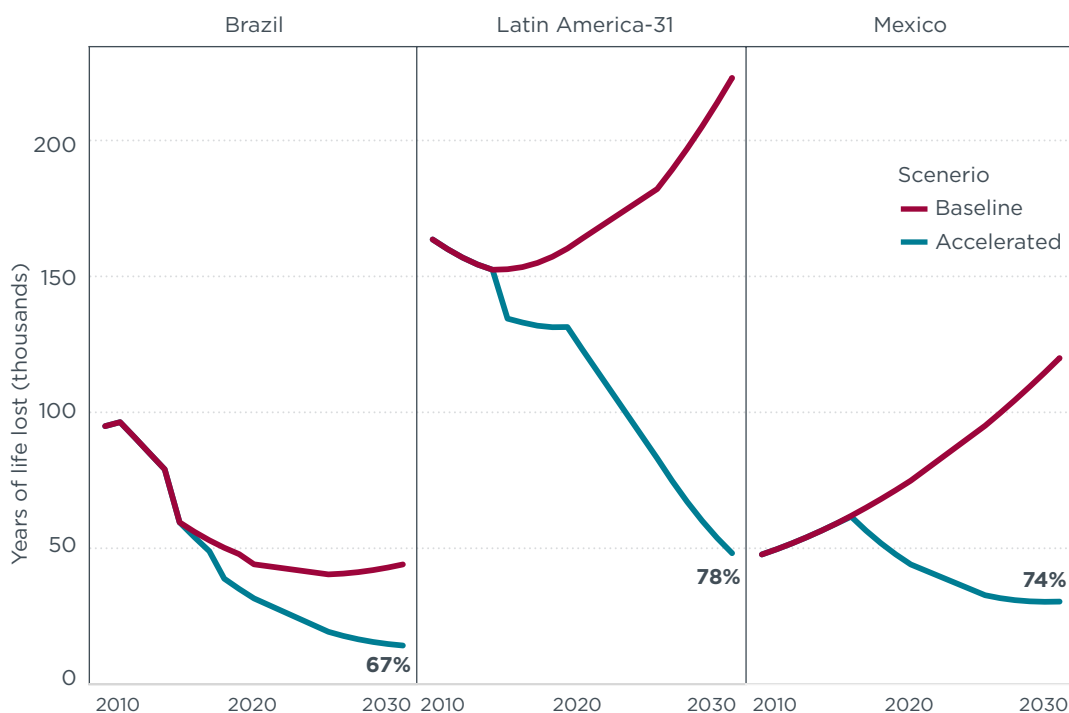
of on-road transportation emissions (MMA).<sup>7</sup> Close alignment of this study with official statistics provides additional weight to the policy implications drawn from these data.

## TRENDS IN HEALTH IMPACTS

Worldwide implementation of new limits on vehicle emissions and fuel sulfur content could avoid 210,000 early deaths in 2030, near the center of the range (120,000 to 280,000) estimated by similar studies.<sup>8</sup> Conclusions about the benefits of policy actions are consistent across studies.

Actions taken already in Brazil will yield a roughly 50 percent reduction in health impacts through 2025 without further efforts to reduce emissions; however, health impacts could begin to increase again starting in 2025 (see Figure 3). New policies in Brazil would accelerate and sustain reductions in health impacts, putting Brazil on the same level by 2030 as early adopters of Euro 6/VI-equivalent standards. Together, these new policies would cut health impacts in Brazil by 67 percent, avoiding 2,400 early deaths in 2030 alone and adding 260,000 years of life cumulatively through 2030.

Other countries in Latin America have made less progress than Brazil. Most of these countries are still at Euro 3/III control levels. New policies in Mexico and other countries in Latin America could cut health impacts by 74 and 78 percent, respectively, compared to the baseline in 2030.



**Figure 3.** Annual years of life lost from premature mortality due to road  $PM_{2.5}$  exposure, and annual years of life gained in 2030 with accelerated policies. Data labels indicate percent reduction in years of life lost under accelerated policies compared to the baseline in 2030.

7 Ministério do Meio Ambiente (2011). 1o Inventário Nacional de Emissões Atmosféricas por Veículos Automotores Rodoviários, Relatório Final.

8 Shindell, D., Faluvegi, G., Walsh, M., Anenberg, S. C., van Dingenen, R., Muller, N. Z., et al. (2011). Climate, health, agricultural and economic impacts of tighter vehicle-emission standards. *Nature Climate Change*, 1(4), 59–66. doi:10.1038/nclimate1066

## POLICY IMPLICATIONS

Brazilian officials should take additional actions to reduce health impacts from vehicle emissions. Since 10 ppm sulfur diesel has been made available to meet P-7 requirements for heavy-duty trucks and buses, national officials should quickly move to implement Euro VI-equivalent (P-8) standards nationwide for HDVs. Furthermore, the phase-out of 500 ppm diesel in favor of 10 ppm diesel outside of metropolitan areas should occur in order to improve interstate commerce and ease the logistical burden on vehicle operators in search of optimal refueling routes. Once P-7 trucks begin to enter the second-hand vehicle market, the exclusive provision of ultra-low sulfur fuel would ensure that vehicles continue to use the most appropriate fuel for optimal function of emission control systems. Ultra-low sulfur diesel will come at a very low cost to carriers, and consequently consumers: only 2.0¢ to 2.7¢/liter.<sup>9</sup> Euro 6-equivalent standards for LDVs will augment the health benefits from tighter standards for HDVs and fuels.

Timely actions to limit new vehicle emissions in Brazil can leverage the benefits of a growing vehicle fleet and boost competitiveness of domestic auto manufacturers with investments in the latest emission control technologies for light- and heavy-duty vehicles. Substantial climate co-benefits of these health-oriented policies further strengthen the rationale for nationwide action, beyond urban areas with the greatest exposure to vehicle emissions.<sup>10</sup>

The implementation of these policies will yield major reductions in other pollutants, including precursors to ozone and secondary particulates. The full measure of benefits, including reduced risk of chronic disease, gives additional motivation for swift action.

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9 Hart Energy and MathPro (2012). Technical and economic analysis of the transition to ultra-low sulfur fuels in Brazil, China, India, and Mexico. Prepared for the International Council on Clean Transportation. Available online at <http://www.theicct.org/technical-and-economic-analysis-transition-ultra-low-sulfur-fuels-brazil-china-india-and-mexico>

10 World Bank (2013). Integration of short-lived climate pollutants in World Bank activities : a report prepared at the request of the G8. Available online at <http://documents.worldbank.org/curated/en/2013/06/18119798/integration-short-lived-climate-pollutants-world-bank-activities-report-prepared-request-g8>