City action

CITIZEN'S REPORT ON AIR QUALITY AND URBAN MOBILITY, KANPUR

RIGHT TO CLEAN AIR CAMPAIGN

2010

CENTRE FOR SCIENCE AND ENVIRONMENT, NEW DELHI

The Centre for Science and Environment (CSE) is a public interest research and advocacy organisation based in New Delhi. The Centre researches into, lobbies for and communicates the urgency of development that is both sustainable and equitable.

The scenario today demands using knowledge to bring about change. In other words, working India's democracy. This is what we aim to do.

The challenge, we see, is two-pronged. On the one hand, millions live within a biomass-based subsistence economy, at the margins of survival. The environment is their only natural asset. But a degraded environment means stress on land, water and forest resources for survival. It means increasing destitution and poverty.

Here, opportunity to bring about change is enormous. But it will need a commitment to reform — structural reform — in the way we do business with local communities.

On the other hand, rapid industrialisation is throwing up new problems: growing toxification and a costly disease burden. The answers will be in reinventing the growth model of the Western world for ourselves, so that we can leapfrog technology choices and find new ways of building wealth that will not cost us the earth. This is the challenge of the balance.

Our aim is to raise these concerns, participate in seeking answers and — more importantly — in pushing for answers and transforming these into policy and practice. We do this through our research and by communicating our understanding through our publications. We call this knowledge-based activism. We hope we will make a difference.

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Right to clean air campaign

Centre for Science and Environment blew the lid on smog and smog makers in 1996 in its book *Slow Murder: The deadly story of vehicular pollution in India*. The study found that the problem of vehicular pollution in India was the result of a combination of outdated engine technology, poor fuel quality, lack of transportation planning and bad maintenance of vehicles on roads. Yet during the early nineties government was indulging in the game of blaming the victims of air pollution by forcing on them a system of pollution under control certificates. The hype over this periodic drive to test tailpipe emissions in the absence of strong action in other areas was cosmetic and diverted public attention from more serious issues of technology, fuel quality and transportation planning.

The connection between poor urban air quality and multiple factors eluded most Indian citizens. To help citizens see through the smokescreen of pollution, to understand the vital CONNECTION and protect public health the *Right To Clean Air Campaign* was launched in November 1996. Since then we are consistently campaigning to:

● **improve the decision making processes related to air quality and mobility planning**
● **build pressure for more transparent policy mechanism**
● **raise public awareness about poor urban air quality and risks to public health.**

This led to an intense phase of learning, action and impacts. The first generation action has helped in arresting the runaway air pollution in some cities. But clean air remains elusive in most cities. It is time for second generation reforms. The future action will have to be more aggressive across the country to cut exposure to killer fumes, reduce energy use and climate impacts of motorisation. The explosive increase in vehicle numbers threatens to undo the small incremental gains. Cities will have to reinvent the idea of mobility, shift towards public transport and non-motorised transport, leapfrog vehicle technology and fuel quality and improve fuel efficiency. Cities will have to find a whole new way out of the choking haze of polllution, congestion and energy guzzling.

If you agree with us, remember to give us your support.

WHY CITY ACTION?

Why are we looking at cities for the big change? Our cities are on a toxic spiral, urged on by growing wastefulness, energy use and car centric mobility. As India is poised for an urban explosion defining the parameters of this growth becomes crucial. Can we make our cities livable? Make public health, urban design quality, equity and community wellbeing the basis of this growth?

Amongst all the challenges that our cities face today, transport and mobility are certainly the most daunting. Growing affluence, increased car ownership, car oriented infrastructure, urban sprawl, are increasing the share of motorized trips and travel distances in our cities. This is marginalizing walking, cycling, bus hopping and increasing harmful and warming emissions. How do we break this spiral?

Solutions lie in the way our cities are organized, and travel choices are made. It is important to act now when cities are expanding their infrastructure funding and discussing transportation policies at the national and local levels to decide the future mobility roadmap. While there are many common challenges across all cities, there are also unique imperatives at different strata of cities – mega cities, second rung cities, small towns – that must guide local action. We annot afford to get this wrong.

But the contours of the future roadmap for any city can emerge from a deeper understanding of the uniqueness of the India's urbanization, its trend, pattern and structure. In India the mega cities, the biggest part of the problem, have already begun to draw a lot of attention. But the next rung of cities are also emerging as the fastest growing urban centres bringing in its wake the problems of pollution, congestion and energy guzzling -- exactly like the mega cities. The problem is growing faster than their capacity to mitigate. These cities will have to act at the early stages of motorisation.

This citizens' report is a spotlight on the challenges of the second rung cities in India. We have selected Kanpur, a prominent commercial city in the northern state of Uttar Pradesh, for an in-depth analysis. How can this city address its unique imperatives while responding to the top down national policy interventions. What is the way ahead, and what can other cities learn.

So far public anger, judicial pressure and executive action have combined to trigger change in some cities. But Indian federal structure allows all cities to make wide technical and administrative choices and take decisions on transportation management, land-use planning, public transport and taxation policy, clean fuel and technology and in-use emissions control. This creates enormous opportunity for change. But this also demands that both national and local policy action are backed by informed choices and public support.

Pattern of urban growth in India

City action needs broader understanding of the unique trajectory of urban growth in India. A major growth spurt occurred during the thirties and forties when agrarian crisis had pushed many out to the towns. But thereafter, urban growth rate slowed down and dropped from 3.8 percent in the seventies to 2.7 percent during the nineties. Studies carried out by urban expert Amitabh Kundu of the Delhi based Jawaharlal Nehru University shows that the share of urban population increased slowly from 17.3 percent in 1951 to 28 percent in 2001.[1] This slower growth is largely to the overall stagnation in migration. The share of total migrants in the country increased only slightly from 27 percent to 29 percent during the nineties but that is still less than 31 percent in 1961. The share of migrants in the total incremental urban population dropped from 21.7 percent in 80s to 21.0 percent in the nineties. This coincides with the drop in the rate of urbanisation during the nineties. It is said that in post independent India it is not the migration so much but the natural organic growth that has been the bigger contributor to urban growth in India.

Though the share of India's urbanized population is about 30 per cent and is much lower than the 70 -80 per cent in the industrialized world, the size of Indian urban population is still more than the total population of the United States. However, the future urban growth is expected to be high. The global consulting firm McKinsey projects urban population of 590 million by 2030 which is country's 40 percent of the total projected population. India is expected to have 68 cities with more than one million population, 13 cities with more than four million, and six mega cities with more than 10 million. Cities will drive Indian economy and are expected to account for 70 per cent of the India's GDP. Typically, the states and Union Territories that have high economic growth rate also show high rate of urbanization. These include Delhi, Chandigarh, Gujarat, Haryana Kerala, Karnataka, etc. while Uttar Pradesh follows close. Managing this growth will be critical for sustainable cities.

Top heavy asymmetrical urban growth: Indian urban population is not evenly distributed across cities. This is very typical of India. A few metro cities are extremely populous and have an enormous concentration of people that is unrivalled by any other city in that region. Take for example Delhi that is estimated to have more than 16 million people now. No other city in the northern India has such a large population — similarly, Mumbai in the west, Kolkata in the east and so forth. On the whole there are 4368 towns in India (as in 2001). Cities with more than a million people are 393 or just 8 per cent of the towns have 69 percent of the urban population (in 2001). The remaining population is distributed in 3979 towns and cities.

Such a large concentration of people is also an opportunity for organizing services and resource utilization more efficient. This can make cities more resource efficient, and mobility more energy efficient and less pollution intensive. It is more cost effective to provide basic services and infrastructure in densely rather than sparsely populated cities.

Mid-girth growth: It is, however, the middle rung cities that is growing faster than big metros today. These cities will require more serious attention in terms of early planning. Kanpur, a prominent commercial city in the northern state of Uttar Pradesh , that has been taken up for an in-depth analysis in this study, represents the dilemma of the middle rung cities of India. While the mega metro cities have an acknowledged pollution and transport crisis that has attracted major planning efforts, and extensive investment, the burgeoning medium cities largely remain neglected. They are also reaching a crisis point but there are no immediate effective

The mid rung cities are growing faster than the big metro cities . These cities will need preventive action during the early stages of growth and motorisation.

policies to put them on a sustainable growth path at the early stages of motorization and growth. These cities will now need special attention as haphazard growth in these cities can lock up enormous pollution and carbon in the future. The new infrastructure investments in these cities and planning will have to be influenced with proper guidelines.

Small cities: The transformation of the even smaller suburban settlement as urban centres is not so pronounced in India and is also stagnating to some extent. Experts explain that this is largely because of the collapse of the municipal governance and poor revenue generation capacity of these towns. Some of these smaller towns have grown due to infrastructure investments and rural to urban migration. However, preventive action is important even in these towns as these are becoming target of hard sell for cars. Car companies are using strategies of ultra low cheap cars to tap the consumer base in small towns and rural areas.

Shadow growth: The mega and the big cities have also triggered massive shadow growth around their boundaries. Top rung cities that have grown due to in-migration and aerial expansion show strong trend towards suburbanisation. Bulk of industrial and manufacturing concentrate around a few large cities. Urban planning in these towns presents a special challenge and have implications for mobiliy planning. Gurgaon, new Bangalore or Navi Mumbai are examples of these neo-boom. Even the second rung cities like kanpur have begun to see suburban growth. Unfortunately, these shadow towns have remained extremely weak in municipal governance and sustainable infrastructure development. They are very poor in public transport infrastructure or pollution management. As these are largely being built by the real estate developers there is very poor supervision and regulatory control over them.

From mobility perspective this has serious implications. For instance, a great part of the motorized vehicles in Delhi also includes the daily influx of vehicles from the surrounding towns of Gurgaon, Faridabad and Gaziabad. This is mainly because the satellite towns have very poor public transport connectivity. A very recent study carried out by RITES in Delhi forecasts that in the next 11 years, personal trips within Delhi will increase by around 50 percent — from 120 lakh (12 million) to 180 lakh (18 million) — but trips from neighbouring cities will see an increase of 137 percent. It says that currently nearly 40 lakh (4 million) trips are made to Delhi by those living in NCR towns but by 2020, over 95 lakh (million) such trips will be made daily. If such an enormous increase in incoming trips begins to get dependent on personal vehicles the pollution and congestion reduction efforts in Delhi will be negated. Metro cities and their satellites therefore need integrated planning for more efficient public transport connectivity but also a check on uncontrolled suburbanization.

Inequity and social imbalances in cities: While all cities at the different levels of strata have unique challenges, nearly all face the common challenge of equity based inclusive planning and growth. The big cities have not been able to absorb labor and investments within the formal sector of economy leading to problem of slums and informal economy. There is a high incidence of urban poverty. About 75 per cent of the urban population is in the bottom income category earning an average of Rs 80.[2] It is estimated that about 21 percent of urban population live in slums. Nearly 40-50 per cent of people live in slums of Mumbai. About 25.7 percent of the urban population lives below the poverty line. While in class I cities 12 per cent of the households are below poverty line, in medium towns it is 23 percent — even higher than rural areas. Social and environmental impacts of these trends are severe as there is also high level of inequity in the provision of basic services in cities. Poor have poor access to basic services including transportation. They are marginalized in the urban planning and pushed to the periphery. This reduces their access to

Our cities have not been able to absorb labour and investments within the formal sector of economy adequately. This has led to the problem of slums. Sustainable mobility will have to address the issue of equity

affordable transportation modes and restricts their livelihood options. Mobility planning will have to address these challenges to be inclusive.

Pollution and mobility challenges in our cities

Cities are pollution hotspots: The fact that we are not being able to manage our urban growth well is evident in the emerging pollution data for the cities. More than half of our cities are reeling under critical level of particulate pollution. Even before we could deal with the problem of particulates, more pollutants have begun to raise their ugly heads. Nitrogen dioxide levels are already rising in several cities. Limited data shows that ozone is also a problem in the big cities. In fact, 80 per cent of cities of the total cities/towns monitored in 2008 under the national ambient air quality monitoring programme at least one criteria pollutant exceeded the annual average standards. It is worrying that smaller cities like kanpur are more polluted than the metro cities. Sprinkling of health studies have shown that that air pollution related public health impacts have taken a gigantic proportion in terms of premature deaths and illnesses from air pollution related diseases in Indian cities. Clean air action is crucial for public health security in cities.

Cities are energy guzzlers: Globally, focus on cities is getting sharper mainly because energy demand is expected to grow more rapidly in cities due to growth in urban population, lifestyle changes, and increase in the level of economic activities. The World Energy Outlook 2009 states that already two-third of world's energy is consumed in cities – by half of world's population. By 2030 cities will be consuming 73 per cent of world energy.
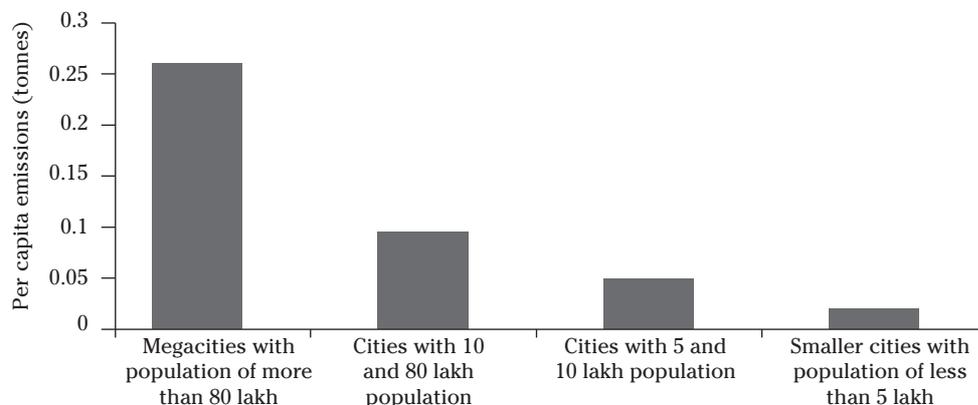
India mirrors this trend. There is still a big difference between big and small cities. Bigger cities that have longer travel distances and also a much larger share of personal vehicles guzzle more fuels. Smaller cities with much less motorsied vehicles use less fuels. The Transport Risk Injury Prevention Programme (TRIPP) of the Indian Institute of Technology, Delhi, estimates that approximately 50 percent of the total urban population lives in cities with less than 5 lakhs (0.5 million) and 15 percent lives in megacities. Yet, megacities are the major contributor to the total CO_2 emissions made. Approximately, one third of the total urban population of India lives in the three megacities that contributes nearly half of the carbon emissions (Graph 1: *Per capita CO_2 emissions varies according to the size of the cities*).

This bears out that while the mega cities must continue to get attention for stringent action the next rung of cities will also require strong preventive action. It is also clear that increased dependence on personal vehicles will further skew energy demand in the transport sector. A Wilber Smith Associate study of 2008 on 30 Indian cities for the Union Ministry of Urban Development shows that the maximum fuel consumption by vehicles for all cities classified in terms of population size is contributed by cars and motorised two-wheelers[3] (Graph 2: *Fuel consumption per day in different classes of cities*). These modes account for approximately for 65 - 90 percent of the total carbon-dioxide emissions that is directly linked with the amount of energy burnt by all vehicles in these cities.

Bigger cities that are more polluted also guzzle more fuel. In fact, the studies now find a strong correlation between per capita local air pollution and green house gas emissions. As cities grow in size both local air emissions and green house gas emissions particularly from transport increase significantly (Graph 3: *Per capita PM and CO_2 in cities*). Another study carried out by the Centre for Science and Environment has found that while the air of Delhi has remained polluted, the total heat trapping carbon dioxide emissions load from vehicles is also increasing.
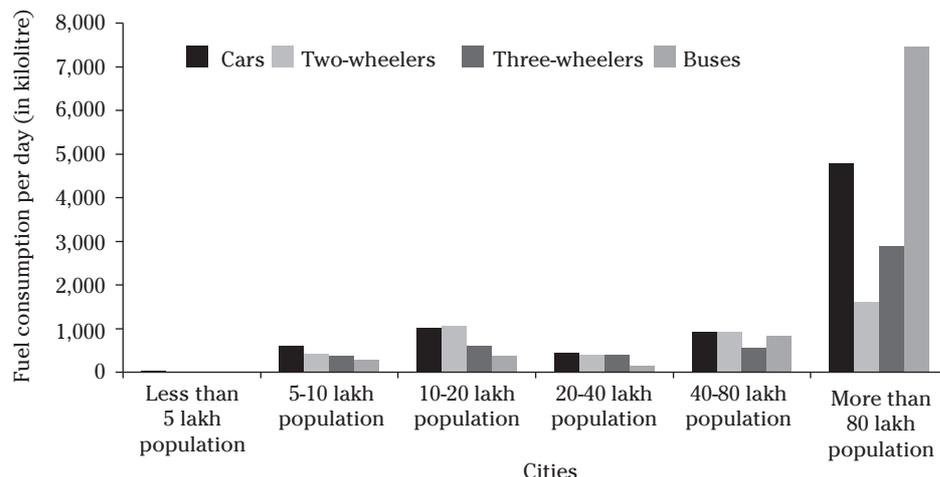
More than half of our cities are reeling under critical level of particulate pollution. More pollutants are raising their ugly heads. Bigger cities that are more polluted also guzzle more fuel

Graph 1: Per capita CO$_2$ emissions varies according to the size of the cities

Per capita emissions (tonnes)

0.3
0.25
0.2
0.15
0.1
0.05
0

Megacities with population of more than 80 lakh | Cities with 10 and 80 lakh population | Cities with 5 and 10 lakh population | Smaller cities with population of less than 5 lakh

Source: Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates

Graph 2: Fuel consumption per day in different classes of cities (in kilo litre)

Fuel consumption per day (in kilolitre)

8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0

■ Cars   ■ Two-wheelers   ■ Three-wheelers   ■ Buses

Less than 5 lakh population | 5-10 lakh population | 10-20 lakh population | 20-40 lakh population | 40-80 lakh population | More than 80 lakh population
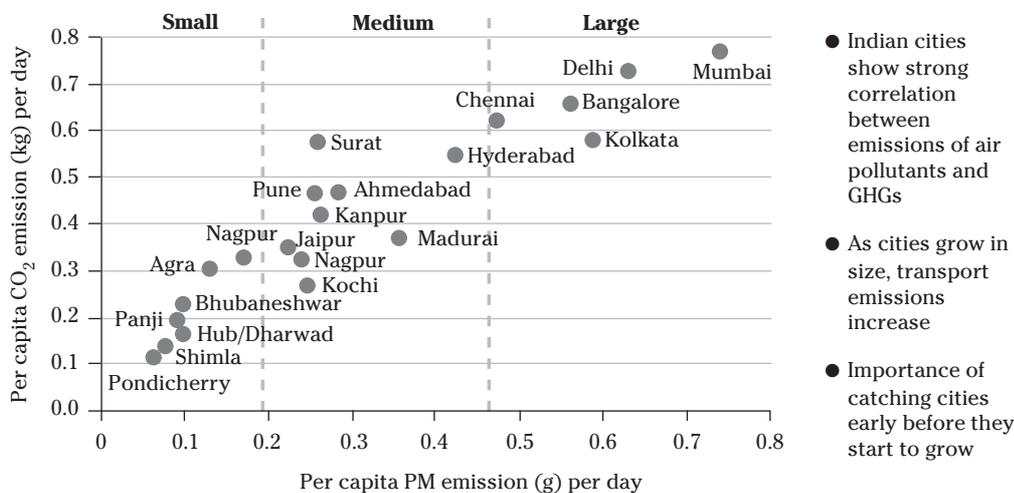
Cities

Source: Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates

Graph 3: Per capita PM and CO$_2$ in cities

Per capita CO$_2$ emission (kg) per day

Small   Medium   Large

0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0

Delhi   Mumbai
Chennai   Bangalore
Surat   Kolkata
Hyderabad
Pune   Ahmedabad
Kanpur
Nagpur   Jaipur   Madurai
Agra   Nagpur
Kochi
Bhubaneshwar
Panji   Hub/Dharwad
Shimla
Pondicherry

0   0.1   0.2   0.3   0.4   0.5   0.6   0.7   0.8

Per capita PM emission (g) per day

● Indian cities show strong correlation between emissions of air pollutants and GHGs

● As cities grow in size, transport emissions increase

● Importance of catching cities early before they start to grow

Source: Analysis of MOUD-Study on Traffic and Transportation Policies and Strategies in Urban Area By CAI-Asia

Motorisation is turning cities into energy guzzlers. Cars and two-wheelers consume the maximum fuel in the transport sector and account for 65-90 percent of the total carbon dioxide emissions from the transport sector.

Personal vehicles — cars and two-wheelers, contribute as much as 60 percent of the total CO_2 emission load from vehicles. Only in 5 years, (2002 and 2007), CO_2 emissions load from cars has increased by 73 percent and from two wheelers by 61 percent in Delhi.

McKinsey estimates also show that the urban areas in India can reduce their greenhouse gas emissions by about 29 per cent by 2020.

International Energy Agency has predicted that the future increase in energy demand in the transport sector of India will be largely driven by the increase in personal cars. Asian Development Bank has predicted that transport energy use will increase six times by 2020. This is ominous in a country where 72 per cent of the crude oil is imported. Energy imprint of motorization will have to reduced in each city.

Urban growth and motorisation: Rising income levels in cities will further fan motorization. The 2010 McKinsey Report estimates that the number of middleclass households earning between Rs 200,000 and Rs one million will increase four fold from 32 million to 47 million.[4] The rising buying power will stimulate market for cars significantly. There has already been explosive increase in vehicles numbers over the past few decades. Vehicle numbers are growing at the rate of 10 percent – 12 percent annually. Currently, motorization is largely driven by the motorised two-wheelers. It is said that if two-wheelers are included then the motoristion rate of Chennai is more than that of the Mexico City. While the stock of cars is expected to increase 5.8 times, public transport trips will increase 2.7 times.[5]

Further boost to motorisation will come from the emerging corporate strategy of the car industry to slash car prices to ultra cheap levels to bring car ownership within the affordable range of a much larger populace in the smaller cities and suburban areas.

The spurt in personal vehicle ownership will completely saturate the road infrastructure. According to the McKinsey about 30,000 lane kilometers are available for private transport but this falls short of the demand that has already increased to 640,000.in 2007. The lane kilometer supply will increase to 540,000 but demand to 980,000. There will be a huge gap of 440,000 lane kilometers.[6] This will add to congestion and pollution and also increase the carbon footprint. Nationally, peak vehicle density (vehicles per lane km) is estimated to be170 which exceeds the basic service standards of 112.[7] On most arterial roads traffic has exceeded the designed capacity of the roads. Building more roads is certainly not the answer. As we have seen in Delhi for instance – it is privileged to have the maximum land area – as much as 21 per cent — under road network. Yet, the city is gridlocked. Only increased usage of public transport and non motorized transport can help to re-engineer change. This is particularly important from the perspective of the large population of the urban poor who are the captive users of public transport, cycling and walking.

This only points towards the fact that cities will have to plan their mobility network differently. Cities will have to look at the reallocation and equitable distribution of road space amongst the road users.

Indian cities have a chance to grow differently: Despite the dire prediction about the motorization, Indian cities can avoid car centric growth path if they continue to build on the strength that it already has. The fundamental difference shows up in the way people travel in our cities. The share of public transport ridership is substantially higher in Indian cities compared to most industrialized countries.

Rising income levels in cities will further fan motorisation. The spurt in personal vehicles ownsership will completely saturate the road infrastructure.

Automobile dependence that leads to more energy guzzling and pollution is still much lower in India that has 8 cars per 1000 persons. When compared with the key developed regions of the world, the advantage of the Indian cities shows up clearly. Share of public transport ridership is much higher in India (See graph 4: *Comparative modal share of countries*). All recent studies show that public transport including buses and rail, meet more than three-quarters of passenger demand for motorized transport in India. In the nonmotorized segment, walking and bicycling meet more than a quarter of all trips in major cities and greater than half in small towns and rural areas. This baseline must be protected.

Closely built dense cities that have short travel distances make walking, cycling and para transit extremely attractive and feasible. TRIPP estimates that the average distance of the 85 per cent of all travel trips in Indian cities is less than 10 kilometer. Nearly 40 to 45 per cent is less than 5 kilometers. This makes our cities very walkable and cyclable. This advantage clearly shows up in the existing modal share. The non motorized transport has a share of about 30 percent in cities with more than 10 lakhs (one million) populations, which increases to nearly 60 percent in smaller cities. The share of public transport is more than 40 percent in cities with more than 50 lakhs (5 million) population (mostly organized bus systems) and about 10-20 percent in cities with 10 to 20 lakhs (one to two million) population (primarily served by informal route taxis).
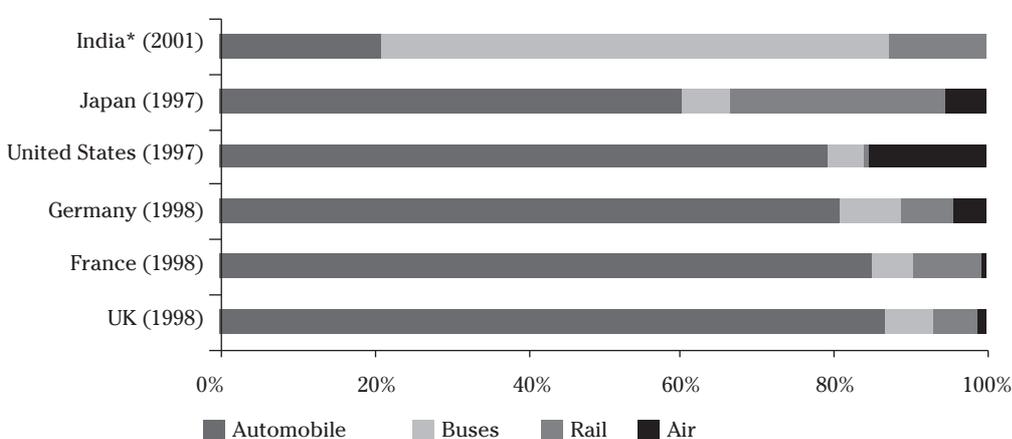
Smaller cities have higher share of non-motorised transport (Graph 5. *Modal share in selected cities of India*). It is ironic that even though most of the passenger kilometers are carried by the public transport and non-motorised transport in cities, cars and two-wheelers occupy most of the road space. The diversity of public and para transit modes and high share of walking and cycling represent the key strength in Indian cities that reduces dependence on personal vehicles.

City action underway

City based action has already begun in Indian cities. Public and judicial action has been one of the prime movers for early action in a few cities. Desperate to escape from the choking haze of pollution of the nineties strident public and judicial action had triggered the first phase of action in Delhi and a few other cities of India. It became necessary to take steps beyond the existing national norms and guidelines to reduce the excessively high pollution levels. Delhi, Mumbai, Kolkata, and seven
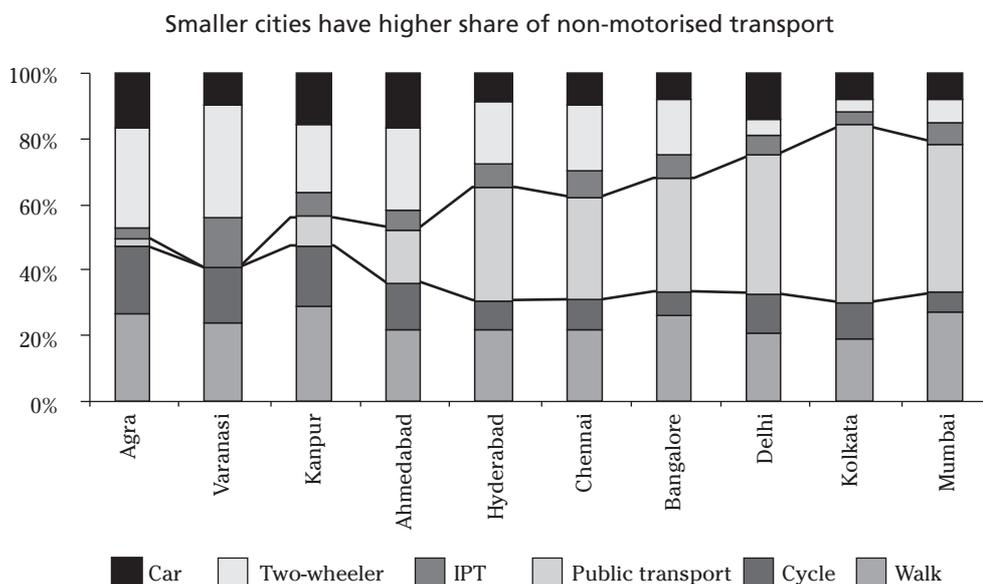
Public transport meets more than three-quarters of passenger demand for motorised transport. Non-motorised transport meets more than a quarter of all trips in major cities and greater than half in small towns

Graph 4: Comparative modal share of countries

Automobile Buses Rail Air

Source: Compiled from various sources

Graph 5: Modal share in selected cities of India

Smaller cities have higher share of non-motorised transport

Legend: ■ Car □ Two-wheeler ▨ IPT □ Public transport ▨ Cycle ▨ Walk

Source: Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates

To escape from the choking haze of pollution strident public and Judicial action triggered first phase of action in Delhi and a few other cities. It became necessary to take steps beyond the existing national norms and guidelines to cut excessively high pollution levels.

other cities including Kanpur were among the first set of cities that took recourse to this action (*See box: Cities and judicial action*).

Many of these cities, though at a different stages of progress, have implemented the first generation action aimed at getting immediate relief from the choking haze of pollution. These largely include improving emissions standards of vehicles, switching fuels from diesel to CNG, getting rid of old diesel commercial vehicles and two-stroke engines and so on. While this has helped to stabilise pollution levels in some cities to some extent, the challenge remains and gets coupled with new generation challenge of congestion and energy guzzling. These cities will now have to set new terms of action.

Cities are the action nodes where real change is expected on ground. Cities also have greater flexibility in decision making to respond to local problems and meet local air quality and mobility targets. They can enable cohesive coordination amongst different agencies for effective implementation. City governments are closer to local concerns and people and can take quick and appropriate decisions needed to reinvent mobility. This will help to ensure ownership, accountability and transparency. Therefore, along with the national policies the state policies on clean air and mobility will have to be strengthened for maximum impact and benefits.

Emerging policy opportunities for mobility management in Indian cities

Various national policies have begun to take shape to provide the national framework for clean air and sustainable mobility in Indian cities. The National Urban Transport Policy sets the framework for sustainable mobility; National Ambient Air Quality Standards issued under the Air Act sets the benchmark for clean air in cities. The mission on sustainable habitat framed under the National Climate Action Plan, provides for sustainable mobility action.

National norms and guidelines work primarily as the common minimum programme for the cities. But more often aggressive action becomes necessary to secure public

CITIES AND JUDICIAL ACTION

The Supreme Court of India that was already hearing a case on air pollution as part of the ongoing public interest litigation in Delhi, stepped in to respond to the growing public concern over air pollution in Delhi during the late nineties. In 1998 the Supreme Court directed formation of a statutory body Environment Pollution (Prevention and Control) authority (EPCA) under the Environment Protection Act. This was made responsible for making recommendations on the air pollution control as well as monitoring implementation of the court directives.

This helped Delhi to gather momentum. Delhi tightened the emissions standards to Euro II levels in 2000 -- five years before the official deadline, and tighter than the Euro I stanards in the rest of the country. Delhi also implemented one of the largest natural gas vehicle programme for its public transport to circumvent the very poor quality diesel that was responsible for very high toxic emissions. Delhi also removed old polluting commercial vehicles, relocated industries, improved power plant emissions.

The scope of the Court's action broadened considerably thereafter. There was a dramatic turn around when in 2002-03 the Supreme Court within the ambit of the same Delhi pollution case, began to look at the other polluted cities as well. In its ruling of April 5, 2002, it warmed "If no immediate action is taken, then it may become necessary for some order being passed so as to bring relief to the residents of the city." Nearly 14 polluted cities were identified in two court orders — that of April 5, 2002, and August 14, 2003. While there is an overlap in the two lists, together they include Agra, Lucknow, Jharia, Kanpur, Varanasi, Faridabad, Patna, Jodhpur and Pune (as in the first order), and Hyderabad, Chennai, Bangalore, Ahmedabad and Solapur (as in the second order).

Subsequently, in January 2003, the Central Pollution Control Board had released air pollution data of 22 polluted cities in the country. The Centre for Science and Environment drew the attention of the Chief Justice Bench in the Supreme Court to the list. In the hearing of August 14, 2003, the bench took serious note of this data. The bench observed that though the air quality had improved in Delhi since 1996, particulate pollution in other cities was turning into a crisis.

The bench widened the ambit of the same air pollution case in Delhi to include seven more polluted cities – Bangalore, Hyderabad, Chennai, Ahmedabad, Kanpur, Lucknow and Solapur. The cities of Mumbai and Kolkata were not included as their respective High Courts were already hearing public interest litigation in those cities. The seven cities have submitted their action plan to cut particulate pollution. The Supreme Court is still monitoring progress in these cities including Delhi. Kanpur is one of these cities.

The city action plans are a coharent steps towards assimilating the existing policy actions and building on them. These action plans have been admitted by the court as the common minimum programme. All the cities are at different stages of progress. To set clear milestones for progress EPCA has identified four key areas that have the potential to engineer a fundamental transition in the near term. Moreover, cities can play an effective and an independent role in these areas. These include the following:

● Gaseous fuel programmes to leapfrog from current polluting diesel to cleaner fuel, particularly in grossly polluting segments like public buses and autorickshaws.
● Public transport and transport demand management to reduce the demand for growth of private motorisation and reduce emissions.
● Vehicle inspection programme for the on-road vehicles to combat pollution from large fleets of existing vehicles.
● Management of transit traffic and phasing out of old vehicles to reduce the burden of pollutants in the city.

Kanpur represents the dilemma of the middle rung cities in India. While the big metro cities have drawn policy attention and extensive investments, these cities have largely remained neglected.

health, reduce energy imprints of motorization and climate impacts. State governments along with the city governments are expected to come up with strategies to meet the objectives of these national policies and also devise their own

Graph 6: Estimated capital spending in sectors (USD per capita per annum)
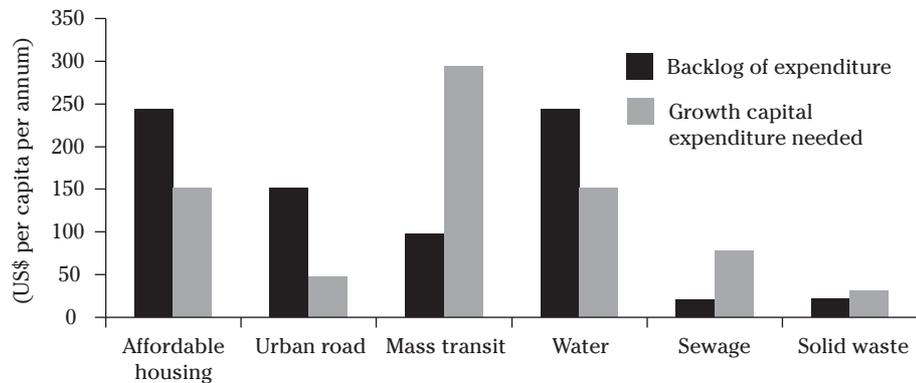
Sources: Anon 2010 India's urban awakening: Building inclusive cities, sustaining economic growth Mckinsey Global Institute, April

policies to supplement the national efforts.

Indian cities are poised for major infrastructure spending. The McKinsey estimates show that among all urban sectors the maximum capital spending is expected to go to transportation and affordable housing in Indian urban centres (See Graph 6: *Estimated capital spending in sectors*). It is important to influence this investment to make the trajectory as efficient and clean as possible. International experience shows that it takes at least a decade for cities to make the turn around.

Transportation spending is scaling up under the Jawaharlal Nehru National Urban Renewable Mission (JNNURM) of the Union government that has also laid down conditional reforms in the urban municipal governance and the transportation sector. Moreover, after the recent recession the central government has given conditional grants under JNNURM to 53 cities including Kanpur as a stimulus package to buy buses. This one time bus scheme is tied to conditional reforms in the transport sector. To access this fund the city government will have to initiate institutional reforms for public transport management and implementation, create dedicated funds from revenues from a variety of heads including higher taxes on personal vehicles and diesel cars, implement parking policy as a car restraint measure, use advertisement policy for revenue, reform bus sector for more efficient delivery, make land-use changes among others. If this is effectively leveraged the city can be transformed substantially.

This citizens' report bares the air pollution and mobility challenges in Kanpur and seeks to find the solutions for a livable city.

However, it is important to assess the effectiveness of such interventions and responsiveness of the cities. JNNURM creates a top down pressure for reform and change. While this can be a stimuli for change it is important to assess if a blanket national approach is sensitive towards local imperatives and solutions. This in-depth city study of kanpur is also an opportunity to test out the efficacy of such interventions.

This study is the beginning of the series of citizens' report on selected cities of India that captures the air quality, transportation energy and mobility challenges and seeks to find a solution for a livable city. This in-depth city investigation will study the unique challenges and imperatives of each city and assess the strategies that are needed to help the cities to meet the clean air standards and reduce teh energy and climate impacts of motorisation.

This series begins with an indepth analysis of the city of kanpur in Uttar Pradesh.

WHY KANPUR?

Kanpur is neither a state capital nor a mega city. But it is the largest city in the state of Uttar Pradesh. It is spread over an area of 260 sq km with a population of 25.51 lakh (about 2.5 million). The population is expected to increase to 48 lakhs (about 4.8 million) by 2030 which amounts to adding a whole new Kanpur in 30 years. Even though it had originally grown as an industrial town, manufacturing is shrinking in this city. According to its City Development Plan, out of 83 heavy industries 38 are still functioning while 45 units have closed. There are 12,240 small scale units. But 47 per cent are sick or closed. Its future growth is expected to be based on trade and commerce.

Its land-use is now dominated by residential and commercial use. Area under industrial use is only 5.5 per cent. Its population is heavily concentrated in the city core and is not sprawled. The population density in its core is six times more than its outer area (See map: *Kanpur: Inner and outer city area*). As the core area begins to get saturated with no redevelopment plans the city is expanding along its radial pattern of road network. This includes two National Highways namely, NH-25 (Kanpur-Lucknow Road) and NH-2 (connecting Kanpur to Kolkata in East and Kanpur to Delhi in the North). Grand Trunk road, Hamirpur road and bypass roads are other major arterial roads in the city. Parwathy Bangla Road, Mall Road, Dad Nagger Road, Jawahar Road, Eye Hospital Road, Prithviraj Chauhan Road and Panki Road are some of the major sub-arterials roads within the city.[8] A Kanpur Nagar Nigam Study during 2003 revealed tremendous increase in vehicular traffic on these roads and increased emissions.[9]

Even though the city is growing the economic profile of the population shows that nearly 60 per cent of the city population lives in slums. The city will have to cater to their mobility needs and make the growth inclusive. Moreover, the green spaces, the lungs and the sink of the city are nearly exhausted inside the city that can get further eroded if car centric growth is encouraged.

Air pollution challenge in kanpur

Air pollution crisis: Kanpur faces the same dilemma of the mega cities. Like Delhi and Mumbai it has begun to act to curb air pollution and even seen improvement. But like the mega cities Kanpur's time to breathe easy is over. Air pollution s rising again. The city will have to act fast to recover its gains. The pollution levels are on

> Kanpur faces the same dilema of the mega cities. Like Delhi and Mumbai it has begun to act to curb air pollution and even seen improvement. But like these mega cities air pollution is rising again.

Map: Kanpur inner and outer city area

Outer city area
Inner city area
K A N P U R
UTTAR PRADESH

Source: City development Plan Kanpur

the upswing again after a few years of control.

● When the first phase of action was initiated in the city, kanpur had the dubious distinction of being the most polluted city. Severe particulate pollution had begun to choke Kanpur. The air quality data of the Central Pollution Control Board (CPCB) revealed that the levels in the city were 4-5 times above the standard. Their levels also exceeded standards almost on a daily basis.

● The small breathing space that the city had gained is on the verge of getting lost. The annual average levels of respirable suspended particulate matter (RSPM, or PM10) in the city stood at 211 microgram per cubic metre in 2000. They dropped to -179 189 microgram per cubic metre during 2003-05. The upward swing is now noticeable — the annual average levels have jumped back to 212 microgram per cubic metre in 2008 — 3.5 times higher than the standard. The levels can be higher during winter.[10]

● Levels of nitrogen oxides (NOx) though below standards, are rising in the city which is a clear sign of growing impacts of vehicles.

● The recent tightening of the air quality standards by the Union Ministry of Environment and Forests has also changed the air quality profile of the locations in Kanpur. While particulate pollution in these locations like Sharda Nagar, Deputy ka Paro, Kidwai Nagar, and Fazal Ganj continue to remain critically polluted, the nitrogen dioxide levels in all these locations have moved from low to moderate levels.

● About 60 per cent of the geographical area of the city has pollution problem with a highly polluted city core. This exposes a large number of people to very high pollution levels.

Studies in Kanpur have shown that the annual monetray benefits to the entire population of kanpur can be enormous if the city is able to meet the air quality standards.

City needs to take tough measures to control growing air pollution and fast. Otherwise, the city will find itself in the toxic haze of the early days.

Public health at risk in Kanpur: Sprinkling of study available from GSVM Medical college and CPCB show lower lung function in people living in Vikas Nagar and Juhilal Colony compared to those living in cleaner environment. UPENVIS has shown that in entire Uttar Pradesh 0.4 million disability adjusted life years are lost due to air pollution and this costs the state about Rs 2.6 billion. The pollution level in kanpur are of serious concerns in the light of the studies in the US that show increase of only 10 microgramme/cu m of particulate matter of less than 2.5 micron (PM2.5) is associated with significant increases in health risks. High exposure to PM2.5 is known to lead to increased hospitalisation for asthma, lung diseases, chronic bronchitis and heart damage. Long-term exposure can cause lung cancer. Rising level of nitrogen oxides can also have serious implications for respiratory diseases.

But it is also clear that if we act on time and improve the air quality we can save lives and illnesses. A study by Usha Gupta Institute of Economic Growth and Bhimrao Ambedkar College has estimated that collectively, the annual monetary benefits to the entire population of Kanpur can be as much as Rs 213 million – which means that the city can save this much — if the city is able to meet the air quality standards.

Where is the pollution coming from? Kanpur is a city of mixed activities. Most of the air pollution is coming from rapidly growing number of vehicles, industrial

activities and growing use of diesel generator sets in the power starved city. The recent assessments carried out by Central Pollution Control Board and the Indian Institute of Technology, Kanpur show that as much as 22 per cent of the killer particles are from vehicles and 33 percent are from industry whereas 47 per cent of nitrogen oxides is from vehicles and 43 percent is from industry.

Vehicles pose a special challenge: We need stringent action in all the sectors to attain clean air in the city. But vehicles are a special problem. Why? Vehicle fumes cause maximum health exposure: Vehicles are of very special concern because vehicle emissions take place within the breathing zone of the people. This increases our daily exposure to deadly dose of toxins. This particularly makes the road users especially the walkers, cyclists, and those staying close to the roads -- within the influence zone of at least 500 meters – to the toxic effect. Studies carried out by the World Bank in other cities have shown that nearly half of the total exposure to particulates that make people ill could be due to the vehicles. That is why vehicles require more stringent measures.

Mobility crisis in Kanpur

Kanpur has fallen in the pincer grip of mobility crisis. Mobility crisis begins to build up in a city when a large share of daily travel trips is made by personal vehicles that occupy more road space but carry fewer people, pollute more, and edge out walkers, bicycles, buses and intermediate public transport. There are early signs of this crisis in Kanpur.

Cities do not have any space to increase road space for more personal vehicles – two-wheelers and cars. Congested roads have slowed down the journey speed. Compared to the mega cities of Delhi and Mumbai, the rate of motorisation is still a lot lower in Kanpur. But smaller and densely built Kanpur is getting increasingly congested. Kanpur with 2.5 million people has 643,245 motorised vehicles – a small fraction of 5.6 million vehicles in Delhi. Every year Kanpur is registering about 40,000 new vehicles. According to the Kanpur transport department at least 100 two-wheeler and cars and 10 commercial vehicles are registered daily. The numbers have increased by nearly 63 per cent during 1999 and 2006.

Even though personal vehicles — cars and two-wheelers — are the largest part of the vehicle fleet and are crowding the city, yet their combined share in meeting the daily travel needs in the city is less than other modes of travel. Two-wheelers carry 21 percent of the daily trips and cars just 16 percent. Building more roads for cars will not help.

To this is added daily influx of vehicles from outside the city especially commercial traffic. Even this number threatens to paralyse the city that is closely and densely built with narrow streets that were originally designed to facilitate short trips, walking and cycling. Even a small spurt in vehicular traffic can gridlock this city.

Dependence on personal vehicles is rising steadily in the city. Two wheelers are 83 percent of the fleet and cars are 13 per cent. At least two-wheelers are more space efficient and use less fuel. But already cars are increasing at a higher rate than two-wheelers. The annual growth rate of growth for two-wheelers is falling and is currently 7 per cent lower than the growth rate for cars which is 10 per cent. Each new batch of vehicles though a little cleaner barely makes an impact on air quality as its rising numbers swamp the effect. This will change the pollution and congestion profile of the city in the coming years.

Studies show that the congestion index of kanpur is poorer than a bigger city like Ahmedabad. In more than 26 percent of the road length the traffic volume has exceeded the designed capacity. This has further slowed down the journey speed.

Journey speed: Growing congestion of vehicles is slowing down the peak hour traffic speed. Against the governed maximum speed of 40 to 50 km/hour the average speed in Kanpur has plummeted to 17 to 20 km/hour – even slower at some stretches. According to the study carried out by the Wilbur Smith for the Union Ministry of Urban Development in 2008 the congestion index of Kanpur is poorer than a bigger city like Ahmedabad. Studies also report that in more than 26 per cent of the road length the traffic volume has exceeded the designed capacity of the roads.

As motorised congestion is increasing, non-motorised transport like cycle rickshaws and bicycles are being blamed for slowing down traffic. Policies are getting harsher against cycle rickshaws and are being removed from arterial roads.

Vehicles threaten energy security: There is very little informtion on the actual transport fuel consumption in the city. However, some studies show that in Kanpur the cars and two wheelers together already use up about 80 per cent of the total energy consumption of 0.1 million tons of oil equivalent per year in the transport sector. If the dependence on personal vehicles continues to increase the oil consumption will increase three times by 2030 when the four and two wheelers will consume 95 per cent of the energy in the transport sector of the city. This has been borne out by the SIM Air study of 2009.[11]

If energy use increases the emissions of heat trapping carbon dioxide that cause global warming will also increase. Already, growing use of personal vehicles is increasing CO_2 emissions from the transport sector of the city. The SIM Air study shows that amongst all vehicle segments the CO_2 emissions from the personal vehicles (cars and two-wheelers) segment are the highest in Kanpur – as much as 84 per cent. Transport CO2 emissions are still much lower than the mega cities. But the growth spurt in the mid rung cities are expected to escalate the emissions in future. Therefore, action at the early stages of the growth of these cities is critical.

The first generation reforms in Kanpur have helped to arrest the runaway pollution in the city. A range of policy opportunities and court mandates have converged to accelerate change in the city.

First generation reforms in Kanpur

In the past few years, Kanpur has taken steps to reduce pollution. These are the first generation reforms that have helped to arrest the runaway pollution in the city. A range of policy opportunities and court mandates have converged to accelerate change in the city. The city government along with the Central Pollution Control Board had first embarked on pollution control during the late eighties when a series of decisions were taken to control industrial pollution in the city. In 2004 Kanpur came under the surveillance of the Supreme Court of India. The court appointed body – Environment Pollution (Prevention and Control) Authority was made responsible for monitoring of the implementation of the clean air action plan submitted by the state government to the Court. The state government along with the city government has additionally initiated programmes to compliment these measures. These interventions have kick started the first generation reforms in Kanpur.

The city action plan for clean air developed for the city under the aegis of the Supreme Court has created an opportunity for change. This provides the framework for controlling different pollution sources – transport, industry, power plants in an integrated way and helps to achieve the balance between the composite action and priority action. This has helped to bring in a greater coordination.

● **Action on vehicles:** A variety of measures have been initiated to control vehicular pollution. It has tightened the emissions norms of vehicles; strengthened pollution under control system with new equipment and norms for

in-use vehicles; introduced CNG programme targeting autos, tempos and buses; Age of the vehicles has been fixed. Kanpur has phased out — 105 buses (>9 year old): 907 tempos (>7 year old), 565 autos (>10 year old), and Maxi cab (>15 year old). Only three wheelers with catalytic converter/ scrubbers are registered and allowed within the Municipal limits. Battery operated three wheelers are being encouraged. New buses have been introduced; Entry time of transit commercial vehicles on Grand Trunk road is restricted and so on.

- **Action on industry:** In kanpur out of 60 air polluting industries 12 industries have been closed and three issued notices for non-compliance with norms; Panki thermal power station does not meet the norm but bag filters/ ESP have been installed. Fly ash is used in cement industry and by NHAI; Open burning of biomass and solid waste has been banned in municipal area and so on.

In spite of all these actions, pollution levels are on the increase. The second generation reforms are now needed to combat the new challenges – growing pollution and mobility crisis.

Kanpur must not repeat the mistakes that Delhi has made of following pro car policies. The second generation challenge is about explosive increase in personal vehicles numbers and erosion of sustainable modes of transport. Delhi has not been able to protect its initial strength — 60 per cent travel needs met by buses 2001 that dropped to 40 per cent in 2008. Kanpur still has the chance to plan its future growth differently. More than 60 pent of the travel needs in Kanpur are met by the intermediate public transport system that include autos, tempos, cycle rickshaws combined with cycles, buses and walking. This is Kanpur's strength and the city should make transportation plans for the urban majority and not for the car owning minority.

People of Kanpur want change

As part of this citizens' report the Centre for Science and Environment along with the city based civil society groups including Eco Friends, Paryavaran Mitra and volunteers has carried out a rapid stakeholders' perception survey in the city. This is part of its ongoing assessment to understand the citizens' perception of the air pollution and mobility problems in the city. The respondents are from different target groups – experts, officials, commuters, doctors, teachers, business, civil society among others. They have reflected on the core issues that must be looked into for making the next generation action agenda. The key highlights are as follows:
- The majority – a whopping 80 per cent have said air pollution is worsening and half of them have said the air is highly polluted
- A thumping majority – 80 percent have said incidence of respiratory diseases, asthma, eye irritation are on the rise.
- More than 90 percent have identified congestion as the biggest problem
- Nearly 90 percent have supported the CNG programme as one of the most effective step so far in the transport sector to clean up the air
- Nearly 65 percent have identified the cleaner domestic fuels as the next clean step
- About 60 percent have indicated improvement in emissions standards as contributing to cleaner air
- Less than half think new roads and flyovers can help to clean up the air
- Majority have said that cycles and cycle rickshaws are important and should be given segregated space
- Nearly 35 percent have rated city public transport as average and 30 percent as poor

Perception survey in Kanpur reveals that the majority feel that air pollution is worsening and congestion is a very serious problem. There is unanimous support for improved public transport and also for cycles and cycle rickshaws.

● About 40 percent feel that intermediate transport is good Availability of intermediate public transport service – autos and tempos is better than the buses
● There is nearly unanimous support for improved public transport.
● Nearly 80-90 percent have said that they will prefer to take public transport if it improves
● Nearly 90 percent have supported dedicated lanes for buses
● The majority find the walking infrastructure poorly maintained and as a result of this they do not enjoy walking. This needs immediate attention as pedestrian traffic is the strength of the city
● Majority are skeptical about higher taxes on personal vehicles.
● Half of the respondents have supported congestion tax
● At least 40 percent have said that fuel adulteration is still a problem

People of kanpur are disenchanted with the problem of air pollution and its health consequences. Public opinion clearly supports technology leapfrog, improvement in public transport and non-motorised transport to stay ahead of the problem. They want qualitative improvement in the service levels of the transportation modes. Articulation of this public support is crucial for political decisions on sustainable transport.

At cross roads

Expenditure on transportation is quite substantial in all cities of India. A review of city budgets carried out by the TRIPP shows that the share of transport in total capital expenditure varies between 30 percent to 45 per cent in cities. This is quite substantial. But most cities are focussing on construction of bridges, flyovers and sub-ways and that hogs the large share of the expenditure. This clearly shows that even though the National Urban Transport Policy has laid down the guiding principles for sustainable mobility, that does not get translated into state level action and that continues to tilt towards car-oriented projects.

States also need state level urban transport policy to influence the state level expenditure. This will also help to intensify bottom up pressure for locally appropriate transportation priorities.

This bears out that states too need state level urban transport policy to influence the state level expenditure. This will also help to strengthen bottom up approach for deciding transportation priority in cities. The cities will not be able to effectively utilise the available funding either from the state governments or the national government if state level policies are not in place.

This is particularly important at this stage when national expenditure on transportation is taking shape based on the guidelines of the National Urban Transportation Policy. While this topdown approach helps to set the terms of action on sustainable mobility in cities, the common framework may not always capture the uniqueness of the individual cities or help to build local political support.

This limitation is showing up in the reform based central government funding programme of JNNURM. This programme requires Kanpur like any other city to develop a City Development Plan (CDP) to outline the priority areas for funding and interventions under JNNURM.

The Kanpur CDP that is expected to decide the future transportation regime in the city has identified the following key thrust areas for intervention: – public transport, replacement of shared auto rickshaws, discouraging private cars and reducing congestion, widening of trunk roads, computerisation of traffic signalling for traffic management, intersection design and footpaths, construction of bus station, widening of roads in innner city, three flyovers and five roads overbridges on Ganges and construction of parking spaces. It also proposes a feasibility study for metro in kanpur.

Limitation of bus led JNNURM reforms in Kanpur: The fundamental limitation of the Kanpur CDP to source funds under JNNURM, is that it is heavily biased towards overtly formal public transport system. It ignores the local strength of Kanpur city in para transit and non-motorised transport for instance. It is typically trying to impose a formal transportation framework not well stiched with the city's transportation regime.

Kanpur has just about begun to develop its formal bus transportation system that meets only 9 per cent of the travel demand currently. Under the stimulus package of the JNNURM the city is acquiring 350 standard buses. But the CDP or the JNNURM reform process does not talk about integration of the emerging formal system with the existing informal system that meets the sizeable travel demand in the city. Kanpur is instead getting caught in the conflict between formal and informal public transport systems. Total confusion reigns. Initially, buses were blamed for congestion and were taken to the city's periphery. Now the JNNURM buses are inside the city but now the intermediate public transport is being blamed for eroding the space for the buses. In fact, the city authorities are clamping down on three-wheelers and cycle rickshaws to create space for the standard buses.

As there is no policy recognition for the para transit the city has not planned for buses as well as the three-wheelers and cycle rickshaws in an integrated manner. Autos and cycle rickshaws are the part of the affordable public transport system for the majority of the city dwellers especially in a city where maximum number of travel trips have very short distances. If their operations are curtailed dependence on personal vehicles to traverse the shorter distances will only grow and increase the larger societal costs of travel. Buses can serve the key arterial roads to effectively link the core city with the new development and the intermediate public transport can be reorganized as effective feeder. Instead modernise this fleet and improve its deployment. Today JNNURM buses are running empty as their higher fares cannot compete with the lower fares of the para transit. This is the limitation of the top down approach that is not backed by local policy priorities.

Equally inexplicable is the CDP proposal for feasibility study for metro in kanpur where even formal buses are not yet affordable and have not succeeded in drawing adequate trips yet. This is imposing the transport model of mega cities on smaller cities without assessing the appropriateness of the systems.

Similarly, usage of non-motorised vehicles and pedestrian volume in Kanpur are also not reflected adequtely in the CDP planning process. This is clearly a case of missing the woods for the trees. Even though footpaths are mentioned it does not insist on the service levels and quality of the footpaths. Insistence on computerised signals for traffic management instead has the risk of impeding direct shortest routes of walkers and causing more pedestrian delays .

Lack of focus on para transit is a flaw that the JNNURM programme has inherited from the National Urban Transport Policy itself that is also weak on informal para transit system in smaller cities. The centralised approach has failed to understand the merit of these systems in restraining car dependency. In the absence of clear funding mandate for the inter-mediate transport and non-motorised transport, the CDP intervention will create bias towards flyovers, road widening and parking supply and incite more personal vehicle ownership and usage.

However, as the JNNURM programme itself is evolving and is now making demands on the cities to prepare a comprehensive mobility plan that will comprehensively identify the interventions as a cogent programme, this offers opportunity to undo

The city development plan is overtly biased towards formal public transportation system. It ignores the strength of kanpur in para transit and non-motorised transport.

some of the original mistakes. Such an action plan can help to strike a balance between composite and priority actions, build interface between national and city level policies and imperatives, and harmonise the plethora of laws, policies and Acts related to a variety of aspects of local transportation planning for effective impact.

However, the city will also need to develop capacity to design and implement the reform agenda. The city is falling behind in the reforms that have been made conditional to the stimulus package.

Setting the agenda for Kanpur

It is time to set new terms of action in kanpur as well as draw lessons for other smaller cities grappling with the challenges of motorisation.

City action needs enforceable targets: Though Kanpur like other Indian cities have taken the steps towards implementing clean air action plan they are not guided by binding and monitorable targets for clean air and sustainable mobility. Clean air standards are not legally enforced. Target for modal shifts, quality indicators for

VOICES FROM KANPUR

As part of the citizens iniative, a City Dialogue on Air Quality and Transportation Challenges was held to debate on the agenda for action in Kanpur in December 2009 . Prominent citizens and policy makers of Kanpur city had gathered to discuss the way forward. Excerpts:

Venkateshwarlu, Divisional Commissioner: To have a clean and a livable city – it is important to reduce air pollution. It is wise to reduce pollution now than to spend money on numerous health problems later. We must make and implement policies for the maximum benefit of maximum number of people.

Mukesh Sharma, Professor, Indian Institute of Technology, Kanpur: The city has some unique air pollution issues. When we compare the two cities – Delhi and Kanpur, we find that population in Kanpur is a fourth that of Delhi, the pollution load is also one fourth, but air quality is as bad as Delhi. Kanpur also has higher population density compared to Delhi. The congestion is worse even though number of vehicles is smaller in Kanpur. Thus, kanpur has a much bigger problem. The way the city has been planned – the highways and the railways cut through the city. This adds to congestion. The amount of silt load on roads is 7 to 8 times higher than any other city. This creates a lot of dust when the vehicles move on roads. Our emission inventory has also found huge emissions from vehicles and road dust emissions, garbage burning and biomass burning. Vehicles contribute 20 percent to pollution load, garbage and biomass burning contributes about 17 to 18 per cent. When we consider finer particles the contribution of vehicles become larger, about 30 per cent. So with this mix of pollution sources – it is challenging to manage air quality. Our studies also show there is long range transport of emissions into the city from other places and nearby towns and cities.

Anil Kumar Singh Sagar, District Magistrate: In Kanpur the City Mobility Plan is urgently needed. We hope that it will

come up soon as the state government has already initiated its preparation. We have also begun to implement strategies to improve public transport. For instance, we have introduced the low floor buses. However, the occupancy is still very poor, -- just about 20 to 30 per cent whereas in other cities like Delhi buses are heavily used. The services and time taken to travel in these buses need to be further assessed. All this will have to be integrated in the mobility plan.

Yashpal Singh, Director (Environment) Environment Directorate, Uttar Pradesh Government: A number of initiatives are in progress in Kanpur to clean up the air and reduce congestion. The Kanpur action plan has introduced and expanded the CNG programme, phased out old vehicles, and enforced pollution control in industries. The CNG programme will have to be strengthened further. All diesel and petrol driven autos and tempos have been converted to CNG. CNG programme had started in April 2006 with initial capacity of 88,000 kg per day. But capacity utilization is 50 per cent. . About 1208 CNG personnel have been trained in CNG safety related issues. The vehicle phase out programme and on road emissions checks are in place. Premix dispensers for two-wheelers have been installed. Adulteration is regularly monitored, and compliance is satisfactory. We are working on a parking policy to reduce congestion.

U N Tiwari, Additional Municipal Commissioner, Kanpur Nagar Nigam: We are introducing improved public transport buses. But the citizens of Kanpur must accept these buses. For this we need affordable fares. Currently, people are paying just Rs 2 to 3 in para transit vehicles. But in the new JNNURM

public and non-motorised transport, and targets for reducing energy consumption in the transport sector are not set and tracked through well defined monitoring systems. Illustratively, the PM10 levels would need to be cut by at least 3.5 times from the current levels to be able to neet the standards. The city needs periodic health impact assessment to drive clean air regulations.

Similarly, Kanpur needs to set target to protect its current modal share and improve the share of all public passenger modes (both formal and informal), cycling and walking. Already their current modal share is more than half. This will need collective improvement. Illustratively, there is precedence in Delhi where the Delhi Master Plan has proposed attaining 80:20 modal shares by 2020. Similarly, Pune has indicated a similar target in its mobility plan. But city plans need clarity about the milestones and timeline of implementation and quality indicators that can help to achieve targets. Implementation of the plans should be monitored against these targets to discipline enforcement, check laxity of action and ensure accountability.

In fact, all cities covered under the JNNURM have been advised to benchmark their

buses they would need to pay higher -- Rs 8 to 10. Acceptability of buses therefore is lower. The city government along with the state pollution control board has also carried out a comprehensive survey of small scale units within the city. We have a scheme for relocating these units. This needs to be expedited so that the polluted and congested core area can benefit. We are hopeful that people in the concerned agencies will help in removing the hurdles for the city development schemes.

Rakesh Jaiaswal, Eco Friends: It is really unfortunate that Kanpur is one of the most polluted cities in the World. The data shows that Kanpur is equally or comparably more polluted than other metros. The city has taken some measures but there are contradictions. Sometime back CNG buses were introduced in Kanpur cities. But later they were removed — I do not know the reasons. Now the low floor buses have been introduced. But there is less acceptability of these buses. So we need to find a solution to augment its ridership. We are making efforts but not getting the results. Every person has an ambition to own a vehicle. But at the same time we need to improve the public transportation system so that the people can switchover. Public participation is must for mobility planning. But people are not aware of what government is planning or doing for city mobility. We want planning for the people – not just for car owners. We need to have public engagement.

Capt. S C Tripathi Urban Environment, Development Society, Kanpur: There is no dearth of knowledge or understanding about the sources of pollution or how serious is the problem of air pollution in the city. It is very difficult to breath here. We also know the solutions. The question is who will do it. If the planning has to be perfect, people should be involved in the planning process. Then people can take responsibility and participate in the implementation. There should be public scrutiny of the projects. Since we are going to live in this city, and breathe in this city, we must do something about improving the air quality. It is also the responsibility of

the government agencies to take note of the groundwork so that they can check and see whether the required work, such as on footpath etc, is happening in a proper manner on not.

S P Selvam, Managing Director, Central UP Gas Ltd: In some ways we are contributing towards improving the living conditions in Kanpur. We have created 7 stations already. But the business plan of CUGL had envisages about 16 stations by March 2010. The capacity utilization is low -- about 50 per cent of gas availability. Slow conversion of vehicles is the key reason. Last year CNG vehicle registration virtually stopped. Unfortunately, the small diesel commercial vehicles are being registered outside Kanpur and they are plying here. This is increasing pollution. Deployment of CNG buses is very poor. This will have to be augmented. We are also requesting the authorities to bring some kind of directives and incentives for the industries to switchover to natural gas. We have laid down long distance pipelines up to the industrial areas of the city. Domestic supply of gas has also started. However, CNG pricing will have to be addressed. Local taxes on CNG is very high in UP which makes the gas costlier for the people. At least VAT on CNG should be discontinued for at least five years.

B P Pundir, Professor, Indian Institute of Technology, Kanpur: Regarding the in-use vehicles there are two issues -- technological and operational. The national norms and the roadmap will have to be decided for the new vehicles. As of now emissions standards for new vehicles in Kanpur are at par with the big cities. But the in-use vehicle fleet poses maintenance challenge. We know that the current pollution under control certificate programme for in-use vehicles is not working – it has not worked in any other place. The reason is there is no quality control. Implementing agencies do not pay attention to calibration, authenticity of tests, training of personnel etc. Unless we introduce high volume big testing centre we are not going to get the benefit of new technology. Simultaneously, we must work on public transport and declare no vehicle zones in certain areas. We have to take tough decisions.

levels of services for various parameters specified by the Union ministry of urban development. This aims to generate information that will be useful in making urban transport sustainable. The mobility benchmark includes detailed indicators in the areas of public transport, pedestrian facilities, non-motorised transport, ITS facilities, travel speed on major corridors, road safety, parking facilities, pollution levels, landuse-transport integration and financial sustainability of public transport. Application of this benchmarking to set and meet targets is possible only if cities institute back up policies.

Enable monitoring of progress: The ultimate key to sustainability is effectiveness of implementation. But it is difficult to monitor progress without good data on indicators of change. Though the clean air and mobility policies have begun to take shape it is not possible to track the changes in mobility pattern and the consequent energy and health impacts in the city. This is mainly because many of the sustainability indicators are not part of the official tracking system. The current data recording system is extremely limited in scope. Cities may have limited air quality monitoring, and basic vehicle registration system and so forth. But a full range of indicators are missing mainly because mobility management is a very new area of governance. Regular official surveys and data recording are not carried out to holistically capture the indicators – for instance, details of vehicle and fuel types and sales, changes in trip length by modes, changes in modal share, usage of non-motorised transport, and many other service level benchmarks for mobility. This is needed to assess the impacts of interventions. The city should develop and adopt a unified data management protocol to reform the existing data keeping systems.

We checked out availability of information according to the Union government's service level benchmarking in Kanpur. We found that while a considerable part of this information is not properly generated, the little that exists is also spread across eight departments in Kanpur.

City should also have the capacity to develop strong baseline data on diseases and deaths. Improve the surveillance and registration of key acute and chronic diseases associated with air pollution for accurate quantification of potential health impacts of air pollution. Standardise methods for surveys. Indian surveillance system should develop capacities to capture a wide range of indicators. This will require strong coordination among the agencies to develop protocols to enable comprehensive and dynamic databases. Transparent access to these databases is also important.

Urban transport and air quality policy at state level: Target setting with clear milestones and timeline is possible in cities if the respective state governments develop enabling policy framework to achieve clean air targets and mobility planning. At present the national government has defined the framework for national air quality management and national urban transport policy to guide cities and set the terms for central funding. But cities can respond more effectively if they have a composite state level urban transport and air quality policy to support local action. This can enable and speed up institutional reforms for coordinated planning and implementation in cities. A state level policy can also have multiplier effect as other cities within the state can also benefit from such a composite policy and action will not remain limited to only those cities that are getting central support or are under court supervision.

Scale of clean air action

Speed up technology roadmap and in-use vehicle management: Clean air target will require aggressive improvement in emissions levels of the vehicle technology

Target setting with clear milestones and timeline is possible if the state government develops enabling policy framework.

and fuel quality to cut emissions at source and reduce exposure to harmful emissions. Setting a stringent roadmap during the ealry stages of motorisation is critical to prevent adverse public health impacts. Kanpur has recently introduced Bharat Stage IV emissions standards and fuel quality with 50 ppm sulphur levels. As the technology roadmap is the responsibility of the Central Government it is important that the city demands early timeline for the introduction of Bharat Stage V and VI technologies not only within the city but also within its effective zone of influence and nation-wide to avoid the risk of misfuelling.

A unique feature of the personal vehicle fleet in Kanpur is the domination of the motorised two-wheelers that are nearly 80 per cent of the fleet. Two-wheelers are one of the most fuel efficient vehicles in the motorised segment. But this advanage may get nullified if they remain more polluting than the cars. Even though India has made a big transition from conventional two-stroke engines to four stroke engines, and made substantial emissions gains, they would still require substantially more cleaner emissions targets. Cities will have to demand tighter standards for this segments as well as encourage transition to battery opereated two-wheeled vehicles with the requisite safeguards against battery disposal and power supply management.

If stringent emissions standards roadmap is linked with high taxes on old polluting vehicles, accelerated fleet renewal can provide more effective pollution benefits.

Also devise strategies for in-use vehicles. Though the city has implemented the upgraded pollution under control certificate and the norms, there are doubts about the effectiveness of the programme. Urgent steps are needed to assess the compliance levels and the authenticity of the tests in the decentralised testing centres. It is advisable to create large high volume test centres with adequate safeguards against fraudulent practices and upgraded test procedures to improve the overall in-use testing systems. There is already a proposal for such a centre in Kanpur. This may be taken up on a pilot basis.

Strengthen the CNG programme: The CNG programme has been the first opportunity to leapfrog beyond the polluting diesel technologies and two-stroke engines in the city. The environment benefit of this programme has been further enhanced because of its link with a public transport augmentation plan — CNG buses and CNG autos. This has the potential to reduce highly toxic particulate pollution. A comparable Bharat Stage II diesel bus emits 46 times higher particulates than a CNG bus. Public health benefits of this is considerable given the fact that the WHO and other international regulatory and scientific agencies, consider diesel particulates to be carcinogens.

To further strengthen the CNG programme the city needs to remove the current glitches in refueling systems and increase CNG supply to meet the increasing demand, adopt a CNG pricing policy that will maintain an effective differential between CNG and diesel prices. Develop institutional capaity to certify and audit conversion agencites in the city, and periodically certify the CNG cylinders in the vehicles as is required by the Comptroller General of Explosives. Encourage dedicated CNG vehicle fleet. Develop a robust periodic and mandatory safety and emissions inspection for the on-road CNG vehicles, as Delhi has done. Also push for best technology choices to get the combined benefit of reducing both particulates and nitrogen oxides and improving fuel efficiency.

- **Challenge of CNG market development:** The Next challenge in Kanpur is to attain a scale for the CNG programme. So far, Kanpur has moved all its three-wheelers and a part of small commercial vehicles and buses to CNG. But the

Environmental benefits of the CNG programme has been further enhanced because of its link with the public transport augmentation programme.

economics of setting up of CNG refueling network needs a critical mass of vehicles to ensure a viable scale of market. Cities like Kanpur face a special challenge of attaining a critical mass of vehicles.

Kanpur like other cities of India have so far followed the model of CNG business combined with supportive business in other sectors – industry, power plant and piped gas network for domestic uses -- to make the entire programme commercially viable.

Another important model has been to link the CNG programme with the bus transport augmentation plan. Kanpur is in the process of expanding its bus transport under the JNNURM programme. Both Kanpur and Lucknow, which have virtually no city bus services, have planned to build public transport systems based on CNG. This is expected to create captive demand for CNG.However, Kanpur experience has also shown that the bus deployment strategy will have to be planned carefully and will have to be well integrated with all local passenger modes.

Another potential expansion area for the CNG programme is the proposal to develop green highway connecting Kanpur with the surrounding towns that can create opportunities for the long distance buses and other commercial vehicles to move to CNG.

The scope of CNG conversion in the personal vehicle segment will remain limited as conversion of cars will be voluntary. Also in smaller cities bulk of personal vehicles are two-wheelers – as much as 80 percent in Kanpur. They are not yet the potential candidate for CNG.

Action on industrial and other pollution sources to meet air quality targets: Kanpur has already initated action on polluting industrial units. This will have to be scaled up and made more stringent. Kanpur as already relocated and closed down many air polluting units. But the remaining units and especially the brick kilns in and around the town will require more stringent action. The city also needs more composite energy management to reduce dependence on diesel generator sets.

Scale up mobility management

Rework strategy for formal bus transport: Kanpur is in the process of building its formal bus system and is augmenting bus numbers. As mentioned earlier, the formal bus system and policy will have to address some critical issue. First of all it is important to carry out proper surveys and assessments to decide the critical bus numbers that the city needs.

Secondly, only buying buses will not help. It will require route planning and integration, fare policy and efficient management model and service delivery system. Kanpur will need new management framework for both state owned and privately owned buses so that Transport Corporations do not suffer from mismanagement and inefficiencies. Private bus service may require a proper business model and also cost sharing arrangement. The city needs to finalise its bus reorganization plan in terms of route planning, integration with other modes, fare policy, deployment strategy for high frequency and speed and a revenue model as soon as possible.

The capital investment and gap financing that the government is expected to bear can become expensive if there are no plans to mobilize revenue to offset the costs of improving bus transport. While financial performance of the bus system will have to improve by lowering cost of capital, consumables, fuels and staff cost, the city

will also have to look at the additional revenue to support the cost of transport. While the new buses have begun to roll these plans are still not in place.

Thirdly, in a city like kanpur formal bus system will have to be integrated well with all passenger modes including para transit systems that cater to the bulk of the travel demand. Formal system must not destroy the para transit.

The misplaced policy on buses is evident in the wrong approach adopted towards it. Initially as a congestion reduction measure buses in Kanpur were taken out to the outer route of the city. Clearly, priority was being given to the cars and not public transport in transport planning. With advent of the JNNURM buses this is reversed. Buses have been brought back to the inner city but now autos and cycle rickshaws are being taken out to make way for the buses. Cars are not being touched.

Integrate all passenger modes – include intermediate public transport:. It is often not understood in Kanpur that a sizeable share of mobility needs is actually met by the informal intermediate transport system – three-wheelers and cycle rickshaws. Formal bus system actually carries just about 9 per cent of the daily trips. But a lot more people use the informal intermediate public transport system of autos, tempos and cycle rickshaws. The combined modal share of buses, autos, tempos, and cycle rickshaws, together cater to more than half of travel demand in the city. short distances make cycle riskshaws and autos very convenient and appropriate. Even a formal bus system cannot always cater to this need. It will be wrong to treat these intermediate transport vehicles as traffic nuisance and remove them to make way for more cars.

Upgradation and modernisation of para transit needs strong policy recognition and support. These are high frequency travel mode very apropriate for short distance and even door to door travel. Cities like Delhi are discussing reorganisation and modernisation of this informal sector. Efforts are being made to register and provide service badges and smart cards to the autos, connect autos with GPS, improve fitness and emissions testing of these vehicles, improve technology levels of these vehicles and so on. Similarly, High Court in Delhi has directed the city government to develop a cycle rickshaw policy. Kanpur with very short travel distances should focus on developing both its formal and informal public transport systems in an integrated way and not one at the cost of the other.

Reallocate roadspace: As road space is limited it needs to be apportioned equitably among road users with priority given to pedestrians, non-motrised vehicles, and public transport.

- **Develop pedestrian plan for the city:** Even today nearly 30 per cent of daily travel trips in Kanpur are walk trips. In fact, in most Indian cities people who commute by walking outnumber those who use their vehicles. High density, mixed land use, and narrow streets have made walking for work and recreation comfortable, feasible and popular in traditional Indian cities. The Wilbur Smith for the Union Ministry of Urban Development shows that most trips fall in 0 to 2 km range.[12] This is immensely walkable. Improvement in public transport ridership will also increase walking as all public transport trips that begin and end with walk trips. Therefore, the city has to plan the pedestrian infrastructure to cater to the present and future demand for walking. Also urban poor are too poor to even afford a bus ride for daily commuting. Over 60 per cent of the people in Kanpur live in low income neighbourhoods. It is important to integrate low income neighbourhoods with high density land-use pattern for more inclusive mobility management.

Bigger share of the mobility needs in the city are met by the informal intermediate transport -- three-wheelers and cycle rickshaws. Upgradation and modernisation of this system needs policy support.

Pedestrian facilities in Kanpur are under tremendous pressure. According to the City Development Plan, majority of the roads and footpaths are encroached. The city needs to adopt a pedestrian policy that

● Mandates pedestrian plans and quality guidelines for infrastructure funding
● Reform of engineering and environmental guidelines for walkways
● Provides for pedestrianisation and segregation of road space by users
● Legal provisions forprotection of pedestrian space that prevents usurpation of pedestrian space for motorised traffic without proper justification
● Provides for walkability audits and pedestrian plans for multimodal integration
● Ensures zero tolerance for accidents

● **Implement bicycle plan for the city:** The city has a captive bicycle ridership. Enhancement of the non-motorised transport infrastructure (NMT) can induce increase in NMT ridership. Even rental bike system can be introduced in the city as bus feeders. The city needs infrastructure plan for bicycles.

Adopt tax measures for public transport: Public transport will have to be incentivised for public good and environmental benefits. This will require reduction in tax burden to reduce both capital and operational costs of buses, especially now when the city is developing formal system. But unfortunately, in most of our cities buses have to shoulder higher tax burden than cars. While private cars pay a miniscule amount as road tax, buses pay several times more. But cars carry disproportionately lower number of daily commuting trips in comparison to higher road space they occupy, and cause more pollution per passenger. While tax burden on buses should be lowered that on personal cars should be increased.

Cars carry much lesser number of daily commuting trips in comparison to the road space they occupy. This cause more pollution per passenger. Even as kanpur augments all public passenger modes, it would also need strategies to restrain car usage. ,

Kanpur however, has taken some progressive steps while rationalizing the taxes on transport in October 2009. Under the new tax regime, city buses have been completely exempted from the additional taxes that accounted for 70 percent of total state taxes. Also the new city buses will pay lesser tax compared to older buses. This might help to weed out older and unfit vehicles. However, more detailed fiscal plan is needed to reduce the capital costs and the cost of operation and also a bus fare policy that will keep this transport affordable.

Build funds for sustainable transport: kanpur should also look at ways to develop urban transport fund not only for formal systems but also for modernisation of the informal para transit and non-motorised systems. At present there is barely any official scheme to stimulate investment in public transport. National Urban Transport Policy has proposed that the state governments should encourage the levy of dedicated taxes to be credited to an urban transport fund to exclusively meet urban transport needs. Cities need to look at the variety of measures to generate funds such as higher taxes on personal cars that can also help to lower their usage and hence the congestion, parking revenue, advertisement revenue, road pricing strategies etc.

There are examples from other cities. Delhi has imposed an environment cess on diesel to create Air Ambience Fund to fund pollution control efforts in the city. Bangalore and Chennai have introduced higher taxes on older vehicles. Surat in Gujarat and Pimpri and Chinchwad in Maharashtra have already created a dedicated urban transport fund partly through budgetary allocation and the rest will come from parking revenue, property tax, etc. Kanpur can review these strategies to develop a fund for itself.

Demand management – frame parking policy to reduce congestion: Even as Kanpur augments public transport services it would need strategies to restrain personal vehicle usage. The first generation restraint measures in Indian cities will be dominated by the parking strategy. In fact JNNURM reform agenda lists parking as a demand management tool. But the city government is still focusing on creating more parking spaces and not considering ways to use parking policy to restrain usage of personal vehicles.. Currently, Kanpur authorities have planned 25 structured parking spaces and earmarked 15,000 sqm of road length for parking development by 2011. The National Urban Transport Policy has stated that the parking should be developed as a travel demand management measure and the full cost parking charges should reflect the value of the urban land. Therefore, the city parking policy must integrate the following principles:

- **Parking pricing**: Appropriately priced parking can reduce demand for parking and shift commuter to alternatives.
- **Implement flexible parking standards and conduct parking audits to assess the reduction in parking demand.**
- **Use park and ride for pedetrianisation and modal integration**
- **Parking restrictions**: If available parking spaces are limited in the targeted areas and priced high cars can be discouraged.
- **Need guidelines for parking for multi-modal integration.**
- **Need parking strategy for residential and mixed land use areas:** Develop common parking, link parking with car ownership, monthly permits for on-street parking on residential areas etc.
- **Parking revenue** can be used for other congestion reduction strategies

Integrate land-use plan with transportation plan: Kanpur already has the advantage of dense and mixed land use develpment. It must build on this compact city planning to reduce travel distances, allow more efficient utlisation of transportation modes, improve access to jobs and other services and prevent sprawl. The densely built cities like Kanpur have an inherent advantage of becomming walkable and public transport oriented. They can build on this with proper planning.

Need city/state based transport energy policy: Transport sector is expected to be one of the major drivers of the energy demand in future. The city needs to encourage fuel efficient vehicles and also reduce vehicle miles travelled. While it is the responsibility of the Central government to set the fuel economy standards for vehicles, the state government can adopt supportive policies to encourage fuel efficient vehicles in the city. This can include tax measures for fuel efficient vehicles, electric vehicles etc. In fact, Uttar Pradesh government has revised its taxes to tax bigger vehices higher. The city government must also assess fuel savings from modal shift to public transport and non-motorised transport.

Frame state urban transport policy and build capacity: For grass roots action and momentum the state government also needs to frame its own state transport policy to give direction to the state level policies and investments. Only top town pressure of national policies will not be enough for the scale of change needed in this sector. Also reforms in the transport sector will require proper institutional mechansim for coordinated action and capacity building. Clearly, there is no 'one best way'. While the national framework will create opportunities for change, solutions will have to be customized for each city according to its imperatives and uniqueness. Strong public opinion, judicial and executive actions have helped to accelerate action in Kanpur. This now needs to gather momentum to make the city livable.

— **Right To Clean Air Campaign Team**

Strong public opinion, judicial and executive pressure have helped to accelerate action in Kanpur. This now needs to gather momentum to make the city livable.

Kanpur city in depth

1. CHOKING HAZE OF POLLUTION

People of Kanpur have not forgotten the dubious distinction the city got during 2002 when it had hit the headlines — "Kanpur's air is the most polluted." In 2006 *The Times* carried an article 'Running Out of Breath' which brought the nightmarish pollution in the city to the international focus. The article said: "*if you want to grasp the enormity of the environmental challenges facing India, visit Kanpur—shockingly polluted, overcrowded, and with a population that's still rapidly expanding.*"

Tiny particles: Kanpur shares the common fate of North Indian cities that are notorious for high level of dust and particles (See Graph 7: *PM10 levels - Northern cities*). Compared to the other parts of India, levels of particulate always remain much elevated and also above standards.

The air quality data of the Central Pollution Control Board (CPCB) reveals that the levels in the city are 4-5 times above the standard and also also exceed standards almost on a daily basis. According to a list submitted by the Ministry of Environment and Forests in the Loksabha in February 2009, Kanpur is the fifth most polluted city in the country in terms of PM10 levels[13] In fact, five cities of Uttar Pradesh dominate the list followed by three cities from Punjab and one city each from Maharashtra and Jharkhand (See Graph 8: *RSPM levels in top ten polluted cities*)

Nitrogen oxide is an emerging threat: Even before the city could deal with its particulate scourge, newer pollutants have begun to rise. Confirming to the national trend nitrogen dioxide – the measure for nitrogen oxides (NOx) that comes largely from the vehicles, have started to rise. Though its levels in most Indian cities is still below the permissible levels, the trend is bullish and rising (See Graph 9: *Nitrogen dioxide — Northern cities*).

Limited data shows spikes of other air toxics like benzene and polycyclic

Graph 7: PM10 levels - Northern cities

Except the hill town of Shimla,Gajraula and Parwanoo most others have high PM10 levels
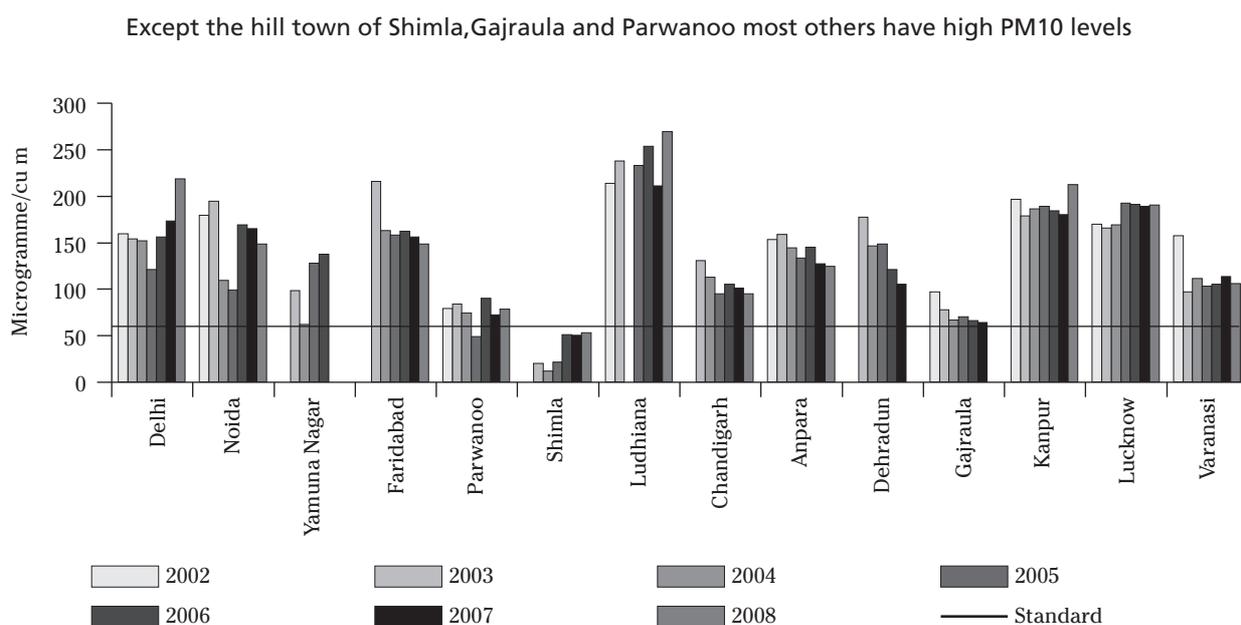
Sources: CSE analysis of CPCB data

Graph 8: RSPM levels in top ten polluted cities

(Annual average concentrations in microgram per cubic meter)

RSPM in microgramme per cubic metre during 2007 in residential areas
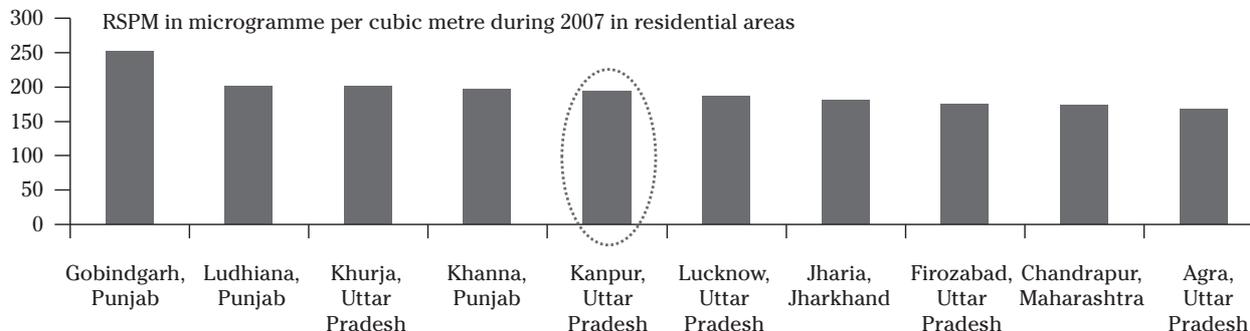
Source: Anon 2009, Lok Sabha, Starred Question No. 51, Most Polluted Cities in the Country, Government of India, Ministry of Environment and Forests
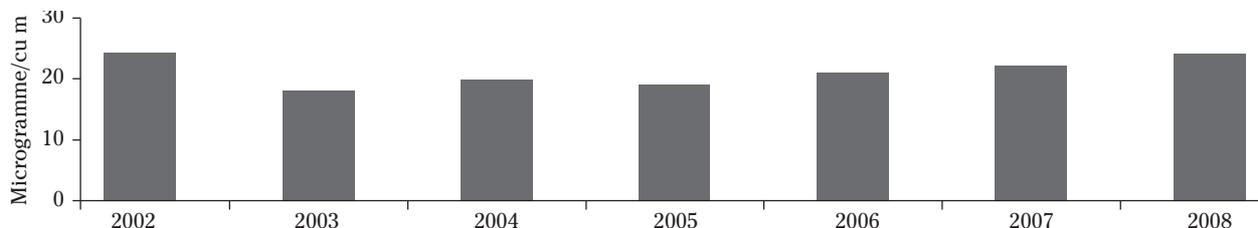
Graph 9: Nitrogen dioxide — Northern cities

NO_2 levels are rising slowly. Cities like Delhi, Dehradun, Yamunanagar and Ludhiana show a rising trend
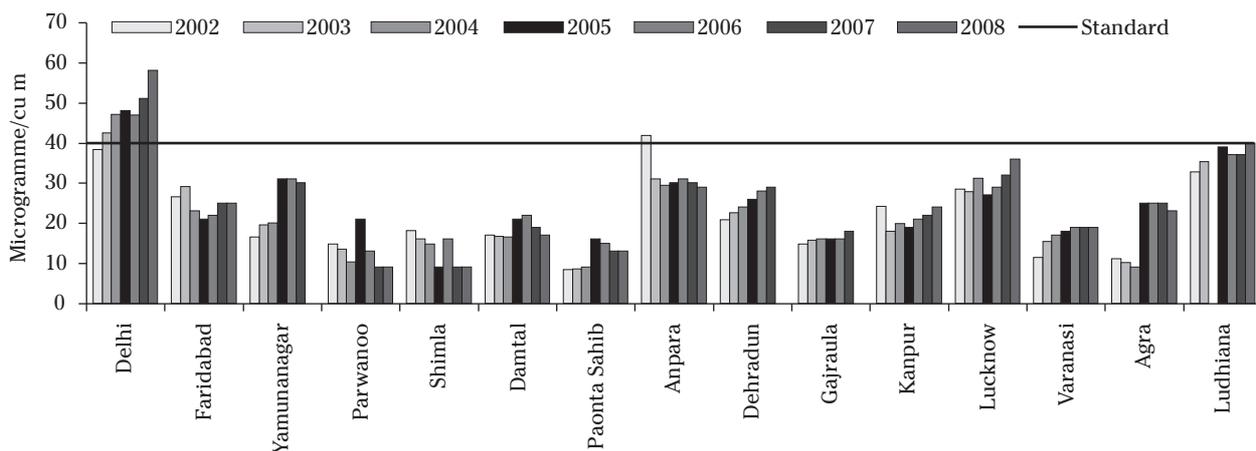
Source: CSE analysis of CPCB data

Graph 10: NO_2 levels in Kanpur (2000-2008)

Still low but rising

Source: Based on CPCB data

hydrocarbons (PAH) and even lead during the early part of the decade. It is this deadly cocktail of pollution that is so worrying. The same trend is observed in Kanpur (See Graph 10: *NO₂ levels in Kanpur (2000-2008)*).

Indian cities will have to be very careful about this pollutant as it is very harmful in itself and is also responsible for catalyzing formation of another very hazardous pollutant in the air – ozone. As of now ozone data for Kanpur is not available. But to avoid this problem in the future Kanpur will require very strong action on vehicular pollution that is hugely responsible for NOx emissions.

Severe winter pollution: Every winter most of our cities wake up to more smog and pollution; more wheeze and asthma. So does Kanpur. Cold and calm weather that cause winter inversion do not allow pollutants to disperse fast and they build up very close to the ground level exposing citizens to extremely toxic air. The air quality index for Kanpur city that was released in 2003 have shown that air quality worsens (very poor to severe) in winter months and also during the early summer months (March, April, and part of May). These months are characterized by dusty winds resulting in high particulate levels. The air quality generally improves in monsoon and post-monsoon period (good to moderate) as rain washes out the pollutants. Over 95 per cent of the time, sub-index values corresponding to particulate levels were responsible for overall AQI.[14]

The joint study of Central Pollution Control Board (CPCB) and Indian Institute of Technology Kanpur *(*IITK) in 2007 also showed that NO_2 levels were higher during the winter months of December and January compared to post monsoon and spring. Both PM10 and NO_2 deteriorated during winter. July showed the best air quality both for PM10 and NO_2 due to the wash out effect of rains.[15]

Growing toxicity: The daily dose of toxin gets worse when the air is laced with deadly toxic substances. The particulate matter can get even more harmful when they begin to absorb toxic soluble gases. Air quality regulators measure the benzene soluble fraction of particulate matter to understand the contribution of combustion sources.

A 2005 study of Indian Institute of Technology (IITK) had reported findings of their chemical analysis for heavy metals and toxic organic fraction (BSOF) in particulate matter in Kanpur. They had looked at the chemical profile of the PM_{10} and $PM_{2.5}$ in terms of heavy metals and benzene-soluble organic fraction (BSOF) in three locations – IITK, Vikas Nagar and Juhi Colony during October 2002–February 2003. The BSOF level varied from 1–170 microgram per cubic metre and heavy metals were highest at more crowded Vikas Nagar followed by Juhi Colony and IIT campus. The levels of PM_{10} and $PM_{2.5}$, heavy metals were almost 5–10 times higher than levels in European cities.[16]

The CPCB had also carried out characterization of RSPM in 2004. They had analysed BSOF in particles at the Vikas Nagar monitoring station. It ranged between 3 per cent and 22 per cent during winter months. Clearly, toxic substances from the combustion sources are lacing the air of Kanpur.[17]

RSPM samples obtained from Gol Chouraha, Ghantaghar, Civil Lines and Ramadevi, in Kanpur were analyzed at IIT, Kanpur. They mainly found Chloride, Nitrate, Fluoride and Sulphate ions at all the four locations.[18] Sulphate and chloride anion were high at all the four locations.

Sulphates: Sulphur dioxide levels have reduced quite drastically in most of our cities due to change in the energy mix and largely with replacement of coal. But its low levels in the air can be deceptive as what exist may still be contributing to the problem of sulphate particles that are more dangerous than the normal particles. IIT Kanpur has reported considerably high sulphate levels ranging between 2.8 and

The complex mixture of pollutants may vary over time and place depending on the sources and meteorological conditions. Several pollutants together can exceed standards on any single day.

43.6 microgramme per cubic metre (See Graph 11: *Ambient sulphate levels in key cities and regions*) . These are considerably high compared to the levels reported in the US and European cities, ranging between 1.9-18.4 and 0.34-9.0 microgramme per cubic metre respectively. High particulate levels in cities possibly provide an ideal environment for the formation of sulphate particles.[19]

The IITK scientists explain that the oxidation of the sulphur dioxide in the air lead to the formation of the deadly sulfur trioxide. The sulphates occur as aerosols. Studies by CPCB also indicate location-wise sulfate levels. At Civil Lines Sulphate concentration ranged from 4 to 35 microgramme per cubic metre, at Ghantaghar 4 to 43 microgramme per cubic metre, at Gol chouraha – 3 to 33 microgramme per cubic metre and at Ramadevi it ranged from 4 to 31 microgramme per cubic metre (See Graph 12: *Sulphate concentration in various locations of kanpur*).[20]

Studies carried out by the IIT kanpur have also shown high contribution of secondary particulates to the total particulate load in the air.

Benzene - A deadly toxin: Limited amount of information has begun to emerge on the range of volatile organic compounds including benzene, toluene and zylene in

Graph 11: Ambient sulphate levels in key cities and regions
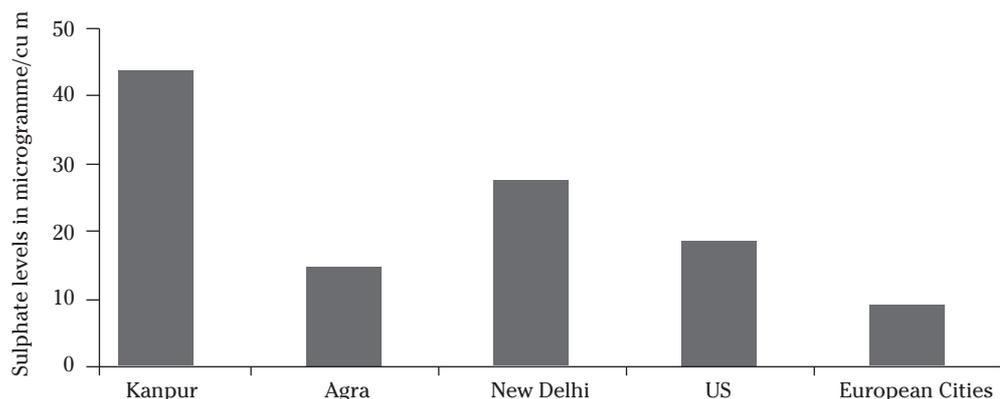
Source: Mukesh Sharma et al 2003, 'Investigations into formation of atmospheric sulfate under high PM10 concentration', Atmospheric Environment, Elsevier Science Limited, UK, Vol 37, No 14, p 2005-2013

Graph 12: Sulphate concentration in various locations of Kanpur

Sprinkling of studies available in Kanpur are the evidences of the lethal effects of air pollution.
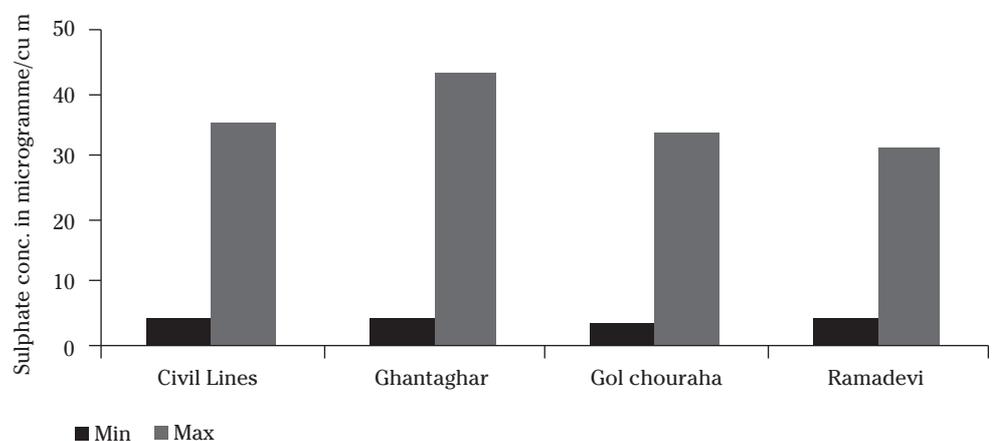
Source: CPCB 2004, Annual Report, Delhi

the city. This data provides the sufficient proof of the mounting toxicity of the air. CPCB had monitored the toxic bunch - Benzene, Toluene, Ethyl benzene, m+p Xylene and O-Xylene, in Kanpur. During a typical winter month of December-2003 the maximum concentration of Toluene was observed at 299 µg/m3. This is approximately 8 times the normal average concentrations observed in Kanpur city. The sources were identified as burning of tyres, wood chullahs, open burning during evening hours for heating, and continuous movement of vehicles on Grand Trunk road etc.[21]

During 2000 benzene level were known to have exceeded the then UK standards by 1.4 times at five locations and the peak hit 90 microgramme per cum. These VOCs are toxic and carcinogenic. Since then benzene content in petrol is being controlled at 1 per cent.

Lead in the air: In the past the main source of air borne lead was the combustion of petrol blended with tetra-ethyl lead. Even though leaded petrol has been phased out in 2000 the concentration of lead was found exceeding the standards recording 1.5 microgramme per cubic meter at some of the busy road intersections in the city during 2002-03.[22] It is known that the trace amounts remain in the environment for a longer period. But there could also be industrial sources.

Lead is a deadly neurotoxin. IIT Kanpur has assessed the dietary and inhalation intake of lead and estimated blood lead levels in adults and children in Kanpur in 2005. The study found that in spite of the introduction of unleaded gasoline, children continue to be at a high risk (probability of exceeding 10 mg/deciliter) because of a high intake of lead per unit body weight.[23]

Overall, it is important to note that pollutants are inhaled as a mixture, yet their combined impact on health is not very well understood. The complex mixture of pollutants may vary over time and place, depending on the sources and meteorological conditions. This is a serious challenge in our cities where several pollutants together can exceed standards on any single day.

2. PUBLIC HEALTH CHALLENGE

In India the largest health impacts are due to particulate pollution. More than 0.1 million people die due to particulate pollution in India annually, says the World Health Organisation. Children, old and infirm are more vulnerable to air pollution. Exposure to air pollution causes both acute (short-term) and chronic (long-term) health effects. Acute effects are usually immediate and often reversible. These include eye irritation, headache and nausea. Chronic effects are usually not immediate and tend to be irreversible. These include decreased lung capacity and lung cancer. Adverse health impacts lead to increased use of medication, increased visits to the doctor, more hospital admissions and premature deaths. These effects are best explained in terms of reduced life years. (See box: *Key pollutants and their health impacts*)

Sprinkling of studies available in Kanpur are the evidences of the lethal effects of air pollution. A study released by the World Bank in 1995, on the health impact of air pollution in the Indian cities (based on 1991-92 data), put the annual number of premature deaths at 1,894 in Kanpur – all India at 40,351. When the centre for science and Environment (CSE) repeated this study in 1997 based on the data of 1995, it showed an increase of about 28 per cent in total premature deaths to 51,779 in the 36 cities studied — a rise of 28 per cent. The study found that in Kanpur the high air pollution accounted for 3,639 premature deaths. The number of air pollution related ailments requiring medical treatment and hospital admissions also skyrocketed from 19 million to 25 million in 36 Indian cities indicating an increasingly ruined state of health.

Since then more studies have provided the clinching evidences. A joint research released in 2004 by Kanpur based IITK, GSVM Medical College, Department of Chest and Tuberculosis and Delhi based CPCB have studied the effects of particulate air pollution on the respiratory health of a groupd of people who live in Kanpur.[24] The study assessed the relationship between daily changes in respiratory health and particulate levels (PM_{10} and $PM_{2.5}$) in three air quality monitoring sites located in the IIT campus, a relatively clean area, in Vikas Nagar, a typical commercial area; and, Juhilal Colony a residential area. It was found that people residing in cleaner site had acceptable values than those in polluted sites. Those in more polluted sites demonstrated a substantial average deficit in lung function. An increase of 100 microgram per cubic metre of PM_{10} could reduce the mean peak expiratory flow rate of an individual by approximately 3.2 litre per min.[25]

There is now a UPENVIS report that shows health effects of urban ambient air pollution are very high in the state of Uttar Pradesh where Kanpur is located. It says that 0.4 million disability adjusted life years (DALY) valued at Rs 2.6 billion are lost due to urban air pollution. The particulate levels in eight cities are 2-3 times higher than the ambient air quality standards. And the industrial air emissions in highly polluted districts range between 0.007 to 1.48 kg per per-capita per year.[26]

Kanpur reflects the national threat. The State of Environment Report 2009 for India released by Ministry of Environment and Forests mentions that respiratory illness is highest in India. Among the six major communicable diseases, maximum cases (2,58,07,722) were reported for Acute Respiratory Infection while maximum number of people (7,073) died due to Pulmonary Tuberculosis in India, during the year 2006. (See Graph 13: *Six major communicable diseases in India – cases and deaths (2006)*). Rising air pollution in Indian cities may further add to the vulnerability of the populations.

Studies in Kanpur have found that people residing in polluted areas show substantial lung function. impairment

KEY POLLUTANTS AND THEIR HEALTH IMPACTS

PARTICULATE MATTER: This has shown a very strong association with premature mortality and heart and lung diseases worldwide. A large number of epidemiological studies in the US and Europe have shown quite conclusively the increase in premature deaths and illness even at ambient levels lower than the ambient air quality standards. Tinier they are deeper they go and more harm they cause —- coarse particles (less than 10 micron), fine particles (less than 2.5 micron), ultrafine (less than 0.1 micron) and the nanos (less than 0.05 micron).

The 116-city study in the US clinched the battle against doubters in 2002. Fine particulate (PM2.5) and SOx related pollution is associated with, all-cause, cardiopulmonary and lung cancer mortality. An increase of 10 microgramme per cubic metre of fine particulate was associated with four, six and eight per cent increased risk from all-cause, cardiopulmonary and lung cancer mortalities respectively. This analysis is based on data of approximately 1.2 million adults from 50 states of the US.

NITROGEN DIOXIDE: This is among the newer concerns. Short-term exposure to NO2 is associated with increased daily mortality and hospital admissions for respiratory and cardiovascular diseases. Mortality due to particulates also gets enhanced if they have higher mean concentrations of NO2. This also threatens to worsen ozone pollution.

OZONE: This is lethal in asthma attacks, affects lungs and increases mortality. While O3 is among the priority pollutants in the western world, it has found very little policy attention in India.

SULPHUR DIOXIDE: This comes from combustion of fossil fuels is, even at low levels, known to increase daily mortality and hospital admissions. This gas along with smoke was held responsible for severe health impacts of the smog episodes during the early phases of industrialisation in the western world. This has reduced considerably due to substitution of high sulphur fuels like coal in our cities.

CARBON MONOXIDE: This reduces oxygen carrying capacity of blood. Improvements in vehicle technology have reduced this. But the threat persists in our cities with very high number of two-wheelers and cars without catalytic converters.

AIR TOXICS: There is a range of air toxics, which are numerous and cause lethal effects even at very tiny dosage. Even in small trace amounts (as small as one-millionth of a gramme per cubic metre of air or lower), these can cause cancer, birth defects and damage the immune system. These are largely a range of polycyclic aromatic hydrocarbons and volatile organic compounds.

For the first time, the CPCB has added a few air toxics and heavy metals to the list for regulations. Standards for toxic air pollutants like benzene, formaldehyde, arsenic, mercury, nickel, polyaromatic hydrocarbons etc have been set. Cancer, as the endpoint of toxic risk, is the overriding concern in toxics reduction programmes worldwide.

But there is also evidence to show that people of Kanpur have enjoyed health benefits with improvement in air quality. Usha Gupta of Institute of Economic Growth, Bhim Rao Ambedkar College, University of Delhi have assessed the change in health benefits with improvement in air quality of Kanpur. They have estimated that a representative individual from Kanpur would gain Rs 165 per year if air pollution was reduced to a safe level. Collectively, the annual benefits for the entire population in the city are expected to be Rs 213 million.[27]

Kanpur needs comprehensively designed health assessment studies to understand the magnitude of the problem, and make regulations responsive and dynamic to reduce health risks. Says WHO, health impact assessment should detail out different health end points, effects on different population strata in terms of gender, age,

Graph 13: Six major communicable diseases in India – cases and deaths (2006)

Legend:
- Entric fever
- Viral hepatitis
- TB
- Acute Diarr
- Acute Resp. Inf.
- Pneumonia
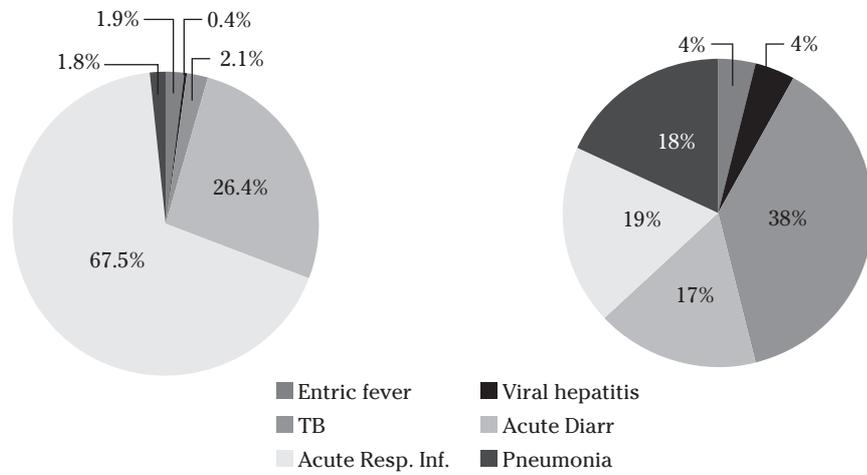
Source: State of Environment Report 2009, Ministry of Environment and Forest

socio economic class etc and pollutants. This can assist decision making.

3. KANPUR'S DILEMMA: LOSING AIR QUALITY GAINS

Despite being one of the most polluted cities in the country Kanpur succeeded in stabilizing its air pollution levels. The mitigation efforts initiated during the early part of this decade helped in the turnaround. Air quality gains were made possible with a series of measures that form the first generation reforms in the city.

The first phase of action in Kanpur was driven by the desperation and urgency for immediate relief from the choking pollution. Judicial and public action has pushed public policy to enable this change. Despite the change Kanpur's air is still polluted and newer challenges confront the city (See Graph 14: *RSPM levels in Kanpur: Losing gains (2000-2008)*). To prepare for the new struggle it is important to take stock of past action and refocus on the future agenda. The fact that Kanpur has successfully begun to implement the difficult measures gives the confidence that it is possible to take on the newer challenges and achieve clean air.

Kanpur like Delhi is also in imminent danger of losing its gains. Pollution levels after a short respite are rising again. The fact is, air pollution continues to remain a serious public health concern despite the improvement

Polluted city core: Air quality data is now available for five different locations in Kanpur — residential locations of Kidwai Nagar and Shashtri Nagar, industrial locations of Fazalganj and Jajmau, and the commercial location of Deputy Ka Parao. Fazalganj has severe levels of particulate pollution followed by Deputy Ka parao (See Graph 15: *Respirable particulate matter chokes most locations in Kanpur (2008)*). In fact the CPCB's Environmental Management Plan (2000) of Kanpur brands the entire densely populated central part of the city and a core commercial area as a high pollution zone. It says about 60 percent of the geographical area of the city has air pollution problems. It is not surprising that the city is considered one of the air pollution hot spots.

The industrial areas such as the Panki power plant, the industrial area and Dada Nagar are very polluted. Fly ash generated by the Panki power plant in the Northern part of Kanpur is also one of the major sources of air pollution in the city. Industrial activity and rapidly growing number of vehicles are the main contributing factors. A study by Kanpur Nagar Nigam during 2003 revealed that the central area of the city
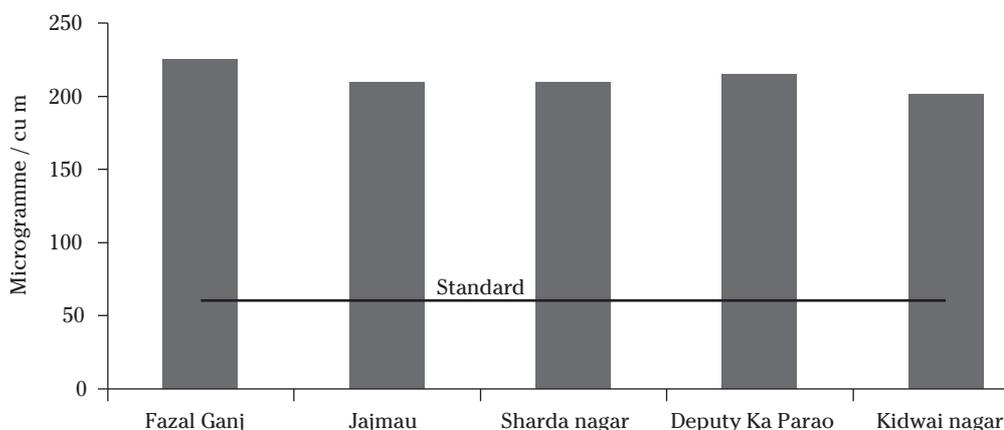
Pollution levels after short respite are rising again. Core areas of the city are highly polluted

Graph 14: RSPM levels in Kanpur: Losing gains (2000-2008)

After a short respite the levels are rising again
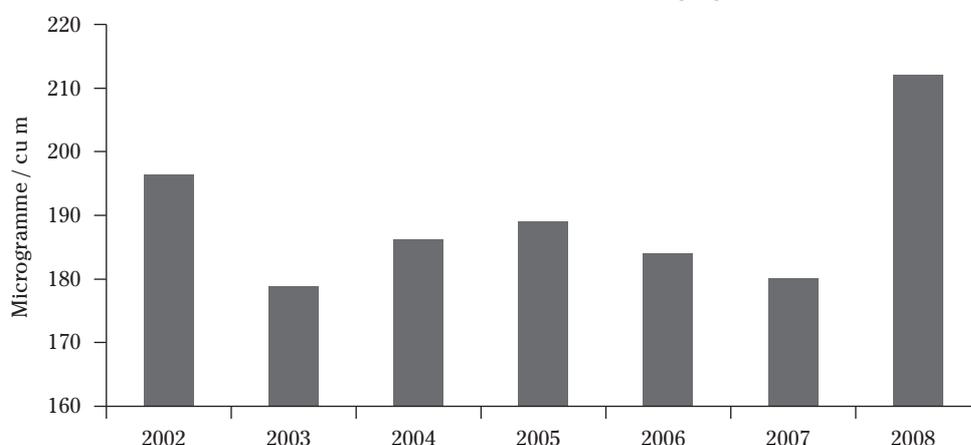
Source: Based on CPCB data

Graph 15: Respirable particulate matter chokes most locations in Kanpur (2008)

Source: CSE analysis based on CPCB data

with high densities of population are worst affected by air pollution. It also blamed lack of proper transportation networks, traffic system, badly maintained roads, heterogeneous nature of traffic for vehicular pollution.[28]

Air pollution correlate with peak traffic time: There are clear evidences now that the air pollution correlates with traffic peaks in the city. IITK study confirms that while the average daily levels may remain low at various locations, the morning and evening peak levels can be high when the traffic load is also high in the city. (See graphs 16: *Pollution peaks correlate with peak traffic hours A: PM10 peak, B: PM2.5 peak and C: NO_2 peak*): This has serious public health implications as very clearly the emerging studies globally show that people are most exposed to traffic pollution as they travel on the road and also because most of them live close to the busy roads. Exposure to deadly fumes of vehicles is highest within 50 to 500 meters from the roads. As our cities are very densely built population exposure can be very high.

New air quality benchmark: The Union ministry of environment and forests has tightened the national ambient air quality standards in 2009. This has tightened the benchmark and also changed the air quality status of the cities. When the air quality of Kanpur is reassessed based on the new standards the air quality status of the locations change. More locations have now moved up in pollution scale. This has serious public health implications

- **RSPM status**: Sharda nagar, Deputy Ka Parao, Kidwai nagar, Fazal Ganj and Jajmau in Kanpur remain "Critical". In these locations the latest reported RSPM levels were 3 to 3.75 times higher than the new standard.

- **NO_2 status**: Sharda nagar, Deputy Ka Parao, Kidwai nagar, Fazal Ganj and Jajmau in Kanpur have moved from "Low" to "Moderately" polluted range.
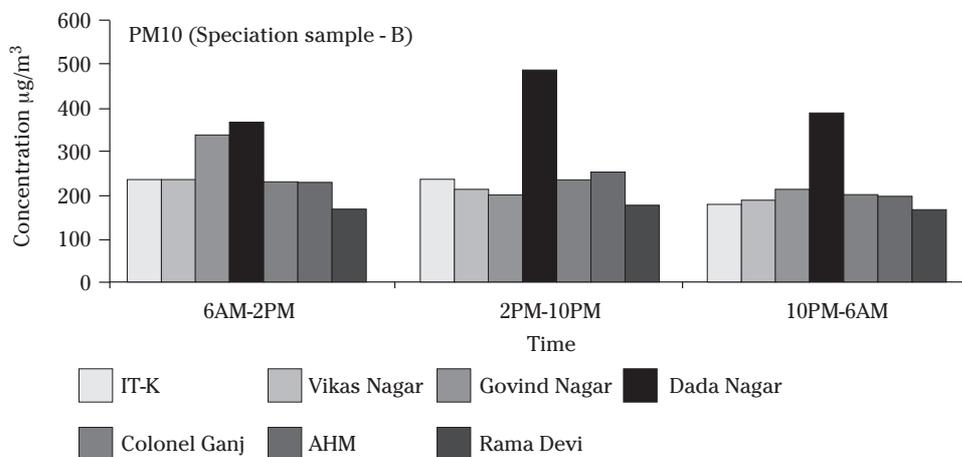
After the recent tightening of the national ambient air quality standards more locations in Kanpur have moved from moderate to high pollution bracket

Graph 16: Pollution peaks correlate with peak traffic hours

A: PM10 peaks

PM10 (Speciation sample - B)

Concentration µg/m³

Time

- IT-K
- Vikas Nagar
- Govind Nagar
- Dada Nagar
- Colonel Ganj
- AHM
- Rama Devi

6AM-2PM · 2PM-10PM · 10PM-6AM

Source: Central Pollution Control Board

B. PM 2.5 peak

PM2.5 (Speciation sample - B)

Concentration µg/m³

Time

- IT-K
- Vikas Nagar
- Govind Nagar
- Dada Nagar
- Colonel Ganj
- AHM
- Rama Devi

6AM-2PM · 2PM-10PM · 10PM-6AM
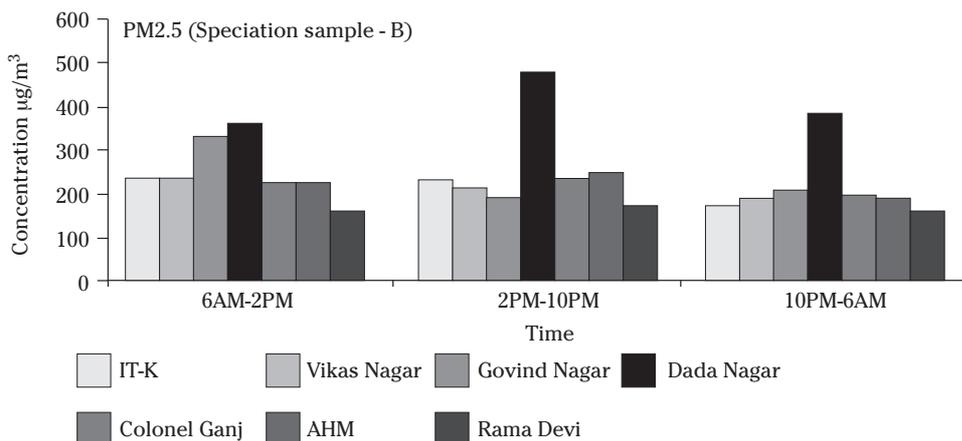
Source: Central Pollution Control Board

C. NO$_2$ peak

NO$_2$ concentration

Concentration µg/m³

Time

- IT-K
- Vikas Nagar
- Govind Nagar
- Dada Nagar
- Colonel Ganj
- AHM
- Rama Devi

6AM-10AM · 10AM-2PM · 2PM-6PM · 6PM-10PM · 10PM-2AM · 2AM-6AM

Source: Central Pollution Control Board

Action on industrial pollution has begun in Kanpur. Now pollution is also increasing from gensets.
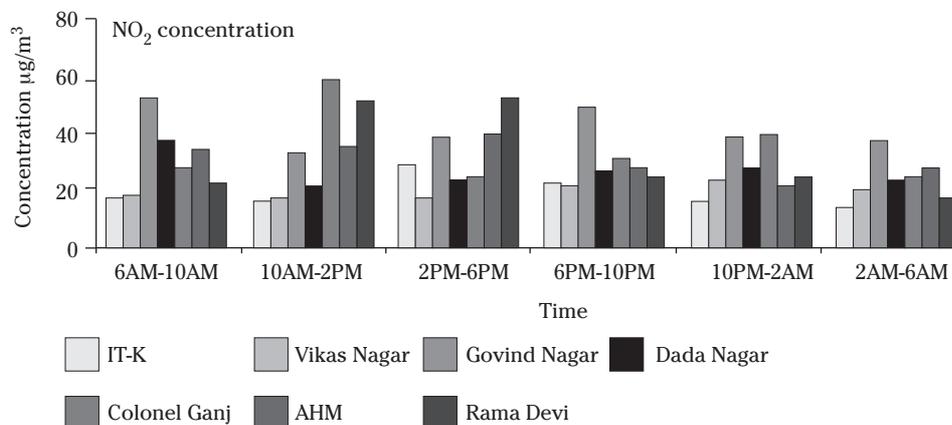
4. WHAT CAUSE POLLUTION IN KANPUR?

Cities can draw up effective pollution control plans if they know how much, at what rate and speed different polluting sources are contributing to the total air pollution load in the city. But in most cities of India it is not yet possible to arrive at a reliable source-wise pollution load estimates. Only in a few cases the air quality regulators and the experts have begun to use these assessment techniques though these are still limited in scope.

More recently, Kanpur was included in the Air Quality Assessment, emission inventory and source apportionment studies that were carried out in six major cities under the aegis of the Union Ministry of Environment and Forests and the Central Pollution Control Board. This has looked at — (i) air quality and detailed chemical characterization of fine particulates (PM10 and PM2.5), (ii) emission inventory of different pollution sources, (iii) contribution of different sources to ambient air quality, (iv) application of dispersion model to get air quality profile and impact of various control options and (v) formulation of action plans and control strategies based on findings of the study.

Vehicles: The draft results of the source apportionment studies bring out clearly that in Kanpur vehicles and industry are the dominant sources of pollution. Vehicles contribute 20 per cent of the PM10 and 47 per cent of NOx whereas industry contributes 33 per cent of PM10 and 43 percent of the NOx. Vehicles also emit 65 per cent of the carbon monoxide, and 11 per cent of sulphur dioxide. This requires stringent action to achieve clean air.[29] (See Graph 17: *Sources of PM10 (2007)* and Graph18: *Sources of NOx (2007)*). Among vehicular sources two-wheelers are contributing maximum to the total load.

However, the studies have not yet assessed the extent of exposure to the vehicular fumes that is always higher formost people travelling on roads and living close to the roadways.

Industry: According to the CPCB report: *Air Quality Trends and Action Plan for Control of Air Pollution from Seventeen Cities, Sept 2006,* major particulate pollution in the industrial sector is from use of coal followed by wood and related fuel. There are several small and medium scale units which are using high sulfur fuel oil that cause air pollution.
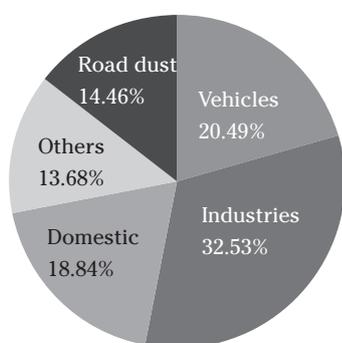
Vehicles emit within our breathing zone. Exposure to vehicular fume cause severe health damage.

Graph 17: Sources of PM10 (2007)

Road dust 14.46%
Vehicles 20.49%
Others 13.68%
Domestic 18.84%
Industries 32.53%

Source: B Sengupta 2009, Strategies for Improving Air Quality in Indian Cities, Paper presented at orientation programme on clean air imperatives of urban mobility organized by CSE during 2-6 March

Graph18: Sources of NOx (2007)
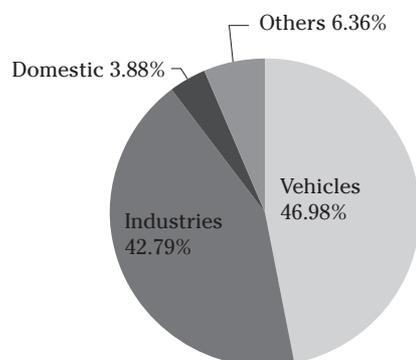
Others 6.36%
Domestic 3.88%
Vehicles 46.98%
Industries 42.79%

Source: B Sengupta 2009, Strategies for Improving Air Quality in Indian Cities, Paper presented at orientation programme on clean air imperatives of urban mobility organized by CSE during 2-6 March

There are more than 70 large-scale industries, which are mainly of leather products, cotton textiles, chemical products, metal industries etc. There are 138 small scale industries which are mainly for leather products, metal products, food products, rubber and Plastics, cotton textiles etc. The inventory of industrial sources shows that Panki thermal Power plant contributes maximum to the total industrial pollution load. Other major sources are Panki Industrial area, Dadanagar Industrial area, Fazalganj Industrial area etc. Panki thermal power plant and industrial units add hugely to the pollution. The burning of poor quality of fuel is an occupational hazard to the workers as well as air quality of the city.

Action on industrial pollution has begun. 398 industrial units have installed air pollution control system. Under Environment Acts 99 industrial units have been closed for non-compliance. Also show-cause notices have been issued to 9 units. Notices have been issued to 179 industrial units.[30]

Household power generation: The city has very poor power supply, for most part the day the city witnesses power cuts for prolonged hours. The power crisis leads to heavy usage of gensets running on diesel mostly at the breathing level causing pollution and exposure to people in shops, markets and on the roads. This also worsens the air quality and according to estimates there are around 20,000 gensets in the city.

Other sources: Kanpur City Development Report says that there are 196 brick kilns in and around Kanpur which to a great extent are responsible for releasing huge amount of smoke. Air pollution from domestic and garbage burning is also serious. The city lacks a proper garbage collection system and safe disposal infrastructure. People find it easy to burn them. This causes huge pollution across the city.

Use of coal, wood, cow dung, etc., in the slum settlements and low-income group colonies along the railway yard generate localized smoke problems, which affect visibility and cause other health problems. The estimated pollution load from household fuel is 5.5 MT/Day. Due to stable wind conditions the problem becomes even more severe during winter.[31]

Pollution control efforts in different sectors are in varying level of progress. The city will have to balance its priority measures for maximum air quality gains.

Action on industrial pollution has progressed. Generator sets are now emerging as pollution source in this power starved city.

5. VEHICLES ARE A SPECIAL CONCERN

The relative contribution of vehicles to total particulate pollution is lower than industry but its contribution to the total nitrogen oxide pollution is higher. From public health perspective vehicles pose a special problem because vehicle emissions take place in the breathing zone of people, and they contribute significantly to human exposure. People living or working in close proximity to high traffic roadways or in vehicles are subject to particularly high levels of exposure. The US based Health Effect Institute scientists point out that in densely-populated developing Indian and Asian cities, as much as 50 per cent of the population lives or works near the roadside. Air pollution data show a marked gradient among local, regional, and roadside levels. Roadside levels of respirable suspended particulates, NOx and NO_2 are reported to be much higher than the ambient levels. According to their studies exposure to the vehicular pollution is the highest within the 50 to 500 to upto 1500 m of the roadways.

In a six-city assessment (including Bangkok, Mumbai, Shanghai, Santiago, Manila and Krakow) the World Bank found that vehicles contributed an average of six per cent of direct PM emissions but 32 per cent of PM exposure. In three of these cities, vehicles contributed an average 50 per cent of the direct PM emissions and over 70 per cent of PM exposure. The WHO, in its report of 2005, *Health effects of transport-related air pollution*, weighed that epidemiological evidence for the adverse health effects of exposure to transport-related air pollution is increasing. This needs to be quantified. A large number of studies are now available that show exposure to vehicle exhaust causes severe health damages.

Motor vehicles emit highly toxic particles and some of the deadliest carcinogenic compounds that fall under the broad categories of VOCs and aldehydes. Benzene, 1,3-butadiene and aldehydes (such as formaldehydes and acetaldehyde) present in vehicle exhaust have been designated as probable human carcinogenic compounds by the International Agency for Research on Cancer, the US National Institute of Health and USEPA. These also induce acute respiratory effects. A shocking evidence comes from a study conducted by the University of California, Los Angeles, US that shows how traffic-related air pollution is also associated with an increased risk of pre term births and low birth weight in infants. There is also a strong link between heart diseases and the daily commuting on roads and increased risk of heart attacks even in healthy young adults.

The emerging global evidences on air pollution-vehicle link has ominous implications for the India where the rapidly growing vehicular fleet, old and ill-maintained vehicles, traffic congestion, poor fuel quality and adulterated fuel have severely enhanced the vehicular pollution load.

Vehicles pose a special problem because vehicle emissions take place in the breathing zone of people.

There are warning bells in India as well. Since 1995, there has been a tremendous increase in the number of vehicles, thus adding more to the pollution load. Evidences of its impact is available from other cities. Twisha Lahiri, the former assistant director and head, department of neuroendocrinology, Chittaranjan National Cancer Research Institute, Kolkata, studied the impact of air pollution on specially exposed groups like taxi-drivers. She observed that exposure to vehicular emissions causes significant increase in respiratory symptoms and lung function impairment.

A study conducted by the Chest Research Foundation and B J Medical College, Pune, in 2004 investigated the levels of exhaled CO as a marker of oxidant stress and compared that with control groups, which are less exposed. It found that the

respiratory tracts of traffic police personnel are exposed to higher levels of oxidant stress (most likely from pollutants emitted from vehicle exhausts), which results in airway inflammation and damage to the respiratory system.

The trend in the car segment is even more worrying with dieselization making its insidious presence. Pollution battle can turn very difficult if dieselization of the car fleet is not checked. Diesel cars that were only 4 per cent of the total car sales in 1999 are already 30 per cent of the new car sales and are expected to be 50 per cent by 2010. Diesel car segment is threatening to push up the emissions of NOx and PM from the car segment several fold. Even though the absolute numbers of petrol cars are much higher than diesel cars, even then PM emissions load from diesel cars is several times higher.

Diesel exhaust is particularly deadly as it contains numerous toxic substances that are known to be genotoxic, cytotoxic, fibrogenic and carcinogenic. New research shows that short exposure to diesel exhaust can induce stress response. A study conducted by the Centre of Expertise in Life Sciences in the Zuyd University in The Netherlands and published in 2008 in the *Particle and Fibre Toxicology Journal* establishes, the effects of diesel pollution on the brain.

In petrol elimination of lead and lowering of benzene has led to marked reduction in their ambient concentration of these pollutants.

In view of these emerging facts from different parts of the world, Kanpur will be well advised to curb vehicular pollution on an aggressive scale.

Vehicles cause high re-suspension of road dust: Vehicular activity fans road dust even more. The recent pollution inventory for the city shows high level of the resuspended road dust. Vehicular exhaust makes this dust more toxic. The particulates on the road are an agglomerate of fine dust from the neighboring soils due to wind led erosion, settlement of dust from tail pipe emissions or erosion of tires. Road dust emissions are resuspended particulate matter entrained in the urban street canopies due to wind erosion and movement of vehicles on the roads.

This emission is enriched with higher concentrations of toxic metals and organic compounds. Major elements reported both in the tail pipe particulate matter emissions and also in the road dust are lead, zinc, cadmium, copper etc. This emission amounts to 25-50 percent of the tailpipe emissions on Grand Trunk road. The estimated road dust emissions (gm/vehicle kilometer travel) in Kanpur were found to be about 300 times more than that of the values reported on roads in developed countries. Zinc and lead were found to be 5-15 times higher than that of the background soil concentrations of Kanpur. Benzene soluble organic fraction (BSOF) in dust samples was taken as an indicator of presence of toxic organic compound. BSOF in road dust varied from 0.3-1.8 percent.

This suggests that road dust emissions that are major sources of air pollution in cities like Kanpur are also laden with harmful heavy metals and organic compounds. Therefore, road dust emissions should be considered in the overall emission inventory and measures should be taken to control road dust emissions along with vehicular emissions.[32]

Resuspended road dust in Kanpur have high concentration of toxic metals .

6. MOBILITY CRISIS IN KANPUR

Even before the city could reduce air pollution, it is hurtling towards congestion nightmare and untamed energy guzzling. This is largely because of growing dependence on personal motorized vehicles that are marginalizing more sustainable modes of transport including public transport and non-motorised transport – cycling and walking.

City in grip of motorization: Kanpur has much less number of vehicles compared to Delhi and other mega cities. But its growth rate already equals that of the bigger cities. The vehicle numbers have already begun to increase rapidly in the city (See graph 19: *Galloping numbers*). Most of these are personal vehicles – cars and two-wheelers that are responsible for choking congestion. According to estimates there are about 0.84 million motorized and non-motorised vehicles plying on roads in the city (motorized vehicles 0.64 million and non-motorised vehicles 0.15 million).To this is added 19,000 motorized vehicles coming from ousidet the city. Every year about 40,000 vehicles are added. According to transport department about 100 two wheelers and cars and 10 commercial vehicles are registered every day in the city. Among the para-transits there are 3,834 tempos and 2,942 autos and 2000 loaders.

Typically, two-wheelers dominate the fleet. In 2006 about 83 percent of the registered fleet was two-wheelers, 13 per cent cars, 4 per cent of trucks. The registration of two wheelers is however falling giving way to cars and jeeps. The average annual rate of increase for cars is about 10 per cent as opposed to about 7 per cent for two-wheelers. As the city becomes richer, it is only to be expected that people will turn more to cars.

Travel speed plummets: Peak hour traffic has slowed considerably in Kanpur. According to the CDP of the total road length, 65 percent have traffic journey speed of only upto 20 km/h during peak periods. In other average journey and running speeds is as low as 17.4 km/h. As there is no significant variation between these two speeds this indicates a saturation-flow condition on the road systems. The Wilbur Smith study also shows that the average journey speed in Kanpur is 20 km per hour. Kanpur has lesser number of vehicles than Delhi but has comparable congestion levels (See Graph 20 A and B: *Traffic speed and congestion index*).

Where is the space for more cars? In Kanpur more than 26 per cent of road length has vehicle capacity ratios of more than 0.8, which denotes forced traffic flow

Maximum people in Kanpur walk, cycle, and use public transport. But future projections show that without interventions this share of ridership will fall

Graph 19: Galloping numbers
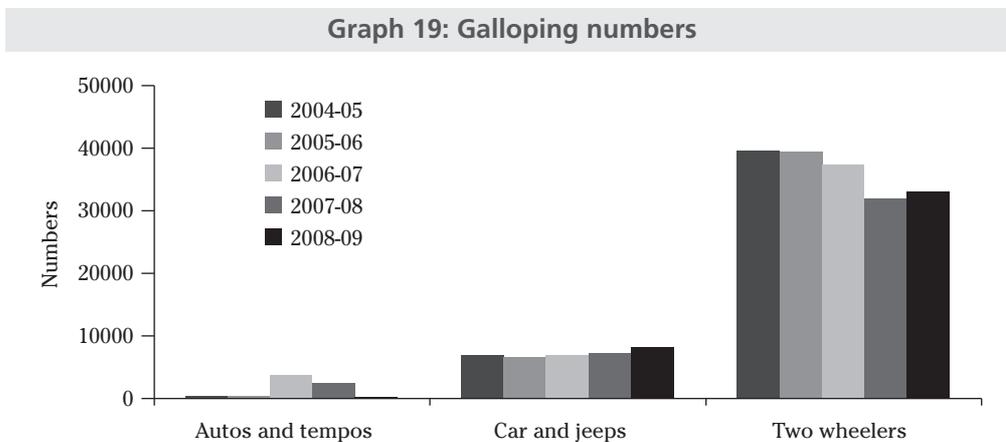
Note: Registered vehicles in Kanpur (year-wise)
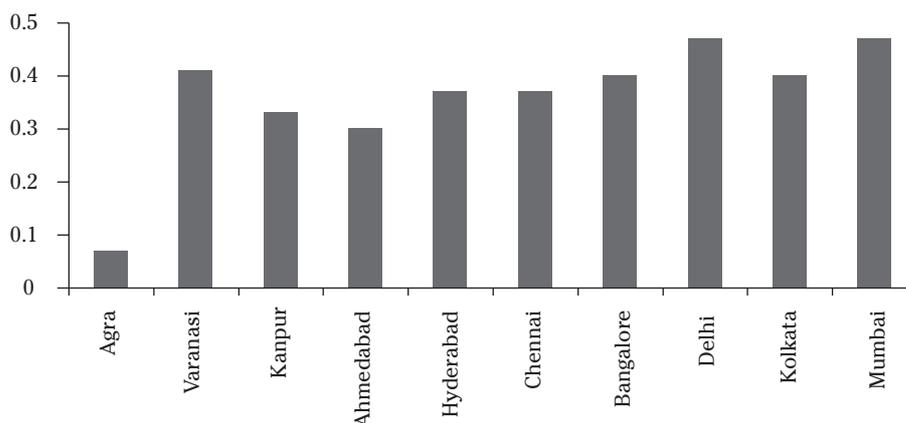**Source:** Anon 2009, Year-wise details of registered vehicles, Motor vehicle department, Kanpur

Graph 20 A and B: Traffic speed and congestion index

A. Peak hour average journey speed on major road network (KMPH)
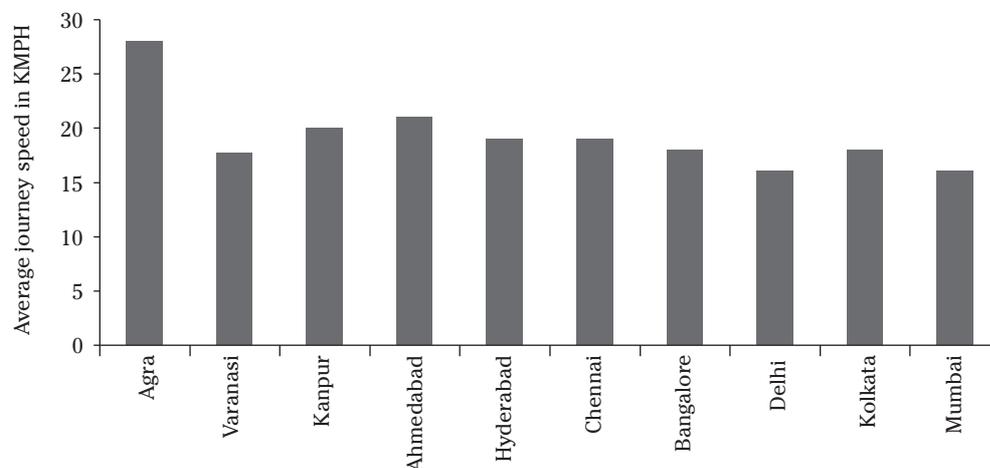
Source: Anon 2009, Year-wise details of registered vehicles, Motor vehicle department, Kanpur

B. Congestion index of cities

Note: Higher index value is better
Source: Anon 2009, Year-wise details of registered vehicles, Motor vehicle department, Kanpur

Voluntary agreement in Europe did not specify individual corporate targets for companies , and no mechanism set to guarantee for meeting targets

conditions and poor level of services. Traffic volume has exceeded the designed capacity on nearly 71 percent of roads. They are already saturated or are nearing saturation. Although 27 percent of road network has a width of over 30m, 50 percent of the existing road capacity has deteriorated due to encroachment. Out of total road network, 70 percent have poor surface quality.[33] Out of total 272m roads surveyed only 30 per cent of road length has a good surface quality. This coupled with inadequate carriageway width signifies lower road capacity, which means reduced level of service on roads.[34] To ease the traffic congestion and to improve the traffic conditions the city government is looking at the options of one-way traffic on certain routes and road widening in some stretches. There is limit to growth. Very little surface is available in the city for road expansion. City will have to look at other ways of reducing traffic volume for efficient utilization of the existing capacity.

City is gridlocked: The city development report states that most of the city core roads (Meston road, Canal Road, Halsey road, Latouchey road, Birhana road (near

Nayaganj), Canal road (near Narona), Nayaganj road and Kidwai Nagar road near Ghantaghar) have traffic volumes that have exceeded the designed capacity of the road. Roads are also encroached and have poor surface quality. Journey speeds is very low.[35] The peak hour traffic composition on interior city locations shows 70 per cent of the peak hour traffic is dominated by the motorised traffic — cars and jeeps (22 per cent), two wheelers (28 per cent) and autos (21 per cent) (See Graph 21: *Peak Hour Traffic Composition on interior city locations*).

The heterogeneous traffic of autos, tempos, rickshaws, cycles, two-wheelers, cars and other small good vehicle – typical of any small Indian city – also slows down traffic movement further. The fast and slow vehicles are not segregated.[36]

How people of Kanpur travel? Maximum people in Kanpur walk, cycle, and use public transport. Currently, 37 lakh (about 3.7 million) trips are made daily of which highest share is that of walking trips at 10.80 lakh (a little over one million), and cycles trips are 7.14 lakh (0.71 million). The share of bus transport is 9 per cent. Two wheelers trips are about 21 per cent and cars 16 per cent (Graph 22: *Modal share in Kanpur*). The large intra-city passenger demand is met by informal inter mediate public transport — auto-rickshaws, tempos and cycle rickshaws. The tempo movement is very high especially on Ambedkar and Mall Road stretches and at Parade and Bara Chauraha.[37]

But future projections show that without interventions the share of public transport trips will fall further and that of cars, and two wheelers will increase (Graph 23: *Travel demand forecast*).

Intercity traffic and railway crossings: The burgeoning numbers in Kanpur get further inflated due to the daily influx of vehicles from the surrounding areas of Kanpur. According to the City Development Plan, Kanpur is facing the problem of intermingling of inter-city traffic with the city traffic. The congestion is evident all along the G.T. Road and at all those places where the railway network cuts the road

**Graph 21: Peak Hour Traffic Composition on interior city locations (%)**
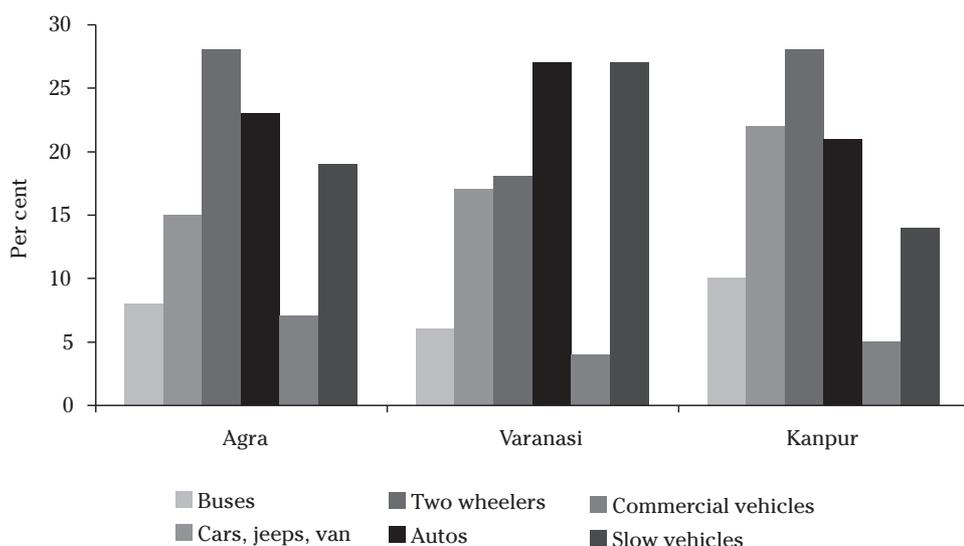
The traffic congestion gets further aggravated due to daily advent of vehicles from the surrounding areas of Kanpur

Source: Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates

Graph 22: Modal share in Kanpur

Public transport, walk and cycle together has a share of 57 per cent
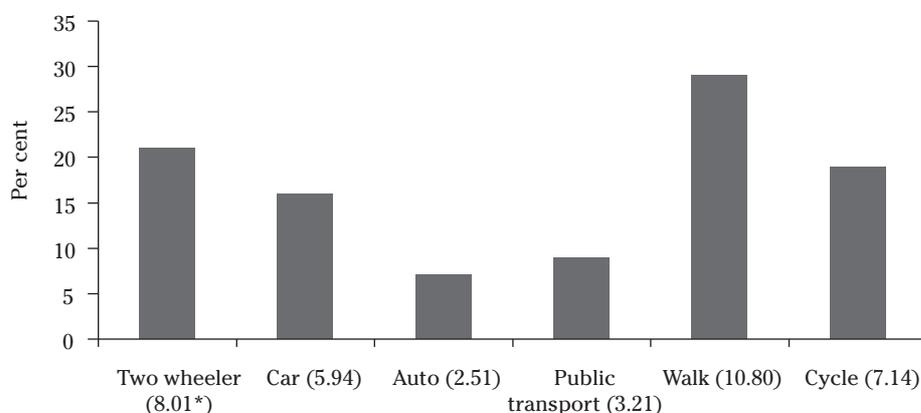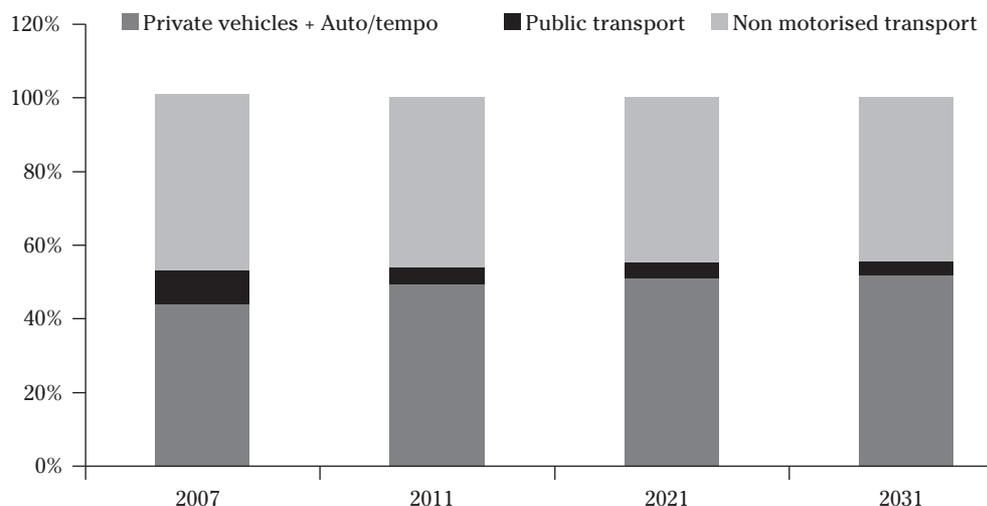

*trips in lakh
Source: Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates

Graph 23: Kanpur: Travel demand forecast

Without any policy to support public transport and protect the non-motorised transport the city will become highly dependent on personal and IPT vehicles

Source: Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates

The total carbon dioxide emissions from the transport sector in Kanpur is still much smaller than Delhi. But personal vehicles are responsible for maximum CO2.

network. The railway network passing through the city has resulted in a large number of rail level crossings – about 16. The railway line between Kanpur and Farrukhabad divides the city into north and south city and a total of 11 level crossing falls between main Kanpur city and south city i.e. on other side of G.T. road.

Some remedial measures have been taken by constructing over bridges and bypasses. These include over bridges (Murray Crossing, Jhakkarkati, Narender Mohan Setu, Govind Puri, Dada Nagar and Panki) and a by-pass on the southern end of the city to ease the traffic congestion. The traffic movement is restricted on railway crossings from Jarib Chawki to Kalyanpur on G.T. road and frequent traffic

jam is seen all along the G.T. road due to passing of trains. Kanpur city is connected to industrial estate at Dada Nagar and Panki through Dada Nagar tri-junction and Vijay crossing. High traffic movement on this corridor cause frequent traffic jams. There is also a high volume of slow moving traffic i.e. hand cart, buffalo cart, between Transport Nagar and trading centres like Gurmandi, Ansmandi, Hatia, Mani Ram Bagia located within inner city.[38] The rail level crossings generate long queues of traffic leading to congestion and traffic jams.[39]

CPCB has assessed the increase in pollution due to closure of the railway crossings and resultant congestion of vehicles. It found that traffic congestion takes place on all significant crossings from Kalyanpur to Jarib Chowki on G.T. Road. At the crossings the air quality monitoring indicates that the suspended particulate matter range between 780-788 microgram per cubic metre and this shoots up to maximum of 4415 microgram per cubic metre when the crossings are closed for train movement. The highest value was observed at Gumti. Nearly 60 per cent of the traffic that idles at the rail crossing when the gates are closed are two-wheelers followed by diesel driven vehicles that account for 22 percent. They create a very thick smoke adding to visual obstruction and high level of particulate matter.[40]

The congestion also increases due to lack of automatic signals. The traffic remains unorganized in many intersections. There are 237 intersections. The intersections with automatic signals are only 45. According to the Kanpur City Development Plan present requirement of constables in traffic cell is 600 whereas the city has about 400 constables. Out of sanctioned staff only 50 percent is available for controlling the traffic. It has been observed that traffic signs and road marking have not been carried out on many major arterial roads which leads to irregular traffic movement and reduced safety.[41]

Truck traffic and wholesale market: The wholesale market attracts a lot of freight traffic. The goods, which reach Transport Nagar first, are carted to wholesalers in inner city and after its re-packaging again transported back to Transport Nagar for further distribution to other cities in eastern U.P. and parts of Bihar. This results in lots of through traffic. There is a railway godown in city between Jhakarkati rail over bridge and Kanpur Central. Items like cement, fertilizers etc. are off loaded in the godown and then sent further to Panki, FazalGanj and Dada Nagar industrial estate. There are demands to shift the railway godown.[42]

Movement of goods trucks has been restricted during daytime but people say as soon as no-entry is lifted around eight at night, the rush of traffic causes severe jams, as the city's traffic merges with the transit traffic. This also leads to high emissions.

A highway passes through the heart of city brings large volume of through traffic with no business in the city. Several trucks are usually seen parked all along the road blocking the road that is already congested with mixed traffic.[43]

The wholesale market attracts a lot of freight traffic. A highway passing through the heart of the city brings in large volume of through traffic. This aggravates pollution.

7. ENERGY IMPACTS OF MOTORISATION

The growing motorization can have severe energy impacts if dependence on personal vehicles continues to increase. Rising number of vehicles correlates directly with the increase in energy consumption.

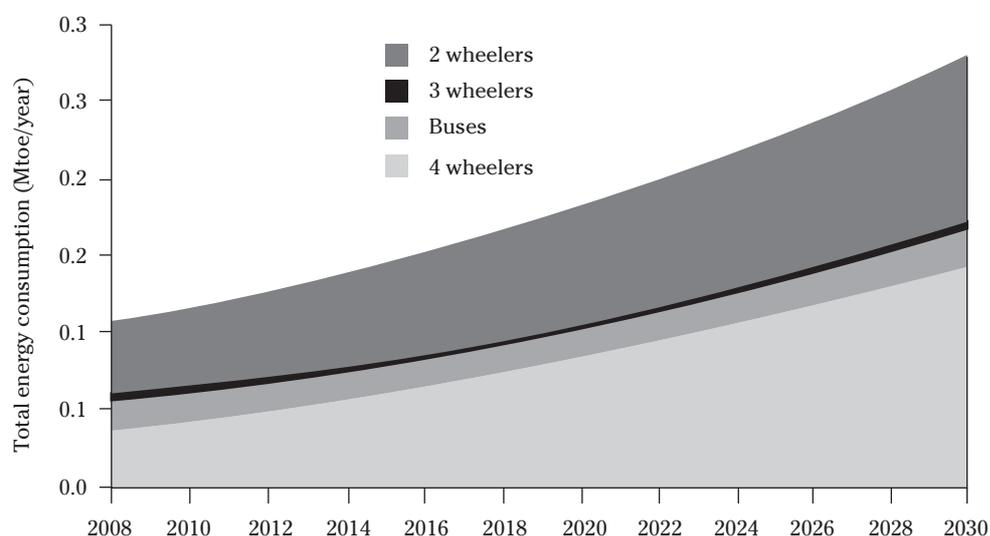**Graph 24: CO_2 emissions from vehicles in Kanpur (2008)**
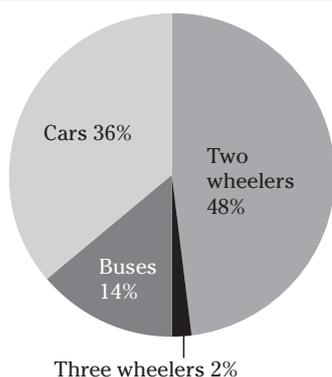
Source: S Guttikunda 2009, Motorised Passenger Travel in Urban India: Emissions and Co Benefits Analysis, SIM Air working paper series: 24-2009

One of the key indicators of the growing demand for transport energy needs is increase in carbon dioxide emissions (CO_2) that depends on the amount of fuel burnt. The total CO_2 emitted in the transport sector of Kanpur is still much smaller than cities like Delhi. But personal vehicles are responsible for the maximum CO_2. A study by Sim Air in 2009 shows that the CO_2 emissions in Kanpur's transport sector is the highest from private vehicles — as high as 84 per cent. The share of two wheelers is 48 per cent and from the cars 36 per cent.[44] (See Graph 24: *Kanpur CO_2 emissions from vehicles (2008)* and Graph 25: *Kanpur: Total energy consumption by vehicle category (2008)*). Therefore, growing motorisation has huge implications for energy security and greenhouse gas

Graph 25: Kanpur: Total energy consumption by vehicle category (2008)

Energy consumption from four wheelers will increase phenomenally

Source: S Guttikunda 2009, Motorised Passenger Travel in Urban India: Emissions and Co Benefits Analysis, SIM Air working paper series: 24-2009

emissions. While buses have 14 per cent share of CO_2 emissions they are several times more space efficient and they carry large number of people which further brings down the per capita CO_2 emission compared to personal vehicles. The same study projects that if no action is taken than the emissions will further increase and private vehicles will be responsible for maximum increase.

## 8. PEOPLE OF KANPUR WANT CHANGE: CITIZEN'S SURVEY

Centre for Science and Environment along with the civil society group, Eco Friends and the volunteers in Kanpur has carried out a rapid stakeholders' survey to understand people's perception of air pollution and mobility problems in the city. The respondents are from different target groups – experts, officials, commuters, doctors, teachers, business, civil society among others. They have reflected on the

Citizen volunteers have carried out a rapid stakeholders' survey in Kanpur to understand people's perception of air pollution and

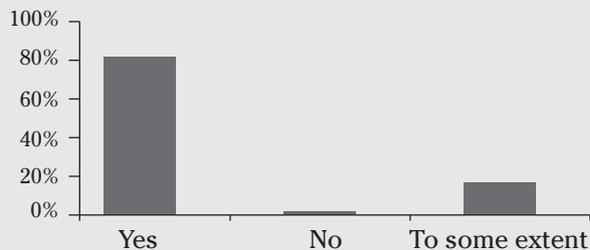### Graph 26 a-k: Findings of the stakeholders' survey in Kanpur
Majority agree that air pollution problem is worsening in the city

a. Air pollution worsening
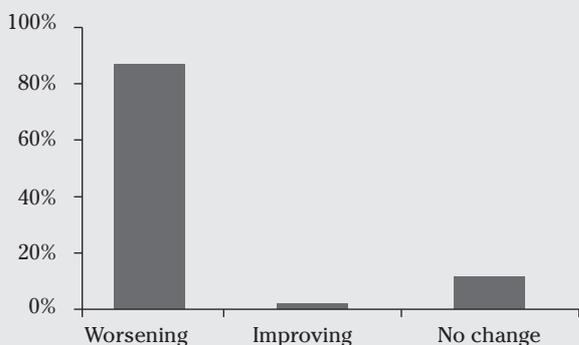
b. Are health problems increasing in the city?
Majority agrees that incidence of respiratory ailments, asthma, and other diseases are not the rise due to air pollution


C. Do doctors tell about the link between air pollution and respiratory symptoms?
Majority agreed that doctors are making the connection between growing illness and air pollution
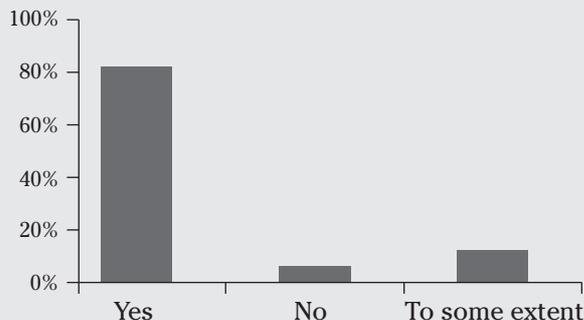
d. CNG programme has helped the most
People are aware of the on going efforts in the transport sector to clean up the air and rate the CNG programme as the most effective strategies so far
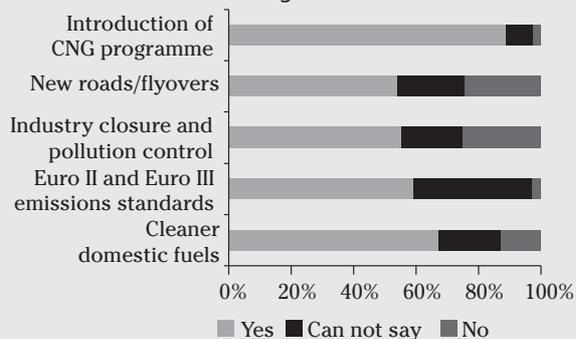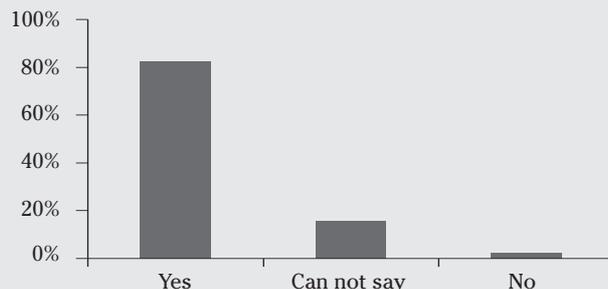

e. Heavy congestion during peak hours
Public anger against growing congestion is palpable
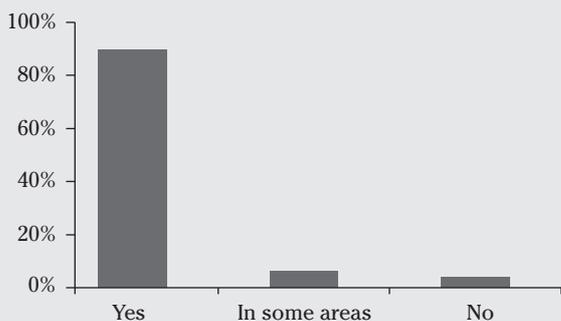
f. Non motorized vehicles should be given more space
There is public support for non-motorised vehicles

core issues that must be looked into for making the next generation action agenda. (See Graph 26 a-k: *Findings of the stakeholders' survey in Kanpur*). This survey was carried out in a participatory way to involve the citizens group, students and people of Kanpur to assess the problem and suggest solutions. This brings out clearly that people of Kanpur consider air pollution, public health and mobility crisis to be a serious problem. There is public understanding and demand for the second generation reforms targeted at the public transport strategies and reforms.

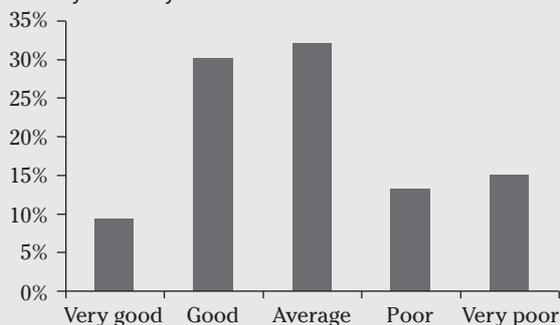**mobility problems in the city. The findings of the survey:**

g. Majority graded quality of bus transport as poor and average

People consider formal bus transport as grossly inadequate
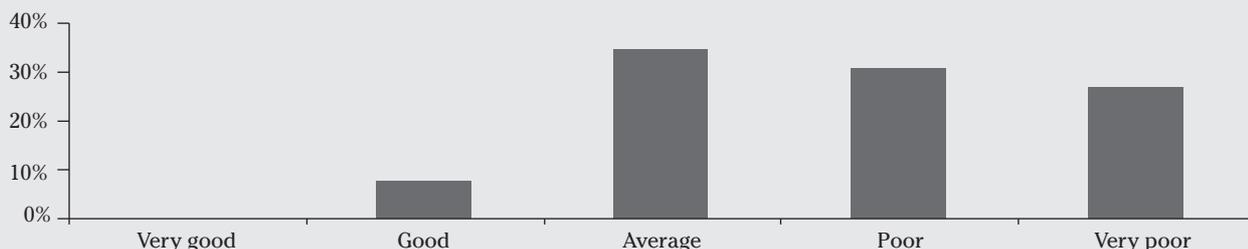
h. Autos and tempos: Majority said needed

Even though the public policy is hostile towards autos majority of people want them as the viable option in a closely built city

i. Huge support for better bus service

Overwhelming majority wants formal bus transport to be revamped
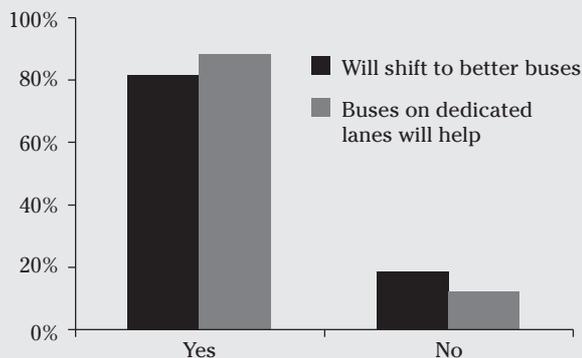
j. Thumbs down to quality of footpaths

People are unhappy with the quality of the pedestrian ways in the city
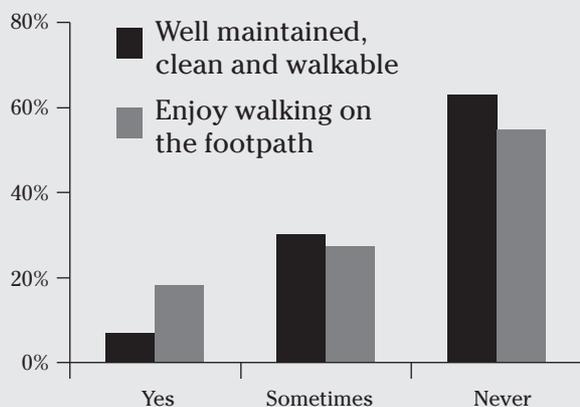
k. Mixed reaction to congestion tax; Nearly 50% said yes to congestion tax. Others skeptical about high taxes

Despite the limited understanding a higher number of people have supported congestion tax, …

49

9. WHAT HAS KANPUR DONE SO FAR?

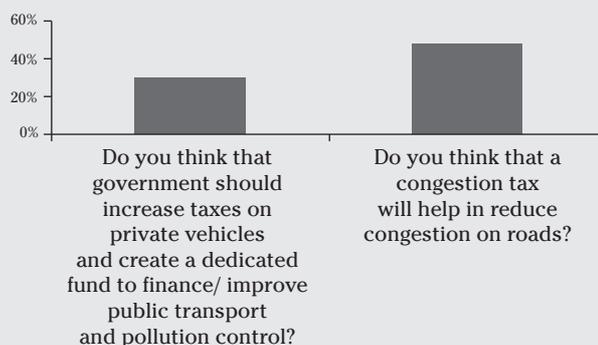Clean air and mobility action has begun in Kanpur. This has shown results and made a difference. The city action plan has progressed in stages. Way back in 1997-98 the Central Pollution Control Board had developed an Environmental Management Plan (EMP) for Kanpur with a strong focus on air pollution reduction. The Plan was submitted to the Uttar Pradesh State Pollution Control Board (UPSPCB) and the Kanpur Development Authority (KDA) for implementation.

This plan had prioritised air pollution control in the transportation sector and had recommended improvement in road network, construction of more road corridors and regulation of traffic to decongest the residential and market areas. It had also proposed to realign the meter-gauge rail track (MG Rail Track) along the broad gauge line.[45] The MG Rail Track across Kanpur was identified as a major source of air pollution due to traffic congestion. Since then nearly 48 major industrial units were shut down and a large number of small scale units had also closed or fallen sick.

The ongoing action gathered momentum after 2004 when the ambit of the ongoing public interest litigation on air pollution in Delhi in the Supreme Court of India was broadened to include Kanpur as well. Ever since then, the Supreme Court appointed Environment Pollution (Prevention and Control) Authority (EPCA) is monitoring the implementation of the action plan in the city. Kanpur has submitted a clean air action plan to the Supreme Court indicating the milestones, timeline and agencies responsible for implementation. On the basis of this the EPCA undertakes periodic review of the implementation of the action plans. The Supreme Court interventions and state government policies have laid the foundation of the first generation policy action in the city. (*See box: The first generation action in Kanpur*).

The EPCA has identified four key areas where cities can play an effective and independent role and also make an impact. These priority areas include the following: i) Gaseous fuel programmes to leapfrog from current polluting diesel to cleaner fuel, particularly in grossly polluting segments like public buses and autorickshaws. ii) Public transport and transport demand management to reduce the demand for growth of private motorisation and reduce emissions. iii) Vehicle inspection programme for the on-road vehicles to combat pollution from large fleets of existing vehicles. iv) Management of transit traffic and phasing out of old vehicles to reduce the burden of pollutants in the city.

Today, new issues and concerns are emerging in the city. This will set the terms of future action and second generation reforms.

The ongoing action gathered momentum after 2004 when the ambit of the ongoing public interest litigation on air pollution in Delhi was extended to include Kanpur.

FIRST GENERATION MEASURES IN KANPUR: TIME LINE

A series of actions have been implemented in kanpur over the last decade

Areas	Status on Action submitted to the Environment Pollution (Prevention and Control) Authority in August 2009
Vehicular pollution control	**Emissions standards for new vehicles** Bharat Stage (BS) II emission norms in 2003, BS III in 2005 and BS IV in 2010 **Gaseous fuel program 2004 onwards** Total 7 stations including 1 mother station and 6 on line stations are operating in Kanpur. Work on others in progress Over 9000 CNG vehicles Training program on safety checks are being conducted **Measures for in-use vehicles** 15 PUC centres upgraded according to new in-use emission norm,. Total PUC centres 26. Age of the vehicles has been fixed. Three wheelers only with catalytic converter/ scrubber are being registered and allowed to ply within the Municipal limits. Battery operated three wheelers are being encouraged. **Phase out of old vehicles** Buses (>9 year old): 105 Tempo (>7 year old): 907 Autos (>10 year old): 565 Maxi cab (>15 year old): phased out **Movement of heavy vehicles** Entry time restrictions are implemented for GT road **Public transport facility** Till date 39 buses are plying only on outer route of the city to avoid traffic congestion **Develop pedestrainsation plan** Scheduled in 2006. Under preparation. **Formulation and implementation of parking policy** 30 tempo parking lots. Private vehicle parking areas are regulated in different areas. **Road building** Roads measuring 87 kms are being constructed during 2008-09 with footpaths and drains. There is a proposal to construct and maintain 68 kms roads with an estimated cost 2563.9 lakhs in year of 2009-10. **Traffic management** Roadside encroachments are being removed. Installation of traffic signals (reports of many signal not working). Traffic system being regulated manually. Traffic restriction are being imposed in peak hours.
Industrial pollution control	Regular industrial air quality monitoring is being conducted. Uttar Pradesh SPCB has issued guidelines & notification for strict compliance of the exhaust norms, Regular public awareness is being carried out. Inventorisation is being done for all air polluting industries and no new industry is being issued NOC in Non-confirming area. 12 industries closed and 3 being issued notices for non-compliance of norms -- Enforcement in 60 industries **Pollution from power plant** Panki thermal power station does not meet the norm but bag filters/ ESP installed. Fly ash used in cement industry. NHAI is using flyash for road building.

……Continue

Areas	Status on Action submitted to the Environment Pollution (Prevention and Control) Authority in August 2009
Other measures	**Greening measure** Tree plantation is being encouraged along road side under social forestry programmes. Tree plantation and green area -- 8.79 lakh trees have been planted in 665 hectares area. 25 greenbelts developed along roadside **Check on fuel adulteration** 66 petrol pumps monitored. Notice issued to 2 pumps and 2 were fined **Gensets** 1263 DG sets of capacity 20 KVA and above identified for enforcement Status of enforcement of emission standards for DG sets to be assessed **Open burning of biomass** Open burning of biomass and solid waste has been banned A complete solid waste management scheme for Kanpur of municipal area has been sanctioned **Bio medical waste treatment** MPCC is operating a plant for disposal of bio medical waste 25 notices have been served to defaulting hospitals. **Kanpur Development authority:** 25 parking spaces with 15000 sq.mt road space has been proposed by 2010. Six flyovers have been proposed at different locations by 2010. Six new subways have also been proposed. Other activities include infrastructure development and management.
Air quality monitoring	Air quality monitoring strengthened Regular monitoring at 6 locations (5 manual and 1 automatic)

Source: EPCA Action Taken Report, as on 31/08/2009 compiled by UPPCB, Central Pollution Control Board

10. EMERGING ISSUES IN KANPUR

Technology roadmap: In accordance with the Auto Fuel Policy of the government of India Bharat Stage IV emissions standards for vehicles and fuels have been phased in 13 cities of India in 2010 that includes Kanpur. It is important for the state government to push for a more stringent post 2010 roadmap to leapfrog the vehicle technology and fuel quality to meet Euro V/VI levels within a tighter time frame. This is needed to reduce the pollution impact of the growing motorization. It is important to cut emissions at source to protect public health.

Natural gas vehicle programme: The CNG strategy has become necessary because the mainstream technologies of petrol and diesel have not advanced in India as much as they have in the industrialized countries. With fuel substitution, Indian cities have leapfrogged to much lower emission levels. Kanpur today is a prominent CNG city in the country *(See Box: Highlights of the CNG programme in Kanpur)*. This programme will continue to remain an important strategy in the future to cut multiple pollutants particularly, particulates and nitrogen oxides. The environmental benefits of this programme can be maximised if following elements are integrated.

● **Technology roadmap for PM and NOx benefits**: The Indian natural gas vehicle progranmme (NGV) has primarily targeted to replace diesel buses, and taxis and polluting three-wheeled vehicles to cut particulate emissions. (See Table 1: *Comparative emissions of diesel and CNG buses in India*). As the cities are now bracing to cut multiple pollutants especially particulates and nitrogen oxides, the NGV program has the potential to reduce both the pollutants if designed appropriately. The city government must work with the Union government to develop a technology roadmap for the CNG vehicles. For instance, in India the bus industry had started with the conventional stoichiometric engines with three-way catalytic converters and while moving to Euro III they moved to lean burn CNG engines. Both the options give enormous prticulate reduction benefit. Globally, however the move is towards advanced stoichiometric engines with advanced three-way cat converters that are more effective in lowering NOx emissions and also improving fuel efficiency as well. Thus, the bus procurement policies in Indian cities embarking on natural gas bus programmes will have to be linked with the best technology options and enabling emissions standards to meet the overall air quality objectives.

● **Getting the prices right:** The success of the NGV programme will depend on the CNG pricing policy. As CNG is displacing mostly diesel in public transport for maximum environmental benefit CNG prices must always remain effectively lower than diesel. Increasingly the CNG prices are becoming market driven with fuel price rationalisation. This will require favourable taxation policy to maintain an effective differential with diesel. The price of gas in Kanpur is higher than

The CNG strategy has become necessary to sidestep toxic diesel and achieve much cleaner emissions.

Table 1: Comparative emissions of diesel and CNG buses in India

Type of bus	CO g/km	HC g/km	NOx g/km	PM g/km	CO$_2$ g/km	Km/litre
Euro II diesel bus on 500 ppm sulphur fuel + DOC	1.45	0.29	6.24	0.35	798.7	3.33
Euro II diesel bus on 350 ppm sulphur fuel + DOC	0.65	0.15	5.85	0.11	766.1	3.44
Euro II diesel bus on 50 ppm sulphur fuel + CRT	1.42	0.04	13.58	0.009	781.38	3.36
Euro II CNG bus +three way catalytic converter	3.18	1.455	5.35	0.0065	729.74	NA

Source: The Energy and Resources Institute, 2004, Fuel Choices for Transport and the Environment, New Delhi, page 9

HIGHLIGHTS OF THE CNG PROGRAMME IN KANPUR
(AS ON 2009)

CNG infrastructure

One Mother Station at Fazalganj and six on-line Stations in Kanpur

Dispensing capacity: 56000 kg/d (204.4 lakh kgs)

Average CNG dispensed — 34099 kg/d (124.46 lakh kgs)

The details are as under-

Fazalganj-Mother station.16000kg/d capacity. (Present filling 10881 kg/d)

Makadikheda- On-line station 8000 kg/d capacity (Present filling 4384 kg/d)

Gumtii No.5- On-line station 8000 kg/d capacity (Present filling 5686 kg/d)

Juhi- On-line station 8000 kg/d capacity (Present filling 8229 kg/d)

Tilak Nagar- On-line station 16000 kg/d capacity (Present filling 4919 kg/d)

One station at BPCL R/O Afim Kothi is under Pre commissioning & testing

Number of CNG vehicles

Cars and taxis: 297

Autos: 8,799

Buses: 396. UPSRTC has 39 operational CNG buses

Auto shuttles; 89

CNG prices: Rs 29 per KG

Delhi and includes the sale tax which Delhi has waived off. The UP government charges VAT on gas. It is important that the government frames a tax policy to maintain an effective differential between the gas and diesel prices.

- **CNG refueling network**: There are seven refueling stations in the city and according to officials of Central UP Gas Ltd (CUGL) the stations have adequate pressure for quick filling and this helps to reduce queues for refueling. However, bus operators complain about dead mileage incurred due to lack of stations in depots. CUGL has opened a CNG mother station at Fazalganj, and four online stations at Juhi, Gumti No 5, Tilak Nagar and Makri Khera. In the second stage they have plans to open five CNG stations at Chakeri, Panki, Chunniganj, Gumti and NH5. According to plans of CUGL by February 2010 CNG pumps will be installed in Hari Filling Station (Kalyanpur), Kapoor Auto (Chunniganj). In addition CUGL have its own pumps at Chakeri and Panaki. CUGL expects that with the augmentation of bus fleet under the JNNURM programme the gas consumption will increase. However, users have pointed out that there is need for further augmentation of the refuelling capacity to meet the demand in the city.

- **Market development:** Commercial viability of the clean fuel programme will depend on the critical mass of the vehicle numbers. In view of this a certain segment of the commercial vehicles segment was mandated to move to CNG. This includes all autos and a large part of the buses. Furthermore, the directions were issued to phase-out all the 15-year old goods carrier tempos in the city. All school buses and corporate buses have also been asked to convert to CNG. All the diesel run tempos have been banned. Only CNG run tempos are allowed to enter and run within the city limits. Further expansion of the long distance bus transport and CNG highway are expected to create a viable market for the growing CNG market in the city.

- **Quality control:** Large number of on-road vehicles have been converted to run on CNG in the city. Quality control of conversion is important for the environmental performance of the programme. A small number of workshops

carry out CNG conversion in Kanpur. They have been certified. Safety related accidents have not been reported in the city yet. However, as the programme begins to expand systems for proper safety audits and checks must be instituted. Dedicated safety and emissions inspection systems are needed for the bus fleet and other vehicles. Systems are needed for recertification of the CNG cylinders in the in-use fleet at specified intervals – usually five years. The road transport officials, auto unions, driver association need awareness and training related to preventive maintenance and regular servicing. Special repair and maintenance workshop equipped with safety audits gadgets and inspection should be put in place. A third party check on the maintenance and inspection regime is very important.

In-use vehicles programme

The vehicles that are already on the road require strict emissions testing and surveillance to keep emissions under check. India has instituted a vehicle inspection programme for in-use emissions inspection. But in most parts of India this programme has fallen to disrepute for corrupt and fraudulent practices. This has reduced the effectiveness of the prgramme. As vehicle inspection is a state subject there is considerable scope of improvement at the city level to make this programme work and also look at other ways of improving the programme.

● **Pollution under control certificate:** The in-use emissions testing programme and norms for the on-road vehicles called pollution under control certificate (PUC) in Kanpur has been upgraded in accordance with the revised national norms and guidelines of 2004. There are 26 PUC centers in the city. The state officials claim that all PUC centre have been audited by technical officers. But like other cities the effectiveness of this strategy is suspect. A small number of people turn up for these tests. This programme should be assessed in terms of compliance, authenticty of the tests conducted and prevent fraudulent practices.

It is also important for the city to considers upgrading the vehicle inspection programme and supplement with a variety of enforcement strategies. Periodic audits are needed to ensure that authentic tests are being carried out; penalty system should improve the compliance rates; full provisions of the 2004 notification on the PUC norms should be implemented that include lambda tests for the vehicles with catalytic converters. On road checks and removal of smoky vehicles from the roads should be implemented.

● **Upgrade inspection system**: It is also important for the city to consider setting up of centralised and automated emissions testing centres to overcome the fraudulent practices in the small decentralized centres. This will also help to introduce more advanced in-use tests for diesel and CNG vehicles in the city. The city may consider a pilot project on this.

According to UP government's plan for the year 2008-09 there are actually proposals to set up Motor Vehicle Testing Station in view of the increasing number of motor vehicles in the state. A fully equipped workshop with modern machines and testing equipments has been proposed. Provisions have been made for such testing workshops under the Motor Vehicle Act 1988, schedule 56(2) and Central Motor Vehicle Rules 1989, rule 63(3). An outlay of Rs. 1028.52 Lac was proposed for this purpose during the year 2008-2009. However, little progress has been made on this front.

Vehicles that are already on the road require strict emissions testing and surveillance to keep gross polluters under check. In-use emissions testing programme requires upgradation.

Phasing out of old vehicles: Kanpur has adopted a phase out plan for the older commercial vehicles. The state governments' submission to the EPCA in 2009 states the age of the vehicles fixed for phase-out: — Buses — Nine years, Tempo and taxis — 7 year, Auto rickshaws 10 year; Maxi cabs — 15 year. Overall 105 nine year old buses, and 907 tempo-taxis were phased out in 2009. This programme can hasten fleet renewal. This is needed to curb high PM emissions emissions from the old diesel fleet.

Bypass transit traffic: This will be a difficult challenge as the highway cuts through the centre of the city. However, the city has already begun to regulate entry of trucks. The city needs clear plans on the location of the truck terminals and location of the wholesale markets. In India the heavy duty truck technology is stagnating and are extremely polluting. Therefore, other regulatory controls on the movement, age etc become necessary.

State of mobility

Modal share of public transport: Public transport like most other cities in India cannot be understood only in the narrow sense of formal bus transport. That could be misleading. There is virtually no information on the modal share in the city except the data put togethr by the Wilbur Smith study for MOUD. That has given a modal share for Kanpur including walk trips. This shows that the modal share of formal bus system with walk trips is 9 percent in Kanpur which is quite low. Share of para-transit at 7 percent is alo quite close to buses. But if we consider the combined modal share of all sustainable modes put tigither then buses, autos, tempos, and cycle,then the modal share increases to 63 per cent. The rest is cars and two-wheelers. Policy recognition of this distinction is very critical to plan for transportation in the city. Majority of the urban population is walking, cycling and using para transit or using bus. Another important message is to develop policy focus to stitch formal bus system and informal intermediate public transit system. In smaller cities informal systems have traditionally played a very important role.

Even though in terms of vehicle numbres cars and two-wheelers are 98 per cent of the vehicles on the road they carry a miniscule share of 16 and 21 per cent per cent of the trips respectively in the city (See Graph27: *Moving vehicles vs. moving people*) . Yet, disproportionately high road space is allocated to cars and two-wheelers. The travel demand forecast for the city shows that without any policy to support public transport and protect the non-motorised transport the city will be become highly dependent on personal vehicles (See Graph 28: *Travel demand forecast by modes in Kanpur*)**.**

Public transport buses: Kanpur has only begun to organized formal bus transport system for the urban area. As of now the scale of this transport is small both in terms of the number of buses and also the modal share. Policy makers point out that currently, there are 6 buses for 100,000 people which is in sharp contrast to 13 in Ahmedabad, 39 in Bangalore, and 43 in Delhi (See Graph 29: *Not enough buses*). The city has now shown renewed interest to augment the formal bus transport system. Spurred by the stimulus package under the JNNURM programme the city is now augmenting the bus numbers. Kanpur is getting a total of 300 CNG buses with the JNNURM funding. Around 14 low floor buses have started to ply on two routes. The next lots of buses are expected to include 150 mini buses, 100 ordinary buses, 30 semi-low floor buses. Identification of land for depots is in progress. The buses will be operated through staff on contract basis, whose training has been planned. The proposal for waiver/ exemption of state taxes on public transport is being processed.
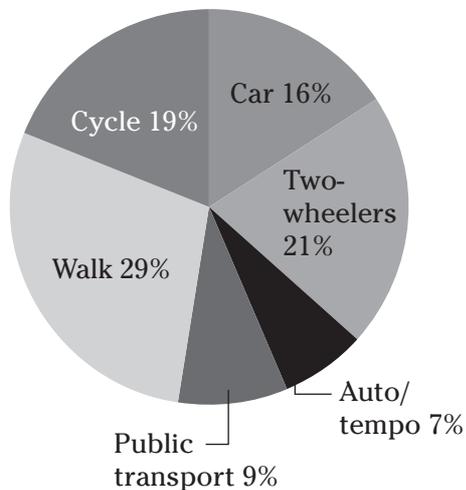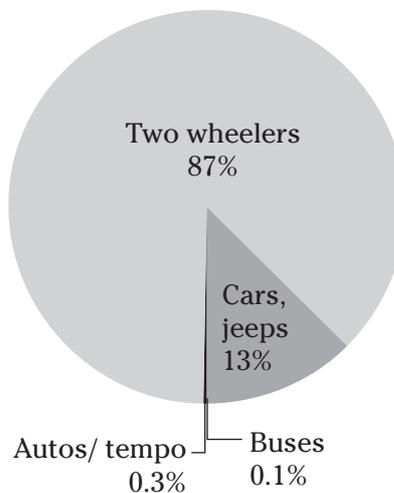
The modal share of formal bus system is only 9 percent in kanpur. But if we consider the combined modal share of buses, autos, tempos, and cycles, then the modal share increases to 63 percent.

Graph 27: Moving vehicles vs. moving people

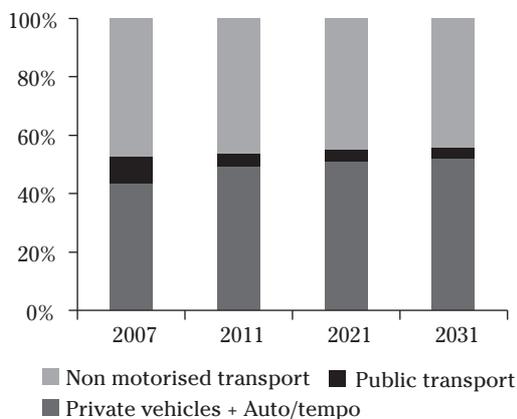Nearly 60% of the people in Kanpur use buses, autos, walk or cycle.

But personal vehicles occupy maximum road space ……

Source: City Development Report Kanpur, and Regional Transport Department, Kanpur

Study assigns very poor ranking to the city for bus transport supply and para transit index.

Graph 28: Travel demand forecast by modes in Kanpur

Source: Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates

But this has also raised questions about the appropriateness of expanding formal bus system without first assesing travel pattern and needs of the city.

Reform of the bus sector: Only increasing bus numbers will not help. While the buses have arrived, the city is not yet prepared with any deployment and operational plan. The city has yet to work on route planning and integration with other modes, infrastructure integration, fare policy, and its overall operational plan. Despite the growing travel demand the bus stops are empty barely anyone is using the buses. According to reports, the 14 buses recently launched on two routes of the city have no fixed stoppage nor any stand. The passengers are often stranded and continue to rely on other modes like three-wheelers. Bus routes are not rationalised and integrated with feeder systems to address the problem of competition between buses and para transit for passengers.

According to officials the city government has just about embarked on the planning for the buses. A study is expected to be carried out by the urban mass transport company limited. Under an agreement with the state government Urban Mass Transit Company Ltd, (UMTC) has begun a survey to identify the route network in the city. The UMTC will assess the load factor, bus timings, and transport demand. On the basis of this study the routes and bus timings will be decided. This survey will also assess the transport demand in different areas of the city and efficiency in transport services. This process will have to be expedited. Without a clear plan the new buses

Graph 29: Not enough buses

(Buses per 100,000 people)
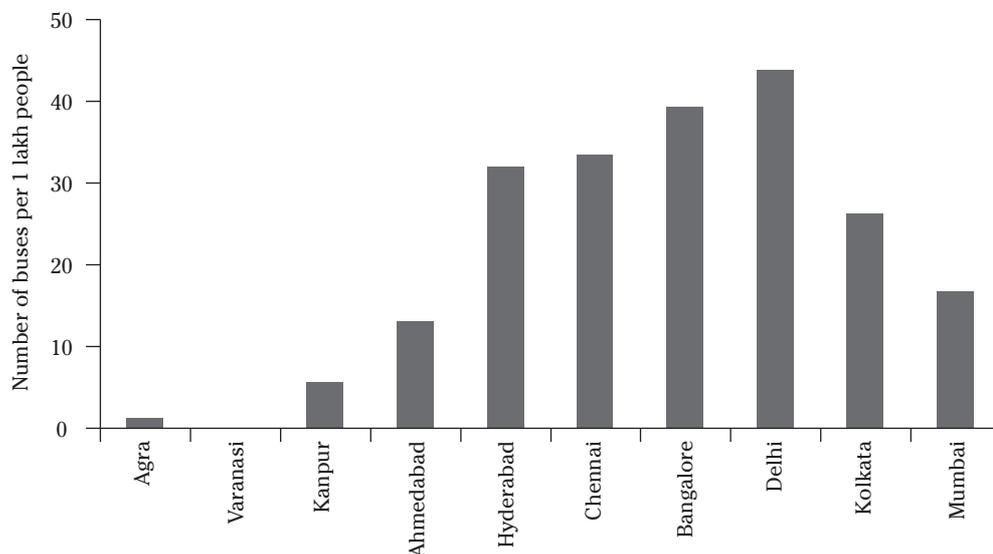
Source: Estimated on the basis of MOUD report: "Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates"

have been now been withdrawn from most part of the city and taken out of the city.

Tax measure for buses: Experience from other cities as well as Kanpur shows that the current tax policies in the transport sector are skewed against the public transport buses. This increases the capital and operational costs of bus transport. Kanpur as part of the ongoing tax reforms has begun to lower the tax load on the bus transport. Under the new tax regime, the vehicle under state transport undertaking operating within the limits of the municipal corporation are exempted from the payment of the additional tax that amounted to 70 percent of the total tax burden. Besides, the newer city buses will have to pay lesser tax compared to older buses. This might help towards weeding out older and unfit vehicles. So far the tax was imposed as per the operation, i.e. km-distance that buses have operated. Now buses paying lump-sum tax for a year might get a rebate of 10 percent.

Fuzzy policy on informal para transit: The study carried out by the Wilbur Smith Associates for the Union Ministry of Urban transport gives very poor ranking to the city in terms of city bus transport supply and para transit index (See graph 30: *Indexing bus and para transit services and congestion*). Even though the city is dominated by para transit and provides a sizeable share of public transport services the quality of the service is poor as there is no policy support for this popular mode of transport.

Typically, the use of informal systems of para transit that include three-wheelers, cycle rickshaws, tempos etc is high in the city. Local authorities point out their share will be much higher than the share shown in the Wilbur Smith study. This is expected in any city where average travel distances are short. People have continued to prefer the para transit especially in the clogged streets due to their small size and maneuverability and also high frequency. In some areas these are more effective even than the standard buses. Even a formal bus system can not cater to such short distances. There are 980 auto rickshaws and tempos plying in the city. There are approximately 5,000 cycle-rickshaws. Studies show that this

According to the City Development Plan of Kanpur, para-transit is the backbone of the public transport in the city. But this is also the most neglected mode.

mode of transport dominate smaller cities (See graph 31: *Number of autos /tempos in selected cities* and Graph 32: *Number of intermediate public transport per lakh of population*).

The study carried out by Wilbur Smith shows that the smaller cities have high values in 'service accessibility index', which means these cities have high percentage of work trips accessibly in 15 minutes due to compact built up and short distances. This makes non motorized vehicles extremely convenient – such as walking, cycling and cycle rickshaws and other informal public transport systems.

Conventional transport planning is ignoring the intermediate public transport system that meets the bulk of the travel demand.

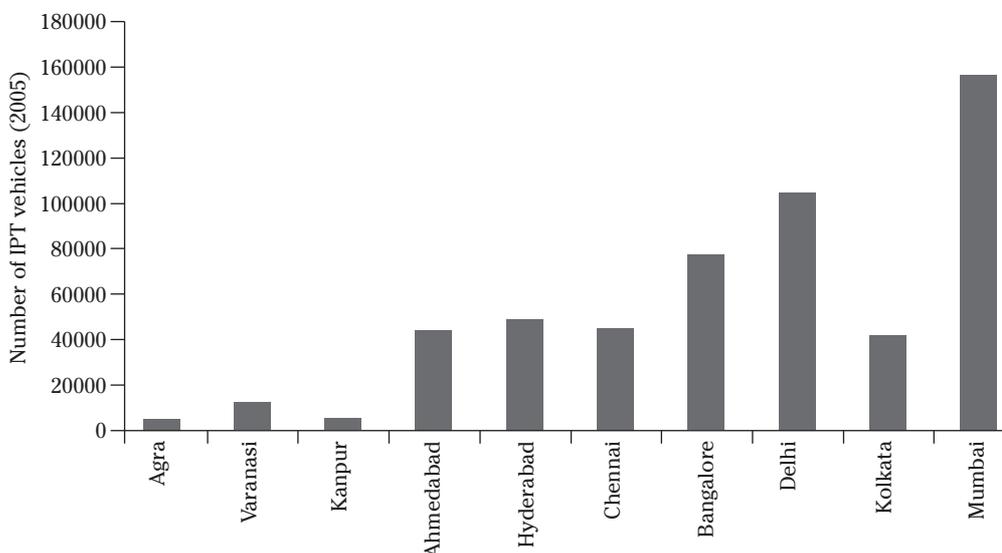## Graph 30: Indexing bus and para transit services and congestion
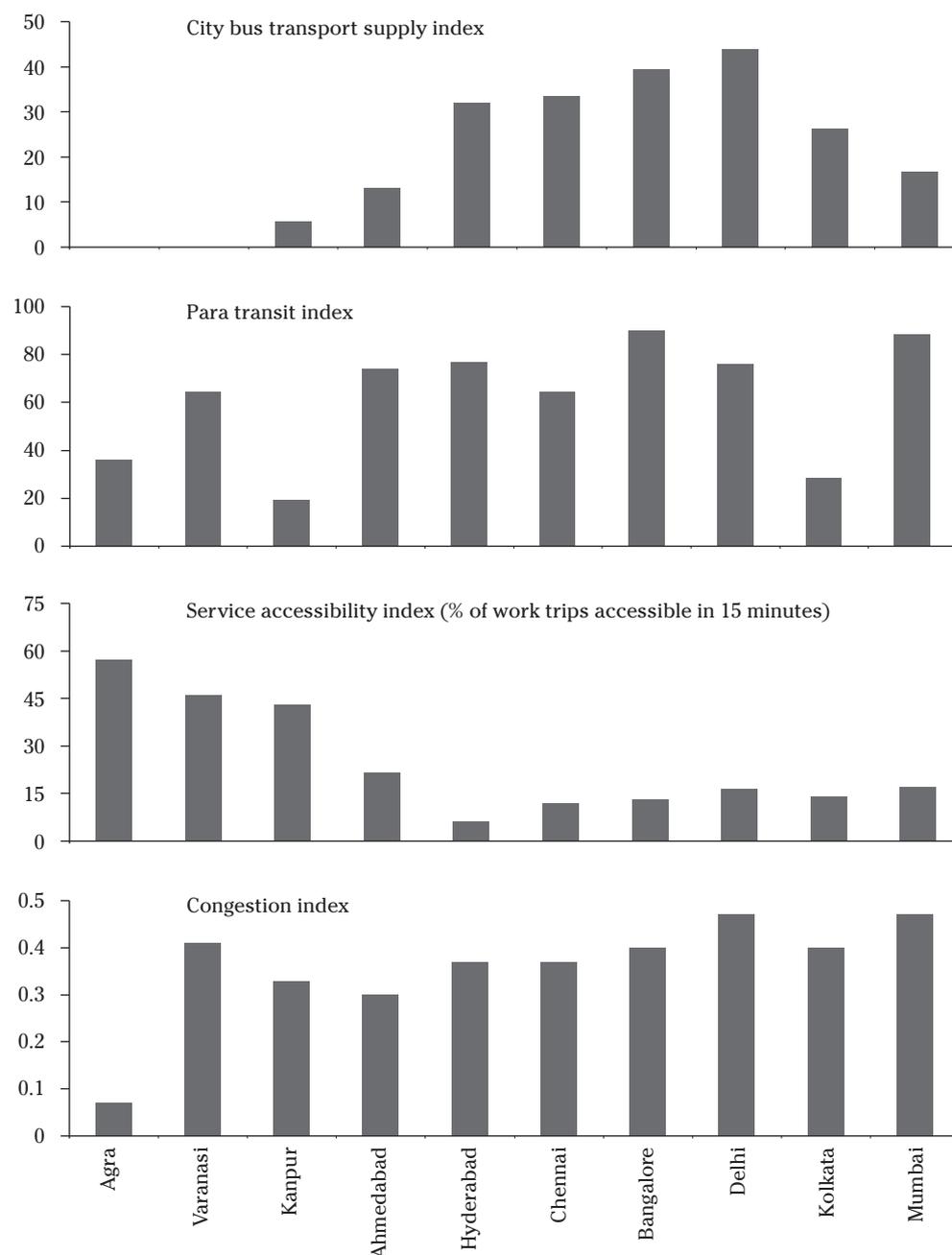
Note: Higher index value is better
Source: Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates

## Graph 31: Number of autos/tempos in selected cities

Compared to big cities the numbers are less

Source: Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates

Graph 32: Number of intermediate public transport per lakh of population

Number of IPT per lakh of population is less than what the city requires
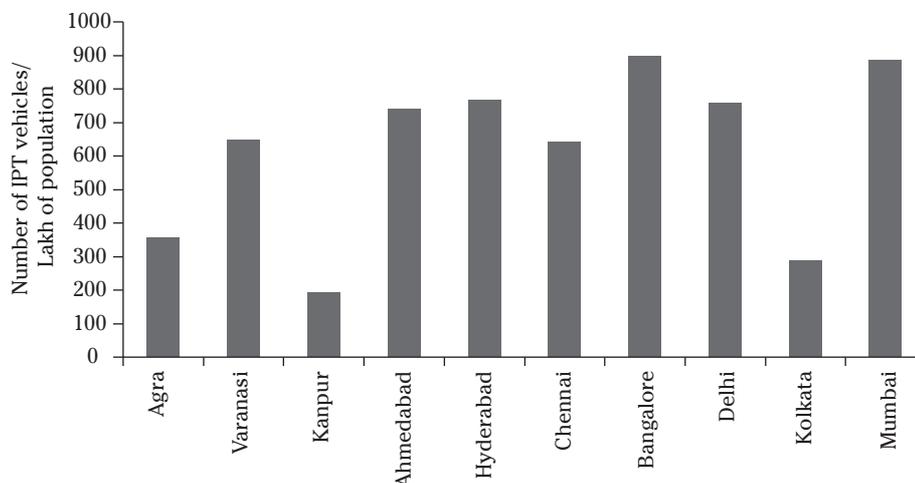
Source: Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates

According to the Kanpur CDP, "These are backbone of public transport."

However, it is becoming increasingly clear that the conventional city planning is ignoring this very vital mode of sustainable transport. It is not clearly understood in the policy circle that these vehicles provide the comfort and also easy accessibility in our densely built cities. If these are discouraged there will be rapid shift towards personal vehicles. The CDP of Kanpur actually perceives these vehicles as traffic nuisance as they do not have proper places earmarked for boarding and alighting the commuters and they stop at any place. They are also held responsible for

slowing down traffic. The planners therefore often make them the target of restrictive policies, confine them to limited areas or even try to ban them or restrict their numbers. Instead more polluting and energy intensive car based mobility is given priority in traffic and road planning. This defeats the purpose of sustainable mobility.

In fact the Divisional Transport Authority of Kanpur is considering imposing restrictions on the registration and issuing of permits to new autos and tempos. As the role of the para transit in the integration of the overall public transport system is not appreciated often they are seen in conflict with the formal public transport system. In fact, one of the reasons behind the proposal to restrict the three-wheelers in Kanpur is that they are seen as directly competing with the JNNURM buses for the passengers. They are also being blamed for the congested roads that make bus operations difficult. Attempt is being made to remove them from the key routes where the buses procured under the JNNURM programme will be operating. This requires immediate policy intervention to organise both the formal bus system and the para transit as a complimentary systems. At the same time an upgradation plan for para transit must be carried out.

The city government must therefore devise an integrated public transport plan that includes both the formal bus system as well as the para transit in the deployment strategy.

Non-motorised transport neglected: The city already has a strong tradition of high usage of zero polluting non motorized transport – cycles and cycle rickshaws. This is the foundation of sustainable mobility. According to City Development Plan there are about 5,000 cycle rickshaws in the city, commonly used for making short trips. The Wilbur Smith study for the MOUD has found that the slow moving vehicle index is higher in case of Kanpur compared to the bigger cities.[46] (See Graph 33: *Slow moving vehicles index*). But unfortunately, Kanpur roads are also unsafe as the non motorized transport users are also the victims of high accident rates. Kanpur today has one of the worst road safety index (Graph 34: *Road safety index*).

The key reason behind the high usage of non-motorized transport is the overwhelmingly large share of trips that fall within the 2km range (See Graph 35: *Kanpur trip length frequency distribution*). Such short distances make use of non-motorized transport most convenient. These are also more affordable. This is the strength of Kanpur that will have to be harnessed.

However, the Kanpur Nagar Nigam plans to restrict the cycle-rickshaws on certain routes in the arterial roads. Clearly, non-motorised transport is facing hostile competition from the formal bus transport as well as car traffic. The zero emitters are being asked to move to make space for polluting and fuel guzzling cars and two-wheelers.

Due to this policy disdain the share of non-motorised modes including cycles, rickshaws, pedestrians, is constantly falling. For example in 1994 the share of this traffic in the total traffic volume in Kanpur was 60 per cent which has fallen dramatically to just 14 per cent today (See Graph 36: *Average share (%) of slow traffic).* This is an unacceptable loss as with replacement of each zero emitter the city is locking up enormous carbon and pollution for the future.

The City Development Plan of Kanpur states that Pankha-Road, Meston Road, Halsary Road, Latouche Road Nayaganj Road, Sutarkhana Road, Cooperganj Road, Birhana Road fall in the inner CBD circle and being major market centre as well as

The City Development Plan has asked for dedicated space for the non-motorised transport. But such plans have not materialised.

Graph 33: Slow moving vehicles and safety hazards
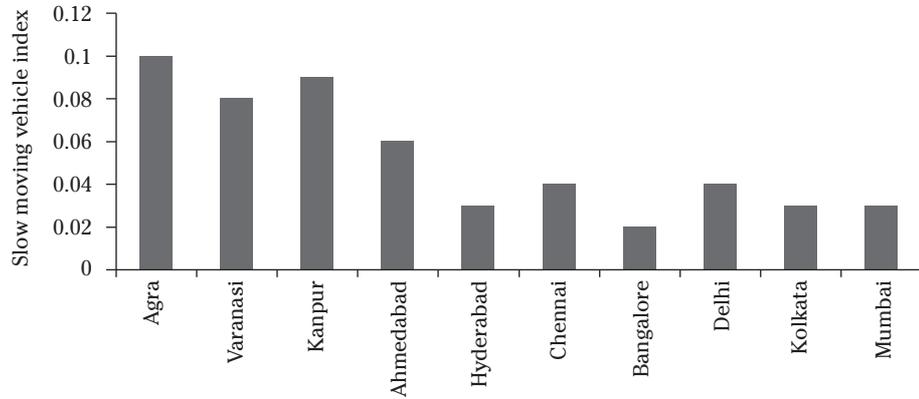
Graph 34: Road safety index
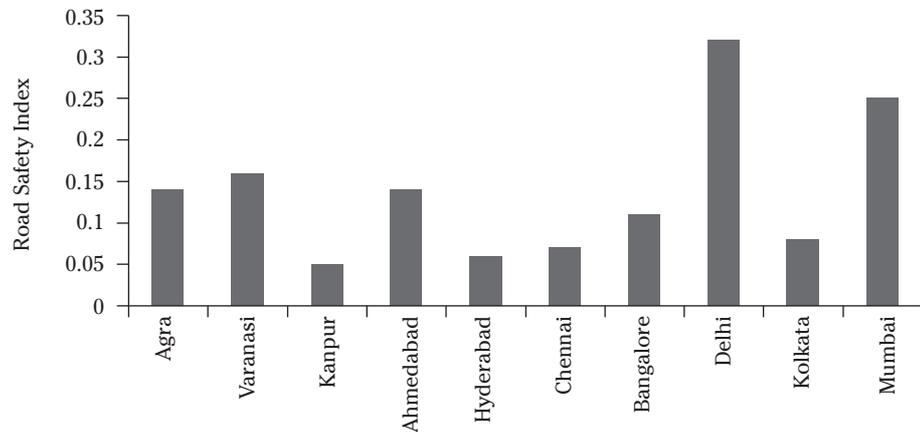
Note: Rank 1- lowest and 5- best
Source: Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates

Graph 35: Kanpur trip length frequency distribution
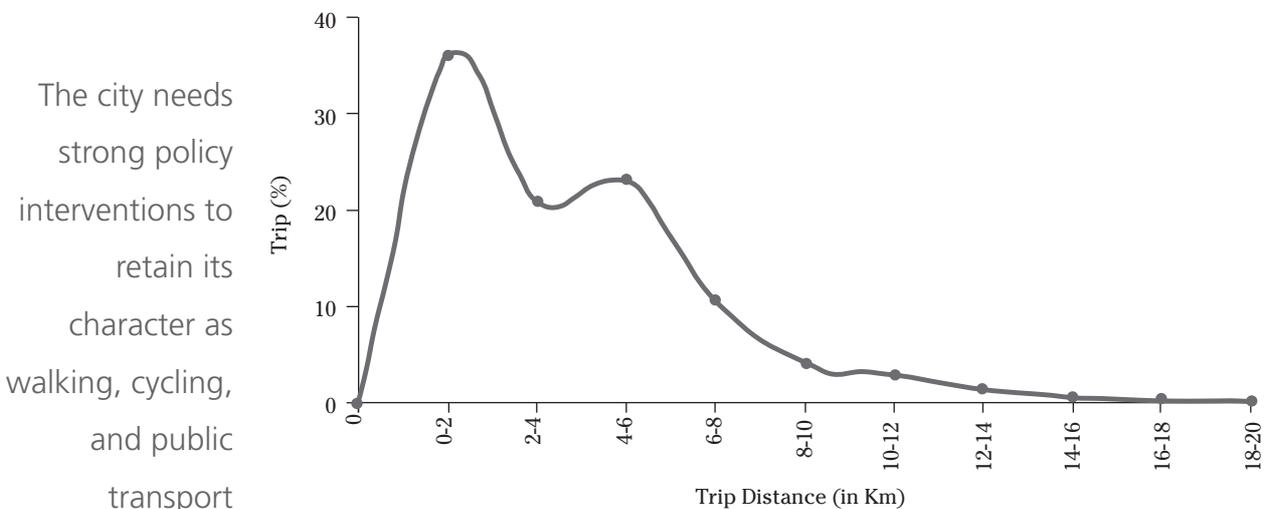
The city needs strong policy interventions to retain its character as walking, cycling, and public transport oriented city.

Source: Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates

Graph 36: Average share (%) of slow traffic

The share of 'slow traffic' is sharply falling, means the policies are not helping to protect their right of way. More motorisation is causing more congestion, which was for which usually slow moving non-motorised vehicles are blamed

Legend:
- 1994: Average share of slow traffic (%)
- 2007: Average share of slow traffic (%)

Cities (x-axis): Kanpur, Varanasi, Bhopal, Nagpur, Pune, Ahmedabad, Kolkata, Guwahati
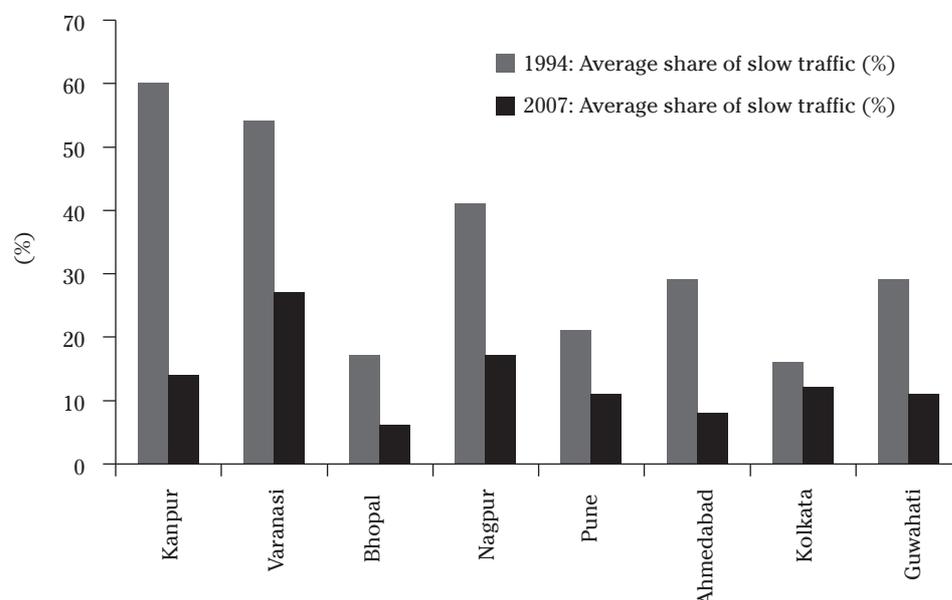
Source: Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates

Kanpur needs a pedestrian policy that will make pedestrian plans mandatory for infrastructure funding and development.

shortest connection routes, these road have very high volume of slow and fast traffic. It suggests that "it is also desirable to impose parking and other movement restrictions and segregate fast and slow vehicles in sections by providing separate tracks for slow vehicles wherever feasible."[47] The city should immediately rationalise road space utiilisation and earmark areas where the segregation is possible to provide dedicated space to these modes and reduce modal conflict with the motorized traffic.

Pedestrians – out of focus: The city needs strong policy interventions to retain its character as the walking, cycling and public transport oriented city. Kanpur like most other Indian cities has high share of walk to work trips. This is the most integral link between sustainable modes. All public transport trips begin and end as a walk trip. But despite high share of walk trips – nearly 30 per cent – the city compares poorly with the mega cities on the walkability index of the Wilbur Smith study (See Graph 37: *Walkability index of selected cities*). It is ironic that the smaller cities that have enormous potential for pedestrian traffic have invested little in improving the walking environment and the infrastructure. Even the opinion survey carried out on the city brings out the disenchantment of the citizens about the walking infrastructure. (See Graph 38: *Pedestrian opinion ranking on pedestrian facilities)* Kanpur also fares poorly on the safety index as it has very unsafe roads."

The City development Plan brings out that except a few roads, all other roads lack footpaths and cross walk facilities. The roads and pavements especially in the main market areas such as Birhana Road etc. are highly encroached. This aggravates congestion.[48] Recently, the city administration has begun anti encroachment drive to free up the pedestrian space. Several illegal structures in Bara Devi area were demolished. Keeping in mind the heavy flow of traffic and the frequent traffic jam witnessed around the Bara Devi Ramleela ground, the Kanpur Nagar Nigam carried

Graph 37: Walkability index of selcted cities

Note: Higher index value is better
Source: Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates
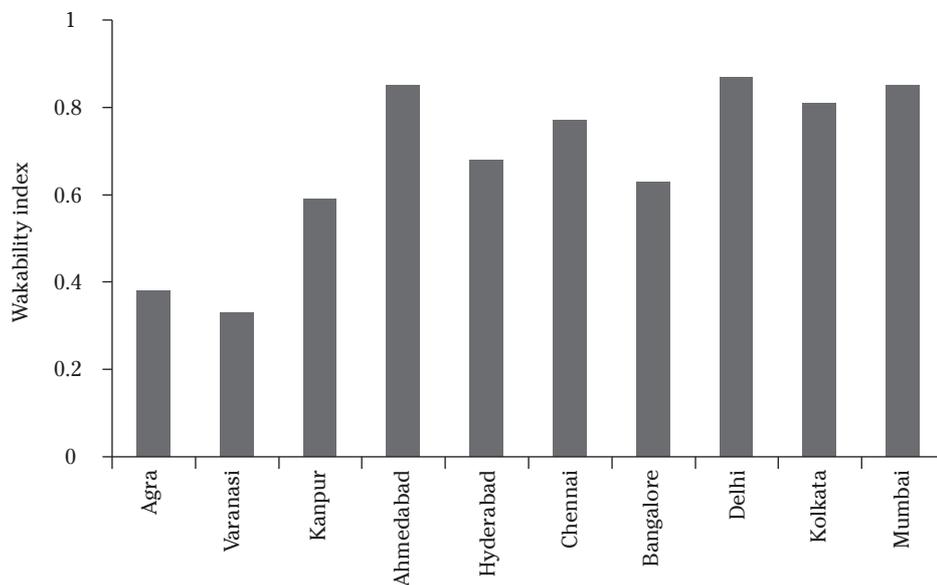
Graph 38: Pedestrian opinion ranking on pedestrian facilities

Pedestrian rank the facilites meant for them too poor in Kanpur, even much worse than Agra and Varanasi, do we care this in Kanpur?
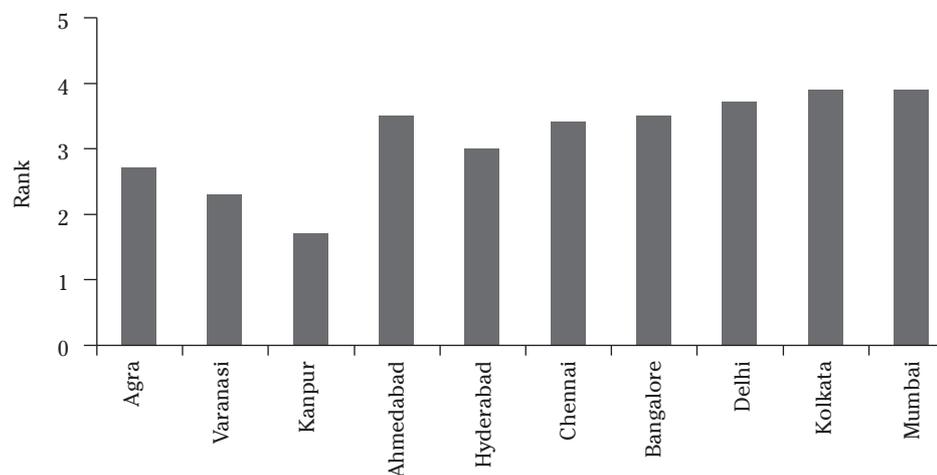
Note: Higher index value is better
Source: Anon 2008, Study on traffic and transportation policies and strategies in urban areas in India, Ministry of Urban Development, Delhi, Wilbur Smith Associates

out a drive in the area. More than 35 illegal structures including shops, tin shed and other constructions were bulldozed and spaces near Cooper Ganj were freed up.

Kanpur needs a pedestrian policy that will make pedestrian plans mandatory for infrastructure funding and development. Construction of pedestrian infrastructure will require mandatory and appropriate design guidelines that are walker friendly. All public transport plans must be linked with a pedestrian plan for proper design integration. Communities should be involved in the decisions on the use of road

space. The city Master Plan must earmark and develop pedestrianised areas in the key commercial areas. The urban local bodies would need to conduct walkability audits of the city roads. It is also the time for the city to look comprehensively at a road users act that will protect the rights and responsibilities of the pedestrians and adopt zero tolerance policy for accidents. The city also need to integrate the needs of the hawkers and vendors in the street design.

Need energy policy for the transport sector: Growing number of vehicles can also undermine the national and state energy security. Transport sector is expected to be one of the major driver of the energy demand in the country in the future. However, it is the responsibility of the Central government to set fuel economy standards for vehicles to enable introduction of the fuel efficient vehicles in the country. Unfortunately, India has not adopted those standards yet.

While the state and the city governments should intensify the bottom up pressure for those standards they should also adopt supportive policies to encourage fuel efficient vehicles in cities. This can include lowering taxes effectively on fuel efficient vehicles, small vehicles, electric vehicles etc. Currently, the central taxes on small cars are lower than the bigger vehicles. In fact, in Kanpur the Uttar Pradesh government has revised its taxes which is now imposed based on the weight of the vehicle. Heavier the vehicle higher the tax, so for cars with unladen weight up to 1000 kg the one time tax is 5 per cent of the cost of vehicle, the next slab of 1000 to 5000 kg the rate is 6 per cent and above this it is 7 per cent of the cost of the vehicle. Motorcycles are required to pay one time tax which is 5 per cent cost of the vehicle. The vehicles with solar and battery power will be exempted from these taxes.

This policy can be further refined and linked more directly with the energy efficiency of the vehicles and modes for more effective impact. The city must also track energy savings from the modal shift to public transport, para transit and non-motorised transport.

Kanpur needs energy policy for the transport sector. The city must track energy savings from modal shift to public transport, para transit, cycling and walking. It must also incentivise energy efficient vehicles.

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11. POLICY OPPORTUNITIES FOR CHANGE

Public policy so far has not been strong enough to stimulate investments in public transport and non-motorised transport. Government budgets and financial plans have so far largely focused on road infrastructure for motorised vehicles, mainly personal vehicles.

Slowly policy opportunities are emerging to influence the new investments. State government programmes linked with the clean air action plan and transportation plan – and also those mandated by the Supreme Court – are channelising investments into the city. In addition to this the second stimulus package for funding of buses and urban transport systems under the Jawaharlal Nehru Urban Renewable Mission (JNNURM) has opened up new opportunities in cities. JNNURM requires certain reforms to be undertaken by states and cities in the area of institutional and financial framework of the urban transport. During the Mission period, JNNURM envisages that the process of planning and delivery of urban infrastructure development and management and services will converge at the urban local bodies with associated reforms in the relevant sectors.

The JNNURM projects in kanpur were initiated in 2005. The Regional Center for Urban and Environmental Studies, Lucknow has coordinated the preparation of City Development Plan for guiding the JNNURM and the Mission funding in the city. According to officials Rs 1,200 crore has been earmarked for five projects to overhaul urban landscape of the city. Currently, work is underway in the areas of water supply, sewage and solid waste management. (See Table 2: *Funding plan finalized in 2006).*
During the first phase of the programme the transport related investments largely happened in the area of road widening and construction of new roads.

However, in 2009 in response to the recession a one time bus funding scheme was announced by the Union Ministry of Urban Development that is tied to conditional reforms specifically in the transport sector. To be able to access this fund the city governments will have to give commitments to initiate institutional reforms for public transport management and implementation, create dedicated funds from revenues from variety of sources including higher taxes on personal vehicles and diesel cars, implement parking policy as a car restraint measure among others. If this scheme is leveraged effectively by the state governments this can transform the transport sector in Indian cities quite substantially. This in fact sets the agenda as follow:

● To devise a strategy for bus ownership and management in the city, based on current best practices and feasible options;
● To understand the costs associated with bus management and options for

Public policy opportunities are now emerging in cities to transform the transportation regime. Cities need to build capacity to guide and implement the reforms.

Table 2: Funding plan finalized in 2006	
Name of plan	**Amount in lakh Rs**
Solid waste management project	4849.0
Beautification of ghats	1152.0
Development of bus stands	1400.0
Road widening and drinking water supply	14482.0
Heritage area development	1432.0
Construction of roads in the Kanpur city	73836.0

Source: Notice of Chief Secretary, UP Govt to all local bodies, dated 20 December 2006

financing and management, including fiscal reforms;

- To examine the possibility of dedicated and or demarcated bus lanes in the city;
- To understand the availability and costs of urban buses in the country, so that decisions can be facilitated;
- To devise an advertisement policy;
- To devise a parking policy;
- To devise a funding mechanism for public transport.

In its current stage of evolution the JNNURM now demands all cities to come up with a mobility plan. Kanpur is in the process of developing that plan. This will more specifically identify the transportation priorities and the related reform agenda in the city. Kanpur Nagar Nigam and Kanpur Development Authority had originally proposed to develop *Urban Mobility Plan of Kanpur* with IIT – Kanpur. But subsequently, Urban Mass Transport Company (UMTC) was brought within the fray. The Mobility Plan will involve origin-destination surveys, zone-wise planning, identify the city's growth areas for transport demand and so on. People's involvement is crucial for popular acceptance. Clearly, this is the right time for a public debate. State government funding has also begun and soon the city is expected to have an urban mobility plan. But cities will have to build capacity to guide and drive the preparation of the City Mobiliy Plan and also provide the policy and legal back up to this plan to have an effective impact.

This presents an opportunity for public participation in shaping up the transportation priorities for the city.

Limitation of the bus led reform process: There are some lessons from the top down interventions to expand bus sector in cities and stimulate reforms. The uniform push to introduce and expand formal bus transport in all cities has raised doubts about its appropriateness in cities where informal para transit provide the sizeable public transport services. As mentioned before, in Kanpur for instance, formal bus transport has very small modal share – only 9 per cent and the share of paratransit is also also close to that at 7 percent when both walk and motorised transport is considered. Clearly, super imposing high cost formal bus transport without proper integration with the existing modes can destroy the small systems that are more sustainable, affordabble appropriate. Their erosion can make people more dependent on personal vehicles even for short distances. This must be addressed immediately and plans and funding should be put in place to modernise the para transit as well as integrate them with the formal systems.

Public transport planning will have to take cognziance of the unique strength of cities and build on that. This policy signal is important now when informal para transit – both motorised and non-motorised are falling victim to policy disdain and car centric planning.

Kanpur is in the process of developing an urban mobility plan.

12. SETTING THE AGENDA FOR KANPUR

It is time to set new terms of action in kanpur as well as draw lessons for other smaller cities grappling with the challenges of motorisation.

City action needs enforceable targets: Though Kanpur like other Indian cities have taken the steps towards implementing clean air action plan they are not guided by binding and monitorable targets for clean air and sustainable mobility. Clean air standards are not legally enforced. Target for modal shifts, quality indicators for public and non-motorised transport, and targets for reducing energy consumption in the transport sector are not set and tracked through well defined monitoring systems. Illustratively, the PM10 levels would need to be cut by at least 3.5 times from the current levels to be able to neet the standards. The city needs periodic health impact assessment to drive clean air regulations.

Similarly, Kanpur needs to set target to protect its current modal share and improve the share of all public passenger modes (both formal and informal), cycling and walking. Already their current modal share is more than half. This will need collective improvement. Illustratively, there is precedence in Delhi where the Delhi Master Plan has proposed attaining 80:20 modal shares by 2020. Similarly, Pune has indicated a similar target in its mobility plan. But city plans need clarity about the milestones and timeline of implementation and quality indicators that can help to achieve targets. Implementation of the plans should be monitored against these targets to discipline enforcement, check laxity of action and ensure accountability.

In fact, all cities covered under the JNNURM have been advised to benchmark their levels of services for various parameters specified by the Union ministry of urban development. This aims to generate information that will be useful in making urban transport sustainable. The mobility benchmark includes detailed indicators in the areas of public transport, pedestrian facilities, non-motorised transport, ITS facilities, travel speed on major corridors, road safety, parking facilities, pollution levels, landuse-transport integration and financial sustainability of public transport. Application of this benchmarking to set and meet targets is possible only if cities institute back up policies.

Enable monitoring of progress: The ultimate key to sustainability is effectiveness of implementation. But it is difficult to monitor progress without good data on indicators of change. Though the clean air and mobility policies have begun to take shape it is not possible to track the changes in mobility pattern and the consequent energy and health impacts in the city. This is mainly because many of the sustainability indicators are not part of the official tracking system. The current data recording system is extremely limited in scope. Cities may have limited air quality monitoring, and basic vehicle registration system and so forth. But a full range of indicators are missing mainly because mobility management is a very new area of governance. Regular official surveys and data recording are not carried out to holistically capture the indicators – for instance, details of vehicle and fuel types and sales, changes in trip length by modes, changes in modal share, usage of non-motorised transport, and many other service level benchmarks for mobility. This is needed to assess the impacts of interventions. The city should develop and adopt a unified data management protocol to reform the existing data keeping systems.

We checked out availability of information according to the Union government's service level benchmarking in Kanpur. We found that while a considerable part of this information is not properly generated, the little that exists is also spread across eight departments in Kanpur.

The city needs monitorable targets for clean air and sustainable mobility.

City should also have the capacity to develop strong baseline data on diseases and deaths. Improve the surveillance and registration of key acute and chronic diseases associated with air pollution for accurate quantification of potential health impacts of air pollution. Standardise methods for surveys. Indian surveillance system should develop capacities to capture a wide range of indicators. This will require strong coordination among the agencies to develop protocols to enable comprehensive and dynamic databases. Transparent access to these databases is also important.

Urban transport and air quality policy at state level: Target setting with clear milestones and timeline is possible in cities if the respective state governments develop enabling policy framework to achieve clean air targets and mobility planning. At present the national government has defined the framework for national air quality management and national urban transport policy to guide cities and set the terms for central funding. But cities can respond more effectively if they have a composite state level urban transport and air quality policy to support local action. This can enable and speed up institutional reforms for coordinated planning and implementation in cities. A state level policy can also have multiplier effect as other cities within the state can also benefit from such a composite policy and action will not remain limited to only those cities that are getting central support or are under court supervision.

Scale up clean air action

Speed up technology roadmap and in-use vehicle management: Clean air target will require aggressive improvement in emissions levels of the vehicle technology and fuel quality to cut emissions at source and reduce exposure to harmful emissions. Setting a stringent roadmap during the ealry stages of motorisation is critical to prevent adverse public health impacts. Kanpur has recently introduced Bharat Stage IV emissions standards and fuel quality with 50 ppm sulphur levels. As the technology roadmap is the responsibility of the Central Government it is important that the city demands early timeline for the introduction of post Bharat Stage IV technologies not only within the city but also within its effective zone of influence to avoid the risk of misfuelling.

A unique feature of the personal vehicle fleet in Kanpur is the domination of the motorised two-wheelers that are nearly 80 per cent of the fleet. Two-wheelers are one of the most fuel efficient vehicles in the motorised segment. But this advanage may get nullified if they remain more polluting than the cars. Even though India has made a big transition from conventional two-stroke engines to four stroke engines, and made substantial emissions gains, they would still require substantially more cleaner emissions targets. Cities will have to demand tighter standards for this segments as well as encourage transition to battery opereated two-wheeled vehicles with the requisite safeguards against battery disposal and power supply management.

If stringent emissions standards roadmap is linked with high taxes on old polluting vehicles, accelerated fleet renewal can provide more effective pollution benefits.

Also devise strategies for in-use vehicles. Though the city has implemented the upgraded pollution under control certificate and the norms, there are doubts about the effectiveness of the programme. Urgent steps are needed to assess the compliance levels and the authenticity of the tests in the decentralised testing centres. It is advisable to create large high volume test centres with adequate safeguards against fraudulent practices and upgraded test procedures to improve the overall in-use testing systems. There is already a proposal for such a centre in Kanpur. This may be taken up on a pilot basis.

Clean air target will need aggressive improvement in vehicle technology and in fuel quality to cut harmful emissions at source.

Strengthen the CNG programme: The CNG programme has been the first opportunity to leapfrog beyond the polluting diesel technologies and two-stroke engines in the city. The environment benefit of this programme has been further enhanced because of its link with a public transport augmentation plan — CNG buses and CNG autos. This has the potential to reduce highly toxic particulate pollution. A comparable Bharat Stage II diesel bus emits 46 times higher particulates than a CNG bus. Public health benefits of this is considerable given the fact that the WHO and other international regulatory and scientific agencies, consider diesel particulates to be carcinogens.

To further strengthen the CNG programme the city needs to remove the current glitches in refueling systems and increase CNG supply to meet the increasing demand, adopt a CNG pricing policy that will maintain an effective differential between CNG and diesel prices. Develop institutional capaity to certify and audit conversion agencites in the city, and periodically certify the CNG cylinders in the vehicles as is required by the Comptroller General of Explosives. Encourage dedicated CNG vehicle fleet. Develop a robust periodic and mandatory safety and emissions inspection for the on-road CNG vehicles, as Delhi has done. Also push for best technology choices to get the combined benefit of reducing both particulates and nitrogen oxides and improving fuel efficiency.

- **Challenge of CNG market development:** The Next challenge in Kanpur is to attain a scale for the CNG programme. So far, Kanpur has moved all its three-wheelers and a part of small commercial vehicles and buses to CNG. But the economics of setting up of CNG refueling network needs a critical mass of vehicles to ensure a viable scale of market. Cities like Kanpur face a special challenge of attaining a critical mass of vehicles.

Kanpur like other cities of India have so far followed the model of CNG business combined with supportive business in other sectors – industry, power plant and piped gas network for domestic uses -- to make the entire programme commercially viable.

Another important model has been to link the CNG programme with the bus transport augmentation plan. Kanpur is in the process of expanding its bus transport under the JNNURM programme. Both Kanpur and Lucknow, which have virtually no city bus services, have planned to build public transport systems based on CNG. This is expected to create captive demand for CNG.However, Kanpur experience has also shown that the bus deployment strategy will have to be planned carefully and will have to be well integrated with all local passenger modes.

Another potential expansion area for the CNG programme is the proposal to develop green highway connecting Kanpur with the surrounding towns that can create opportunities for the long distance buses and other commercial vehicles to move to CNG.

The scope of CNG conversion in the personal vehicle segment will remain limited as conversion of cars will be voluntary. Also in smaller cities bulk of personal vehicles are two-wheelers – as much as 80 percent in Kanpur. They are not yet the potential candidate for CNG.

Action on industrial and other pollution sources to meet air quality targets: Kanpur has already initated action on polluting industrial units. This will have to be scaled up and made more stringent. Kanpur as already relocated and closed down

The CNG programme is poised for next generation expansion. This needs robust emissions regulations, proper pricing policy, market development plans, and a good refuelling network.

many air polluting units. But the remaining units and especially the brick kilns in and around the town will require more stringent action. The city also needs more composite energy management to reduce dependence on diesel generator sets.

Scale up mobility management

Rework strategy for formal bus transport: kanpur is in the process of building its formal bus system and is augmenting bus numbers. As mentioned earlier, the policy on formal bus system will have to address a variety of issues. First of all it is important to carry out proper surveys and assessments to decide the critical bus numbers that the city needs.

Secondly, only buying buses will not help. It will require route planning and integration, fare policy and efficient management model and service delivery system. Kanpur will need new management framework for both state owned and privately owned buses so that Transport Corporations do not suffer from mismanagement and inefficiencies. Private bus service may require a proper business model and also cost sharing arrangement. The city needs to finalise its bus reorganization plan in terms of route planning, integration with other modes, fare policy, deployment strategy for high frequency and speed and a revenue model as soon as possible.

The capital investment and gap financing that the government is expected to bear can become expensive if there are no plans to mobilize revenue to offset the costs of improving bus transport. While financial performance of the bus system will have to improve by lowering cost of capital, consumables, fuels and staff cost, the city will also have to look at the additional revenue to support the cost of transport. While the new buses have begun to roll these plans are still not in place.

Thirdly, in a city like kanpur formal bus system will have to be integrated well with all passenger modes including para transit systems that cater to the bulk of the travel demand. Formal system must not destroy the para transit.

The misplaced policy on buses is evident in the wrong approach adopted towards it. Initially as a congestion reduction measure buses in Kanpur were taken out to the outer route of the city. Clearly, priority was being given to the cars and not public transport in transport planning. With advent of the JNNURM buses this is reversed. Buses have been brought back to the inner city but now autos and cycle rickshaws are being taken out to make way for the buses. Cars are not being touched. But subsequently, buses have been further withdrawn from the cities and taken to the periphery.

Integrate all passenger modes – include intermediate public transport:. It is often not understood in Kanpur that the bigger share of mobility needs is actually met by the informal intermediate transport system – three-wheelers and cycle rickshaws. The majority use the informal intermediate public transport system of autos, tempos and cycle rickshaws. The combined modal share of buses, autos, tempos, and cycle rickshaws, together cater to more than half of travel demand in the city. short distances make cycle riskshaws and autos very convenient and appropriate. Even a formal bus system cannot always cater to this need. It will be wrong to treat these intermediate transport vehicles as traffic nuisance and remove them to make way for more cars.

Upgradation and modernisation of para transit needs strong policy recognition and support. Cities like Delhi are discussing reorganisation and modernisation of this

Only buying buses will not help. This needs route planning and integration, fare policy, efficient management model and service delivery models.

informal sector. Efforts are being made to register and provide service badges and smart cards to the autos, connect autos with GPS, improve fitness and emissions testing of these vehicles, improve technology levels of these vehicles and so on. Similarly, High Court in Delhi has directed the city government to develop a cycle rickshaw policy. Kanpur should also focus on developing both its formal and informal public transport systems in an integrated way and not one at the cost of the other.

Reallocate roadspace: As road space is limited it needs to be apportioned equitably among road users with priority given to pedestrians, non-motrised vehicles, and public transport.

● **Develop pedestrian plan for the city:** Even today nearly 30 per cent of daily travel trips in Kanpur are walk trips. In fact, in most Indian cities people who commute by walking outnumber those who use their vehicles. High density, mixed land use, and narrow streets have made walking for work and recreation comfortable, feasible and popular in traditional Indian cities. The Wilbur Smith for the Union Ministry of Urban Development shows that most trips fall in 0 to 2 km range.[12] This is immensely walkable. Improvement in public transport ridership will also increase walking as all public transport trips that begin and end with walk trips. Therefore, the city has to plan the pedestrian infrastructure to cater to the present and future demand for walking. Also urban poor are too poor to even afford a bus ride for daily commuting. Over 60 per cent of the people in Kanpur live in low income neighbourhoods. It is important to integrate low income neighbourhoods with high density land-use pattern for more inclusive mobility management.

Pedestrian facilities in Kanpur are under tremendous pressure. According to the City Development Plan, majority of the roads and footpaths are encroached. The city needs to adopt a pedestrian policy that

  ● Mandates pedestrian plans and quality guidelines for infrastructure funding
  ● Reform of engineering and environmental guidelines for walkways
  ● Provides for pedestrianisation and segregation of road space by users
  ● Legal provisions forprotection of pedestrian space that prevents usurpation of pedestrian space for motorised traffic without proper justification
  ● Provides for walkability audits and pedestrian plans for multimodal integration
  ● Ensures zero tolerance for accidents
  ● Integrate the needs of the hawkers on the design of the streets

● **Implement bicycle plan for the city:** The city has a captive bicycle ridership. Enhancement of the non-motorised transport infrastructure (NMT) can induce increase in NMT ridership. Even rental bike system can be introduced in the city as bus feeders. The city needs infrastructure plan for bicycles.

Public transport will have to be incentivised for public good and environmental benefits.

Adopt tax measures for public transport: Public transport will have to be incentivised for public good and environmental benefits. This will require reduction in tax burden to reduce both capital and operational costs of buses, especially now when the city is developing formal system. But unfortunately, in most of our cities buses have to shoulder higher tax burden than cars. While private cars pay a miniscule amount as road tax, buses pay several times more. But cars carry disproportionately lower number of daily commuting trips in comparison to higher road space they occupy, and cause more pollution per passenger. While tax burden on buses should be lowered that on personal cars should be increased.

Kanpur however, has taken some progressive steps while rationalizing the taxes on transport in October 2009. Under the new tax regime, city buses have been completely exempted from the additional taxes that accounted for 70 percent of total state taxes. Also the new city buses will pay lesser tax compared to older buses. This might help to weed out older and unfit vehicles. However, more detailed fiscal plan is needed to reduce the capital costs and the cost of operation and also a bus fare policy that will keep this transport affordable.

Build funds for sustainable transport: kanpur should also look at ways to develop urban transport fund not only for formal systems but also for modernisation of the informal para transit and non-motorised systems. At present there is barely any official scheme to stimulate investment in public transport. National Urban Transport Policy has proposed that the state governments should encourage the levy of dedicated taxes to be credited to an urban transport fund to exclusively meet urban transport needs. Cities need to look at the variety of measures to generate funds such as higher taxes on personal cars that can also help to lower their usage and hence the congestion, parking revenue, advertisement revenue, road pricing strategies etc.

There are examples from other cities. Delhi has imposed an environment cess on diesel to create Air Ambience Fund to fund pollution control efforts in the city. Bangalore and Chennai have introduced higher taxes on older vehicles. Surat in Gujarat and Pimpri and Chinchwad in Maharashtra have already created a dedicated urban transport fund partly through budgetary allocation and the rest will come from parking revenue, property tax, etc. Kanpur can review these strategies to develop a fund for itself.

However, this will need careful planning in terms of identifyinng the revenue streams, preparing guidelines for tapping both conventional and non conventional sources and so on.

Demand management -- frame parking policy to reduce congestion: Even as Kanpur augments public transport services it would need strategies to restrain personal vehicle usage. The first generation restraint measures in Indian cities will be dominated by the parking strategy. In fact JNNURM reform agenda lists parking as a demand management tool. But there is very little public and policy understanding of the parking crisis in the city that devours scarce urban land, aggravates pollution, congestion and leads to social tension. The city governments is still focusing on creating more and more parking spaces and not considering ways to use parking policy to restrain usage of personal vehicles and encourage public transport. Currently, Kanpur authorities have planned 25 structured parking spaces and earmarked 15,000 sqm of road length for parking development by 2011.

The Wilbur Smith study shows that the problem of on-street parking is very high in smaller cities like Kanpur. Close to 50 per cent of road length in small cities such as Agra, Varanasi and Kanpur is used for parking whereas the in bigger cities of Delhi, Kolkata and Mumbai it is 14 per cent, 19 per cent and 16 per cent respectively. According to the City Development Plan of Kanpur parking supply and demand presents a very grim picture. The city government is now planning to build expensive multistoried car parks in prime areas such as Phool Bagh. But the parking policy must integrate the following principles to reduce demand for parking and also use parking to promote other sustainable modes of travel restrain private vehicle usage.

- **Parking pricing**: Appropriately priced parking can influence demand for parking

and commuter choice for alternatives. It is important to decontrol parking pricing so that charges can begin to refelct the capital cost, operational and maintenance cosost of a parking space. Eliminate free parking, introduce graded parking rates, avoid fixed annual payment, price parity between surface and multi-level parking etc. The parking charges must recover the actual cost of providing the parking . Free parking should be allowed only to non-motorised transport – cycles and cycle rickshaws. Parking rates should be higher for bigger cars and SUVs.

● **Implement flexible parking standards and conduct parking audits to assess the reduction in parking demand.**

● **Guidelines for parking for multi-modal integration.** Use parking for integrating public transport modes and also for pedestrianisation of city centres and commercial areas. People can park their personal vehicles and use public transport or walk. These parking lots can be well connected by feeders and cycle riskshaws. But parking design must accord priority to the cycles, and para transit over cars.

● **Parking restrictions**: If available parking spaces are limited in the targeted areas and priced high cars will be discouraged. Close particular streets or commercial areas for passenger cars (except deliveries, taxis and buses) and pedestrianise; Protect NMT lanes and footpaths and green areas from parking and impose stringent penalty for parking violations.

● **Parking strategy for residential and mixed land use areas:** Develop common, priced and public parking, link parking with car ownership, introduce purchase of monthly permits for on-street parking in residential areas etc. Such measures can be phased in.

● **Parking revenue** can be augmented through periodic lease agreements with the parking operators to tap the increased earnings from parking. Part of the revenue should be set aside for sustainable transportation modes.

Air quality and mobility management rests with cities. But there is no "one best way". Solutions will have to be customised for each city according to its imperatives and uniqueness.

Integrate land-use plan with transportation plan: Enable compact city planning to reduce travel distances, allow more efficient utlisation of transportation modes, improve access to jobs and other services and prevent sprawl. The densely built cities like Kanpur have an inherent advantage. They can build on this with proper planning.

Need city/state based transport energy policy: Transport sector is expected to be one of the major drivers of the energy demand in future. The city needs to encourage fuel efficient vehicles and also reduce vehicle miles travelled. While it is the responsibility of the Central government to set the fuel economy standards for vehicles to enable introduction of fuel efficient technologies, the state government can adopt supportive policies to encourage fuel efficient vehicles in the city. This can include effective lowering of taxes on fuel efficient vehicles, small vehicles, electric vehicles etc. Currently, the central taxes on small cars are lower than the bigger vehicles. In fact, in Kanpur the Uttar Pradesh government has revised its taxes which is now imposed based on the weight of the vehicle. Heavier the vehicle higher the tax, so for cars with unladen weight up to 1000 kg the one time tax is 5 per cent of the cost of vehicle, 6 per cent on the 1000 to 5000 kg slab and 7 per cent on the higher weight categories. Motorcycles pay 5 per cent of the cost of the vehicle as taxes. The vehicles with solar and battery power are being exempted from these taxes.

This policy can be further refined for more effective impact.

Build capacity: Reforms in the transport sector will require proper institutional mechansim for coordinated action and capacity building. There is already a lot of policy discussion related to institutional integration and creation of Unified Multimodal Transport Authority. These should be expedited. These reforms will have to be guided.
The state and the city governments must also build capacity to assess the impacts of the policy initiatives on the intended benefits – air quality and energy consumption – to guilde policy action. The city government must assess air quality improvement and fuel savings from modal shift to public transport and non-motorised transport.

Clearly, there is no 'one best way'. While the national framework will create opportunities for change, solutions will have to be customized for each city according to its imperatives and uniqueness. Strong public opinion, judicial and executive actions have helped to accelerate action in Kanpur. This now needs to gather momentum to make the city livable.

Voluntary agreement in Europe did not specify individual corporate targets for companies , and no mechanism set to guarantee for meeting targets

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