Framework For Clean Air Action Plan
Learning From Each Other

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Stakeholder Workshop on Air quality and transportation challenges in Nigeria: Agenda for Clean Air Action Plan

A joint initiative of Federal Ministry of Environment, The Federal Republic of Nigeria and Centre for Science and Environment, India
Why this conversation?

Our common and unique challenges – polluted air and public health

To learn from each other and find solutions together…..
Delhi – one of the most polluted cities in the world – serious public health impacts....
Air pollution makes headlines in Delhi

During the first week of November, Delhi went under a thick smog. The breeze nearly stopped, and the skies turned grey and calm. The smog, masks, scarves or handkerchiefs.

The resultant outcry in the smog-hating city was not new and that it happened once more this year insisting that this was nothing new and that it happened every winter.

The new twist came from a new study indicating that the air pollution was linked to the rapid rise in the city's population since October 2011, according to experts. New Delhi's air pollution has reached alarming levels. For proof, just look out of the window. The grey-white 'haze' that has been covering the city since October 22, is now a reality. The smog is real and it's here to stay.

Smog leaves Delhi gasping for breath

Smog delays Sheila Dikshit's flight to Puniab

Disadvantage Delhi: Smog here to stay
51,779 DEAD BY BREATHING

AIR POLLUTION TOLL RISES FROM 40,351 IN 1991-92

30% More Deaths  In 1995! In Some Indian Cities Deaths Have Doubled

The Government Is In Control.

So It Thinks.

A DELUSION!

Gas chambers!
Pollution is killing more people in Indian cities

<table>
<thead>
<tr>
<th>Year</th>
<th>Delhi</th>
<th>Mumbai</th>
<th>Kanpur</th>
<th>Chennai</th>
<th>Calcutta</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991-92</td>
<td>7,491</td>
<td>4,477</td>
<td>1,804</td>
<td>863</td>
<td>5,728</td>
</tr>
<tr>
<td>1995</td>
<td>9,868</td>
<td>7,023</td>
<td>3,038</td>
<td>1,291</td>
<td>10,647</td>
</tr>
</tbody>
</table>

More ill.
Rising pollution-related sicknesses and hospitalisation

<table>
<thead>
<tr>
<th>Year</th>
<th>Delhi</th>
<th>Mumbai</th>
<th>Kanpur</th>
<th>Chennai</th>
<th>Calcutta</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991-92</td>
<td>39.5 lakh</td>
<td>26.5 lakh</td>
<td>8.03 lakh</td>
<td>4.5 lakh</td>
<td>29.3 lakh</td>
</tr>
<tr>
<td>1995</td>
<td>60.0 lakh</td>
<td>40.0 lakh</td>
<td>15.4 lakh</td>
<td>8.8 lakh</td>
<td>54.5 lakh</td>
</tr>
</tbody>
</table>

More 1992 figures are of World Bank.
1995 figures are generated by CSE.

YOU LINE UP FOR A TAILPIPE TEST WHILE REAL CULPRITS GO SCOT-FREE

ONE MORE YEAR OF SLOW MURDER

Centre for Science and Environment (CSE) is a public interest organisation engaged in research, and lobbying for and communicating the urgency of sustainable development. CSE's campaign against air pollution began on November 1, 1996 with a public meeting, an exhibition and the release of a first-time exposé on smoggy secrets: Slow Murder: The deadly story of vehicular pollution. Since then, we have focussed on gathering information to better nail the culprits. We are networking with interested people and institutions to appraise everyone of air pollution's clear and present dangers.

For health's sake, demand your right to clean air!

JOIN OUR CAMPAIGN AGAINST AIR POLLUTION
BEFORE YOU BECOME ANOTHER VICTIM

DONATE TO ENABLE RESEARCH AND RAISE A FUSS

CSE
CENTRE FOR SCIENCE AND ENVIRONMENT
41, Tughlakabad Institutional Area, New Delhi 110 062
Tel: 980 3394, 980 1110, 980 1124, 980 6399 Fax: 980 5679
Email: anumita@cse@delhiernet.in

YES, I would like to ( ) join the campaign
( ) Donate money for the Campaign Against Air Pollution.
My contribution, Rs. ___ in a Cheque (No. ___)
( ) A Money Order or a Demand Draft is enclosed.
All donations are exempted from Income Tax under Income Tax Act 1986.
Please mention the same.

Name:________________________
Occupation:_________________
Address:_____________________
Telephone:___________________
Fax:________________________
Email:_______________________
Media reportage on air pollution in cities of Africa...

Air, air, everywhere, nor a place to breathe in Lagos! By Ogaga Ifowodo

Aerial measurements shed light on pollution from Lagos

Air pollution in cities like Lagos, London, Beijing, Delhi, and Nairobi is a significant issue. These cities are a part of the African megacity of Lagos and the so-called 'Oceans of Smog' have raised concerns about air quality. This has led to increased advocacy for policies to promote the use of cleaner energy and improve the environment. In recent years, news reports and scientific papers have highlighted the problem, with calls for solutions to improve air pollution in urban areas.

Let Nema explain cause of air pollution in city

London, L.A., Beijing, Delhi, Nairobi... Is Smog an Inevitable Urban Growing Pain?

These cities are facing similar challenges due to urban development and industrialization which contribute to increased pollutants in the air. Efforts are being made to reduce pollution by implementing cleaner technologies and policies. However, achieving sustainable solutions to combat air pollution is a complex and continuous process.
Wednesday, October 12, 2005: The first-ever smog in Lagos Nigeria, which lasted for more than six hours.

This led LAMATA to facilitate the Lagos Air (vehicular emission) Quality Monitoring Study (LAQMS) in February 2007.
Towards air quality management……

Most of our cities do not know enough about their air quality

Air quality monitoring grid is still limited and evolving in our regions……
## Some key cities with air quality monitoring stations

<table>
<thead>
<tr>
<th>City</th>
<th>Monitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delhi</td>
<td>11 (all online monitors generating real time data)</td>
</tr>
<tr>
<td>Chennai</td>
<td>11 (5 manual and 6 online)</td>
</tr>
<tr>
<td>Kolkata</td>
<td>10</td>
</tr>
<tr>
<td>Hyderabad</td>
<td>9</td>
</tr>
<tr>
<td>Bangalore</td>
<td>9</td>
</tr>
<tr>
<td>Kanpur</td>
<td>9</td>
</tr>
<tr>
<td>Visakhapatnam</td>
<td>8</td>
</tr>
</tbody>
</table>

India monitors 247 cities….There are 5000 cities and towns

Only 16 cities have online monitoring facilities…. 

Air quality monitoring grid in India
The WHO database on outdoor air pollution of 2013 has listed African countries that monitor particulates:

- Nigeria, Algeria, Botswana, Ghana, Madagascar, Mauritius, Senegal, South Africa, and Tanzania, Ethiopia and Zimbabwe.

- Egypt, Madagascar, Tunisia, and Morocco have published reports of PM monitoring data.

- Nigeria has established urban air quality monitoring systems.
2013 WHO database: Nigeria is one of the 9 countries in Africa monitoring particulates. Other include Algeria, Botswana, Ghana, Madagascar, Mauritius, Senegal, South Africa, and Tanzania.

Air quality monitoring in Nigeria

• Air quality monitoring in Abuja by 3 agencies.
  • FME’s automatic monitoring station at International conference Centre monitors CO and SO2 levels.
  • Automatic station of the Metrological agency monitors SO2, NOx, CO and PM10 levels.
  • NESREA has a mobile air quality monitoring. Power supply is a major constraint.
India: In grip of killer particles and multi pollutant crisis

• Close to half of urban population breath the air which exceeds the standard of PM10.

• NO2 is rising steadily

• Ozone levels are rising

• Unacceptable toxins and heavy metals

India: Between 1975 and 1995 when GDP doubled, vehicular pollution increased 8 times and industrial pollution 4 times. Need preventive action

Source: CSE computed based on data from Central Pollution Control Board, India
Smaller cities more polluted in India today

Top 20 PM10 pollution hotspots

Source: CSE computed based on data from Central Pollution Control Board, India
Annual average PM levels of select African cities are well above WHO guideline.

Reported pollution levels in African cities are lower than some of the worst hit cities in India.

They are still much higher than the stringent WHO guidelines.

In Delhi levels are 10 times higher.
High PM10 levels in Nigerian cities

Source: Federal Ministry of Environment Nigeria
Particulate matter and carbon monoxide: Concerns in Abuja

June to July 2013

November to December 2013

Source: Federal Ministry of Environment Nigeria
Other air pollutants: An emerging challenge

Source: Federal Ministry of Environment Nigeria
Towards air quality management……

… setting standards, assessment of pollution sources, exposure mapping
National ambient standards to set air quality goals for public health protection

India’s National Ambient Air Quality Standards in relation to other standards

Table 1: A comparison of standards (in microgramme per cubic metre)

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>WHO air quality guidelines</th>
<th>India NAAQS</th>
<th>USEPA NAAQS</th>
<th>USEPA NAAQS proposal</th>
<th>EU standards under consideration</th>
<th>Best value in this table</th>
</tr>
</thead>
<tbody>
<tr>
<td>PM10 annual</td>
<td>20</td>
<td>60</td>
<td>150</td>
<td>65-85</td>
<td>40</td>
<td>20 (WHO)</td>
</tr>
<tr>
<td>PM daily</td>
<td>50</td>
<td>100</td>
<td>12</td>
<td>11-13</td>
<td>50</td>
<td>50 (WHO)</td>
</tr>
<tr>
<td>PM2.5 annual</td>
<td>10</td>
<td>40</td>
<td>12</td>
<td>11-13</td>
<td>25</td>
<td>10 (WHO)</td>
</tr>
<tr>
<td>PM2.5 daily</td>
<td>25</td>
<td>60</td>
<td>35</td>
<td>30-35</td>
<td>NA</td>
<td>25 (WHO)</td>
</tr>
<tr>
<td>Ozone 8 hour</td>
<td>100</td>
<td>100</td>
<td>150*</td>
<td>120-140*</td>
<td>100$</td>
<td>100 (WHO &amp; India)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>150* (0.075 ppm)</td>
<td>120-140* (0.060-0.070 ppm)</td>
<td>100$</td>
<td></td>
</tr>
<tr>
<td>Ozone 1 hour</td>
<td>180</td>
<td>180</td>
<td>-</td>
<td>-</td>
<td>180 (WHO &amp; India)</td>
<td></td>
</tr>
<tr>
<td>NO₂ Annual</td>
<td>40</td>
<td>40</td>
<td>100* (53ppb)</td>
<td>-</td>
<td>-</td>
<td>40 (WHO &amp; India)</td>
</tr>
<tr>
<td>NO₂ daily</td>
<td>-</td>
<td>80</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>80 (India)</td>
</tr>
<tr>
<td>NO₂ 1 hour</td>
<td>200</td>
<td>-</td>
<td>188* (100ppb)</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>SO₂ annual</td>
<td>-</td>
<td>50</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>50 (India)</td>
</tr>
<tr>
<td>SO₂ daily</td>
<td>20</td>
<td>80</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>20 (WHO)</td>
</tr>
<tr>
<td>SO₂ 10 minutes</td>
<td>500</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SO₂ 1 hour</td>
<td>-</td>
<td>-</td>
<td>197* (75ppb)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO 8 hour</td>
<td>-</td>
<td>2,000</td>
<td>10,350* (9ppm)</td>
<td>-</td>
<td>-</td>
<td>2,000 (India)</td>
</tr>
<tr>
<td>CO 1 hour</td>
<td>-</td>
<td>4,000</td>
<td>40,250* (35ppm)</td>
<td>-</td>
<td>-</td>
<td>4,000 (India)</td>
</tr>
</tbody>
</table>

Note: $ its target value not limit value; * USEPA standards are converted in microgramme per cubic metre; @ http://www.epa.gov/air/criteria.html;
Sources: (1) India National Ambient Air Quality Standards (NAAQS), http://kpcb.nic.in/National_Ambient_Air_Quality_Standards.php, viewed on July 7, 2013
(2) Bob O Keefe 2012, Air Quality Standards Under Active Review Worldwide, Health Effects Institute, HEI Annual Conference, Chicago
(3)USEPA National Ambient Air Quality Standards (NAAQS), http://www.epa.gov/air/criteria.html, viewed on July 7, 2013
In 1991 Nigeria’s ambient air quality standards were adopted. These include TSPM, SO2, CO and NOx among others.

According to the FME, these need revision.

<table>
<thead>
<tr>
<th>Air pollutants</th>
<th>Emission limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particulates</td>
<td>250 microgramme per cubic metre</td>
</tr>
<tr>
<td>SO2</td>
<td>0.1 ppm</td>
</tr>
<tr>
<td>Non-methane hydrocarbon</td>
<td>160 microgramme per cubic metre</td>
</tr>
<tr>
<td>CO</td>
<td>11.4 microgramme per cubic metre or 10 ppm</td>
</tr>
<tr>
<td>Nox</td>
<td>0.04-0.06 ppm</td>
</tr>
<tr>
<td>Photochemical oxidant</td>
<td>0.06 ppm</td>
</tr>
</tbody>
</table>
Lessons from other countries….Need stringent legal framework for compliance

USA: Clean Air Act in the USA:
-- Requires national ambient air quality standards and periodic review.
-- States have to submit a State Implementation Plan showing how they will meet the standards and by when.
-- The states must lay out a specific plan on how and when they will meet standard for specific pollutant.
-- If the State fail they can be subject to sanctions—withholding federal funds for example—or have the EPA produce a FIP Federal Implementation Plan.
-- Have a separate Toxic Air Contaminant program. Controlled directly from the source.

Europe:
-- European Commission has set health-based target for air quality.
-- The Thematic Strategy on Air Pollution aims by 2020 to cut the annual number of premature deaths from air pollution by almost 40 per cent from the 2000 level.
-- Set a cap on concentration on most polluted areas.
-- Europe also sets standards for each toxic air pollutant individually, based on its particular health risks.
Need public information system in air quality to make it relevant to public health

Delhi relays real time data

-- User friendly
-- Station wise Continuous realtime hourly update
-- 24 hour average data
-- Back data available
-- There are maintenance issues
Implement air quality index, health advisory and pollution emergency measures

National Air Quality Index in India
Breakpoints for AQI Scale 0-500 (units: μg/m3 unless mentioned otherwise)

<table>
<thead>
<tr>
<th>AQI Category</th>
<th>PM$_{10}$ 24-hr</th>
<th>PM$_{2.5}$ 24-hr</th>
<th>NO$_2$ 24-hr</th>
<th>O$_3$ 8-hr</th>
<th>CO 8-hr (mg/m$^3$)</th>
<th>SO$_2$ 24-hr</th>
<th>NH$_3$ 24-hr</th>
<th>Pb 24-hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good (0-50)</td>
<td>0-50</td>
<td>0-30</td>
<td>0-40</td>
<td>0-50</td>
<td>0-1.0</td>
<td>0-40</td>
<td>0-200</td>
<td>0-0.5</td>
</tr>
<tr>
<td>Satisfactory (51-100)</td>
<td>51-100</td>
<td>31-60</td>
<td>41-80</td>
<td>51-100</td>
<td>1.1-2.0</td>
<td>41-80</td>
<td>201-400</td>
<td>0.5-1.0</td>
</tr>
<tr>
<td>Moderately polluted (101-200)</td>
<td>101-250</td>
<td>61-90</td>
<td>81-180</td>
<td>101-168</td>
<td>2.1-10</td>
<td>81-380</td>
<td>401-800</td>
<td>1.1-2.0</td>
</tr>
<tr>
<td>Poor (201-300)</td>
<td>251-350</td>
<td>91-120</td>
<td>181-280</td>
<td>169-208</td>
<td>10-17</td>
<td>381-800</td>
<td>801-1200</td>
<td>2.1-3.0</td>
</tr>
<tr>
<td>Very poor (301-400)</td>
<td>351-430</td>
<td>121-250</td>
<td>281-400</td>
<td>209-748*</td>
<td>17-34</td>
<td>801-1600</td>
<td>1200-1800</td>
<td>3.1-3.5</td>
</tr>
<tr>
<td>Severe (401-500)</td>
<td>430 +</td>
<td>250+</td>
<td>400+</td>
<td>748+*</td>
<td>34+</td>
<td>1600+</td>
<td>1800+</td>
<td>3.5+</td>
</tr>
</tbody>
</table>
# Health advisory to people in Indian cities

<table>
<thead>
<tr>
<th>AQI</th>
<th>Associated Health Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good (0–50)</td>
<td>Minimal Impact</td>
</tr>
<tr>
<td>Satisfactory (51–100)</td>
<td>May cause minor breathing discomfort to sensitive people</td>
</tr>
<tr>
<td>Moderately polluted (101–200)</td>
<td>May cause breathing discomfort to the people with lung disease such as asthma and discomfort to people with heart disease, children and older adults</td>
</tr>
<tr>
<td>Poor (201–300)</td>
<td>May cause breathing discomfort to people on prolonged exposure and discomfort to people with heart disease</td>
</tr>
<tr>
<td>Very Poor (301–400)</td>
<td>May cause respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart diseases</td>
</tr>
<tr>
<td>Severe (401–500)</td>
<td>May cause respiratory effects even on healthy people and serious health impacts on people with lung/heart diseases. The health impacts may be experienced even during light physical activity</td>
</tr>
</tbody>
</table>
Air quality Index in Senegal

The Senegalese Ministry of Environment and Sanitation has set up a Centre for Management of Air Quality. There are 5 fixed monitoring stations in Dakar. Also a portable air quality monitoring van. The air quality measurements are characterised and communicated to the public through a simple air quality index.

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Averaging time</th>
<th>Maximum Limit Value</th>
<th>WHO</th>
<th>Senegal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulphur Dioxide (SO₂)</td>
<td>1 hour</td>
<td>500 (10 min)</td>
<td>125</td>
<td>125</td>
</tr>
<tr>
<td></td>
<td>24 hours</td>
<td>125</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>Year</td>
<td>50</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>Nitrogen Dioxide (NO₂)</td>
<td>1 hour</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td></td>
<td>Year</td>
<td>40-50</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Ozone (O₃)</td>
<td>1 hour</td>
<td>150-200</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td></td>
<td>8 hours</td>
<td>120</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>Carbon Monoxide (CO)</td>
<td>1 hour</td>
<td>30 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8 hours</td>
<td>10 000</td>
<td></td>
<td>30 000 (24h)</td>
</tr>
<tr>
<td>Particles &lt;10 µm (PM10)</td>
<td>24 hours</td>
<td>50 *</td>
<td></td>
<td>260</td>
</tr>
<tr>
<td></td>
<td>Year</td>
<td>20 *</td>
<td></td>
<td>80</td>
</tr>
<tr>
<td>Lead (Pb)</td>
<td>Year</td>
<td>0.5-1.0</td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

Air Quality Index (AQI) values...

<table>
<thead>
<tr>
<th>Levels of Health Concern</th>
<th>Colors</th>
</tr>
</thead>
<tbody>
<tr>
<td>When the AQI is in this range...</td>
<td>... air quality conditions are:</td>
</tr>
<tr>
<td>0 – 50</td>
<td>Good</td>
</tr>
<tr>
<td>51 - 100</td>
<td>Moderate</td>
</tr>
<tr>
<td>101 - 200</td>
<td>Unhealthy</td>
</tr>
<tr>
<td>&gt; 200</td>
<td>Very Unhealthy</td>
</tr>
</tbody>
</table>
Need air quality monitoring plan

• Design and implement air quality monitoring grid to generate data

• Adopt supportive low cost monitoring strategy to build awareness and to do exposure mapping. UNEP advisory on low cost monitoring

• Public information system on daily air quality

• Adopt health advisory

• Our cities need to bridge the gap in data availability to citizens and also assess personal exposure.

• Invest in data generation to inform policy action on health protection.

• But do not wait to take action. There is enough evidences out there…
Integrate public health criteria in air quality and city development policies
Global Burden of Diseases 2010: House hold air pollution second largest killer in India

- About 1.04 million direct premature deaths from indoor air pollution annually in 2010
- 31.4 million disability adjusted life years—measure of years lost due to ill-health, disability
Global health Burden: Air pollution and road injury

Rate of healthy years lost to injuries and air pollution from motorized road transport 2010

In India total number of road accident deaths is equivalent to wiping out at least 40% of Maldives population every year

Source: Global Burden of Diseases 2010 Study, Leading causes of death worldwide, associated DALYs, and burden attributable to motorized road transport, 2010
Mounting global health evidences

Scale of global studies provide clinching evidences……

Eg. the Arden Pope study (Journal of American Medical Association 2002) based on American Cancer Society data ….16 years, about 500,000 people in 116 metropolitan areas to arrive at irrefutable findings.

………. a mere increase of 10 microgramme per cum of PM2.5 can increase the risk of lung cancer by 8 per cent, cardiopulmonary deaths by 6 per cent, all deaths by 4 percent.

These findings are equally valid for India …

Lungs are same everywhere……
Studies in India looking at a more diverse health end points….

Predictably respiratory health symptoms dominate….
Broadens to other health end points – cardiovascular, eye disorders, cellular changes, cancer, premature deaths….

Source: CSE
Diabetes: First large-scale population-based study links diabetes with air pollution. Increase in insulin resistance in lab test .... and an increase in markers of inflammation (which may contribute to insulin resistance) after particulate exposure.

Strong and consistent association between diabetes prevalence and PM2.5 concentrations. For every 10 \( \mu g/m^3 \) increase in PM2.5 exposure, there was a 1 per cent increase in diabetes prevalence. Counties with highest versus the lowest levels of PM2.5 pollution had a more than 20 per cent increase in diabetes, which remained after controlling for diabetes risk factors. (Diabetes Care 2011)

Heart: Acute effects of fine particulate air pollution on Cardiac Arrhythmia: PM2.5 exposure within approximately 60 min was associated with increased PVC counts in healthy individuals. (He F et al 2011, The APACR Study. Environ Health Perspect)

Blood pressure: Traffic-related Air Pollution and Blood Pressure in Elderly Subjects With Coronary Artery Disease: Found positive associations of systolic and diastolic BP with air pollutants. The strongest associations were with organic carbon, multiday average exposures, ect. (Delfino, Ralph J.a et al 2010,, Epidemiology, May 2010)

Effect on foetus: Studies have shown damaging impact of PAH on even fetus
Health of children in Delhi seriously compromised …..

2012 epidemiological study on children in Delhi (CPCB and Chittaranjan National Cancer Institute of Kolkata):
-- Covered 11,628 school-going children from 36 schools.

-- Every third child has reduced lung function. Sputum of Delhi’s children contains four times more iron-laden macrophages than those from cleaner environs, indicating pulmonary hemorrhage.

-- The levels of these biomarkers in children have been found to be higher in areas with high PM10 levels.
Alveolar macrophage - biomarker of air pollution

Exposed group; Kolkata taxi driver
Increase in AM number

Control area: Sundarbans

Larger AM – particle laden
Cities in African region: Health cost of air pollution

The UN Economic Commission of Africa has estimated that the cost of air pollution in a number of African cities can be as high as 2.7 per cent of GDP.

In Africa about 176,000 deaths premature deaths due to air pollution. The WHO assessment of pre-mature deaths in Africa is below world average. But data is also a barrier

Data for Nigeria in the newly released Little Green Data Book 2015 indicates that 94 per cent of the population is exposed to PM2.5 levels that exceed WHO guidelines and air pollution damage costs about 1 percent of Gross National Income.

A study by University of Nairobi: The economic loss per year in Kenya of vehicle emissions and associated air pollution is 115 million KSh from related illnesses and deaths.
Africa: One of the highest death rate from non-communicable diseases

- The African region is also reporting one of the highest death rates from non-communicable disease. Air pollution can exacerbate this
- In Sub-Saharan Africa NCDs are projected to surpass infectious diseases by 2030
- NCDs are estimated to account for 24 per cent of all deaths in Nigeria
- Cancer risk is increasing in all regions

Age-standardized Mortality Rates by Cause, WHO Regions, 2008
Jigsaw of traffic pollution and health evidences from Nigeria

- Study by Delta State University on ambient particulate pollution and its possible health implications in Nigerian cities (2001-2006): Significant prevalence of cough, catarrh, eye infection, asthma, chronic bronchitis etc.

- A descriptive cross-sectional study of road traffic workers and university students in Lagos: Compared with the students, the traffic workers had higher forced expiratory volume in one second and forced vital capacity.
  - Traffic policemen had significantly higher levels of exhaled CO than the students.
  - Health of people who spend long hours along roadsides are at risk.

- Study assessed air quality along busy roads in Kano metropolis in December 2009 to September 2010: Traffic emission within Kano metropolis is not within the safe limits; transport-related pollution in Kano metropolis is hazardous to health.

- Uyo metropolis study, South-South Nigeria: Exposure to ambient air pollution by occupation and transportation mode was associated with high incidence of respiratory symptoms. Those traveling longer and more daily were significantly associated with higher odds for respiratory function impairment.
Addis Ababa – High impact of vehicular pollution

- A specific medical study of patients and their exposure to the pollution level in Addis Ababa. Out of the top 20 leading causes of out patient visit by region in all health centers and hospitals, the occurrence of acute respiratory infections was of prime concern. This may be largely attributed to the noxious emissions of the vehicle transportation. Data shows that cases of acute respiratory infection were about 148,000 in 2006-2007, which reached up to 207,000 in 2007-2008.

- In a study of adults and children in an urban community in Jimma, Ethiopia, it was found that among 3,592 individuals living within 150 m of a road, the risk of wheeze increased significantly in linear relation to proximity to the road. This indicated that living in close proximity to road vehicle traffic is associated with an increased risk of wheeze.

Ghana: Acute respiratory illness is among the top 10 causes of out patient hospital visit. The Africa is also reporting one of the highest death rates form non-communicable disease. Air pollution can exacerbated this.
Be warned: Most health effects occur at much lower levels than reported in our cities

Integrated Exposure-Response function for Ischemic Heart Disease

HEI Global Burden of disease, 2013
India and Africa’s vulnerability

• The Asiawide review of existing studies show that the estimated health effects are similar to those found in the extensive studies in western countries.

• But the risk in Asia and Africa could be more serious. Science has yet to assess our unique risk factors

• High levels of particulates and pollution cocktail

• The problem of multiple pollutants

• Impact of poverty: Socio economic variables are not included in health studies to influence public policy. Poor nutrition and underlying diseases make them more vulnerable

• More younger population in our part of the world

Understand risk transition

• Double burden of disease. Modern or community risks increasing

• This has important implication for environmental monitoring strategies

Source: CSE
Action: Include health criteria in public policy

- There is enough global evidence on health impacts to act. We do not have to reinvent wheel.

- Local data helps to further refine the air pollution control strategies

- Exposure monitoring in micro environment is critical to assess public health risk

- Include health cost and benefit criteria in decision making process
Pollution control is a difficult challenge: Learn from Delhi............
First generation reforms in Delhi…..

Delhi has fought hard to get breathing space

On vehicles
- Introduced low sulphur fuels and petrol with 1 per cent benzene
- Mandated pre-mix petrol to two- and three-wheelers
- Moved from Euro I to Euro IV over the last decade
- Implemented largest ever CNG based public transport programme
- Capped the number of three-wheelers
- Phased out 15 year old commercial vehicles
- Strengthened vehicle inspection programme (PUC)
- Efforts made to divert transit traffic
- Set up independent fuel testing laboratories to check fuel adulteration

On industry
- Relocated polluting units
- Tighter controls on power plants. No new power plants.

Air quality monitoring
- Adopted new ambient air quality standards
- Expanded air quality monitoring and reporting

Other sources
- Emissions standards for generator sets
- Ban on open burning of biomass
First Generation action in African countries

• **Air quality monitoring and management:**
  – Eight countries in the region have operational routine air quality monitoring systems.
  – Several countries have operational routine monitoring systems: Botswana, Ethiopia, Ghana, Madagascar, South Africa, Tanzania, Zambia and Zimbabwe.
  – Air quality management developed in South Africa, advancing in Ghana; at an intermediate stage in Botswana, Madagascar, Zambia and Zimbabwe etc.

• **Emissions and fuel quality standards:**
  – Sixteen countries have set fuel specifications for gasoline and 14 for diesel; 50 ppm sulphur fuels in east Africa and South Africa;
  – Several countries have sulphur content between 2,000 and 5,000 ppm;
  – Five countries have promulgated emission standards for vehicles, and only eight have set air quality standards (another two have proposed them);
  – The phase-out of lead has now been essentially completed across the region – except Algeria.
First Generation action in Nigeria

- Ban on use and importation of two-stroke engines
- Use of four-stroke engines as alternatives (fuel-efficient; less pollution; more durable).
- Vehicles with no emission reduction technology are banned
- Cleaner fuels to be introduced
- Mass transit system planned
- Establishment of emission testing centres
- New models of vehicle shall comply with the emission standards of pollutants as prescribed in the developed Regulations.
Lesson from Delhi
Lost gains. After a short respite pollution curve turns upward

Particulate pollution decline and rise again due to rapid increase in vehicle numbers

NO2 levels rising steadily

Significant reduction in pollution initially; Saved more than 3600 premature deaths a year. But this gain is lost.
Vehicles are a special problem…
It is more important to understand integrated exposure

- There are many pollution sources in cities – vehicles, industry, power plants, open burning, cook stoves, road dust, construction activities.
- All need stringent measures
- Those close to our breathing zone need priority measures
Vehicles need special attention
Motorisation in India ..... 

Need stringent and preventive action and decision here to influence the future stock -- several times higher than the legacy stock

Source: CSE
Motorisation in Nigeria

• The country has 12.5 million registered vehicles

• In 2012, 20 vehicles per 1000 people. Low but expected to increase rapidly due to economic growth and introduction of low cost private cars in the local market.

• The average number of cars per middle-class household is 0.8 (around one third of middle-class Nigerians have a car that is less than five years old); 5% of homes have two cars.

• 4000,000 vehicles get added every year

Lagos – vehicles contribute about 43% of PM2.5 and in Abuja – 87%

Vehicle numbers in cities of Africa are comparatively less than Indian metro cities... but poised for rapid growth...
Ambient air quality vs Exposure

Total air quality approach focuses on the relative contribution of different pollution sources to the ambient pollution.

More important to understand the relative health risk of various sources in cities – Exposure -- emission-to-intake relationship for a specific source as the fraction of emissions inhaled by an exposed population.

Pollution concentration in our breathe is 3-4 times higher than the ambient air concentration.

Vehicular emissions contribute to significant human exposure. In densely-populated cities more than 50 – 60% of the population lives or works near roadside where levels are much higher.

Chennai
PM$_{2.5}$ emission apportionment

PM$_{2.5}$ exposure apportionment

Source: S Guttikunda – SIM Air
CSE assessment of exposure to pollution while traveling on roads

Average exposure to PM2.5 ranged between 192 to 642 micrgramme per cum. Peaks as high as 457 to 1170. The average ambient level ranged between 191 to 277.

Source: Based on CSE exposure monitoring and DPCC data for ambient levels
In Kolkata and Delhi, the people’s exposure to vehicle exhaust is 3 to 4 times higher than the world average. Exposure (iF) is the population-weighted intake fraction, or the grams of vehicle pollution inhaled per grams of vehicle pollution emitted.

Action plan for vehicular pollution……

Vehicle technology and fuel quality roadmap……

Quick harmonization across regions to be enabled……
India -- Weak emissions standards .... 10-15 years behind Europe

Source: India, Europe compiled from Diesel Net, USA data provided by Axel Friedrich, Germany

Note: Europe has additionally introduced particle number standards at Euro V level
Future norms of US and Europe are tightening NOx norms for diesel more
Technology now exists for clean vehicles. Buy we do not have the roadmap
U.S. and Europe light-duty vehicle emission standards

Proposed official roadmap in India:
-- Euro IV nation-wide in 2017-18
-- Euro V: 2020-21 (with 10 ppm sulphur fuel)
-- Euro VI: 2024

Too little too late. Need to leapfrog to Euro VI by 2020:
Only at Euro VI level gap between petrol and diesel emissions begin to close gaps

Euro 5+ (2011) and 6 include $6 \times 10^{11}$/km particle number limit
Euro 6 PM mass limit uses revised PMP mass protocol
Emerging roadmap in Africa region

• **Leaded petrol phased out** – except Algeria – A success story

• **From January 2015,**
  – East Africa: Kenya, Uganda, Rwanda, Burundi and Tanzania moved to 50 ppm.
  – North Africa: Morocco, Tunisia and Mauritius have met 50 ppm or below target
  – Nigeria and South Africa: Euro II emissions standards
  – Ethiopia is planning its roadmap

• **South Africa**: to introduce 10 ppm by 2017. Six refineries to build capacity. Proposed EU 5 Vehicle emissions
• Nigeria imports 70% of its fuels to meet national demand
• 4 refineries cannot meet domestic demand; Possible privatisation of state refineries.
• To build a new private refinery in 2019. To meet new specifications.
• The Port Harcourt (Alesa Elema) refinery in Nigeria has capacity to produce less than 50 ppm sulphur.
• Change to cost USD 1.5 billion in capital cost to upgrade at fuel production to produce less than 50 ppm sulphur fuel

<table>
<thead>
<tr>
<th></th>
<th>Diesel production volume (barrels per day)</th>
<th>Diesel sulfur content (ppm)</th>
<th>Gasoline production volume (barrels per day)</th>
<th>Gasoline sulfur content (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ghana</td>
<td>11,157</td>
<td>1,777</td>
<td>10,483</td>
<td>127</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>30,070</td>
<td>737</td>
<td>15,054</td>
<td>42</td>
</tr>
<tr>
<td>Nigeria</td>
<td>88,084</td>
<td>1,635</td>
<td>83,933</td>
<td>111</td>
</tr>
<tr>
<td>Senegal</td>
<td>7,252</td>
<td>1,940</td>
<td>2,252</td>
<td>32</td>
</tr>
</tbody>
</table>

Source: International Council on Clean Transportation
### TABLE 1.4: Five-Year and Ten-Year Net Present Value of Refinery Investment Costs versus Health Benefits

<table>
<thead>
<tr>
<th></th>
<th>SSA Total</th>
<th>West Africa</th>
<th>East Africa</th>
<th>East Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-Year Refinery Investment Costs</td>
<td>$2.76 B</td>
<td>$0.47 B</td>
<td>$2.13 B</td>
<td>$0.59 B</td>
</tr>
<tr>
<td>Health Benefits over 5 Years¹</td>
<td>$25 B</td>
<td>$18 B</td>
<td>$5.3 B</td>
<td>$1.0 B</td>
</tr>
<tr>
<td>10-Year Refinery Investment Costs</td>
<td>$6.14 B</td>
<td>$4.69 B</td>
<td>$2.48 B</td>
<td>$0.99 B</td>
</tr>
<tr>
<td>Health Benefits over 10 Years¹</td>
<td>$43 B</td>
<td>$32 B</td>
<td>$9.0 B</td>
<td>$1.8 B</td>
</tr>
</tbody>
</table>

¹ Central value shown for elasticity=1.5; ranges for elasticities of 1.0 and 2.0 are shown in the report. For Scenario 2 (lower sulfur fuel and pollution control equipment) and alternate 2-stroke motorcycle emissions assumptions.

Results from 2009 study sponsored by The World Bank—

Source: International Council on Clean Transportation
India: Price distortion has increased share of diesel consumption in India significantly adding to the toxic risk.............

Nigeria: Price difference between gasoline and diesel has helped to lowe diesel use in cars in Nigeria. But its use in buses and trucks high. Need clean diesel and gasoline
Several countries have discouraged diesel cars.

- **In Brazil** diesel cars are not allowed because of the policy to keep taxes lower on diesel.

- **In China**, taxes do not differentiate between petrol and diesel fuel. Diesel cars are less than 1 per cent of all cars in China. Beijing does not allow diesel cars as a pollution control measure since 2003.

- **Sri Lanka** has imposed several times higher duties on diesel cars compared to petrol cars and have reduced diesel car sales. Moved to 10 ppm sulphur fuel after fuel prices reduced.

- **In Denmark, Germany** and several other European countries the tax on diesel cars including annual taxes is higher than the petrol cars.

- **In Paris** diesel car operations are not allowed to reduce the peak pollution levels during severe smog days.

- **France** to phase out diesel cars.
Diesel cars are legally allowed to emit more particulate and nitrogen oxide.

One diesel car emits as much NOx as 3 to 5 petrol cars. PM is several times higher.

Source: MP Walsh
In June this year the International Agency for Research on Cancer of the World Health organisation (WHO) has reclassified diesel exhaust as Group 1 list of carcinogen that have definite links to cancer.

Diesel exhaust is now in the same class of deadly carcinogens as asbestos, arsenic or tobacco among others.

The IARC-WHO has urged worldwide efforts to reduce exposure to diesel fumes as much as possible.
## How safe it is to have diesel particles in our air?

Other governments consider toxic Air contaminant Unit Risk Factors to prioritise action

<table>
<thead>
<tr>
<th>Toxic Air Contaminant</th>
<th>Unit Risk/Million People</th>
<th>Detection limit (ppb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetaldehyde</td>
<td>2.7</td>
<td>0.10</td>
</tr>
<tr>
<td>Benzene</td>
<td>29</td>
<td>0.05</td>
</tr>
<tr>
<td>1,3-Butadiene</td>
<td>170</td>
<td>0.04</td>
</tr>
<tr>
<td>Carbon Tetrachloride</td>
<td>42</td>
<td>0.02</td>
</tr>
<tr>
<td>Chromium, Hexavalent</td>
<td>150,000</td>
<td>0.06 (in nanogram)</td>
</tr>
<tr>
<td>Para-Dichlorobenzene</td>
<td>11</td>
<td>0.30</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>6</td>
<td>0.10</td>
</tr>
<tr>
<td>Methylene Chloride</td>
<td>1</td>
<td>0.10</td>
</tr>
<tr>
<td>Perchloroethylene</td>
<td>5.9</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Diesel particulate matter</strong></td>
<td><strong>300</strong></td>
<td><strong>N/A</strong></td>
</tr>
</tbody>
</table>

Note: Unit Risk represents the number of excess cancer cases per million people per microgramme per cubic meter TAC concentration over a 70 year lifetime exposure.

A diesel particulate matter unit risk value of 300 is used as a reasonable estimate in the "Risk Reduction Plan to reduce Particulate Matter Emissions from Diesel Fuelled Engines an vehicles (ARB, October 2000)"

Source: California Air Resource Board
Black carbon emissions from diesel vehicles are several times more heat trapping than CO2.

CO2 emissions from the upstream diesel refining process will increase: European Commission has found lifetime pollution costs of Euro IV compliant diesel car is much higher than petrol cars.

**Rebound Effect**: Diesel fuel has higher carbon content than petrol. If more diesel is burnt encouraged by its cheaper prices and more driving, more heat-trapping CO2 will escape.

Nullifies marginal greenhouse gas reduction benefit of diesel car …..
Global move towards Clean diesel
It is possible to reduce harmful diesel emissions drastically.
But India is dieselising without clean diesel

Need clean diesel (10 ppm sulphur) along with advanced after treatment system. Diesel begins to clean up at Euro VI level.
Refinery upgradation costs:
Industry estimates -- INR 50,00 to INR 80,000 crore

Vehicle improvement costs

To Euro V: Petrol cars – INR 1200-1500; diesel cars – more than INR 15,000 (ICCT 2014)

To Euro VI: Petrol cars – INR negligible; diesel cars – more than INR 20,000 (ICCT 2014)

Through successive stages of emissions standards Indian market has absorbed significant cost pressures: Bus.. Approx 150% increase in prices (Eg Bangalore); Compact car prices upto 30% between 2000 and 2010

It is possible to design fiscal strategy to meet the cost of transition....
India: Barriers in refinery sector: Fiscal burden…..

India dismantled petrol subsidy in 2011 and diesel subsidy in 2014. Diesel subsidy was phased by increasing prices gradually over a period of one and half years.

Source: Working group report on Petroleum and Natural Gas Sector for the 12th 5-year plan
The Auto Fuel Policy Committee 2014 has proposed the following:

Special fuel upgradation cess of 75 paise per litre on petrol and diesel. This can generate Rs 64,000 crore over 7 years.

Equalise retail price of Bharat Stage III and IV fuels. The excess collected from the repricing of Bharat Stage III to be called ‘high sulphur cess’.

Revenue from these sources to be spent on refinery upgrades.
Nascent steps in Delhi

Air Ambience Fund (based on polluter pay principle):

Air Ambience fee of 25 paise per litre on sale of diesel fuel has been implemented. Revenue from this cess is used to create Air Ambience fund to meet the cost of Delhi's clean air action plan. Current size of fund – INR 310 crore

Fund from the penalty on diesel buses (2002) -- Rs 30 crore

Proposed pollution compensatory charge on incoming trucks – revenue to be taken to public transport fund
Action: Accelerate emissions standards
Develop financing strategy for quick transition to clean fuels….

Set timeline to move quickly to Euro IV and VI

Develop Clean Fuel Fund to improve quality of fuel

Fiscal strategy across the world

• Setting differentiated tax rates

• Tax reduction to refiners for lower sulfur fuels

• Directly subsidizing the supply of lower sulfur fuels

• Incentives targeting consumers, such as tax reductions implemented at the pump, -- combined with an increased tax at the pump for higher sulfur diesel.

• A small cess per litre of fuel sold and create dedicated clean fuel fund to help meet the cost of clean fuel
Case study Sri Lanka: With import duty changed the vehicle market dramatically

Market response to import duty
Share of diesel cars drops dramatically

Source: Dr Jayaweera
Alternative fuel strategy… CNG transition in India and Nigeria …
….. to leapfrog to cleaner emissions and for energy security….
Nigeria: CNG taxis

- Pilot project between the Nigerian National Petroleum Corporation (NNPC) and NIPCO, through a joint venture, Green Gas Ltd.

- Significant infrastructure development in and around Benin City.

- Use of natural gas led to significant savings for taxi drivers. Green Gas refuels over 4,000 taxis and cars.

- Policy and regulatory support from the government is needed.

- Drive CNG programme with effective emissions and safety regulations; include more vehicle segment.
CNG vehicles in Nigeria

• The CNG project began in 2009

• Over 5,000 vehicles run on CNG in Nigeria, according to Nigerian Independent Petroleum Company (NIPCO) Plc, an indigenous downstream petroleum and gas operator

• More than 4,000 vehicles had converted to use CNG in Benin, the Edo State capital

• 500 vehicles were also operating on CNG in Lagos

• The company, NIPCO has about 10 CNG operating stations nationwide. Others are under construction.
CNG helped Delhi to leapfrog: Euro II diesel bus emits nearly 46 times higher PM than Euro II CNG bus in India.

CNG Bus Emissions in 2004

PM emissions from buses in grammes per kilometre

- Bharat stage II Diesel Bus (500ppm max. sulfur)
- Bharat stage II Diesel Bus + CRT (50ppm max. sulfur)
- Bharat stage II CNG Bus + 3 way catalyst

Source: Teri
<table>
<thead>
<tr>
<th>Type of bus</th>
<th>CO g/km</th>
<th>HC g/km</th>
<th>NOx g/km</th>
<th>PM g/km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Euro II diesel bus on 500 ppm sulphur fuel + DOC</td>
<td>1.45</td>
<td>0.29</td>
<td>6.24</td>
<td>0.35</td>
</tr>
<tr>
<td>Euro II diesel bus on 350 ppm sulphur fuel + DOC</td>
<td>0.65</td>
<td>0.15</td>
<td>5.85</td>
<td>0.11</td>
</tr>
<tr>
<td>Euro II diesel bus on 50 ppm sulphur fuel + CRT</td>
<td>1.42</td>
<td>0.04</td>
<td>13.58</td>
<td>0.009</td>
</tr>
<tr>
<td>Euro II CNG bus + three way catalytic converter</td>
<td>3.18</td>
<td>1.455</td>
<td>5.35</td>
<td>0.0065</td>
</tr>
</tbody>
</table>

Source: ARAI/Teri
December 2002: CNG programme established

Finally, it’s bye bye diesel buses
Diesel and CNG pathways to meet Euro VI norms

Diesel emissions control route more complicated

Ensure on-road performance
Import of old vehicles... a special challenge in the region....
Concerns around vehicle imports in Nigeria

- **High pollution** from imported automobiles that do not follow emission standards.

- **Fifteen year old vehicles are allowed to be imported**

- **Nearly 70 per cent of the imported vehicles are old/secondhand**

- The government is promoting vehicle assembly plants/local manufacturers.
Vehicle import policies in Countries: Opportunity to influence and harmonize policies on vehicle’s emission norm and road-worthiness and age

- **Angola**: Motor companies not allowed to import used vehicles; individuals allowed to import regardless of age
- **Botswana**: Maximum of 100,000 kms on the vehicle
- **Burkina Faso**: No import restrictions on vehicle age basis
- **Mali, Malawi, Zambia, Central African Republic, Democratic Republic of Congo, Cameroon**: No import restrictions on vehicle age basis
- **Chad**: Vehicle inspection upon importation
- **Côte d’Ivoire**: A fine of FCFA 150,000 is imposed on vehicles older than 10 years and an additional FCFA 10,000 for every year.
- **Gabon**: Used vehicles must be less than four years old
- **Ghana**: Used vehicles over five years old pay graduated penalty according to year of manufacture and capacity
- **Seychelles**: Used vehicles must be less than five years old
- **Sudan**: Imported second-hand vehicles are illegal, except for immigrants, vintage and racing cars, vehicles adapted for physically disabled, and donated vehicles for welfare organizations
- **The Gambia**: Import of second hand vehicles restricted through taxation – increases in vehicles exceeding 10 years and roadworthiness must be proven before import
- **Mauritius**: Has a three year age restriction
- **Zimbabwe**: Banned importation of vehicles older than 8 years old and recently increased import duty
Challenge of in-use vehicle emissions and testing..........
Vehicle emissions testing

• In **Nigeria**, vehicle inspection centres have been set up to monitor the roadworthiness and emissions from in-use vehicles.

• In **Ethiopia**, annual vehicle inspection is mandatory. The vehicle road worthy test is being conducted to measure exhaust emissions against the standard set by the Authority.

**Kenya** – setting up vehicle testing centre

**Delhi**
• Upgraded vehicle testing centre for commercial vehicles – emissions tests and roadworthiness tests

• In-use emissions tests
  • Gasoline vehicles – Two speed idle tests for CO, HC and lambda
  • Diesel vehicles – Smoke density tests. Norms tightened for Euro IV compliant vehicles
  • Enforcement on visibly smoky vehicles
Rwanda: Vehicle emissions testing

- Rwanda National Police and Rwanda Environment Management Authority to implement vehicle emissions testing programme:
  
  - All vehicles to undergo emissions inspection. Norms for roadworthiness and emissions being implemented.
  
  - Commercial vehicles to undergo test every six months. Private vehicles every year.
  
  - Traffic Police can ask for impromptu emissions testing for any grossly polluting vehicle.
  
  - If fail vehicle to be impounded or high monetary penalty
Vehicle inspection system in other regions of Africa

• Nairobi: Vehicle inspection centres. Mainly for public service vehicles and commercial vehicles
• From January 2015, all private vehicles more than 4 years will also have to undergo the inspection

• At present only visual tests are done.

• Emissions testing -- limited
ACTION: In-use vehicle emissions

-- Introduce smoky vehicle test. Catch them and penalise
-- Link up annual vehicle insurance with the test to ensure compliance. Expand testing facilities.
-- Improve norms and testing procedure especially for diesel vehicles
-- Fix age and emissions standards for importation of vehicles
-- Do not allow big trucks to enter cities during the day
-- Higher taxes on older vehicles
Addressing fuel efficiency

- **India**: has framed fuel economy regulations for cars. Now working on heavy duty fuel regulations. Also to address operational issues.

- **Ethiopia**: To develop fuel economy regulations for vehicles.

- **Kenya**: The Energy Regulatory Commission (ERC) in partnership with the University of Nairobi carrying out a baseline vehicle fleet analysis, including vehicle imports, and will undertake a cost and benefit analysis on fuel economy and cleaner fuels and vehicle policies.

- **Mauritius**: UNEP and its partners are assisting the government in the review of the implementation of its Excise Bill (2011) that sets forth a CO2 levy on motor cars or the granting of a CO2 rebate from the excise duty payable on motor cars. This is probably the first “feebate” system in the developing world.

Action: Need action plan to reduce energy impacts of motorisation

-- Need fuel economy regulations to guide and benchmark vehicle import and production

-- Promote fuel efficient vehicles with fiscal incentive
Mobility crisis and air pollution

Dependence on personal vehicles and infrastructure designed for vehicles locking in enormous pollution.....
Mobility crisis

...... an increasing share of our daily trips are being made by cars that occupy more road space, carry fewer people, pollute more, guzzle more fuel. They edge out pedestrians, bicycles, cycle rickshaws and buses...........
Traffic congestion in Nigerian cities

• **Lagos** – A study (Bashiru and Waziri 2008): 57% of commuters and motorists spend between 30 to 60 minutes on the road due to traffic congestion in Lagos. Worst traffic congestion occurred on Mondays.

• **Abuja**: (Study by Agbonika 2011): The worst congestions in Abuja occur at 8 am and 6 pm. 18.57% of the sampled commuting population live within the city centre. But major government offices away from residential areas. This induces huge traffic
Need mobility transition
How people travel in India

Source: Based on analysis of data provided in reports: 1) ICLEI-South Asia 2009 2) WSA/MOUD 2008
More roads are not the answer
...Lesson from Delhi

Source: On the basis of Economic Survey, Delhi Govt
Give priority to people’s movement to reduce pollution, congestion, energy and climate impacts.................
Opportunity in Africa and India
Our inherent strength...........

How people travel in India?
- We have built walkable cities:
  - 30-60% trips carbon neutral.

How people travel in Africa?
- Majority walk and use public transport
Roads not designed for public transport walking and cycling can lock in more pollution

Engineering changes once made cannot be reversed easily… It permanently decides our travel choices.
Car centric infrastructure in Abuja
Case Study – Outer Ring Road (Nehru Place Flyover)

Travelling from A to B

Originally 30M across the road

Locations:
- Pamposh-Enclave
- Nehru Place
- CR Park
- Kalkaji
Case Study – Outer Ring Road (Nehru Place Flyover)

Travelling from A to B – Pedestrian Route 1

1000M via FOB

A

CR Park

FOB

B

Pamposh-Enclave

Nehru Place

Kalkaji
Street Network

Source: UTTIPEC
Africa has less than 3% of the world’s motor vehicles. But more than 11% of global road fatalities. This estimate can even be more.

- **Nigeria:** Road safety programme – vehicle tracking system; to install speed limiting devices; designing policy for non-motorised transport

- **Ethiopia:** Ministry of Health developing strategic plan to prevent injuries and establish emergency medical services. Ethiopia also had created a national road safety coordinating office, in line with WHO recommendations.[i]

- **Kenya:** National Transportation Safety Authority established to manage road safety

- **Uganda:** Approval of nation wide non-motorised transport policy

- **Gambia:** Developing an inter-ministerial committee on road safety but does not have funding to implement anything yet.

- **Zambia:** MoU with the relevant organisations

- **Tunisia:** Road safety observatory which brings together many parties

- **Senegal:** Put in place an inter-ministerial committee to look at the issue and is working with driving schools
Bus and para transit system (mini taxis) for efficient and affordable public transport system
How do we make public transport attractive and affordable?

Delhi
Buses are getting marginalised

Addis Ababa
Importance of mini taxis in public mobility needs

Lagos
Why buses?.............

-- **Spine of public transport:** Buses provide the bulk of public transport services – as much as 40-60 per cent – in cities that have city bus services.

-- **High targets for public transport:** MPD 21 targets 80% public transport share by 2020; Pune 80%; Kolkata 90%... Delhi buses along with bus rapid transit system can help to meet at least 73% of the target.

-- **Buses allow greater flexibility, geographical coverage, cost effectiveness, and space efficiency.** Can flexibly and easily meet the needs of changes in demography and land use. It can cover areas with lower travel demand.

-- **A bus occupies twice the road space taken by a car but carries 40 times the number of passengers.** Bus can displace anywhere between 5 and 50 other vehicles and allow enormous oil and pollution savings (IEA).

-- **Poor people are most dependent on affordable and cheap public transport to access jobs and services.** Urban poor can use upto 25-30 per cent of their income on transportation.

-- **Per person emissions several time less than cars**
Reality check in Delhi
Public transport losing ground. We are losing our advantage

Source: Anon 2008, transport demand forecast study: study and development of an integrated car multi-modal public transport network for NCT of Delhi, RITES, MVA Asia Ltd, TERI, September
State of bus in cities of Africa

• **Bus seats per thousand people:**
  
  – World Bank’s Urban Transport Indicators database-- average number of bus seats per thousand urban residents of Latin America, Asia, the Middle East, and Eastern Europe is around 30 – 40.

  – In Africa the average number is 6 bus seats per thousand residents.

• **Transport affordability:**
  
  – High travel costs… The average cost of a one-way trip is about 0.30 $, which is high in relation to the average household budget.

  – This has increased walk share

http://www.eurist.info/images/Projects/UBA_Finance_Africa.pdf
Public transport system

• A study in Abuja identifies challenges to develop transit ways to major activity centres:
  • Absence of pedestrian walkways,
  • Widespread use of low-occupancy vehicles for public transport, city-wide traffic congestion,
  • Inefficiency of institutional mechanism for managing transport.
  • The study recommends establishment of Abuja Area Transportation Authority for sustainable transportation management

• A study on the quality of transport services in Ibadan metropolis:
  • Urban residents commute on foot to meet their travel demands.
  • Dissatisfaction with the transport services
  • Household’s income is highly correlated with modal choice
  • Intra-transport services are poorly maintained.
  • Revitalize transport services in Nigeria to improve accessibility
Delhi BRT
Design roads for all road users
Give priority to clean mode of transport to protect public health

Moving vehicles vs. moving people
Lagos: BRT‘lite’

- In 2008, Lagos launched a BRT ‘lite’ corridor with 22-kilometre route, 26 stations and 220 high capacity buses.
- System designed to carry 60,000 passengers a day by 2010. It is carrying 220,000 passengers per day, with more than 100 million person-trips being made in the first 21 months of operation.
- A 30% decrease in average fares.
- Commuters travel time have been reduced by 40% and waiting time by 35%.
- Direct employment for 1000 people and indirect employment for over 500,000 people.
- Strategic public transport authority (LAMATA), a focus on user needs and deliverability within a budget and programme.
- Community engagement programme
Action: Bus sector reforms

-- Scale up bus transport as part of integrated public transport system
-- Service level benchmark and service guarantee
-- Improve overall economic efficiency of bus transport
-- Reduce tax burden on buses
-- Rationalise budgetary allocation in the transport sector. A lot money tied to car centric signal free roads and flyovers that impede bus routes can be diverted and ploughed into bus transport.
-- Develop dedicated urban transport fund with innovative financing
-- Apply travel demand management for additional revenue to invest in public transport. -- like tax station naming, fuel surcharge, parking revenue, congestion tax etc, TDM measures to generate revenue, etc

We cannot afford to miss the bus.............
Do not destroy informal intermediate public transport service…. White and blue mini buses/vans, Matatus, Boda Boda in African cities Or Auto rickshaw and cycle rickshaws in Indian cities…
Intermediate public transport systems like mini bus taxis are reliable, affordable and provide high frequency public transport services

These meet more than 70% of public transport service in African cities

Do not destroy this affordable system. In 2011, an assessment by Ethiopian Institute of Architecture found that transport fares have increased much more than household income in the last three years. This has made its services unaffordable for a large percentage of the population.

Bigger formal systems like LRT and BRT will be more expensive.

Need supportive systems of mini bus taxis. Congestion will worsen if these are replaced by cars.
Initiative in some cities to organise and manage minibuses/minivans: A good practice among developing countries

-- Eg Addis Ababa --- Owners of blue and white taxis organised under 13 owners' associations based on the zoning system reintroduced in 2011.

-- Number of members in each association varies, with a minimum number of 500. These associations engage in service route management

-- The 13 minibus taxi owners associations are to be reorganized into two bigger share companies. -- Members of the associations are expected to change their vehicles into midi buses, with a capacity of up to 24 passengers.

-- Similar initiatives in Nairobi

Mini and midi bus taxis should NOT be phased out if light rail system comes. These should only be improved
Indian cities also reorganising intermediate public transport
These are vehicle of the future……..

-- Three-wheeler policy in Delhi:
-- All three-wheeler drivers to get public service vehicle badge and smart cards.
-- GPS connectivity to improve the meters and compliance.
-- In-use vehicle fitness and emission testing systems
-- Integrate with mass transit system.
Integrate transport systems – LRT, BRT, bus, Minis bus taxis, walkways

Expand well designed and safe pedestrian facilities to support public transport

The interchange points of LRT, BRT and bus stations need to be planned and executed carefully for easy transfers and access

Common ticketing
Need norms for multi-modal integration
Case study from Delhi

Metro station in Delhi

Now
After
Delhi is developing guidelines for modal interchange location

**Bus stop, cycle rental:** within 50 meter level walk from station exit

**Cycle and two wheeler parking:** within 100 meter level walk from station exit

**Auto rickshaw stand:** within 150 meter level walk from station exit

**Private car/taxi/auto rickshaw “drop off”:** with barrier-free of exiting pedestrians and NMT

Pedestrian exits, bus-stops and Cycle-rickshaw stands must be closest to main pedestrian exits from station.

**Car parking** if provided, must be BEYOND 250 M distance of Station/ or PT interchange point

**Pairing of Origin-Destination (O-D) Nodes:** Provide cycle/ auto stands at nearby important destinations.
Compact and closely built city design allow shorter travel distances.

Average trip length in most African cities less than 5 km. This makes city very accessible and walkable.

Poverty and lack of affordable transport options.

Congestion have increased share of walking in our cities...It is faster to walk.

Reasons for high footfalls in our cities.....Protect and increase pedestrian traffic for clean air.
Delhi: wrong road design force people to cross in unsafe manner. This compromises public transport usage.
Disadvantage: Pedestrians
Give safe crossings at grade. It is inconvenient for people to negotiate foot over bridges...

Assessment of sidewalks in most African cities show many road facilities are wide, with no signals, striping, or pedestrian islands, have long gaps between crossings, -- This makes pedestrian movement difficult.
Delhi has adopted street design guidelines

Indian Road Congress guidelines for roads have been reformed to make pedestrian and cycling friendly

Adopt street design guidelines for design solutions
It is possible to transform streets to make them pedestrian friendly

- Streets of Delhi retrofitted

Connaught Place

Source: CSE
Need street activities
Need to rethink ban on street vending: A regressive step

- Lagos State Government has recently restated that it would fully enforce the provisions of the law restricting street trading in the metropolis.

- Section 1 of the Street Trading and Illegal Market Prohibition Law 2003 restricts street trading and hawking in the metropolis.

- According to the State Task Force on Environmental and Other Special Offences (Enforcement Unit), the new drive is to reduce traffic congestion on the road, often caused by the activities of street trading.
Design roads for all street activities
Informal market needs space too...

This gives street vitality. Makes streets safe from crime. Improves livelihood security.
In Indian city of Bhubaneswar: Space for vending built into road design

Eye on the street: Activities make public space safe

Raj path road, Bhubaneswar, India

Source: CSE
Action: Adopt non-motorised transport and pedestrian policy

-- Need policy on non motorised transport. Uganda has framed a NMT policy

-- Adopt and mandate people friendly street design guidelines.

-- Discourage car centric road design

-- Promote physical design for multi-modal integration

-- The Addisa Ababa Local Development Plan aims to “promote cost-effective movement systems” and “accessibility through improving relationships between people, places and activities”.

-- Master plan to focus on plans for non-motorised transport
Restrain car usage to reduce crippling congestion and pollution....

Need parking policy and vehicle taxation policy as demand management measure for clean air..........
What’s going wrong with parking?

- **Parking: wasteful use of cars**: For about 90 to 95 per cent of the time a car is parked. (CRRI)

- **Insatiable demand for land**: Annual registration of cars generate demand for land bigger than 310 football fields in Delhi! Land is expensive and can be used for other social and public amenities.

- In Lagos the parking demand of the existing car fleet is equivalent to 115 football fields.

- **Inequitous use of land**: A car is allotted 23-26 sq m for parking. Under low cost housing scheme only 18-25 sq m is allotted to very poor families.

- **Parking takes away walkspace from pedestrians**: Urban common, green spaces, walkways at risk.
2006: National Urban Transport Policy in India

Land is limited and there is a limit to the additional parking space that can be created in the city. This will also require ... well thought out pricing policy to control the demand for parking.

• The provision of parking for personal motorised vehicles cannot be considered as a matter of public good.
• Individual user of personal vehicle should pay for the use of the space for parking and parking facilities. The ‘user pays’ principle should govern the pricing of parking.
• Government should not subsidise this cost
• Use a wide variety of tools for pricing parking -- time variable rates –etc.
Control demand for parking

Develop parking district plans to:

Limit legal parking area. Do not allow unlimited parking. Eg. Delhi Master Plan allows 3 parking spots per 100 sqm in commercial areas. Tokyo with higher car ownership allows only 0.5 ECS in its CBD to discourage car use.

Demarcate legal on-street parking

Impose high penalty on illegal parking

Enforce high and variable parking charges

Promote park and ride in LRT and BRT

Promote Park and walk in pedestrianised areas

Do not allow parking in green areas and walkways

Source: ITrans
Parking in Abuja

• Parking policy in Abuja implemented in 2012.
• Mandatory for all vehicle owners to pay a fee of N50 for every 30 minutes between 7am to 7 pm.

• Beyond the stipulated time allotted on a purchased ticket will have their vehicle clamped and towed, and forced to pay N5000 into the account of the enforcement company at a commercial bank before the vehicle is released.

This was challenged by private savings and loan firm in the city.

• A Federal High Court sitting in Abuja in 2014 declared the park and pay policy of the Federal Capital Territory Administration, FCTA, illegal, saying it has no law backing its operations.

• Ordered the immediate stoppage of the pay and park facility.
Steps in Indian cities

Bangalore:
-- Pay and park scheme to be expanded to cover 85 roads. Roads classified into premium parking, business parking and ordinary parking. Hourly tariff has been increased.

-- Provision of yearly revision of parking fee linked to wholesale price index

-- Parking Information System and parking meters

Aizawl, Gangtok and cities of Rajasthan: Car cannot be bought without proof of parking

Delhi:
-- Parking district management plan included in Delhi Master Plan. Needs implementation. Parking is prohibited in green areas and play grounds.
Effectively priced parking can make a difference

Grosvenor square, London

Source: TRL in ITDP (2011): Europe’s Parking U-Turn
Parking and clean air

It is still not clear to many how parking management and restraints can reduce air pollution and give public health benefits.

**Boston** froze their parking requirements at a level that is only 10 per cent higher than the 1973 level to meet the Federal clean air standards.

**New York**: very high parking fees and limited parking supply have lowered car ownership far below the average rates in other US cities.

**Amsterdam** - parking fees expanded to meet EU directives regarding NO2 and PM10 emissions. Car plate numbers are registered with emissions information. Trucks are allowed to unload for a maximum of 15 minutes in spots where they are not allowed to park.

**Zurich** considers total NO2 emissions when determining the amount of parking to be allowed.

**Aizawl, Sikkim** have made proof of parking mandatory for purchase of cars; **High Court of Jodhpur** has given similar direction.
India lagging behind… Indian cities tax the bus higher than the car. This should change……..

World bank study in India: Buses pay more taxes

In Delhi:
Buses pay at least Rs 13,000 per year as road tax
Cars: One time road tax works out to be a mere Rs 300 per year
Vehicle taxation in Nigeria

In November 2013, the Federal Government raised duty and levy payable on imported new and used cars from 20 to 70 per cent and 0 cent on the completely knocked down (CKD) units that local assembly plants require.

- In Nigeria, cars have to pay 35 per cent duty and 35 per cent levy while commercial vehicles have to pay 35 per cent duty.
- Complete knocked down units do not have to pay any duty, semi knocked down are charged 5 to 10 per cent.

<table>
<thead>
<tr>
<th>YEAR</th>
<th>CARS INWARD</th>
<th>CARS OUTWARD</th>
<th>LORRIES &amp; BUSES INWARD</th>
<th>LORRIES &amp; BUSES OUTWARD</th>
<th>OTHER VEHICLES INWARD</th>
<th>OTHER VEHICLES OUTWARD</th>
<th>TOTAL INWARD</th>
<th>TOTAL OUTWARD</th>
<th>GRAND TOTAL</th>
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</thead>
<tbody>
<tr>
<td>2009</td>
<td>58,990</td>
<td>18</td>
<td>122,264</td>
<td>71</td>
<td>14,814</td>
<td>11</td>
<td>196,068</td>
<td>100</td>
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<tr>
<td>2010</td>
<td>61,147</td>
<td></td>
<td>127,595</td>
<td>162</td>
<td>3,511</td>
<td>16</td>
<td>192,253</td>
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<td>2011</td>
<td>93,522</td>
<td>667</td>
<td>150,935</td>
<td>375</td>
<td>2,075</td>
<td>12</td>
<td>246,532</td>
<td>1,054</td>
<td>247,586</td>
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<tr>
<td>2012</td>
<td>106,787</td>
<td>213</td>
<td>160,006</td>
<td>708</td>
<td>2,593</td>
<td>22</td>
<td>269,386</td>
<td>943</td>
<td>270,329</td>
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<tr>
<td>2013</td>
<td>110,625</td>
<td>2</td>
<td>167,524</td>
<td>13</td>
<td>2,077</td>
<td>1</td>
<td>280,226</td>
<td>16</td>
<td>280,242</td>
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<td>2014*</td>
<td>92,649</td>
<td>7</td>
<td>154,408</td>
<td>18</td>
<td>868</td>
<td>54</td>
<td>247,925</td>
<td>79</td>
<td>248,004</td>
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<tr>
<td>Total</td>
<td>523,720</td>
<td>907</td>
<td>882,732</td>
<td>1,347</td>
<td>25,938</td>
<td>116</td>
<td>1,432,390</td>
<td>2,370</td>
<td>1,434,760</td>
</tr>
</tbody>
</table>

2014* Provisional Figure
-- Improve overall economic efficiency of bus transport
-- Reduce tax burden on buses
-- Rationalise budgetary allocation in the transport sector. A lot money tied to signal free roads and flyovers that impede bus routes can be ploughed into bus transport. This will release enormous amount of money.
-- Reform rates and policy of some key revenue heads like advertisement, parking, and vehicle taxation to be able to tap substantial amount of earnings from them.
-- Bus companies to can undertake commercial development in their depots and terminals
-- Apply travel demand management measures to increase taxes on personal vehicles. Use the additional revenue for public transport.
-- Explore best practice models -- like tax on wage bill, station naming, fuel surcharge, congestion tax etc, TDM measures to generate revenue, and increase bus ridership
World Bank assessing similar approach in other cities…((Yet to be released study)

Potential revenue in billion units
Fares – 35 billion units
Rent on property – 40
Parking -- 30
Station naming rights – 5
Betterment – 75
Fuel tax – 15
Vehicle registration – 2
Advertisement -- 3

Generates a lot more than the target of meeting the O&M cost of 93 billion units

(Source: OP Agarwal, UMI)
Policy opportunity in our regions...
### ASTF Action Framework

For 4 key areas -- road safety, accessibility and infrastructure, emissions and enabling conditions... This needs support and action

<table>
<thead>
<tr>
<th>Priority area</th>
<th>Actions</th>
<th>Time bound target</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Road safety</strong></td>
<td>Implement the African Action Plan for the Decade of Action for Road Safety 2011 – 2020</td>
<td></td>
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<tr>
<td></td>
<td>Set up dedicated institutions for road safety and allocate funding</td>
<td>2017</td>
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<tr>
<td></td>
<td>Insure comprehensive data collection and reporting mechanisms on road safety incidents and trends</td>
<td>2015</td>
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<td></td>
<td>Develop and adopt a Non-Motorised Transport Policy</td>
<td>2015</td>
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<tr>
<td></td>
<td>Develop and adopt Non-Motorised Transport Design Guidelines</td>
<td>2015</td>
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<tr>
<td><strong>Vehicle emissions and energy efficiency</strong></td>
<td>Ensure air quality monitoring takes place in all main cities</td>
<td>2017</td>
</tr>
<tr>
<td></td>
<td>Develop vehicle emission standards and suitable inspection and testing</td>
<td>2016</td>
</tr>
<tr>
<td></td>
<td>Develop vehicle import regulations at both regional and national levels, based on either vehicle age, mileage or emissions</td>
<td>2016</td>
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<tr>
<td></td>
<td>Develop regulations for the adoption of cleaner fuels - especially low sulphur fuels - at a national level</td>
<td>2017</td>
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<tr>
<td></td>
<td>Undertake a country level fuel economy analysis and develop a national level policy to improve fuel economy</td>
<td>2017</td>
</tr>
<tr>
<td><strong>Accessibility and sustainable infrastructure</strong></td>
<td>Develop a national policy on sustainable urban transport</td>
<td>2017</td>
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<tr>
<td></td>
<td>Develop integrated transport plans with a specific focus on multi-modal transport</td>
<td>2018</td>
</tr>
<tr>
<td></td>
<td>Undertake an assessment and develop a national policy on mass-transit systems</td>
<td>2017</td>
</tr>
</tbody>
</table>
All our cities need Clean Air Action Plan

Principles of co-benefit to guide the roadmap of clean air action plan

-- Set and meet clean air target to protect public health

-- Reduce energy and climate impacts of growth and motorisation

-- Adopt affordable strategies that are equituous and meet the needs of the poor and all other vulnerable sections

--- Ensure safe mobility for all

-- Enhance quality of life

-- Integrate the needs of livelihood security
Develop detailed Clean Air Action Plan for priority areas

Air quality monitoring and management
   Air quality monitoring and public information system with Air quality index
   Involve medical community for health exposure assessment and information
   Need pollution source assessments and develop source-wise action plan

Reduce emissions from vehicles
   Leapfrog emissions standards and improve energy efficiency
   Reinvent mobility – Public transport, walk and cycle, intermediate public transport along with safe access

Reduce emissions from power plants
   If coal based then tighten the standards and siting policy
   Hydro power and other renewables are an opportunity in Ethiopia

Reduce emissions from air polluting industry
   Inventorise industrial sources and assess emissions for control measures

Improve energy access of the poor to reduce biomass based cooking

Action on open burning
   Monitoring and awareness campaign to stop open burning

Road dust and construction activities
   Adopt dust control measures for construction industry, roads, and traffic
Change the mindset....
Whiff of change.......... 
Abuja drafting cycling policy 
Car free day Kampala, Uganda

http://www.fabio.or.ug/page19.php
Cities are moving away from car centric infrastructure.

Before

After

Seoul’s Cheonggyecheon restoration project

Cities that have destroyed roadways

San Francisco
Milwaukee
New York
Portland
Toronto
Seoul
Dutch Minister visits the queen on a bicycle

Source: GIZ
Thank You