

India-California Air Pollution Mitigation Program (ICAMP)



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Summary of **Workshop at California**

21–23 October 2013

The California Air Resources Board (CARB) has successfully implemented a variety of emission control measures that have led to declining emissions even as the overall fleet size has increased. This experience offers valuable lessons for other regulators. This project envisages knowledge transfer for capacity building to accelerate integration of short lived climate pollutants (SLCP) reduction with on-going transport development initiatives in India. It also intends to develop and test robust frameworks for similar knowledge-to-action dialogues in other areas and in different South Asian countries. With this in mind, The Energy and Resources Institute (TERI), the University of California, San Diego (UCSD), and CARB have developed a joint project titled, 'India–California Air Pollution Mitigation Program' (ICAMP). The programme aims to develop an action agenda of scientific research, technology development, and innovative pilot programmes to reduce emissions from the transport sector in India. The consortia invited the International Council on Clean Transport (ICCT) and Okapi Research to become partners of ICAMP.

Objectives

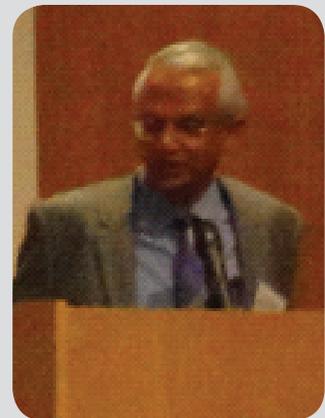
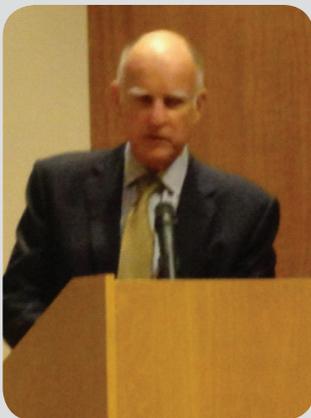
ICAMP was created to convene stakeholders and experts concerned with public health, environmental damage, climate change, environmental justice, economic development, and transport industry competitiveness to develop an action agenda of scientific research, technology development, and innovative pilot programmes to reduce black carbon and ozone precursor emissions from the transport sector in India. The origin of ICAMP is a report chaired by Prof. V Ramanathan (Distinguished Professor, UCSD), which showed that California, under CARB's leadership, has drastically cut down its PM2.5 emissions from the diesel transportation to, such an extent that ambient black carbon (or soot) concentrations have reduced by about 90 per cent since the mid-1960s. California witnessed this reduction in spite of the fact that diesel fleet transport increased by a factor of three or more. In addition, the Ramanathan report showed that the reduction in black carbon is equivalent to mitigating about 21 million tonne of CO2 annually. The primary objective is to develop concrete, and practical pathways to reduce black carbon particles and ozone precursor emissions from the transport sector in order to improve public health, protect agricultural productivity, and mitigate climate change. This is planned through the following steps:

- *ICAMP workshop at California:* In-person interaction among scientists, policymakers, and transport stakeholders with deep knowledge about determinants of emissions as well as control options in a neutral setting to generate an initial set of ideas for intervention.
- *Refining of agenda:* Research to refine this agenda to more concrete and detailed proposals.
- *Policy conclave at New Delhi:* High-level policy consultation to disseminate idea and build partnerships for further research and policy pilots.

Three-day workshop to launch ICAMP

A three-day joint workshop in Oakland, California, was conducted by TERI, UCSD, and CARB from the 21st to 23rd October 2013 to launch ICAMP, a programme funded by the World Bank to deal with the issue of reducing emissions from the transport sector. The workshop intended to facilitate knowledge exchange between the Indian and the US delegation on science and impacts of vehicular emissions, vehicular technologies, fuel quality requirements, and urban transportation issues. The Indian delegation comprised high level officials of the Indian Union and state governments as well as NGOs and academics. The US delegation consisted of representatives of the California Air Resources Board as well as US academics and NGOs. The workshop was inaugurated by Mr Jerry Brown (Governor of California) in the presence of Dr R K Pachauri (Director-General, TERI), Ms Mary Nichols (Chairman, CARB), and Prof. Ramanathan (UCSD).

The workshop discussed the need to reduce air pollution in light of degrading environment quality, increasing health issues, and growing losses due to adverse effects on agricultural crops and harvest, and other related issues. While officials from CARB shared their experience on reducing the emissions even as the economy of California and its transport requirements have grown, the Indian contingent expressed their views about the Indian context and priorities. There was a clear consensus in joining hands for knowledge sharing to work towards sustainable transportation development in India. The deliberations and discussions in the workshop helped in paving a way forward for ICAMP. These discussions will be continued within working groups formed at the meeting and at the Policy Conclave in New Delhi in February 2014.



Proceedings

The workshop of ICAMP started off in the city of Oakland, California, USA, on 21 October 2013. The first day of the



workshop had two distinct segments. In the first segment, Mr A S Bhal from the Ministry of Urban Development (MoUD), Government of India, initiated the proceedings by giving a talk about potential strategies to mitigate transport pollution. He mentioned growing population, congestion, energy consumption, emissions,

and health effects as the key challenges in the sector. Thereafter, he focussed his talk on sustainability — social, economic, and environmental — of transportation systems. He stressed on the basic Avoid, Shift, and Improve (ASI) approach to improve the system as well as trip and vehicle efficiencies. He explained how the ASI approach not only reduces emissions on a local and global level but also improves energy efficiency. Further, it can also support the vitalization of public spaces, social cohesion, and economic attractiveness of a city. Focusing on travel efficiency, he emphasized upon non-motorized transport, public transport systems, integration of land-use transport, and travel demand management measures. *Speaking on vehicular efficiency, he mentioned that although diesel consumption is growing rapidly, the quality of diesel in India does not meet the international standards.*



Mr H K Dash (Additional Chief Secretary, Gujarat, India) explained the state-level scenario in the State of Gujarat in India. He talked about the improvements made in the transport sector in the state during last decade. Introduction of BRTs, enhancement of public transport systems, and introduction of cleaner fuels were mentioned as

the success stories. *He also showed his willingness to establish partnerships with California in improving transportation efficiencies and reducing emissions.*

Thereafter, eminent CARB scientists made a detailed presentation to the participants from India, CARB's mode of operation, the scientific projects being carried out, and the different technologies involved in the mitigation trials. Dr Bart Croes (CARB) along with Dr Jorn Herner, Dr Tony Brasil, and Dr Paul Hughes explained the strategies involved in reducing particulate matter (including black carbon) and NO_x emissions in California. The reductions in pollutant concentrations in California were attributed to advancement of vehicular emission norms and technologies, improvements in the quality of fuels, and an effective inspection and programme commissioned

in the state. It was highlighted that the reductions in air pollutant emissions were achieved without any compromises in economic growth. Black carbon concentrations in California have decreased by about 50 per cent in the last 20 years despite a multi-fold increase in vehicular fleet and diesel consumption.

Plenary session I: Inaugural

The first plenary session of the workshop was the formal inauguration of ICAMP by Mr Jerry Brown (Governor of California), in the presence of Prof. V Ramanathan (Distinguished Professor, UCSD), Dr R K Pachauri (Director-General, TERI), Mary Nichols (Chairman, CARB), and other distinguished personalities from the US and India at the Federal Building, Oakland, CA. The event was graced by the presence of a strong Indian delegation including Mr R K Singh (Secretary, Ministry of Petrol and Natural Gas (MoPNG, India), Mr A S Bhal (MoUD, India), Mr H K Dash (Additional Chief Secretary of Gujarat, India), and Mr P Reddy (Secretary, Municipal Administration, Tamil Nadu). Prof. Ramanathan explained the basis and the genesis of ICAMP. He highlighted the improvements observed in the air quality of California without any compromise with the economic activities. Dr Pachauri stressed the need for urgent action in the Indian context. Governor Brown expressed his support for the current initiative and other possible important partnerships in India. Ms Nichols shared the experiences in CARB and the efforts made to reduce emissions from the vehicular sector. Mr Dash (Additional Chief Secretary, Gujarat, India) and Mr Singh (Joint Secretary, MoPNG) shared their views about Indian conditions at the state and federal levels, respectively.

Plenary session II (Part 1): Cross-cutting issues

Prof. V Ramanathan along with Dr B Croes (CARB) and Dr. B Van Bronkhorst set the stage for the day's proceedings. The workshop started with the first session on 'Nature of Air Pollution in California and India.' The Californian experiences were shared by Dr Croes and the issues in the Indian context were presented by Dr S Guttikunda (Urban Emissions.info). He presented the deteriorating state of air quality in India cities. He also showed the trajectories of future particulate matter (PM) emissions under different possible scenarios. Issues of varying



terrain in India and its impact on vehicular efficiencies and emissions were also discussed. Moreover, emissions from high-emitting older vehicles were also shown to be a major concern. Dr Guttikunda also explained the link between the transportation sector and other sectoral activities such as power plants/brick kilns.

The impact of air pollution has been found to be evident both on health and agriculture. Dr T K Joshi from Maulana Azad Medical College (MAMC), New Delhi, showed the mechanisms by which air pollutants affect

the respiratory tract. He explained how air pollution is closely linked with increased mortality, hospital admissions, decrement in lung function, increased air way resistance and obstruction, cardio-vascular disorders, adverse reproductive outcomes, and lung cancer. He mentioned the effects of air pollution in Delhi. Emergency room visits for asthma, COAD, and acute coronary events increased by 21.30 per cent, 24.90 per cent, and 24.30 per cent, respectively, on account of higher than acceptable levels of pollutants in Delhi. On the other hand, Dr J Burney (UCSD) presented her work on effects of ozone on agricultural productivities. The modelling work showed that ozone has been affecting the agricultural yields of many important crop varieties, particularly in the Indo-Gangetic plains where agricultural activities are predominantly very high.

Dr Linda Smith presented the health effects of transport related air pollutants. She identified Diesel PM (listed as a TAC and a component of PM2.5), ozone, black carbon, NOx, Toxic Air



Contaminants (TACs) like Benzene, 1, 3-butadiene, etc., as the pollutants of major concern. She mentioned that 8,900 premature deaths every year are attributed to PM2.5 pollution in California. She explained the effect of ozone on reduced lung function, increased school absenteeism, and asthma exacerbation in children and

mentioned that about 630 premature deaths in California were attributed to ozone pollution. She finally presented estimates of additional 1,200 premature deaths due to PM emissions from diesel and 214 additional cancer cases per million population per year.

Conclusion: It was concluded that India is growing at a fast pace, and consequently, vehicular emissions are on the rise. Health and agricultural impacts of the air pollutants are quite evident and must be addressed.

Plenary session II (Part 2): Mitigating air pollution and governance challenges

The second day of ICAMP, Part 2 of plenary session II, focused primarily on two aspects of mitigating air pollution: what has already been done? And what needs to be done? The session was chaired by Dr Robin King, Director of Urban Development and Accessibility at the World Resources Institute (Washington DC, USA). Dr Alan Lloyd (ICCT, California) started by giving an overview of what has worked in California for mitigating air pollution. Strong interest in public health and civil society as well as strong research base and technology-forcing standards were key to making the mitigation programme in California a success. Awareness about adverse health effects from the children's health study and the Los Angeles field studies, the extent of crop and property damage due to air pollution, and poor visibility made the general public raise strong demand for cleaner air and push the authority to take corrective measures.

Participation of institutes such as CalTech, Stanford University, University of California, University of Southern California, California State Universities, and national labs along with strong government research programmes like the ARB Research Division (Air Resources Board) and Office of Environmental Health Hazard Assessment (OEHHA) provided a strong research base. In 1998, CARB classified diesel PM as a toxic air contaminant and ARB Risk Management formulated the Diesel Risk Reduction Plan in 2000. A pictorial comparison of the filters used for PM collection showed a decreasing gradient of diesel PM concentrations as technology improved. The lowest emission was observed when engines were retrofitted with a Diesel Particulate Filter (DPF).

Dr Lloyd mentioned that there are still some issues that California needs to improve; for example, links between land-use planning and vehicle emissions, strategies that shift human



behaviour towards efficient travel, investments in non-motorized transport, and investments in public transport. He raised an alarm that developing nations will experience growth in health risk from vehicular emissions. He suggested that future health gains will be protected by accelerated adoption of fuel/vehicle standards

and this will have a direct effect on positive economic growth. He concluded his lecture by putting forth some suggestions for India, such as policies based on sound science, a systems approach that works, monitoring of ambient air, ability to recall vehicles, enforcement of fuel quality standards, and existence of a legal framework. He said these should exist for implementing regulations and most importantly judicial framework should exist for citizen lawsuits.



Dr Llyod's lecture was aptly followed by a presentation from Mr Sumit Sharma from TERI, India, whose lecture on achievements and challenges on air pollution in India helped the audience to vividly gauge the air pollution scenario of California and India. Mr Sharma reminded us about the deadly London Smog of 1952

and that of Donora, Pennsylvania, in 1948, and also detailed about the air scare that Delhi, the capital city of India (also called the asthma capital of India), had experienced last year between October 22 and November 2. While that episode was related to agricultural burning more than transport specifically, it did serve to raise awareness on air quality challenges. He presented a series of graphs describing how emissions from the transport sector could lead to the formation of ozone and accumulation of black carbon, greenhouse gases (like methane),



gaseous pollutants (NO_x, SO_x, etc.), particulate matter and how these could ultimately lead to hostile impacts on climate, agriculture, buildings, and human health. The vehicular fleet in India has increased exponentially, nearly 463 times between the years 1951 and 2011, compared with an 3.5 times increase in the population. Though megacities like Delhi and Kolkata are the major contributors, transitioned cities like Bangalore, growing cities like Jaipur, and small cities like Panjim are also in the queue. Second-tier cities have shown greater increase in vehicle number. Lack of public transport infrastructure, regional differentiation in the air quality standards, unregistered and overloaded vehicles, limited vehicular maintenance and ineffective Pollution Under Control (PUC) systems are the major negative key players hindering the issue of cleaner air. Though India has learnt some lessons from AFP 2002, no progress has been made to improve performance of in-use vehicles. Mr Sharma advocated some solutions for control of transport emissions before concluding his presentation. He suggested that Ultra-low Sulphur Diesel (ULSD) should be provided along with a clear roadmap for advancement of emission norms for the whole country, effective inspection and maintenance programme, high standards for fugitive emissions, enhancement of public transport (bus/rail/waterways), and non-motorized transport and use of alternate fuels (CNG, LPG, etc.).

Dr Thomas W Kirchstetter, Scientist of Lawrence Berkeley National Laboratory and Adjunct Professor, UC Berkeley, discussed the decreasing concentrations of black carbon in California and the way to control motor vehicle emissions has been implemental in this decrease. The average atmospheric black carbon concentration in California (that includes San Diego, San Francisco, San Joaquin Valley, Sacramento, N. Central Cost, but excludes Los Angeles) has decreased from approximately 3.8 µg/m³ in 1966–67 to about 0.4 µg/m³ in 2010 (from figure in the presentation), which is almost 9.5 times lesser. He advised that use of newer technologies such as retrofitting engines with DPFs will help in bringing down pollutant levels at a faster rate and this was supported by evidences from studies carried out in California.

Prof. S N Tripathi from IIT, Kanpur, India, described aerosol measurement strategies from the Indian perspective. He introduced the audience to AFRINET, which is a network of about 35 aerosol observatories across the country to generate for the first time regional synthesis using primary data and estimate the aerosol trends and National Carbonaceous Aerosol Programme (NCAP), a black carbon research initiative in India. Aerosol Optical Density (AOD) was found to be increasing at a rate of 2.3% (of its value in 1985) per year



and more rapidly (~4%) during the last decade. This spectral variation of AOD reveals the significance of anthropogenic activities on the increasing trend in AOD. He presented results of aerosol radiative forcing, fog processing of secondary organic aerosol, aerosol acidity and oxidative mechanism, and effect of mixing and aging on black (brown) carbon optical properties.

Dr Nithya Ramanathan, co-founder and president of Nexleaf Analytics, California made an interesting presentation on how easily black carbon can be measured using a simple and low-cost method. She showed that using a cell phone, real-time reporting of black carbon levels could be done. The colour of the filter is made to match with the reference filters and this colour directly correlated with the black carbon levels. This study has been conducted both in India (Project Surya, with which TERI is also associated) and in California. Results from various validation studies were presented at ICAMP.

Ezra Finkin, Director of Policy, Diesel Technology Forum, USA, told the ICAMP participants about the role of diesel in the economy, the clean diesel system, benefits of clean diesel technology, policy framework supporting clean diesel system, and about advocacy, outreach, and public education supporting clean diesel. Mr Finkin said that cleaner diesel fuels such as ULSD (also mentioned by Teri's Mr Sumit Sharma) produce lower emissions and enable advanced emission treatment systems (catalysts and filters). Also, Emission treatment technologies such as particulate filters and oxidation catalysts reduce emissions of ozone-forming compounds (NO_x and VOCs) and advanced engine technology such as advanced engine electronic combustion control, fuel injection systems, and turbochargers optimize performance and low-emissions. Mr Finkin discussed the journey to clean fuel, the US regulatory framework that supports successful adoption of clean diesel system, California's innovative policies, and reduction of emissions from off-road equipment such as agriculture tractors, bulldozers, and mining trucks.

Dr Prashant Gargava, senior environmental engineer, Central Pollution Control Board (CPCB), India, delivered a captivating lecture on air quality management in India. He focused on the initiatives taken, things that have been done and achieved, and what still needs to be done. He analysed whether India is on the right track regarding the air pollution mitigation roadmap. He briefed the audience about the regulatory provisions, industrial and vehicular pollution control norms, fuel quality improvement, air quality monitoring and its status in India, emerging issues in urban air quality management, and the six-city (Delhi, Mumbai, Chennai, Bangalore, Pune, and Kanpur) study on source apportionment. He suggested that in order to move forward, we need to follow an integrated approach



that includes exposure assessment, evolving strategies on the basis of requirements, properly coordinate with the concerned agencies, think beyond numbers with a focus on reduction of toxic constituents, and formulate emission reduction strategies.

Presentations were followed by segments where governance issues were discussed by Dr David G Victor, UC San Diego; Dr Tony Brasil, Chief, Heavy Duty Diesel Implementation Branch, CARB, USA; and Mr R K Singh, Joint Secretary, Ministry of Petroleum and Natural Gas, Government of India. Dr Victor's lecture explored some of the reasons why policies with huge benefit-cost ratios do not always get adopted. He discussed the organization of political interest groups, the division of responsibility for change and accountability for policy failure, and the potential for exogenous technological surprises to 'fix' or alleviate governance failures. He emphasized the role of NGOs and urged participants to bring the issues to the public as an important interest group. This was taken forward by Dr Brasil who highlighted the need for emission reductions, heavy duty emission control strategies, and diesel engine emission reduction strategies. He discussed control strategies (cleaner



fuels, cleaner engines, operational controls, retrofit, and retire) and truck and bus regulations of California. Mr R K Singh gave a description of the Auto Fuel Policy (AFP) of India in detail. He mentioned the progressive improvement of the policy, the roadmap for fuel norms, implementation status, impact analysis of the AFP, and the gap in

the fuel quality between India and that of the Western world. He concluded with the vision and terms of reference that India has on AFP for 2025.

Conclusion: Air pollution levels are enormous in India. Vehicular sector has major contributions. Some interventions have been taken but there is a long way to go reduce share of emissions from the sector.

Plenary session III: Role of state governments in India

Mr U Panwar and Ms M Panwar (both Secretary, Government of Uttarakhand) presented the scenario in the State of



Uttarakhand in India. They explained how the state economy is dependent on tourism activities. Heavy tourist influx (20–25 million), adverse geography, and high vehicular emission lead to problems of air pollution in the urban areas. Traffic density exceeds carrying capacity of the region. Ms Panwar stated that emission and fuel quality standards in India are set by the federal government and felt that Uttarakhand should be provided with better quality of fuels and vehicles. She also supported the introduction of stricter standards of emissions and fuel quality. Mr Panwar mentioned the weak enforcement of laws due to lack of resources and capacity and stressed on the importance of structural and governance reforms and the potential contribution of the Jawaharlal Nehru National Urban Renewal Mission (JNNURM). On public health, Ms Panwar informed that due to a focus on infectious diseases and malnutrition, air pollution and environmental health have taken a back seat; she hopes that these issues get significant attention. Mr Panwar clearly showed his support to carry out a pilot project in the Uttarakhand and looked forward to partnerships with institutions from the US.

Mr Dash expressed his views about the development



that has happened in the State of Gujarat and despite rapid development, there has been considerable improvement in the environmental quality. He specifically mentioned how the city of Ahmedabad, once one of the hotspot cities in terms of air pollution, has improved its air quality considerably and have gone down the list now. He talked about initiatives such as the BRT, introduction of CNG, better monitoring, and enforcement in industries. He also mentioned sensor and camera-based monitoring of industrial stack emissions and introduction of the new emissions trading scheme in the state. He expressed the willingness of the state to establish partnerships and MoUs with US institutions for knowledge sharing and cooperation.

Mr Reddy (Secretary, Tamil Nadu, India) mentioned that cities are major contributors to air pollution due to high emission rates. Its main sources are garbage burning, fuel-induced air pollution, inefficient vehicles, three-wheelers, congestion, and industrial pollution. The mandate for emission control is spread over many agencies ranging from the Regional Transport Office (vehicle testing), Pollution Control Board (industrial and ambient monitoring) to the Chennai Unified Metropolitan Transport Authority, Transport Department, and other state and urban level planning bodies involved in public transport





and development of sustainable alternatives such as pedestrian footpaths and bicycle tracks. In Chennai, out of four areas where PM_{10} is measured, one area (T Nagar) has consistently shown about 80% excess PM_{10} . The area has a high density of commercial development exceeding the Floor Space Index in some cases

by multiples of 3 or 4. Mr Reddy also mentioned that Chennai has become alive to the problem of air pollution in an indirect way, driven by the need to reduce congestion in the city. It has responded by taking steps to increase the penetration and attractiveness of public transport. Between 1971 and 2008, the average annual growth of population is 2 per cent, whereas the growth of vehicles is 12 per cent per annum. About 29 lakh vehicles are already registered in 2010 and 2 lakh vehicles are added every year. The share of public transport has come down from 54% in 1970 to 27% in 2008. The number of trips has doubled and congestion has increased three times. Presently, the average vehicle speed is 15 kmph, which is expected to improve to 25–30 kmph by 2026. The city has an ambitious target of increasing the public transport from 27% to 46% of motorized transport and 70% of all modes by the year 2026 and reduce the private transport from 34% to 15%. There are plans of mass rapid transport systems (MRTS) Phase I, Phase II, and Phase II extension and suburban rail in three directions. About 45 km of Metro rail is under construction and another 28 km is recommended. Plans are also made for Mono rail planning/bidding for 110 km; BRTS is planning stage for 150 km; and outer ring road connecting the industrial area with the port. There are also mobility plans for other major cities in Tamil Nadu, including Coimbatore, Madurai, Tiruppur, and Trichy. Mr Reddy also emphasized the importance of reinforcing the ‘walk to work principle’ in urban planning and development of new industrial estates. Drawing on the California experience, he mentioned that a multi-agency programme for air pollution reduction, setting apart specific actions for each agency, and arranging for independent monitoring of the outcomes periodically would help.

Dr Jessica Seddon concluded the discussions on



governance-related issues. She highlighted some key governance-related points that had emerged in discussions, namely gaps between existing ambient air and emission control standards and the mechanisms for their enforcement; the continuation of political disagreement over efficiency

standards and the importance of being pragmatic about policy design in a democratic setting; and the importance of thinking about institutional changes to support implementation of

sustainable transport planning in addition to addressing vehicle and fuel policy. She also mentioned the potential for coalitions of common interest to be created between those interested in particular policy measures for different reasons. Fuel subsidies, for example, create a fiscal burden in addition to incentivizing diesel use. Dr Seddon drew on a number of social science frameworks for understanding interest groups, political bargaining, and organizational change to explain how these could help in designing incentive-compatible action plans to reduce air pollution.

Dr J Samet (Professor and Flora L Thornton Chair, Department of Preventive Medicine, USC Keck School of Medicine) gave a special talk on air pollution and global health issues. He began his talk with an overview of several infamous air pollution disasters of the 20th century and pointed out that cities in developing countries are now facing the problem of highly deteriorated air quality. He explained the methodologies followed in estimation of global burden of disease due to air pollution. He explained that cohort studies of $PM_{2.5}$ and mortality conducted in the US and Western Europe have been used to assess the dose-response relationships and that new models are needed to estimate exposure-response functions at high levels of PM in Asia, and other regions. He showed that indoor air pollution is the fourth and ambient air pollution is the ninth most important cost of death in the world and much more important in developing countries. Dr Samet showed that 0.6 and 1.2 million deaths are attributed to $PM_{2.5}$ ambient and $PM_{2.5}$ pollution in India and China. He also presented a series of International Agency for Research on Cancer (IARC) announcements which first declared that diesel engine exhausts are carcinogens and very recently outdoor pollution has been linked to growth of cancer cases. He then finally showed the enormity of the problem in the cities of developing countries in terms of their air pollutant levels which are almost 7–10 times more than what you find in cities of developed countries.

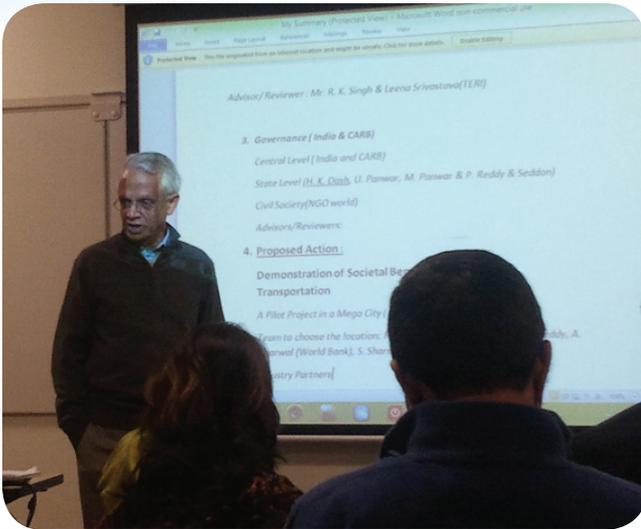
Conclusion: Many Indian states are dealing with problems of vehicular pollution and deterioration of air quality. Some of them have already taken significant measures to combat them. States are willing come forward to establish partnerships for knowledge transfer.

Breakout group discussions

Four multi-disciplinary breakout groups were formed discuss in detail the issues of science, technology, health, and policy related to the transport sector.

Public health

While the general public health effects of transport-related emissions are well-established in global studies, there is a need to better understand the Indian scenario. For assessing the risk due to air pollution, the group recommended for the development of emission inventories, observational networks to monitor black carbon, and contribute to exposure assessments



and assessment of intake fraction and dispersion modelling. It also recommended personal monitoring of intersections and residential home exposure. A discussion was also carried out on biological markers of exposure.

The group recommended that for establishing health outcomes, it is important to rely upon data from the Global Burden of Disease and hospitals/ER admissions; national health data from the Census, National Family Health Survey, and other sources; and personal health data on respiratory or cardiovascular diseases and symptoms from cohort or other long-term follow-up studies. The group especially wished to target the most susceptible subpopulations, such as traffic police and children.

On public health advocacy, the most important means were identified as media, civic mobilization, and NGOs concerned with health.

The main challenges identified by the group include the challenge of identifying a feasible and targeted intervention. Also, in terms of demonstrating the impact of intervention in the transport sector on public health, the change may not be large enough to get distinguished in the midst of other non-diesel sources of pollution. More advanced studies are required which may incur higher costs.

The group clearly identifies public health research as a strong medium to build up compelling evidence for effective policy making on improving air quality.

It was discussed whether perceptions of harm due to air pollution are a recognized crisis. The answer was, “not especially or consistently”. There were episodes of severe pollution-related events that caught peoples’ attention, but these were short-lived. Everyday exposure and air quality didn’t seem to be a much serious problem as the overall numbers would indicate. The implication of the discussion was that while there is scope for attracting attention to the need for policy and other measures to manage air quality, the campaign should be well-timed during higher-pollution months. More generally, the lack of public awareness pointed to the *need for more consistent*

monitoring and reporting of air quality, in ways that were easily intelligible to the public; for instance, neighbourhood colour-coding, ‘smog alerts’, etc.

Economic impact

The group felt that the first thing to do is to clearly define the problem and its objectives. It was felt that to sensitize important policy-makers, the group needs to come up with a 1–2 page document defining the problem, which could be supplemented with publications/evidence that confirm the claims. Ideally, this problem definition would include:

- Baseline assessment of current state
- Scenario if no action is taken, emphasizing concrete and salient impacts such as economic losses in agriculture, lost days of work/school, delays in air traffic, etc.
- Alternative scenario, if action is taken

The group proposed a measurement mechanism to adjudge the impact of interventions. This could be achieved through a combination of tracking of different parameters.

- Changes in emissions from vehicles
- Reductions in ambient air pollution (PM, Black Carbon)

The interventions should be chosen to produce measurable improvements in the near term. Long-term objectives can be mentioned, but will likely not have as much policy impact due to changes in governments. The targets for emission reductions would be developed from the baseline assessment.

It was strongly recommended that to influence policies, air pollution objectives must ultimately be translated into economic impacts that include health damage, agricultural crop loss, lost days of work/school, and delays in air traffic. These could be reported as well as translated into estimates of economic impact for maximum effect.

It was also emphasized that while climate change is a critical consequence of air pollution, glacier melt and other related impacts could not be prioritized over the local impacts over human health and economy.

The group felt that in order to inform the reduction targets for air pollution as well as the problem statement, a baseline study needs to be performed to define the current problem. The baseline study can utilize existing data; e.g., detailed emissions inventories that have been done in the Indian cities, and may involve new data collection through a monitoring network. A monitoring network would be set up, both to measure environmental impacts before, during, and after the intervention.

It was felt that it could be useful to perform an environmental impact study, similar to what was done in the CARB study, focusing on a particular intervention — e.g., introducing CNG in Delhi, construction of a metro, etc. — in order to demonstrate the potential of such a project. A concern was raised on the issue of who will coordinate and run the



initiative/pilot project.

Policy and Governance.

The group reviewed the current system for air quality management in India (outlined in the inception note). Two important points were noted: (i) limited monitoring infrastructure, except around some industrial areas; and (ii) absence of structural coordination between the pollution control authorities (central and state pollution control boards) and land-use planning, infrastructure, and other decision-making that contributes to emissions. The former makes it difficult to track performance, identify hotspots, and enforce national standards, while the latter makes it difficult to develop and implement long-run action plans.

The group discussed ways to motivate states and cities to tackle air pollution in whatever way was most appropriate for their ecological setting, infrastructure, economic structure, etc., by **creating a performance-linked incentive fund**. The central government (or international development bank, or somebody else) would first have to develop the monitoring infrastructure to track performance as well as decide on mutually acceptable performance goals. But, once the goals were set and rewards for achievements determined, it was felt that this kind of 'challenge fund' approach could lead to innovative measures that might also contribute to national learning. The fund would also create a 'demand' for experience and best practices in air quality management, including tools such as the United States State Implementation Plans (SIPs) that could then be shared through CA-India (or

other) capacity-building initiatives.

Technology

Several points were noted:

- There is already a roadmap for cleaner fuels and tighter emission standards. The question is how to *accelerate access to fuels and enforcement of emissions standards* so that the anticipated fleet expansion would come in as cleaner vehicles. Year 2025 might be too late to achieve air quality goals through fleet turnover, as the rate of growth will be slower by then. Can this target be rescheduled to 2020?
- *Would it make sense to leapfrog to Euro VI?* This is something that needs to be investigated. A discussion on the costs of refinery conversion and costs to customers of cleaner fuel took place. An ICCT analysis showed that an up-front cost on the order of \$5 billion and a per-litre cost of 50 paise would be incurred for upgradation of oil refining facilities. This was later questioned by Mr Singh.
- Retrofitting would have to happen along with new vehicle standards in order to have a significant impact on air quality. This could be started by picking high-emitting 'captive fleets', such as drayage, city vehicles (trash trucks), buses, and public fleets. The cost of retrofitting need to be established, along with the potential for indigenous filter technology development.
- These measures would require significant amount of funding. Perhaps, these could come as some kind of climate mitigation finance.

The policy recommendations provided on Page 39 of the

Inception Draft is reproduced as Table 1. The data was reviewed and endorsed by the breakout group.

Table 1: Plan to mandate lower sulphur content (10 ppm) for all road vehicle fuels and tighten emission standards to Euro 6/VI

Mandate lower sulfur content (10 ppm) for all road-vehicle fuels and tighten emission standards to Euro 6/VI and beyond for all vehicle types is feasible within a near-term timeline. Table 2 below shows feasible timeline.

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Fuel Sulfur content (ppm)	50			10							
LDV Emission Standard	BS Va		BS Vb		BS VI			Euro 7/US Tier 3 equivalent			
HDV Emission Standard	BS V				BS VI			Euro VI/US2010 equivalent			
2/3-Wheeler Emission Standard	BS IV				BS V			BS VI			

All implementation dates are for the beginning of the fiscal year (April 1)

and beyond for all vehicle types is feasible within a near-term timeline

Beyond vehicles: Transport systems

While much of the workshop focused on California's experience with fuel and vehicle emissions control, participants also emphasized the need for India to address other aspects of sustainable transport. The group identified a number of challenges in the area of urban transport in India. They are issues related to mobility, congestion, insufficient linkages to urban planning, appropriate role of government, institutional jurisdictions, lack of sufficient financial and technical capacity and resources, lack of alignment between what individuals want (comfortable, affordable, reliable service) with government concerns (pollution, public health, financial health), and lack of public education and understanding,

The group identified short-term biases as the need for supporting infrastructure, financial systems, and technical capacity. There is a need to consider feasibility to create a viable and sustainable urban transport system. *It was stressed upon that capacity building and institutional strengthening is the key, just technological interventions will not work.* Traffic demand management is equally important as supply side management. Urban reform and linkages to planning processes are found to be very important. There is a need for understanding financial viability of the alternatives, as well as financial mechanisms and cost sharing. There needs to be a balance between affordability and willingness to pay. We now need to think about viability gap, facilitation funding, etc., instead of subsidies.

The group also discussed the indicators of urban transport; e.g., technical (visibility, air quality) and economic (travel time, perhaps monetized; affordability of use, convenience and reliability).

Surveys need to be planned with adequate needs assessment and public perceptions that seek to answers for the identification of problems, willingness to pay for improved service, affordability, quality of service, changes with the interventions, etc.

The group opined of having an experiment/pilot project which is well-structured, and systemic. They emphasized on adequate measurement and communication of the results. They also stressed on its replication on a bigger scale in the long run.

A specific case of Dehradun, Uttarakhand, was discussed where specific challenges (seasonal traffic transit to Mussoorie) and tourist surges have been encountered. The matter is further complicated by heavy construction activities going on in the city. A high proportion of small school buses offer, both challenge and opportunities in the city. There could be opportunities for hybrids, newer technologies, however they are not in compliance with **Jawaharlal Nehru National Urban Renewal Mission (JNNURM)** standards. There is a need for full-time technical assistance and/or consultants to ensure

successful implementation, and a plan to ensure financial sustainability.

Major Discussions and Outcomes of the Workshop

- Air pollution has been a major issue in India now. A total of 80% cities violate PM standards and about to violate NOx standards
- Air pollution is resulting in severe health damage; 0.6 million mortalities attributed to ambient air pollution in India. It has emerged as fifth highest killer (cause of death) in India. The gaseous pollutants also add to the health burden along with effects over agricultural productivity (especially of ozone)
- There is a need to provide a sound science base involving the creation of an emission inventory and a robust modelling system to appropriately target major sources of emissions creating adverse air quality
- California has reduced ambient pollutant concentrations by reducing emissions from transport sector, despite a multi-fold increase in diesel consumption and continued economic growth. India can learn from this experience and customize the options as per local conditions to reap maximum benefits
- India has a road map of achieving BS-IV norms in some cities and BS-III all across India by the year 2010. However, currently there is no way ahead after that. There is an Auto Fuel Policy Vision Committee in place to lay down afresh roadmap for further advancement of vehicular emissions and fuel quality norms in India
- The workshop has recommended major advancement of vehicular emissions and fuel quality norms (to Euro-VI equivalent and above) by the end of this decade.
- It was also concluded that urban reforms, capacity building, and institutional strengthening is equally important as just technological interventions will not work effectively
- A robust legal framework should exist for implementing and enforcing the regulations.
- It was recommended that a Public Awareness and Mobilization (PAM) campaign should be launched with a preferred implementation time of November through January when air quality is typically very bad
- As a major outcome, the workshop has called for partnerships between the US and Indian institutions (government and private) for knowledge sharing and support. An MoU between California and few of the state governments in India also seems to be a great possibility
- It has been decided that an action agenda will be prepared



to clearly draft customized strategies for India to reduce vehicular emissions

- It has been decided to formulate a pilot project based on the recommendations to demonstrate the societal benefits of clean diesel transportation
- A policy conclave will be organized in New Delhi in February 2014 wherein the action agenda will be discussed with broader group of stakeholders including policy-makers

Key Policy Recommendations

- Need to examine the recommendations in the new Auto Fuels Policy 2025 report. (This report is expected to be issued in the next month). We should review these recommendations and look for synergies with the list of recommendations in the inception draft. It'll be important to take advantage of this newly issued policy document to re-enforce/modify our policy recommendations
- Need to emphasize the need for public transit as well as to make sure that adequate consideration is made to maintain a viable non-motorized transit system within the cities.
- Need to leverage the success in the California programmes by retrofitting diesel vehicles with particulate traps. In order to do this, an analysis needs to be carried out for different regions in India and to select criteria for the selection of cities. Cities should be selected based upon analysis of chances for success by retrofitting the on road diesel fleet. (There was a strong feeling that we need to make sure that we can deliver what is promised.)
- In selection of the cities in India, it is important to keep an eye on the potential transferability of the approach used for the cities to others in the Asian region. The World Bank has made it clear that one attraction of this programme is to be able to transfer the approach to other polluted cities in the region. In this case the World Bank will play a larger role in selecting the cities

- In some cities, it is recommended that the focus should be on government fleets such as buses, garbage trucks etc., so that the chances of success would be maximized

Can success in California be used to inform Policy in India?

The following policy recommendations flow from an examination of what policies were successful in reducing per vehicle emissions California and what may be appropriate for India, recognizing that broader considerations in land use planning, public transport, and roles of various modes of transport are also relevant for India:

- Follow a systems approach whereby vehicles and fuels are integrated as a system
- Set up an incentive programme, financial if possible, to remove old vehicles from the road
- Provide a sound science base involving the creation of an emission inventory and a robust modelling system so that one can appropriately target the major sources of emissions creating adverse air quality. This would include both industrial, domestic, and transportation related sources
- A comprehensive monitoring programme should be set up and maintained to assess the impact of control technologies on air quality
- A policy needs to be set up on enforcement to provide the government with the authority to recall defective vehicles and to enforce fuel quality standards
- A robust legal framework should exist for implementing the regulations. For example in California, the federal government, state government, regional environmental agencies, and local prosecutors and private citizens can all bring legal action. A similar setup, tailored to India, should be recommended
- In addition to the above, the successful enforcement of regulations in California includes the imposition of statutory fines which have increased over time and with the severity of noncompliance
- Lastly it was recommended that a PAM campaign (PAM) should be launched with a preferred implementation time of November through January when air quality is typically bad



For feedback, contribution or subscription, please write to:

India-California Air Pollution Mitigation Program (ICAMP)

Sumit Sharma

Centre for Environmental Studies | Earth Science and Climate Change Division | The Energy and Resources Institute (TERI)
IHC complex, Lodi Road, New Delhi-3 | Phone: 011-24682100, 24682111 | Fax: 011-24682144