Carbon Impact Assessment of Growing Transport Sector on Environment –Causes and Remedial Measures

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ABSTRACT

The threat posed by global warming has made climate policy one of the most important dimensions. Rising CO_2 emissions worldwide confirm the need to act and to move away from the current energy trend. Climate scientists have observed that carbon dioxide (CO_2) concentrations in the atmosphere have been increasing significantly over the past century, compared to the rather steady level of the pre-industrial era (about 280 parts per million in volume, or ppmv).The 2013 concentration of CO_2 (396 ppmv) was about40% higher than in the mid-1800s, with an average growth of 2 ppmv/year in the last ten years. Significant increases have also occurred in levels of methane(CH_4) and nitrous oxide N_2O).The paper elaborates the key sectors causing the irreversible damage to the climate, its quantum of impact for the developing nation like India & the policy recommendation that could be looked into, to tackle the situation.

Introduction

Developing countries have several factors in common that contribute to the severity of their transport problems. Overall population growth and increasing urbanization have led to the especially rapid growth of large cities, which have been overwhelmed by the sudden jump in travel demand.The supply of transport infrastructure and services, by comparison, has lagged far behind demand. Public sector finances, in general, are so limited that funding for transport improvements is woefully inadequate. Globally, Asia is a relatively minor source of air pollution from vehicular emissions. Although 56% of the world's population live in Asia, it only has 11%of the world's cars and 28% of its trucks and buses, and they generate less than 20% of the common types of vehicular emissions, including carbon monoxide(CO), hydrocarbons (HC), benzene, aldehydes, polycyclic aromatic hydrocarbons (PAH), and NOX, and only about 10.5% carbon dioxide (CO2) (Kingsley etal., 1994).Indian cities face a transport crisis characterized by levels of congestion, noise, pollution, traffic fatalities and injuries, and inequity far exceeding those in most European and North American cities. India's transport crisis has been exacerbated by the extremely rapid growth of India's largest cities in a context of low incomes, limited and outdated transport infrastructure, rampant suburban sprawl, sharply rising motor vehicle ownership and use, deteriorating bus services, a wide range of motorized and non-motorized transport modes sharing roadways, and inadequate as well as uncoordinated land use and transport planning. In recent decades, urban centers in less-industrialized countries have experienced unprecedented growth, and megacities with populations of 10 million or more people have emerged in many countries. In India alone there are four such cities, with three others expected to join the ranks in the next 20 years. Globally, many rapidly growing cities are being overwhelmed by environmental problems, especially those related to air pollution. Deterioration of air quality is a problem that indirectly experienced by a majority of the 300 million urban Indians, who constitute30% of India's population.

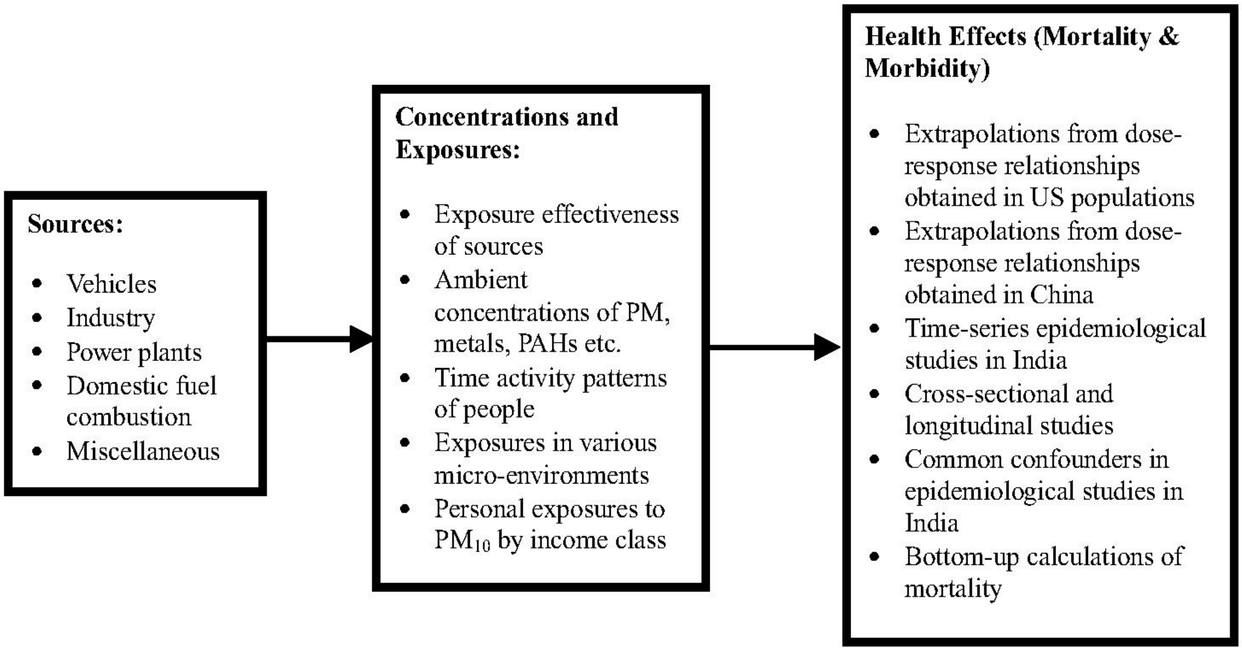


Fig: The causal chain of human health risks along with sources & concentrations/exposures.

Megacities of India are no exception to the global pattern of deteriorating urban air quality. Indian cities are among the most polluted in the world, with concentrations of a number of air pollutants being well above recommended by World HealthOrganization (WHO) levels (WHO/United Nations Environment Program 1992, Mage et al 1996). Despite the magnitude and urgency of air pollution as a public health issue, scientific understanding of health risks from air pollution in Indian cities is poor, and there is a paucity of scientific studies on the health effects. The few that have been done show much cause for alarm, and it is apparent to scientists and lay people alike that the residents of India's megacities face significant risks to their health from exposure to air pollutants.

As per one of the Environmental Protection Agency (EPA) report, particulate pollution in Indian cities is far worse, so it is likely that per-capita mortality from urban air pollution in India is at least as high as that in the US.

In addition to particulate air pollution, other primary pollutants are also a cause for concern in India. Thus, we also provide source inventories for these primary pollutants (CO, nitrogen oxides, and hydrocarbons) when possible. Causal chain shown in above figure for its Indian context, summarizes important findings in terms of what is known, what is uncertain, and what is missing. In fact, measurements have shown that the air quality in many small towns is just as poor [Tata Energy Research Institute (TERI) 1997].Most cities have exceeded the National Ambient Air Quality (NAAQ) standards.Air pollution has become one of the leading causes of death in India.Transport's emissions have increased at thefaster rate than any other sector. Twenty percent of poorly maintainedvehicles produce about 60% of vehicular pollution in India (Pundir, 2000). Main causes for the shocking increase in vehicular emissionshave been the exponential growth in the number of motor vehicles;inadequate public transport and inept management; haphazard urbandevelopment; congestion; obsolete vehicular technology; poor fuelquality; laxity in traffic enforcement; and an increase in freight movedover roads (The World Bank, 2005; Badami, 2005; Pucher et al., 2007).

Contribution of the Transport Sector to Green House Gas (GHG) Emissions:

In recent years, the increasing contribution of the transport sector togreenhouse gas (GHG) emissions resulting from the use of fossil fuels, and their effects on global warming and climate change have been amajor concern. According to the World Bank, in developing countries theshare of GHGemissions are low, but the energy consumptionwithin thetransport sector is growing much faster than other sectors (Karkeziet al., 2003).It is estimated that there are about 900million vehicles(excluding two-wheelers) worldwide that emit more than 26% of GHGemissions (Lee Chapman, 2007). In India, CO2 emissions from theconsumption of fossil fuels have increased from 293MMT (millionmetric tons) to 1293MMT between 1980 and 2006 (EIA, 2006). Roadtransport accounts for nearly 35% of commercial fuel sold in India. ADBprojects the CO2 emission from on-road transport in India will increaseabout 600% in next three decades (2005–2035) (ADB, 2006). Following figure shall give the compact current picture of the trend in growth of different components from 1950s' to 2000's.

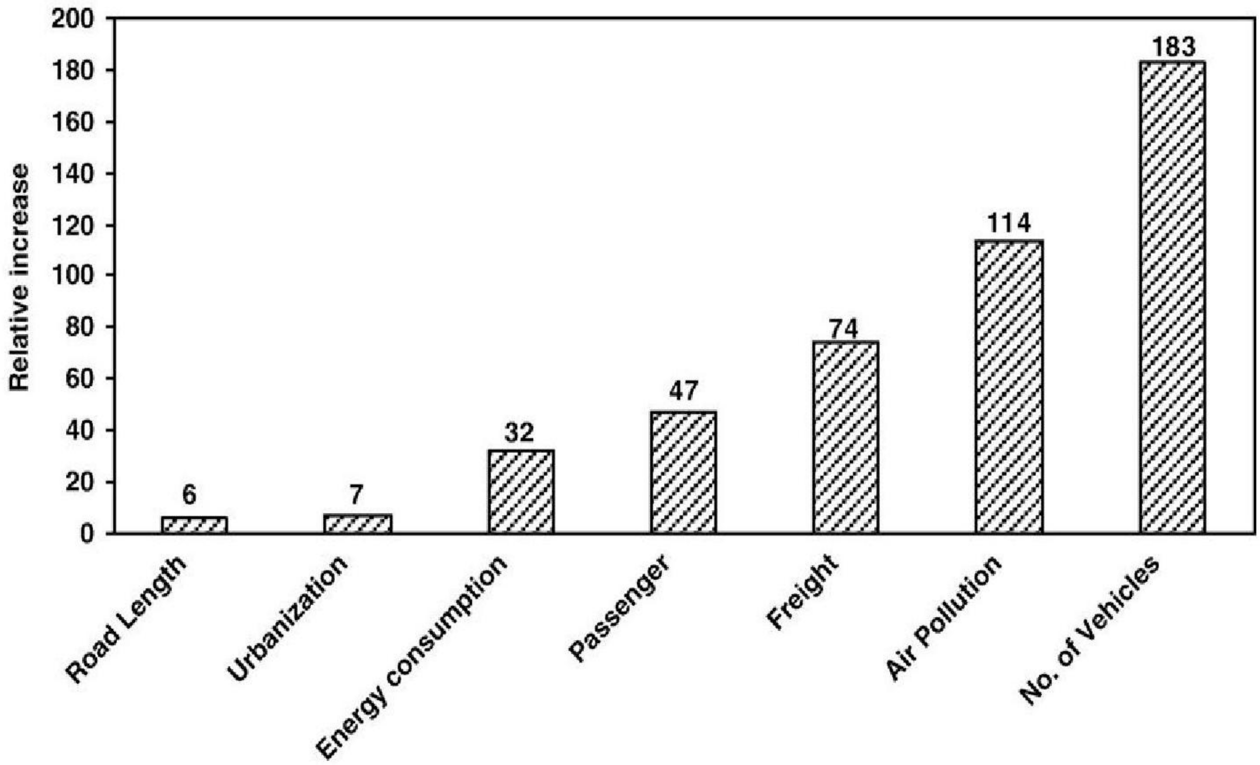
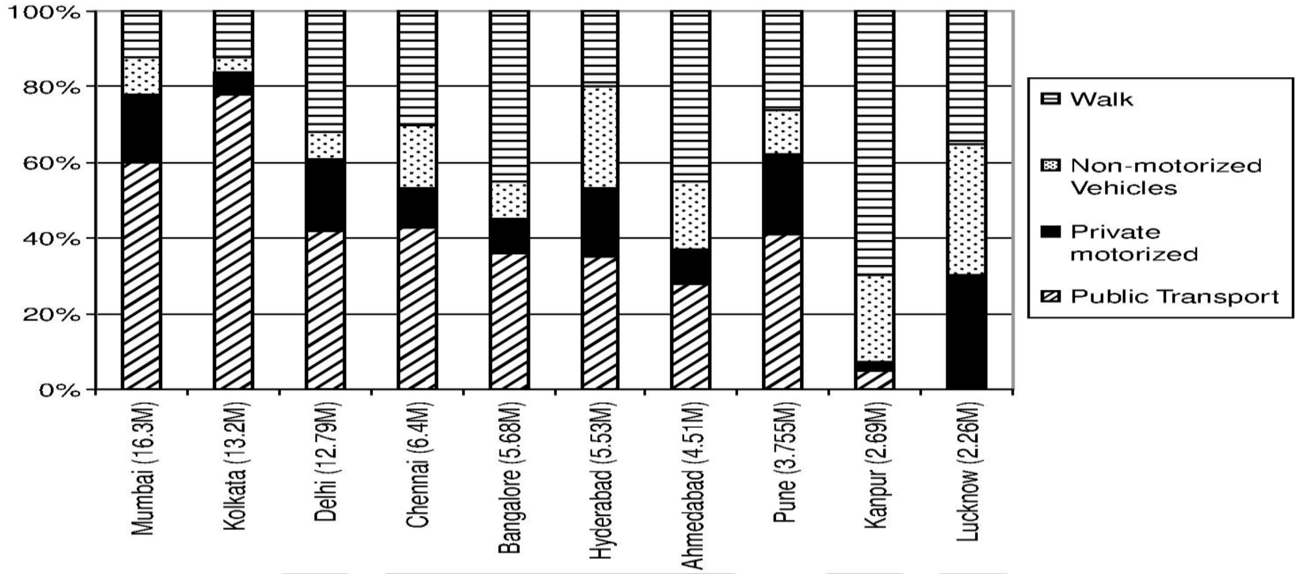


Figure: Relative increase in the infrastructure, vehicle population, energy consumption & travel demand during the last five decades (1951-2000) in India.

Travel behavior:

As Indian cities have grown in population, they have alsospread outward. Indeed, the lack of effective planning andland-use controls has resulted in rampant sprawleddevelopment extending rapidly in all directions, far beyondold city boundaries into the distant countryside. That hasgreatly increased the number and length of trips for mostIndians, forcing increasing reliance on motorized transport.Longer trip distances make walking and cycling lessfeasible, while increasing motor vehicle traffic makeswalking and cycling less safe.

As in most developing countries, a high percentage of travel in Indian cities is by walking or cycling, mainlybecause much of the population is too poor to affordmotorized transport. Walking and cycling are mostimportant in smaller cities, accounting for over two-thirds of all trips. As city size increases and tripdistances become longer, the relative importance of walkingand cycling falls to about half of all trips in medium-sizedcities and about a third in the largest cities. There isconsiderable variation, however, even within city-sizecategories. Among the megacities, for example, walkingand cycling are much less common in Mumbai than inDelhi, perhaps due to Mumbai's superior public transportsystem. Among the smaller cities, Kanpur and Lucknowhave much higher proportions of walking and cycling thanPune, which has a very high level of motorcycle ownershipand use (due to a large middle class), as well as extensivecharter bus services organized by Pune's industrial firms for their employees (Pune Municipal Corporation, 2004). Bycomparison, Kanpur and Lucknow have much lower levelsof motorcycle use (due to lower incomes) and minimal busservices. Instead, they rely on a mix of paratransit modessuch as auto rickshaws, cycle rickshaws, jeep taxis, andtempos (large auto rickshaws).As of 2002, private motorized transport (mainly cars andmotorcycles) accounted for a small but rapidlygrowingpercentage of travel, about 10–20% of all trips (as per fig below).



Percent distribution of urban trips by means of travel demand for selected Indian cities (Sources: World Bank 2002)

There are no reliable time-trend data on modal splitdistributions, but the statistics on vehicle fleet sizes dramatize the extremely rapid growth of motorcycleownership, which increased 16-fold between 1981 and2002. Private car ownership increased almost 7-fold duringthe same period. The sprawling, low-density developmentaround Indian cities has made cars and motorcyclesincreasingly necessary to get around, especially given theunsatisfactory alternative of slow, overcrowded, undependable,and dangerous public transport services. At the sametime, rising incomes among the Indian middle and upperclasses have made car and motorcycle ownership increasinglyaffordable.

Noise, air, and water pollution are all serious problems in Indian cities, and transport sources contribute to all three kinds. The most reliable and comprehensive statistics are for air pollution. As shown in fig. below, levels of air pollution concentrations are highest for suspended particulate matter (SPM) and respirable suspended particulate matter (RSPM), which exceed World Health Organization (WHO) air quality standards, as well as official Indian government standards, for all of the cities shown (Bose, 1998; Vasconcellos, 2001; Padam and Singh, 2001; Ministry of Petroleum and Natural Gas, 2002; Sibel and Sachdeva, 2001). Indeed, for India's three largest cities, SPM and RSPM levels are three to four times higher than the WHO's maximum acceptable levels, and among the highest in the world, indicating a very severe health hazard (World Health Organization, 2000; Kandlikar andRamachandran, 2000).

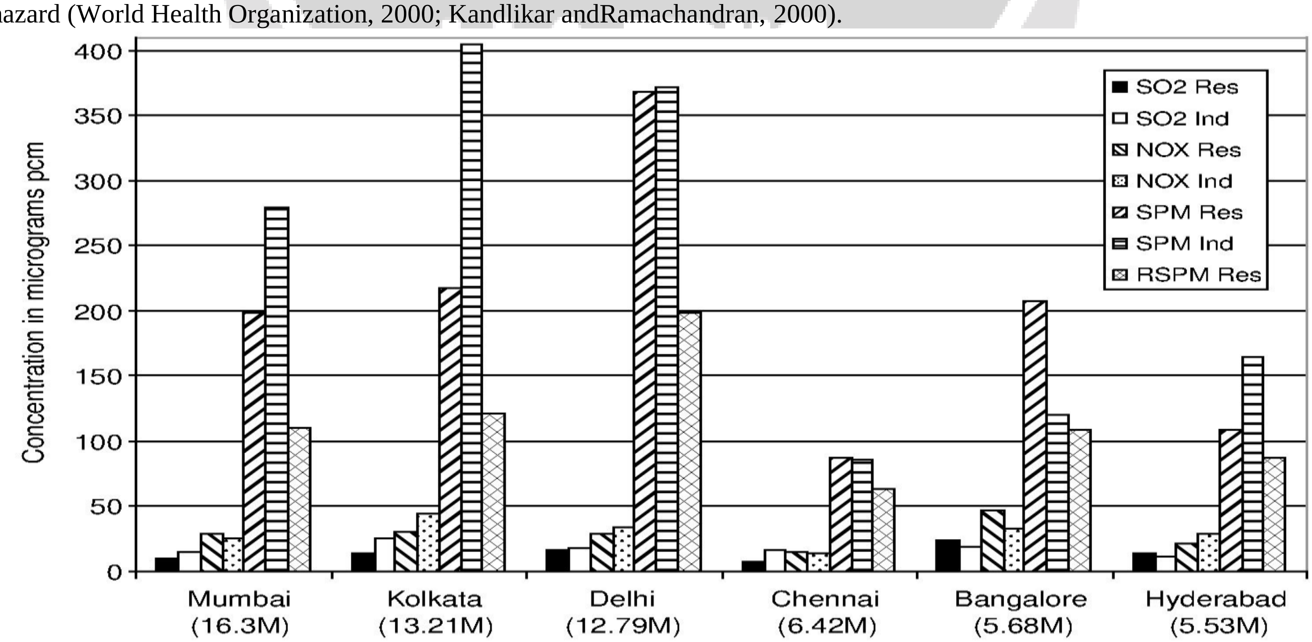


Fig: Air Pollution Levels in Largest Cities (Source: Minstry of Petroleum & Natural Gas. Note: Shown are average ambient air pollution concentrations in Indian cities, measured in micrograms per cubic meter.

While levels of CO, NOx, and Sox are generally considered moderate to low in most Indian cities, ozone levels have been increasing in virtually all Indian cities, causing a range of respiratory illnesses and irritation. One important source of air pollution remains the large and mostly old fleet of motorized two-wheelers (motorcycles and scooters) and three-wheelers (auto rickshaws) with highly inefficient, poorly maintained, very polluting 2-stroke engines (Tata Energy Research Institute, 1997). Diesel buses, trucks, and some taxis are the biggest transport sources of particulate pollution, but they are joined by substantial industrial emissions of particulates and also from atmospheric dust, especially in northern India, which is drier and dustier than southern India. The Indian Government has tried to mitigate particulate pollution by mandating conversion of all buses, auto rickshaws, and taxis in Delhi to CNG fuel by January 2001. Although well-intentioned, the sudden shift led to massive disruptions as well as corruption to avoid compliance (Environmental News India, 2001).

Sourcesof Urban Air Pollutionin INDIA:

The main categories of urban air pollution sources in India are *vehicular emissions, industrial emissions, fuel use for domestic purposes such as cooking, and a potentially large miscellaneous category, which includes burning of household wastes and emissions from small businesses and cremation grounds.* Natural sourcesof PM are also significant, depending on location and season. While particulatesfrom natural sources are not conventional pollutants, their contributions aretypically taken into account in inventories of total suspended particulates (TSP),since natural sources can be both a major contributor to polution and a source ofuncertainty. However, natural dust particles are coarse and do not contribute significantlyto PM fractions that actually get deposited in human lungs.

1. Emissions from Motor Vehicles:

Transport in general and road transport in particular constitutes a major share in the CO_2 emissions. Vehiclesusing fossil fuels (diesel and gasoline) produce CO_2emissions in quantities that depend on the carbon presentin the fuel molecule. It accounts for a major share of energyconsumption in India, especially the petroleum products.There exists only a limited possibility for fuel switchingat least in the short run of a decade or so. Hence, thissector can aggravate foreign exchange burden bydemanding huge oil imports.Globally, the transport sector nowcontributes 25% of all the CO_2 emissions released into theatmosphere. Approximately 80% of those emissions arefrom road transport. Although, currently, India is one ofthe lowest per capita emitters of CO_2, at 0.27 metric tons ofcarbon equivalent, energy sector's carbon intensity is high, and the country's total CO2 emissions rank among theworld's highest. In 2002, CO_2 emission in India was around280 million metric tons of carbon equivalent which wasaround 4% of the world total (International EnergyAnnual 2002). Between 1980 and 2002, India's carbonemission increased at an astonishing rate of 5.7% perannum against the world average of 1.26%.Since land-based passenger transport sector accounts fora significant proportion of energy consumed in the country, its share in CO2 emission will be equally significant.Rapid urbanization in India has led to an increase in transportation demand that public transport systems have been unable to adequately meet. Consequently, the use of personal vehicles has increased dramatically. Between 1986 and 1991, the total number of vehicles in India increased roughly threefold, from about 9 million to 25 million, and itwas estimated that the number of vehicles would reach well above 40 million by the year 2000 (Government of India [GOI] 1993).Moreover, facilities for pedestrians and cyclists are virtuallynon-existent in most cities, thus forcing them to sharecrowded rights of way with rapidly moving motor vehicles.Nationwide, about 70% of the vehicles are gasoline-fueled personal vehicles, two- or three-wheeled vehiclesthat have two-stroke engines. Other gasoline-fueled vehicles, mostly cars and motorcycles with four-stroke engines, make up 14% of the fleet, and diesel-fueled trucks and buses make up ~8% of the total.

The number of two- and three-wheeled vehicles, which also represents the largest fraction of all vehicles, has been growing at the rate of ~20% annually and, between 1987 and 1993, increased threefold, from 7 million to ~20 million. The number of two-wheelers is expected to keep rising, with a projected 36 million by 2000. Passenger cars and diesel-fueled vehicles, although fewer in numbers, will double in the same time period. In the mid-1980s, the introduction of cars by Maruti, a public-sector company jointly launched by the Indian government and Suzuki of Japan, gave impetus to car purchasing by members of India's upper classes. Because the government's liberalization program, launched in the early 1990s, has encouraged car production by multinationals in India, there has been an even more dramatic rise in the number of passenger cars in the country. Recent figures showed that, between the late 1980s and 1997, the annual sales of automobiles increased >10-fold, from 40,000 to 400,000. In keeping with the increase in numbers of vehicles, the vehicular use of gasoline and diesel fuel more than doubled over the time period of 1981–1994, increasing from 1.5 and 7.2 million tons, respectively, in 1981, to 3.5 and 14.8 million tons in 1994. Although >80% of the vehicular fleet consists of vehicles that use gasoline, the total amount of diesel fuel consumed in India exceeds the usage of gasoline by close to a factor of five. Diesel fuel is the primary fuel for buses, trucks, and other commercial vehicles, which consume larger quantities of fuel per road mile and also constitute a larger share of road miles traveled. In addition, a significant amount of diesel fuel is consumed in the generation of power by captive power plants (which supply roughly 10% of the energy consumed in India). The distinction between gasoline and diesel fuel is important because the contributions of both fuel types to multiple pollutants and air pollution health risks are significant, but the technical and policy solutions for reducing these emissions may be quite different.The principal pollutants emitted by vehicles are carbon monoxide (CO), NOx, particulate matter (PM10), volatile organic compounds, and semivolatile polyaromatichydrocarbons (PAHs). Sulfur oxides are emitted in various quantities dependingon the sulfur content of the fuel. Exhaust gases from gasoline-fueledvehicles also contain lead (Pb) additives, which continue to be used although therehas been a recent move toward unleaded gasoline in the major cities. The growth in no of vehicles have further given a push to growth in pollution. An international study has indicated that the emission ofselected local air pollutants (such as the carbon monoxide, nitrogen dioxide, etc.) in the megacities of India is above theWHO guidelines (Grubler, 1993).

There are several reasons to expect larger emission factors for vehicles in India than their equivalents in industrialized countries. A majority of vehicles in India are not equipped with pollution control equipment, and only recently has the government mandated installation of catalytic converters on cars sold in the major metropolitan areas. In addition, maintenance of vehicles is poor, and there is very little monitoring and enforcement of emission standards. Another key issue in the derivation of emission factors is the quality of fuel used. In the Indian context, the quality of fuel, especially adulteration of gasoline by kerosene, is a particularly important, if understudied, issue. Lubricating oil, which is sold in unpackaged form mainly for use in motorized two- and three-wheeled vehicles, is also adulterated. Furthermore, gasoline is not the only petroleum product that is adulterated. In addition to exhaust, automobiles can release pollutants from crankcase emissions.

2. Power Plant and Industrial Emissions:

After gaining independence in 1947, India embarked on a path of rapid industrialization in all the major manufacturing sectors—iron and steel, heavy manufacturing, industrial and petrochemicals, and agricultural and paper products. Today, despite its label as a “less-industrialized country,” India is heavily industrialized, with a thriving manufacturing sector that until recently was largely indigenous. The CPCB has catalogued over 1500 large-scale industrial units in 17 industrial categories (CPCB 1995), accounting for about 60% of India’s industrial output. Small-scale industries are an important part of the Indian economy and account for the remaining 40% of the industrial output. At present, India has over three million small factories (Confederation of Indian Industry 1996). The industrial belt around metro cities, is responsible for more than 10% of India’s industrial productivity, with a substantially greater fraction of the country’s chemical, petrochemical, and drug manufacturing.Industries contributing to air pollution include textile mills, chemical and pharmaceutical engineering units, and foundries. Industries emit a wide variety of process-specific pollutants—gaseous organic and inorganic compounds, complex vapors that undergo phase transformation after emission into the atmosphere, and PM with process-specific composition (e.g. heavy metals and PAHs). The presence of a large number of small-scale industrial plants makes pollution control more difficult because small-scale operations are more financially strapped and less technologically capable than largescale ones, and their numbers make the already lax monitoring and enforcement of pollution control laws even more difficult. Curiously, while a catastrophic industrial disaster in India—theBhopal tragedy—was the catalyst for enactment of the Emergency Planning andCommunity-Right-to-Know Act (EPCRA) in the US, leading to the creation of aToxics Release Inventory (TRI), such databases are not available for India. Theresult is that data for estimating industrial emissions are sparse.

Coal-fired power plants generate two-thirds of India’s electricpower (GOI 1996). Its coal-fired power capacity is expected to grow from 55 GW in 1996 to ∼80GWby 2002. Indian steam coal is high in ash content (30%–50%) but lowin sulfur (<0.5%). More than99%of the coal used in the generation of electric power in India is domestic steam coal. Additionally, the ash is very high in silica and aluminum (>90%). This results in very high resistivity for the fly ash (10^{13} to 10^{15} cm), which makes it difficult for conventional electrostatic precipitators (ESPs) to collect fly ash efficiently. Conventional ESPs are the only devices used in Indian power plants for control of PM; thus, more efficient pre- and postcombustion methods such as coal washing and the useof flue gas conditioning are not being applied. Existing efficiencies of ESPs of 85%–95% result in emissions of >45 million tons of fly ash from Indian power plants each year (Confederation of Indian Industry 1996). The main method of disposal of fly ash from power stations is mixing it with water; the resultant slurry is pumped through pipes to ash disposal ponds. Coal combustion in thermal power plants also emits a variety of toxic heavy metals, such as Pb, Zn, Ni, Co, Cd, Cr, and Cu.

The industrial-pollution estimates must be seen only as order-of-magnitude assessments. Admittedly, they represent a crude approximation of a vastly more complicated picture, illustrating the difficulties in estimating reliable inventories in the absence of systematic monitoring of emissions from various industrial sectors on a plant-by-plant basis.

3. Domestic Fuel Combustion:

Fuel combustion from domestic sources is a major cause of pollution in India. Although health risks from these sources appear to be greatest in rural areas, there are significant emissions in cities as well. Smoke emissions from burning wood, coal, cattle dung, and other biomass fuels are a significant source of indoor PM in many cities, although these sources can also contribute to outdoor PM. The combustion of biomass and coal is usually incomplete and often occurs in simple stoves, which are either small pits or open clay boxes. The resulting emissions contain large quantities of PM, carbon monoxide, and unburned hydrocarbons. Emissions from biomass combustion also contain a large number of polyaromatic hydrocarbons, such as benzo(*a*)pyrene, that are mutagenic and carcinogenic. In addition to these organic substances, coal and kerosene smoke also contains Sox and trace metals.

Besides biomass, coal, kerosene, and liquefied petroleum gas (LPG) are the main fuels for domestic uses such as cooking and heating. From a health viewpoint, however, it is the use of solid-biomass-based fuels that are burned inefficiently and vented in close proximity to people that is the cause for greater concern. Household fuel usage is the key determinant of domestic air pollution, with fuels such as dung and wood that are lower on the "energy ladder" being significantly more polluting than modern clean-burning fuels such as LPG and electricity. Intermediate fuels such as kerosene are less polluting and more efficient than biomass-based fuels. PM10 and other emissions from biomass fuels can be two or more orders of magnitude higher than those for modern fuels for the same level of end-use energy provided. The use of more efficient smokeless stoves and better ventilation mechanisms can reduce the levels of emissions and exposure. However, although improved stoves help mitigate pollution exposures, they do not eliminate them. In the long term, only clean fuels can help eliminate exposure.

Climate change is expected to hit developing countries the hardest. Its effects—higher temperatures, changes in precipitation patterns, rising sea levels, and more frequent weather-related disasters—pose risks for agriculture, food, and water supplies. At stake are recent gains in the fight against poverty, hunger and disease, and the lives and livelihoods of billions of people in developing countries. Addressing climate change requires unprecedented global cooperation across borders.

Conclusion and Key Policy Suggestions:

1. Technology policies are one of the options available for the reduction of carbon emissions and the usage of energy. However, gains in the efficiency of energy consumption will result in an effective reduction in the per unit price of energy services. As a result, consumption of energy services should increase (i.e., 'rebound' or 'take-back'), partially offsetting the impact of the efficiency gain in fuel use. Definitions of the 'rebound' effect vary in the literature and among researchers. Depending on the boundaries used for the effect, the size or magnitude of this behavioral response may vary. The 'take-back' or 'rebound' effect refers to an increase in the supply of energy services with a corresponding decrease in the effective price, the size of which depends upon the underlying cost structure. This in turn may result in an increase in demand in response to these price decreases. Therefore, increased demand for the service, without an offsetting increase in fuel price, can erode technological efficiency gains. Although this premise is undeniably rooted in neoclassical economic theory, the real controversy lies in the identification of sources and size of the rebound. Many of the developed nations have relied on this structure to control the harmful emissions involved primarily with increasing energy usage.

2. Alternatively, vehicles powered by electricity or hydrogen hold the potential to solve a number ofchallenges that relate to automobile use, such as climate change, deterioration of local airquality, security of energy supply, and high fuel prices. Substituting alternatives for fossil fuels holds the potential to solve these issues. In this area, significant strides have been made with battery-electric vehicles (BEVs) and fuel cell vehicles (FCVs).As problems related to automobile use grow more urgent, the case for radical innovation builds and the large scale adoption ofsuch alternatives becomes more likely.To ensure the effective implementation, a multi level perspective of a mix of above two techniques could be really helpful in this direction with transitions as combinations of top-down (e.g. climate change, shifts in environmental values) and bottom-up (e.g. technological developments in niches) influences, mitigating the bias towards high-level influences.Typically, governments refrain from 'picking a winner'. Yet, both technologies will require specific policy support to be successful.Many auto giants(like GM, Mitsubishi, BMW, Chevrolet Volt) are already trying it as standalone techniques but a mix of the two can really be helpful towards alternative to current internal combustion engine (ICE) technology to reduce climate worsening.

3. Carbon taxing could be another policy tool which could be explored to deal the current grim situation of constant global warming threat due to gradual upset of climatic changes.The recognition of the climate change effect fromgreenhouse gases has led countries to implementregulations and taxes to curb these emissions. Withina few years, it is expected that the use of price mechanismsto combat climate gas emissions will be expanded,although it is likely that many countries will participatein a quota-based emission trading system forgreenhouse gases to fulfill the Kyoto Protocol.For countries that consider implementing a carbontax, it is recommended to have a broad based, cost efficient tax,which is uniform for all sources and greenhouse gases.With a more uniform distribution of the tax burden, it ispossible to accomplish larger reductions in the GHG emissions at lower costs.

4. A step towards usage of alternative fuel, biofuels (ethanol); could be a solution to resolve the current global warming potential threat. No-one has been able to avoid the debate raging over the pastyear in respect of biofuels, discussing whether these should beviewed as a threat or an opportunity. From the situation wherebybiofuels were considered to be one of several vital solutions to theclimate problem, how it could be executed is another issue involed with it.Climate benefits and greenhouse gas (GHG) balances are aspectsoften discussed in conjunction with sustainability and biofuels.Ethanol is currently the dominant biofuel on both a global anda Swedish national scale, which is why the debate often focuses onethanol. In Sweden, the use of ethanol has increased over the pastfew years and now accounts for more than 3% of fuel consumptionfor transportation by road.Most of this ethanol is imported,mainly from Brazil, while domestic ethanol from grain accountsfor barely a fifth. On a global scale, the two dominant ethanol-producingcountries today are Brazil and the USA. The production process of producing ethanol from cereals/ crops do have carbon emissions but by making the correctdemands and developing the good systems (while at the same timeavoiding the bad ones); i.e. could allow us to promote the developmentof ‘‘good” ethanol and counteract the production of ‘‘bad”ethanol.

5. Usage of agiler metals in transportation industry like magnesium that can significantly contribute to the environmental conservation (which is dependent on particularly the CO_2 emissions produced by rail & road transport vehicles). The basic feature of magnesium being 35% lighter than aluminum, (which is used as structural material for vehicles & aerospace applications) supports the above fact. The lightness of structural magnesium components results in reducing the weight of transportation means & hence reducing the fuel consumption & CO_2 emissions.Weight reduction seems to be the best cost effective option for significant decreasing of fuel consumption & CO_2 emissions. Triggered by the Corporate Average Fuel Efficiency (CAFÉ) standards & other environmental legislations, most car producers are going to use 40-100kg of magnesium alloys in near future.It could be reviewed as a key policy initiative to introduce the current & future applications of magnesium in the transportation industry with special attention to the needs of alloy developments & advancement in production technologies.

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