Briefing

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The Potential of Lower Vehicular Emissions in Indian Cities

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Background

There are currently around 90 cities that the Central Pollution Control Board (CPCB) identified as critically polluted. Particulate matter (PM), especially fine particulate matter ($PM_{2.5}$), dominates the concern. $PM_{2.5}$ has been found to have particularly damaging effects on human health. Other air pollutants such as NO_2, ozone (O_3), and air toxics are also problematic. The health problems caused by these pollutants are affecting not only large cities, but also many smaller, rapidly expanding cities across India.

Vehicles are one of the most important contributors of these pollutants. They are generally the dominant emitters of NOx. Vehicles are also significant emitters of PM, though their share of PM emissions varies from city to city. Studies of certain cities have found vehicles to account for as much as half of all PM emissions. Worse, almost all vehicular PM emissions are fine particles ($PM_{2.5}$), which can travel deeper inside lungs and are emitted directly into the breathing zones of large numbers of people. Vehicles are also important contributors to ozone formation, as NOx and hydrocarbon (HC) emissions react in the air to form O_3.

Vehicles' contribution to air pollution is likely to grow in India. Vehicle sales have grown greatly over the last decade, and the trend is predicted to continue. It is estimated that the number of vehicles plying on Indian roads will grow to over 500 million by the year 2035. That is a fivefold increase over the estimated number of vehicles in India today.

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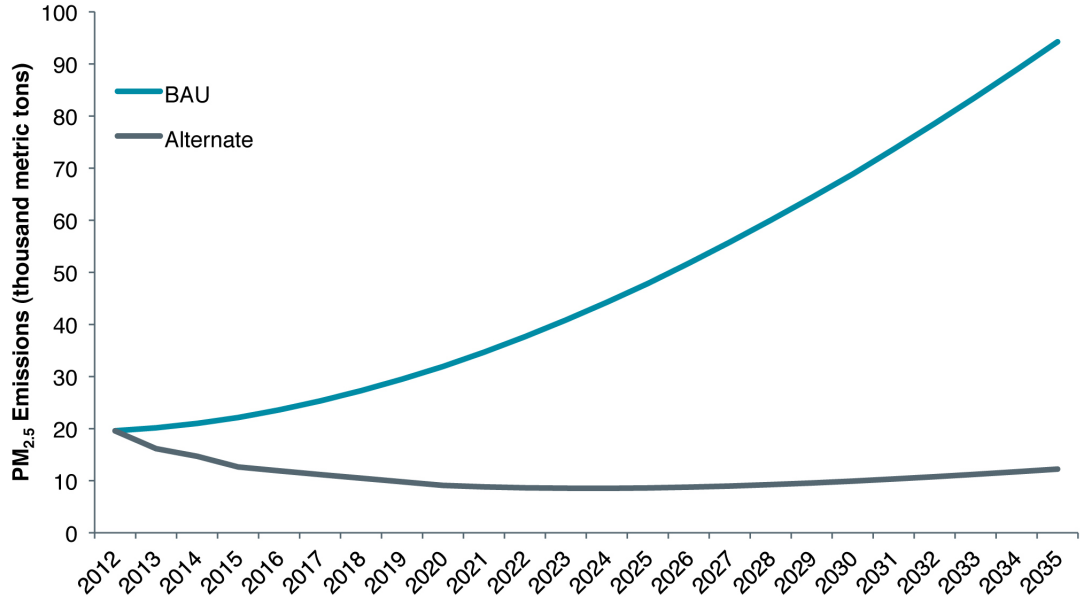
The Potential of Lower Vehicular Emissions in Indian Cities

The ICCT recently developed a fleet emissions model to estimate the effect of various vehicular policies on future vehicular emissions in India. The business-as-usual (BAU) scenario modeled what India had accomplished through 2010, assumed ongoing trends would continue, and that no further policy action would be taken. An alternate scenario modeled what emissions would look like if India took various steps to control vehicular emissions. Figure 1 compares predicted annual emissions of PM, the pollutant most harmful to human health, in the 337 cities under the BAU scenario and the alternate scenario through the year 2035.

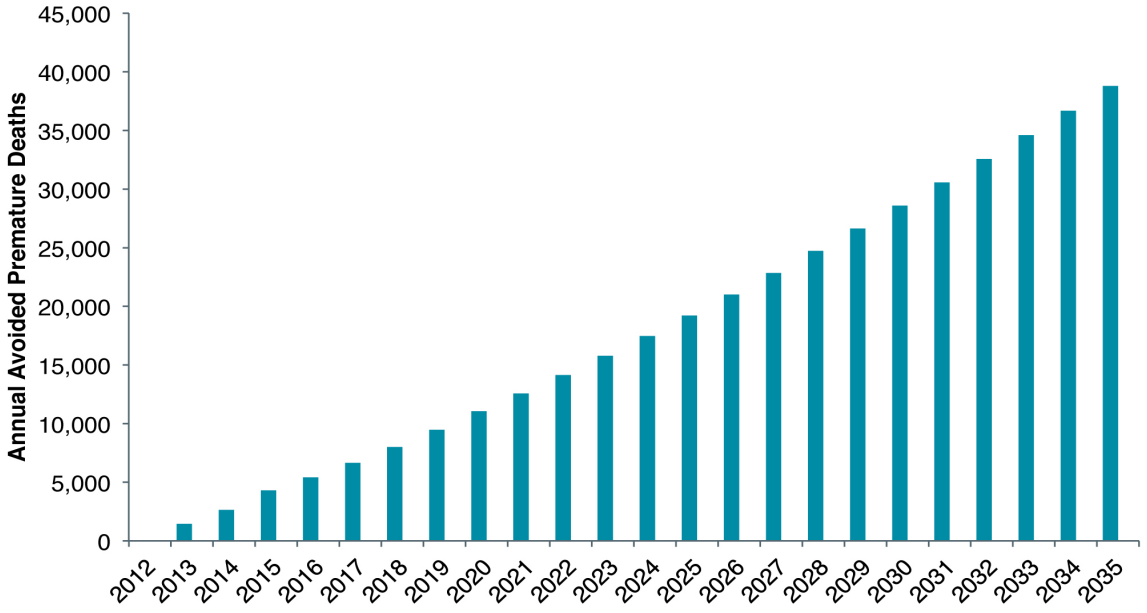
The effects on premature mortality of lower PM emissions under the Program scenarios relative to the BAU scenario were modeled by an ICCT health assessment model. The results are shown in figure 2.

Figure 1. Predicted annual emissions of PM under the alternate scenario and the BAU scenario in India's 337 largest cities.



The alternate scenario, which envisions the adoption of the most stringent vehicular emissions control policies, predicts almost 39,000 premature deaths can be avoided in India's 337 largest cities in the year 2035 alone. Between 2012 and 2035, a total of over 425,000 premature deaths can be avoided. Undoubtedly, the benefits of lower vehicular emissions will continue beyond 2035. And many more lives can be saved from reductions in emissions of other pollutants as well.

Figure 2. Predicted annual premature deaths avoided under the alternate scenario.



Immediate Vehicular Policy Steps for Indian Cities

Although the alternative scenario envisions comprehensive and long-term changes in India's vehicular emissions policies, there are a number of immediate steps India as a whole and major cities in particular can take with respect to vehicular air pollution. These will also have important near and long-term impacts on air quality and public health in India's most polluted cities. The recently concluded six city source apportionment study, which was sponsored by the Central Pollution Control Board (CPCB), recommended several policy options to bring vehicular air pollution under control. These recommendations included:

- Progressive tightening of emissions regulations including universalization of Bharat IV norms throughout the country, followed by introduction of Bharat V and VI standards
- Implementing the "One Country, One Fuel Quality and One Regulation" so that cleaner fuels are supplied across the country
- Banning of old commercial vehicles in cities, as well as a scrappage program from buses and trucks that do not have any emissions controls on them
- Implementation of mandatory, periodic inspection and maintenance program
- Financial incentives for hybrid-electric vehicles
- Improved traffic management including restricting entry of private vehicles in heavily congested city centers
- Promotion of mass transit systems

All of these recommendations are sensible, and some specific steps for critically polluted cities are discussed further:

New Vehicle Emission Standards

India can take the relatively easy action of adopting Bharat IV emission across the entire country as soon as possible. Since Bharat IV standards are already required in 20 major cities, the technologies, knowhow, and infrastructure for further expansion already exist. Moving to Bharat IV will improve air quality as the fleet turns over, with benefits increasing year by year. After adopting Bharat IV, India can plan to adopt stricter emission standards, such as Bharat VI, by 2015-2016. Such large scale adoption of Bharat VI standards well before the end of the next five year plan is needed to show dramatic improvements in air quality in critically polluted cities over the next five years.

With new vehicle emission standards, India can move to a "one country, one standard" policy. The current system of stricter standards in select cities means that many vehicles registered outside of them with lower standards traverse these cities' roads, which hurts efforts to improve air quality in India's most polluted cities. This is especially true for heavy-duty vehicles, which are primarily registered in rural areas but frequently make trips to urban areas.

Fuel Quality Standards

Bharat IV (50-ppm sulfur) fuels can be supplied in all critically polluted cities by January 1, 2013. At present, the 20 major cities are receiving Bharat IV fuel supply, and the Ministry of Petroleum and Natural Gas (MoPNG) has announced plans to supply BS IV fuels to a total of 50 cities soon. This program could be expedited since it has major benefits for emission reductions from existing as well as new vehicles, and as a result has the potential to impact PM and NOx emission levels in these cities immediately. With 50-ppm sulfur fuels, cities could also draw up action plans to retrofit vehicles with emission control devices as discussed below.

The move to Bharat IV fuels in these cities needs to be quickly followed up by the move towards ultra low sulfur fuels (ULSFs). The ULSFs, which contain 10-15 ppm of sulfur will not only further bring down emissions from all on-road vehicles, but will also enable the emission control technology associated with Bharat VI emission standards perform at the most efficient level. Therefore, the supply of ULSFs across the country within the 12th five-year plan should be a principle strategy for reducing air pollution from vehicular sources.

As with new vehicle emission standards, India can adopt a "one country, one fuel" policy. This will ensure that vehicular emissions are not out of compliance with standards behind because of fuels. It will also ensure all vehicles plying the roads of India's most polluted cities are not refueling with lower quality fuels.

Retrofitting & Upgrading Public Vehicles

Retrofitting or upgrading public transport vehicles can have a significant impact in reducing vehicular air pollution. This will most likely have to be done on a city-by-city basis in coordination with state governments, as each city would need to consider the state of its buses, auto-rickshaws, and other paratransit vehicles. Similarly, specific actions to reduce emissions from these vehicles will vary from place to place. In some areas switching to alternative fuels, such as CNG, might make sense whereas in other places, where lower sulfur fuels might be available more quickly, retrofitting buses with Diesel Particulate Filters might be a better option. City transit operators will require technical support and guidance in implementing these retrofit projects so that full benefits from these programs can be realized. Therefore, implementation of such programs should happen through a two year pilot program to retrofit 50-100 buses where low sulfur fuel is available with particulate filters, and monitor their in-use emissions and fuel economy performance closely. Upon the completion of the two-year pilot program, the program could be scaled up, assuming the benefits of the pilot program are demonstrated.

In-Use Vehicle Policies

Tying into policies related to public vehicles, Indian cities can also take steps to reduce emissions from private vehicles. Many cities in India have pollution under control (PUC) programs, which require all vehicles to undergo an emissions inspection twice a year (four times a year in Delhi), but many problems plague these programs.

India as a whole and specific cities can study the success of in-use vehicular emissions control programs in other countries and implement upgraded PUC programs in its most polluted cities. Some areas in which there is much room for improvement include merging vehicle registration, safety checks, and emissions compliance into annual one-stop inspection; better training and management of PUC system personnel; computerizing the PUC system to the maximum extent possible to minimize human error; centralizing the inspections into facilities that are not linked to vehicle repair; and fully enforcing PUC compliance. India can also establish more stringent national PUC standards that are linked to new vehicle emission standards and deterioration rates to ensure vehicular emissions are in line with their original design.

The end result should be timely maintenance of most vehicles so that their in-use emissions performance matches their design capability and removes gross emitting vehicles that cannot be repaired. Proper management of emissions from in-use vehicles can have a great impact on improving air quality, since the dirtiest of the vehicles on-road today make a disproportionate contribution to the overall emissions of the on-road fleet. While implementing new emission standards and

converting or retrofitting public transport vehicles will affect a portion of these cities' vehicle fleets, a good PUC system will affect almost all vehicles.

Management of Commercial Trucks

Commercial trucks, especially older trucks, are a significant cause of poor air quality in India. Taking them off the roads of India's most polluted cities will have an immediate impact on air quality. To this end, China's dual sticker registration system can serve as a model. All pre model year 2000 (pre-Euro) trucks can be registered with red stickers while post model year 2000 trucks can receive a yellow sticker. Cities can then prohibit red sticker trucks from operating within their city limits. This system can be modified by individual cities according to their specific needs. It can also be updated and tightened over time.

The dual registration system described above can also be a starting point for a scrappage program for out-of-date trucks. Not being able to take trucks into many cities will create an incentive for businesses to replace older trucks with newer ones. India can reinforce this incentive by offering financial and other incentives for the replacement of outdated trucks, as is done in many countries.

Costs & Challenges

There are technology and administrative costs associated with the vehicular policy steps outlined above. These costs will present a challenge to many cities, as they will to India as a whole. However, reduced premature mortality and sickness from air pollution will mean a more productive workforce and lower healthcare costs that far exceed the near-term costs of implementation of these programs.

One of the problems for these cities meeting the NAAQS is that there is no explicit linkage between the policy set by the new NAAQS and the city and state level action plans to address pollution, as well as associated planning tools such as comprehensive city mobility plans. Cities therefore need to be provided with institutional planning and support tools to integrate air quality goals in their planning process. These should include better and more continuous monitoring of air quality at key locations in the city, assessment of sources of emissions and updating the inventory of emissions, relating the critically polluted days with data on hospital visits and health impact monitoring.

Conclusion

The steps outlined above are concrete policy initiatives that can be implemented over the course of the 12th five-year plan. With continuous and improved monitoring, and determined implementation of these steps, concrete improvement in air quality within the most heavily polluted cities of India can be demonstrated over this period. The long-term public health and air quality benefits of these actions will be even greater.