

India-California Air Pollution Mitigation Program (ICAMP)

Initiative for Mitigating Air Pollution
from the Transportation Sector

Co-Chairs: R.K. Pachauri, M. Nichols, and V. Ramanathan

A joint initiative by the University of California at San Diego (UCSD),
The Energy Resources Institute (TERI), India,
and the California Air Resources Board (CARB)

Sponsor: The World Bank



**India-California Air Pollution
Mitigation Program Technical
Proposal to World Bank
July 1, 2013**



ICAPM-I

Indo-California Air Pollution Mitigation Initiative Identifying Practical Approaches to Reduce Emissions from Transport Sector

D. Description of Approach, Methodology and Work Plan

Objective: To convene stakeholders and experts concerned with public health, environmental damage and climate change, environmental justice, economic development, and transport industry competitiveness to develop an action agenda of scientific research, technology development, and innovative pilot programs to reduce black carbon and ozone precursor emissions from the transportation sector in India.

a. TECHNICAL APPROACH AND METHODOLOGY

Reduction of black carbon and ozone precursors represents an important opportunity for furthering human development and mitigating climate change.

Transport-related emissions of black carbon (BC) and tropospheric (ground level) ozone precursors are damaging to the environment, health, crop yields and climate. Globally, there are three primary societal benefits of mitigating black carbon and ozone: First, their mitigation would save millions of premature deaths and morbidity that result from both direct and indirect effects of these pollutants. Indoor air pollution was linked to 3.5 million premature deaths in 2010, and ambient air pollution to another 3.2 million.¹ Second, it will protect billions of dollars worth of crops lost annually to air pollution damages. Published estimates of crop losses range from \$11-18 billion annually for rice, maize, wheat, and other staples of global food security. Third, technologically feasible reductions in BC, methane and ozone precursor emissions could reduce the anticipated increase in global temperature over the coming decades by about half.² Although reducing CO₂ emissions is essential for avoiding climate change over the longer run, this would lessen the prospects for dangerous warming by mid century.

Diesel combustion in the transport sector is a major contributor to the BC and NO_x emissions. NO_x is an important pre-cursor for ozone. The prevalence of dark particles among the emissions makes them an especially powerful contributor to atmospheric warming. The World Health

¹ Lim, et al (2012). A comparative risk assessment of burden of disease and injury attributable to 67 risk factors and risk factor clusters in 21 regions, 1990–2010: a systematic analysis for the Global Burden of Disease Study 2010. *The Lancet* - 15 December 2012 (Vol. 380, Issue 9859, Pages 2224-2260) DOI: 10.1016/S0140-6736(12)61766-8

² Recent scientific studies summarised in the UNEP/WMO 2011 Integrated Assessment of Black Carbon and Tropospheric Ozone have demonstrated that reducing BC and methane (an ozone precursor) emissions using known technologies and practices has the potential to reduce the average global warming experienced over the next four decades by 0.5°C (range 0.2-0.7°C).

Organization (WHO) also classified diesel engine exhaust as carcinogenic in 2012, following on substantial evidence of a link between emissions and lung cancer as well as respiratory illness.

India's air pollution is a known public health and environmental challenge that is likely to stay for long in a business as usual scenario. It is embedded in a complex political and institutional environment that has, so far, limited significant change – although there are signs of increasing pressure and appetite for air pollution reduction. For example, national ambient air quality norms in India have been tightened, and funds have been allocated to strengthen national air quality monitoring efforts. State Governments in Gujrat, Tamil Nadu and elsewhere have experimented with increased industrial monitoring as well as citizen audits.

- The majority of Indian cities (about 80%) have shown high levels of ambient particulate concentration, well above even current legal standards for ambient air quality. Many of the cities violate the standards by more than 2 to 3 times. This conclusion is based on limited measurements (both in terms of number of stations and pollutants) – the actual situation on the ground could be much worse, particularly in increasingly congested smaller cities that are hubs for freight transport and lack access to higher-quality fuels mandated for certain cities. The limited data also obviously constrain regulatory enforcement capacity, above and beyond the political and administrative challenges of enforcement. As per a study conducted by the Central Pollution Control Board (CPCB) in six cities (Delhi, Kanpur, Bangalore, Pune, Chennai and Mumbai) the transport sector contributes a majority of NO_x and 30-50% of the PM emissions. High levels of PM concentrations in Indian cities have exposed a significant part of the population to acute and chronic health effects. In 2010, the WHO calculated a respiratory disease mortality rate of 101 persons per 100,000 in India. Research studies by TERI also attributed 50 thousands mortalities to ambient air pollution in India.
- This situation is likely to continue in the future as India's economic growth creates pressure for more freight transport by road as well as more passenger vehicles, particularly the two- and three-wheelers that are accessible to lower-income groups.
 - The increase in the number of vehicles could be reduced if standing policy recommendations to reduce rail freight tariffs, invest in freight capacity, and expand urban public transport are accepted and implemented. However, this dramatic modal shift is not going to take place in a shorter time frame. Moreover, the dependence of rail transport on diesel (about 50% in passenger and 35-37% in freight) and the concomitant diesel particulate emissions have been the sources of concern.
 - Emissions could also decrease if currently-discussed policy recommendations regarding fuel standards and emissions control technologies are accepted and implemented. As the experience of many countries with regulatory initiatives that

create additional costs for industries involved in transportation shows, however, such efforts have historically been opposed.

- The subsidy regime in India makes diesel prices cheaper than petrol for all customers, creating a strong incentive for passenger and freight vehicles to use diesel. The diesel prevailing in the market is also relatively high-sulphur. Currently, Euro-IV equivalent fuel is provided in only few Indian cities and rest of the country is fuelled with Euro-III equivalent diesel. This also limits the potential for use of tail-pipe control and treatment devices for PM reduction.
- While the general policy outlook remains challenging, there are some nascent policy experiments and political momentum to build on, including the National Black Carbon Research Initiative, introduction of tighter vehicular emissions and fuel quality norms, advocacy and pursuit of cases that have led to court orders in various cities for conversion of public transport and auto-rickshaws to CNG.

The California Air Resources Board (CARB) has successfully implemented a variety of emissions control measures that have led to declining emissions, and declining ambient concentration of PM and black carbon even as the overall fleet size and diesel consumption have increased significantly. (Ramanathan et al, 2013) This experience offers valuable lessons for other regulators.

- California has been able to reduce ambient BC concentrations by 50% in the last 20 years despite a 50% growth in diesel consumption. Going back to the 1960s, the reduction in ambient BC is about 80% despite a fourfold increase in diesel consumption.
- Though the regulatory environment in California is distinct from that in India and its states, the foundation of science, air quality monitoring, and policy actions integrated with transport and land use planning could offer lessons applicable to India.
- CARB's main objective in targeting the diesel transportation sector was to mitigate the health effects of PM exposure, which is also a source of major concern for India.
- Some of the policies and programs undertaken by CARB have been attempted, with some modification, in countries of varying income levels and administrative infrastructure. These lessons could also provide valuable insight for efforts to learn from experience.
- Other than the road transport sector, California has experiences to share on reducing diesel based emissions from locomotives and managing air quality at potential "hot spots" such as ports and rail yards.

This project envisages knowledge transfer for capacity building to accelerate integration of PM and black carbon reduction with on-going transport development initiatives in India.

This could later lead to the building of robust frameworks for similar knowledge-to-action dialogues in other issue areas and in different countries of South Asia.

Our primary goal is to develop concrete, practical pathways for reducing health, agriculture, and climate-damaging black carbon and ozone pre-cursor emissions from the transportation sector.

The first steps in this pathway include identifying

- A research agenda to inform policy choice,
- Technology developments required to enable innovative emissions reduction programmes (regulatory, market-based, and otherwise), and
- Effective, incentive-compatible interventions to be pilot-tested.

We propose to organise a joint program of knowledge exchange and stakeholder dialogue between world-renowned scientists, policymakers and air quality regulators from India and California, and stakeholders in India's air quality management.

We use three steps to generate an action agenda for scientific research, technology development, and specific, feasible interventions - to promote a low-emission development path for India's transport sector:

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

TERI's Director General Dr. Pachauri, hosting the event in India, is expected to invite the Indian Minister of Environment and Forests. We will invite senior leaders from the Planning Commission, Ministry of Road Transport and Highways, Ministry of Petroleum and Natural Gas and other relevant Ministries and elected leaders and Chief Ministers of selected states and metropolitan leaders to ensure the integration of environmental and development objectives at national and sub-national levels. This meeting is expected to help refine and build stakeholder confidence in a robust air quality governance program that is more firmly integrated with broader investments and policy plans for transport. The meeting will highlight the potential of BC and ozone precursor reduction policies in mitigating the health and other impacts due to vehicular emissions.

The process draws on insights from the literature on regulatory innovation, in particular the approach “controlling of harms” by examining the production of harm (such as emissions) closely to identify points where it is most vulnerable to disruption.³

The initial focus will be on India. Output from our proposal will be applicable to Bangladesh and other South Asian countries and potentially to other nations with similar socio-economic and policy contexts.

The exchange of in-depth knowledge on the socio-economic ecosystems underlying transport emissions, the lessons from regulatory and non-regulatory experience in both countries, and the perspectives of influential stakeholders in emission mitigation will contribute to four main results:

- Broader sensitisation of policymakers/stakeholder groups on the issues of BC and other emissions from transport sector.
- Formation of new issue-based professional networks for continuing dialogue on emissions mitigation as the state of science, technologies, and monitoring evolves.
- Social innovation, or the adaptation of existing experience and success into specific proposals for contextually appropriate, regulatory and non-regulatory instruments for rapid results in an important global economy.
- Development and testing of a format for science-policy-development dialogue that could be replicated for other aspects of SLCP mitigation as well as in other policy areas where solutions rely on local, contextualized knowledge in addition to global science, innovation, and resources.

There are successful precedents for this kind of work. In renewable energy, a series of conferences in Bonn, Beijing, Washington and India brought together prominent scientists with policy makers and business people to exchange ideas so that successful models in one country or region could be adapted to fit the economic and cultural context in another. In the case of the Washington International Renewable Energy Conference, 144 pledges to apply renewable energy solutions emerged from the municipal, regional and national participants.

b. WORK PLAN

TASK 1. PREPARATION OF A BACKGROUND PAPER: (MONTH 1-3)

The Background Paper will have two sections:

³ See, for example, Sparrow, Malcom (2008). *The Character of Harms : Operational Challenges in Control*. Cambridge University Press.

The first section will summarize the successful experience of the California Air Resources Board (CARB) in controlling the air pollution in the transport sector of California. The section will review the achievement of emissions reduction while the overall fleet size has increased; the design and enforcement of a variety of emissions control measures; and the valuable lessons for other regulators offered by this experience.

In the second section, preliminary research will be carried out on the state of the transportation sector in India, covering the emissions from the transport sector and their contribution to the total of the major pollutants (PMs as a whole and Black carbon in particular, O₃, and its precursors - NO_x, and VOCs); the different kinds, the sources and the quality of the fuels used in this sector; the trend of the transport sector in terms of the total number and the profile of the fleets etc. over the last decade or so; highlights of the enormity of the issue, compile available estimates of the local and regional impacts of these pollutants on public health, agricultural production, climate and water supply etc.; the estimated impacts on global climate; existing policies, laws, and regulation (PLRs) and other control measures taken for their abatement; and institutions that are responsible for the emission control and fuel quality regulation.

Output 1: Background Paper

The Background Paper will be based on secondary literature and data analysis. The paper will prove the successful experience of CARB in controlling air pollution in the transport sector and provide an overview of the transport sector in India and the potential for replicating the CARB experience. This paper is intended to sensitize Indian's policy makers on key scientific findings on impact and the range of policy options and opportunities for remediation. It will be a starting point for the knowledge exchange program in California.

TASK 2. ORGANIZE A KNOWLEDGE EXCHANGE WORKSHOP AT UCSD AND A SITE VISIT WITH CARB (MONTH 4)

The Regulatory Innovation Workshop will be a meeting of regulators, policymakers from national and state levels in India, and scientists from India, with counterparts in California, and scholars with expertise in regulatory design to discuss current practices in air quality management, potential opportunities for innovation, and lessons from experience. This could help sensitize regulators and scientists to ways that they can work together for emissions monitoring, policy formation, and policy advocacy. It could also expose regulators to current and best practices in the field.

CARB staff will brief Indian delegates about how they operate; how they are governed; how they support targeted science and targeted field mitigation trials; how their ground network of BC, Ozone and PM monitors are maintained; and how they are calibrated in standard facilities costs entailed. Management and Site Visit participants from the California Air Resource Board are as follows:

Mary D. Nichols, Chairman; Kurt Karperos, Chief of Planning and Science Division, Air pollution policy and planning; Edie Chang, Deputy Executive Officer, AB32 climate program; Bart Croes, Chief of Research Division; Jorn Herner, Chief of Emissions Research, Diesel
Todd Sax, Chief of Mobile Source Analysis, Emission Inventory Methods; and Michael Benjamin, Chief of Monitoring and Laboratory Division, Routine PM Monitoring Methods.

Overall, the Workshop will provide the participants with the details of the policy environment and points of leverage for any approach to reducing transport sector emissions in India. This, in combination with the display of the CARB “live, interactive case study” of opportunities, will establish a basis from which the Indian meeting can identify prospective interventions.

It is expected that key experts from India will participate in the Workshop at UCSD and Site Visit with CARB.

Output 2: Workshop and Site Visit in California

Successful delivery of a workshop in UCSD and a site visit to CARB. Workshop documentation to be submitted after the events.

The workshop and site visit will help identify several (3-5) **high potential interventions** to be fleshed out as policy proposals by the Consulting Experts in continued dialogue with the participants in the workshop. This will initiate the process of knowledge to action. The feasibility and enabling conditions of these potential interventions for India will be analysed in detail in Task 3 – Develop the Action Agenda.

The Site Visit will make sure all the participants have a firm grasp of the science, technology, and policies of the problem and have a good understanding of a broader range of options for significantly cutting BC emissions from the transportation sector in spite of exponential growth in the sector.

TASK 3. DEVELOP AN ACTION AGENDA: (MONTH 4-10)

The team would undertake additional research to generate specific proposals for research agendas, technology development, and potential interventions based on ideas that come from the California meetings and in-depth analysis of the proposed items against the specific situation of India. To develop this Action Agenda, the following analysis will be undertaken:

- Analyze the techno-economic feasibility of the proposed pollution control measures;
- Discuss the applicability of the proposed **high potential interventions** identified in Task 2, in the specific economic, social, institution, and political contexts of India;
- Identify the knowledge gaps and existing/missing economic-social elements that will prevent the proposed interventions from being effectively implemented; and
- Propose action plans to address the knowledge gaps and to deal with the existing/missing economic-social elements to eventually achieve the goal of emissions control.

This draft would be developed in ongoing consultation with the participants in the workshop and dialogues.

Output 3: Draft Action Agenda

A Draft Action Agenda of SLCP emissions control from the transport sector of India will be delivered. The Draft Action Agenda will cover the research, technology development, and policy intervention design based on detailed analyses of the ideas emerging from the workshop and knowledge transfer.

TASK 4. POLICY CONCLAVE IN NEW DELHI: (MONTH 10-14)

Principals will organize a high-level policy discussion focusing on national and key subnational actors in India around the interventions identified in the first meeting. The goal at this point will be to sensitize the policy makers at the central and state levels on the issue of BC and Ozone control and build a coalition of key stakeholders in near term action. This meeting will be held in the spring of 2014 and would comprise an initial technical discussion to review and refine this draft action plan, and culminate in a high-level consultation with key policymakers and industry leaders in India.

It is expected that participants from the US, in addition to the experts from India, will be invited to the Policy Conclave in New Delhi.

Output 4: Workshop in Delhi and Final Action Agenda

- 1 Final Action Agenda;
- 2 A coalition established to follow up on the near-term actions;
- 3 Documentation of the Policy Conclave in New Delhi.

Proposed Deliverable & Payment Schedule

- 10% upon contract signature
- 30% upon delivery of Output 1 (Background Paper)
- 30% upon delivery of Output 2 (Knowledge Exchange Workshop in UCSD and the Experience Site Visit with CARB)
- 20% upon submission of Output 3 (Draft Action Agenda)
- 10% upon delivery of Output 4 (Workshop in New Delhi and Final Action Agenda)

c. ORGANIZATION AND STAFFING

The coordinating institutions of the two workshops are: The University of California, San Diego's Scripps Institution of Oceanography, The Energy Resources Institute in Delhi and the California Air Resources Board.

Leadership for the project will be provided by an Advisory Group composed of Dr. Rajendra Pachauri; Mary Nichols, Chairman of the California Air Resources Board; and Dr. V. Ramanathan.

The Advisory Group will benefit from the counsel of a broader Steering Committee composed of Bart Croes, (CARB Research Chief); V. Ramanathan (UCSD-SIO); Catherine Witherspoon

(independent consultant); Jessica Seddon (Okapi), A. Lloyd The International Council for Clean Transportation (ICCT), and potentially others as the project develops.

Scientific leadership will come from Professor V. Ramanathan who is one of the most accomplished scientists in the world for black carbon and other short lived climate pollutants. Ramanathan is a Distinguished Professor at the Scripps Institution of Oceanography, University of California, San Diego. He discovered the greenhouse effect of chlorofluorocarbons and numerous other manmade trace gases. Along with Paul Crutzen, he led an international team that first discovered the widespread Atmospheric Brown Clouds (ABCs). He showed that ABCs led to large scale dimming, decreased monsoon rainfall and rice harvest in India, and played a dominant role in the melting of the Himalayan glaciers. Professor Ramanathan is the Chair of the Surya Project. The Surya project provides sustainable, effective, incentive-based action plans, infrastructure and technologies to switch to cleaner-burning technologies such as efficient stove technologies, solar cookers, solar lamps and biogas plants. His awards include the Tyler prize, the Volvo Prize, the Rossby Prize and the Zayed prize. He has been elected to the US National Academy of Sciences, American Philosophical Society, the Pontifical Academy by Pope John Paul II and the Royal Swedish Academy of Sciences, which awards Nobel Prizes. In 2012, he was honoured by Pope Benedict with an appointment to the Council of the Vatican Academy. In 2012, UNESCO awarded the Climate and Policy professorship to Ramanathan in New Delhi, India.

Dr. Rajendra Kumar Pachauri is the Chair of the Nobel Peace Prize-winning Intergovernmental Panel on Climate Change (IPCC), the scientific intergovernmental body that provides decision-makers and the public with an objective source of information about climate change. He is also Director General of TERI (The Energy and Resources Institute), a major independent research organization providing knowledge on energy, environment, forestry, biotechnology, and the conservation of natural resources. Dr. Pachauri is a prominent researcher on environmental subjects, recognized internationally for his efforts to build up and disseminate greater knowledge about man-made climate change and to lay the foundations for the measures that are needed to counteract such change. He has been appointed as Senior Adviser to the Yale Climate and Energy Institute (YCEI) from July 2012 prior to which he was the Founding Director of YCEI (July 2009 – June 2012). He is active in several international forums dealing with the subject of climate change and its policy dimensions. He was awarded the second-highest civilian award in India, the 'Padma Vibhushan', in January 2008 by the President of India and received the 'Officier De La Légion D'Honneur' from the Government of France in 2006. He has been conferred with 'The Order of the Rising Sun, Gold and Silver Star' by His Majesty Akihito, Emperor of Japan, the 'Commander of the Order of the White Rose of Finland' by the Prime Minister of Finland, the 'Commander of the Order of Leopold II' by the King of the Belgians and Mexican Order of the 'Aztec Eagle' by the President of Mexico in June 2012.

With a distinguished 33 year Foreign Service career, Ambassador Reno Harnish is experienced in the development of frameworks for international cooperation. As Principal Deputy Assistant Secretary of State for Oceans, Environment and Science, he organized and chaired the Washington International Renewable Energy Conference, which brought together the US President, four US Cabinet members and 125 Ministers in a three day event that resulted in more than 145 commitments by nations, cities and companies to adopt renewable energy. Ambassador Harnish led the US Government team of nine agencies in a process including the development of an information sharing web process through the Renewable Energy and Energy Efficiency Partnership (REEEP). Also through REEEP he facilitated three regional preparatory sessions for the developing countries in Africa, Latin America and Asia; and through the Renewable Energy Policy Network for the 21st Century (REN-21) he promoted international dialogue on renewable energy adoption. Later, in 2009, he led the negotiation of US entry into the International Renewable Energy Agency and signed the founding document that year. He also convened numerous international meetings in his role as US Ambassador in Azerbaijan and Chief of Mission in Kosovo.

Dr. Jessica Seddon (Wallack)'s research and consulting focus on institutional design for integrating environmental and other development goals in public and private infrastructure investment. She is the Founder and Managing Director of Okapi Research and Advisory, a professional network and consulting group. Dr. Seddon has advised a number of state and national government initiatives in India, most recently the Prime Ministers' National Transport Development Policy Committee and the High Powered Expert Committee on Urban Infrastructure. She is currently involved in developing interdisciplinary, practice-grounded research and innovation programs as Head of Knowledge Management at Villgro Innovations Foundation, a social enterprise incubator, and as Senior Research Advisor at the Indian Institute for Human Settlements, a prospective National Innovation University focused on urban issues. Dr. Seddon also serves on the advisory boards of the Wilderhill Global Clean Energy Index (NEX) and Prakti Design. She has published book chapters and articles on infrastructure, Indian political economy, IT and governance, environmental regulation and other institutional design topics in international academic and policy journals including Foreign Affairs and Harvard Business Review. Her work has been supported by grants from Google.org, Australian Development Research Awards, ICICI Foundation for Inclusive Growth, Stanford University, and University of California, San Diego, among others. She is a term member of the Council on Foreign Relations, and former CFR International Affairs Fellow with the U.S. Environmental Protection Agency. Prior to founding Okapi, Dr. Seddon served as Head of Research at the Indian Institute for Human Settlements, Director of the Centre for Development Finance at the Institute for Financial and Management Research in Chennai, and Assistant Professor, Political Economy, at UC San Diego's Graduate School of International Relations and Pacific Studies. She has also worked in the Chief Economists' Offices of the World Bank and Inter-American

Development Bank. Dr. Seddon earned her Ph.D. from Stanford University Graduate School of Business and her B.A. from Harvard University.

Sumit Sharma is a Fellow and Area Convenor of the CES (Centre for Environmental Studies) group of TERI. Qualified by the graduate and post-graduate degrees from Delhi College of Engineering and Indian Institute of Technology-Delhi, respectively, he has been working in the group for last 9 years. He has worked on number of projects related to air quality management which involves air quality monitoring, emission inventories, air quality modelling (dispersion and receptor), and drafting air quality management plans. Recently, he has worked on the source apportionment study carried out for the city of Bangalore, in which he was actively involved in carrying out air quality modelling exercises and developing scenarios for air quality improvement. He also has been working on regional scale ozone pollution in which state of the art WRF-CMAQ air quality models are used for prediction of air quality based on future scenarios. During his work, he has been interacting with number of Government agencies like MoEF, and CPCB, corporate sector, and academic institutes. He has also been conducting workshops and training programs in India for sensitization and capacity building of various stakeholders groups on the issue of air pollution.

ANNEX 1: TEAM COMPOSITION, TASK ASSIGNMENTS & LEVEL OF EFFORT (LOE)

Key Personnel

Name of Staff & Firm associated with ⁴	Area of Expertise Relevant to the Assignment	Designation for this Assignment ⁵	Assigned Tasks or Deliverables	Location ⁶	Number of Months
Veerabradhan Ramanathan, Scripps Institution of Oceanography	Science of short lived climate pollutants	Project Lead/Principal Investigator	Background, Draft and Final Action Agenda	San Diego, CA, USA	1
Reno Harnish, Scripps Institution of Oceanography	U.S. Ambassador (ret.)	Co-Principal Investigator	Knowledge Exchange Workshop and CARB site meeting Lead	San Diego, CA, USA	2.25
Mr. Sumit Sharma, TERI	Air quality, emissions and control	Project Investigator, TERI Principal Investigator	Air quality, emissions and control	New Delhi, India	4
Dr. Leena Srivastava, TERI, employee, local	Advisor	Policy conclave	Advisor to Policy conclave	New Delhi, India	0.5
Dr. IH Rehman, TERI, employee, local	Advisor	Policy Conclave	Overall coordinator to Policy Conclave	New Delhi, India	0.5
Dr. Arabinda Mishra, TERI, employee, local	Advisor	Policy Conclave	Coordinating policy conclave	New Delhi, India	0.75

⁴ Indicate if the proposed staff is an employee or agent of your consulting firm/organization or a sub consultant.

⁵ Title or position as described in the TOR or otherwise named in your proposed Organization and Staffing under Section D, sub section (c).

⁶ Relative to the assignment subject of the Contract, indicate if the staff/consultant local or international.

Dr. Anindita Dutta , TERI, employee, local	Environmental health expert	Policy Conclave	Environmental health expert for Policy Conclave	New Delhi, India	2
Ms. Anju Goel, TERI, employee, local	Transport emissions expert	Policy Conclave	Transport emissions expert for Policy Conclave	New Delhi, India	3
Ms. Akshima Ghate , TERI, employee, local	Sustainable transport expert	Policy Conclave	Sustainable transport expert for Policy Conclave	New Delhi, India	2.5
Dr. Jessica Seddon, OKAPI Research	Regulatory Policy Options	Project Investigator, Okapi Principal Investigator	Regulatory Policy Options	Mumbai, India	1.1

ANNEX 2: CURRICULUM VITAE (CV) OF PROPOSED KEY PERSONNEL

Biographical Sketch**V. RAMANATHAN****(a) Education:**

Annamalai University, India	Engineering	B.E., 1965
Indian Institution of Science,	Engineering	M.Sc., 1970
State University of New York at Stony Brook	Planetary Atmosphere	Ph.D., 1974

(b) Appointments:**Faculty Positions:**

2005- date: Distinguished Professor, Scripps Institution of Oceanography, University of California at San Diego

2013-Date : UNESCO Professor of Climate and Policy, TERI University, India

1990- Date: Victor Alderson Professor of Applied Ocean Sciences, Scripps Institution of Oceanography, University of California at San Diego

Research Positions:

1991-date: Director, Center for Clouds, Chemistry and Climate, Scripps Institution of Oceanography, University of California San Diego, La Jolla, California

1996-2010: Director, Center for Atmospheric Sciences, Scripps Institution of Oceanography, University of California San Diego, La Jolla, California

1998: First K.R., Ramanathan Visiting Professor, Physical Research Laboratory, India

OTHER POSITIONS:

1992-date: Board of Directors, Tata Energy Research Institute, Arlington, Virginia

1993: Chief Scientist, Central Equatorial Pacific Experiment (CEPEX)

1996-2002: Co-Chief Scientist, Indian Ocean Experiment (INDOEX)

1996-2002: Chair, International Steering Committee, (INDOEX)

1999-2000: Science Editorial Board, NASA Earth Observatory

2002-2008: Co-Chief Scientist, The Atmospheric Brown Cloud Project (ABC)

2005-2006: Member, NCAR, Earth Observing Laboratory External Advisory Committee

2005-date: Chairman, International ABC project

2006-2009: Chairman, National Academy of Sciences Committee for giving strategic advice to the US Climate Change Science Program

2008-2011: Vice-Chair, UNEP-WMO assessment committee for Black Carbon and Ozone

2012-date: Member, Science Advisory Panel, Climate and Clean Air Coalition, UNEP.

(c) Honors

Elected to the **Royal Swedish Academy of Sciences**, 2011

Tyler Prize for Environment with co-recipient Dr. Richard Alley, February 2009.

Commencement Speech, University of California, San Diego Sixth College, June 13, 2009

Zayed Prize for scientific and technological achievements in environment with co-recipient Prof. Jane Lubchenco, June 2008

Cozzarelli Prize. The National Academy of Sciences, 2007

Bjerknes Lecture, American Geophysical Union, Global Dimming and Its Masking Effect on Global Warming, 2006

Elected to **American Philosophical Society**, 2006

Member, **Pontifical Academy of Sciences**, 2004

Elected to **U.S. National Academy of Sciences**, 2002-Date

Volvo Environment Prize, 1997 (shared with S. Manabe).

"for pioneering work over several decades has helped us to understand one of the critical aspects of human activity"

Foreign Member, **Academia Europaea**, 1996

Johannes Gutenberg Lecturer, Mainz, Germany, 2004

Pioneer Award, the National Science Foundation, October 2003

"In recognition of your vision, leadership, and entrepreneurial spirit in pioneering the Science and Technology Center concept."

Rosby Medal, American Meteorological Society, 2002

The highest award given by AMS *"for fundamental insights into the radiative roles of clouds, aerosols and key gases in the earth's climate system"*

W. S. Jardetzky Lecturer, Lamont Doherty Observatory, Columbia University, 2000

Elected to Stony Brook 40; Among Stony Brook's Finest Philosophers, Financiers, Administrators, Inventors, Jurists, Philanthropists..... State University of Stony Brook, 1998

Fellow, American Academy of Arts and Sciences, 1995

Buys Ballot Medal, Royal Netherlands Academy of Sciences, 1995 One of the oldest prizes by the academy established in 1887 and given once every ten years.

"for outstanding scientific work in the science of the atmosphere over the last decade"

Medal for Exceptional Scientific Achievement, NASA, 1989

(d) Selected Publications

- 1) Hu, A., Y. Xu, C. Tebaldi, W. M. Washington, and V. Ramanathan (2013), [Mitigation of short-lived climate pollutants slows sea-level rise](#) *Nature Climate Change* 3(5), 1–5, doi:10.1038/nclimate1869.
- 2) Ramanathan, V. et al (2013), *Black Carbon and the Regional Climate of California Report to the California Air Resources Board (Contract 08-323)*. http://www.arb.ca.gov/research/single-project.php?row_id=64841.
- 3) P.J. Crutzen, L. Bengtsson and V. Ramanathan (Co-Chairs), *Fate of Mountain Glaciers in the Anthropocene: A Report by the Working Group Commissioned by the Pontifical Academy of Sciences*. Scripta Varia 118, Vatican City, 2011.
- 4) Evan, A.T., J.P. Kossin, C. "Eddy" Chung, V. Ramanathan: Arabian Sea tropical cyclones intensified by emissions of black carbon and other aerosols. *Nature* Vol. 479, pp. 94–97, 2011
- 5) United Nations Environment Programme, 2011 (Link) Integrated Assessment of Black Carbon and Tropospheric Ozone: Summary for Decision Makers. Chair: D. Shindell. Vice Chairs: F. Raes, V. Ramanathan.
- 6) Ramanathan, V. and Y. Xu: The Copenhagen Accord for limiting global warming: Criteria, constraints, and available avenues., *Proc. Nat. Acad. Sci.*, 107 (18) 8055-8062, 2010.
- 7) J. Wallack and V. Ramanathan: The Other Climate Changes, Why Black Carbon Also Matters, *Foreign Affairs*, Sept/Oct 2009, pp. 105-113, 2009.
- 8) Ramanathan, V. and G. Carmichael: Global and regional climate changes due to black carbon, *Nature Geoscience*, 1, 221-227, 2008.
- 9) Ramanathan, V., and Y. Feng: On avoiding dangerous anthropogenic interference with the climate system: Formidable challenges ahead, *Proc. Natl. Acad. Sci.*, 105, 14245-14250, 2008.
- 10) Ramanathan, V., M.V. Ramana, G. Roberts, D. Kim, C.E. Corrigan, C. Chung, and D. Winker: Warming trends in Asia amplified by brown cloud solar absorption, *Nature*, 448 (7153): 575-U5, 2007.
- 11) Ramanathan, V., et al.: Atmospheric Brown Clouds: Regional assessment report with focus on Asia, 354 PP, *Published by the United Nations Environment Programme*, Nairobi, Kenya, 2008.
- 12) Ramanathan, V: Greenhouse Effect Due to Chlorofluorocarbons: Climatic Implications. *Science*, 190: 50-52, 1975.

e) Education

Courses Taught: The four dimensions of Climate Change; Climate Change Science; Radiative Transfer, Climate Dynamics, Global Warming-Scientific Basis, Introduction to Climate, Climate Change, Climate.

Thesis Advisor and Postgraduate-Scholar Sponsor: Current: Students: Liliana Nunez, Kristina Pistone, Yangyang Xu. Post-Doctoral fellows: Jen Burney; P.S. Puppala; Richard Thomas. Past: J.T. Kiehl; L. Donner; T.P. Charlock; V.Ramaswamy; A.A. Raval; B.J. Soden; Y. Weizuo; W.D. Collins; R. Hallberg; C. Wang; J.P. Chen; S.C. Sherwood; C.P. Weaver; G.McFarquhar; W.D. Conant; C. Volpe; E.R. Boer; A. Vogelmann; V. Galinsky; B. Tian; J. Cole; J. Lobert; J. Meywerk; X.L. Jones; K. Rajeev; R. Roca; S.K. Satheesh; D.Z. Jevtic; K. Markowicz, E.S. Chung; A.K. Inamdar; D. Kim; C.E. Chung; E.M. Wilcox; O.L. Hadley; F. Bender

For details, please visit V. Ramanathan's Publications <http://www-ramanathan.ucsd.edu/publications.html>

Certification

I certify that (1) to the best of my knowledge and belief, this CV correctly describes me, my qualifications, and my experience; (2) that I am available for the assignment for which I am proposed; and (3) that I am proposed only by one Offeror and under one proposal.

I understand that any willful misstatement or misrepresentation herein may lead to my disqualification or removal from the selected team undertaking the assignment.



Date: July 2, 2013
/ Day/Month/Year

[Signature of staff member or authorized representative of the staff]

Ambassador (ret.) Reno L. Harnish III

Director, Center for Environment and National Security
Scripps Institution of Oceanography
University of California, San Diego

Telephone: 858-534-2542 **E-Mail:** rharnish@ucsd.edu

Summary of Qualifications:

Chief Executive with expertise in all areas of management and 13 years of million/billion dollar program management experience. Top Secret-SCI Clearance active. Elicited unprecedented production and morale in organization of 2,400 employees. Extensive experience resolving international political and business problems. Fluent in German, Italian and Swedish with some Azeri and Arabic. Awarded for Presidential Meritorious Service (twice) and for State Department Distinguished Service. Active member Defense Threat Advisory Committee, Department of Defense. Occasional work for US Department of State, Office of the Inspector General.

Professional Experience:

Director, founded Center for Environment and National Security, Scripps Institution of Oceanography, UC San Diego 2009 until present. Conduct independent research. Organized symposia on Climate and National Security: Securing Better Forecasts and Water, Climate, Finance: The New Intersection. Frequent speeches and media appearances on defense, diplomacy and development interactions with the environment. Consulting for World Bank and EPA.

Principal Deputy Assistant Secretary of State for Oceans, Environment and Science 2006-2009 (and acting Assistant Secretary from January-August 2009). Led a Bureau of 250 US employees. Represented US at G-8 Environment Ministers meeting in Kobe.

- Chaired US Government hosting of a 123 country, 9,000 person renewable energy conference and trade show, where President and 4 cabinet members spoke, resulting in 144 new renewable energy projects.
- Negotiated an internationally accepted definition of sustainable bio fuel production.
- Created grant management system for increase from \$30 million to \$170 million in economic assistance funding.
- Signed founding statute of International Renewable Energy Agency to bring US Government into membership.

Ambassador, US embassy Baku 2003-2006. Chief Executive of multi-agency mission of 500 people and \$75 million in program funding. Established excellent relations with Deputy Commander European Command and cooperation with Department of Defense on maritime security program for Caspian Sea.

- Conceived and implemented one year campaign to improve parliamentary election practices in Azerbaijani, strengthen bilateral relations and facilitate meeting of Azerbaijani and US Presidents.
- Convinced US agencies to approve funding for \$2.5 billion natural gas pipeline despite environmental disinformation.

- Moved Azerbaijan to closer relationship with NATO by securing Partnership Agreement, military exercise and landing rights.

Chief of Mission, US Office Pristina, Kosovo 2002-2003. Chief Executive of multi-agency mission of 300 people with \$40 million of program funding in a post-conflict environment. Excellent working relationship with UN Mission in Kosovo, KFOR command and US brigade commander.

- Increased refugee returns to Kosovo, demonstrating increased ethnic tolerance, thus opening path to current independence.
- Persuaded UN to reduce costs and increase revenue of central power plant, thereby enhancing economic growth.
- Inhibited efforts of Kosovo indigenous leaders to create an army.

Deputy Chief of Mission, US Embassy Cairo 1999-2002. Chief Operating Officer for 2400 employees and \$2 billion in annual programs.

- Negotiated security arrangements for Cairo airport for Central Command following attack on the USS Cole.
- Led Presidential visit in support of Camp David II.
- Tripled the placement of Sudanese refugees.

Deputy Chief of Mission, US Embassy Stockholm 1996-1999. Chief Operating Officer in a mission of 150 people. Mobilized Sweden to cooperate with US in support of Baltic States and led major increase in efficiency of consular operations.

Education:

- MIT Seminar XXI 1995/96 alumnus
- Master of Arts in Economics, 1975, American University.
- Master of International Service, 1973, American University, School of International Service.
- Bachelor of Arts in Political Science, 1970, San Diego State University.

Publications:

- *Renewable Energy Gains Global Momentum*, October 2008, Resource magazine, James Fisher, Gale A. Buchanan, Ray Orbach, Reno L. Harnish III and Puru Jena.
- *Global View on Advancing Renewable Energies*, September 2008, MRS Bulletin, Puru Jena, R.L. Harnish III, J. Fischer and M. Dresselhaus.
- *Government Credit Subsidies for Energy Development*, 1975, American Enterprise Institute with Murray Weidenbaum.

I have not worked for the World Bank. I certify that (1) to the best of my knowledge and belief, this CV correctly describes me, my qualifications and my experience; (2) that I am available for the assignment for which I am proposed; and (3) that I am proposed only by one Offeror and under one proposal. I understand that any willful misstatement or misrepresentation herein may lead to my disqualification or removal from the selected team undertaking the assignment.

Reno L. Harnish July 1, 2013

CURRICULUM VITAE

Name of Firm: The Energy and Resources Institute (TERI)

Name of Staff: Mr. Sumit Sharma

Proposed position: Air pollution specialist

Designation: Associate Fellow, Centre for Environmental Studies

Date of Birth: 04/08/1980

Years with Firm: 10 years

Nationality: Indian

Key Qualifications:

Mr. Sumit Sharma is presently working in TERI as Fellow and Area Convenor (Centre for Environment Studies, TERI); convening a group of 15 researchers focussed on various environmental issues. In 2011, he was conferred with the 'Roll of Honour' in recognition to the work carried out by him. In last 10 years, worked on more than 20 projects of varying magnitudes and developed the domain knowledge in the field of air pollution. He has worked with big teams both as a team member and project leader. His main responsibilities include: writing proposals, forming teams, executing projects of environmental relevance, report preparation, presentation and discussions, and dissemination of results to the relevant stakeholders. His profile also involves regular interactions with various government departments, academic institutions, NGOs, and industries. He has also organized a number of training programmes and workshops on different environmental issues.

Education:

- **PhD** (pursuing parttime) from Indian Institute of Technology (IIT), New Delhi, India (initiated 2012)
- **M. Tech.** (Energy & Environmental Management) from Indian Institute of Technology (IIT), New Delhi, India in 2006
- **B.E. (Environment)** from Delhi College of Engineering, New Delhi, India in 2002

Employment Record:

1. (a) Year: Since Oct- 2003
(b) Organization: The Energy & Resources Institute (TERI)
(c) Designation: Associate Fellow

2. (a) Year: Jan-2003 to Oct- 2003
(b) Organization: Shriram Institute for Industrial Research (Delhi)
(c) Designation: Environmental Engineer

3. (a) Year: Jun-2002 to Jan- 2003
(b) Organization: Spans Enviro-tech (Delhi)
(c) Designation: Environmental Engineer

Related Projects Experience:

Clean vehicles and fuels issues in India (Shakti Foundation) 2013-ongoing

Project investigator-Objective of the project to generate awareness by conducting workshops and writing research papers on clean fuels and vehicles in India, assessment of driving cycles, and control of emissions from in-use vehicles in India.

Strategic assessment of state of air quality under alternative policy interventions in transport sector (DFID) (2012-ongoing)

Project Investigator : Objective of the project is to evaluate the potential of fuel quality and emission control norms to mitigate emissions from road transport sector in India. Research and policy papers have been planned on assessing the cost benefit of improving fuel quality and vehicular emission norms in India. The project involves National scale emission inventorisation, air quality modelling, health impact assessment and costs benefit analysis. The project findings will be disseminated through a workshop.

Creation of Energy scenario in the future to improve air quality in East and South Asia (Toyota Motor Corporation) (2011-2013)

Project investigator-Objective of the project to guide a team of researchers to develop future energy and emission scenarios for India and predict ozone pollution levels at different regional scales. Responsibilities also include carrying out computer simulations of air quality using state of the art models.

Status of pollution generated from road transport in six mega cities (2011- ongoing)

Project investigator-Objective of the project is to guide a team of researchers to develop emission inventory of pollution generated from road transport sector in 6 cities of the country. Responsibilities also include estimation of emissions using state of the art models, preparation of reports and presentation and discussion of results.

Directions, Innovation and Strategies for Sustainable Development in Goa (Gulbenkian Foundation, Portugal) (2010- 2012)

Project investigator-The objective of the project is to work out directions for sustainable development in Goa through the construction of baseline and alternative scenarios. Responsibilities includes coordinating and guiding a team of about 20 people from multi-disciplinary background, analysis of air pollution and socio-economic status in Goa.

Source Apportionment study at Bangalore (IOC) (2006-2010)

The project was a policy guiding activity to reduce the air pollutant emission loads from various sectors. The project had implications over the road map suggested in the Auto Fuel Policy for tightening of vehicular emission norms.

The study explored the relative **contribution of various polluting sources** (vehicular, industrial, domestic, and natural sources) to the overall air pollution load in the Bangalore city using receptor and dispersion modelling techniques. It involved emission inventory preparation, secondary and primary data collection, compilation, analysis, dispersion and receptor air quality modelling using ISCST3 and CMB8 air quality models, and preparation of **air quality management plan**

Reduction of energy consumption/CO₂ emission and improvement of air quality in Asia (Toyota) (2008-11)

Project investigator- The project aimed at generating **scenarios of energy consumption and emissions** of pollutants in India. My work involved preparation of emission inventory and application of state of the art **3-D air quality and meteorological models** (WRF & CMAQ) that could help in analysing the regional influence of various pollutants such as PM, NO_x, Ozone etc.

Multi-scale regional air quality modelling using CMAQ and MM5 models for Bangalore city (Toyota) (2005-08)

The project aimed at application of 3-D urban air quality models (MM5 & CMAQ) that could help in devising strategies for improving the air quality in urban areas. As a case study, Bangalore city is chosen and a detailed analysis of air quality is carried out using the models and the results are shared with various stakeholders through a conference.

State Environment Policy and Environment Mission (Rajasthan State Pollution Control Board) (2009-2010)

The objective of the project was to draft the state **environment policy** and **environmental mission** for the State of Rajasthan. Major responsibility was to draft chapters for urban development and air pollution, analysing the urban scenarios in the state, state of air quality, interventions taken by the government and strategies to improve the overall environmental conditions. Mission document was further provided with an action plan with estimated cost of interventions for various strategies. The project required knowledge of existing **environmental laws and policies** both at the central and state levels. The policy document will act as a guiding document for the policy makers for environmental conservation in the state.

Environment Status Report –Pune Municipal Corporation (2010)

The objective of the project was to prepare the Environment Status Report –for Pune Municipal Corporation. Work component handled in the project includes drafting the air chapter for the report based on air quality analysis, studying the sources of air pollution and the interventions taken to abate pollution in the city.

Green India (2009)

TERI

The project aimed to **guide the policy makers** to reduce the ecological footprints of anthropogenic activities and conserving the resources. Main responsibility was to draft the 'Air' chapter for the GREEN INDIA project. It included **air quality assessment of Indian cities**, identification of key issues related air pollution in India, and devising strategies to mitigate and evaluating their economic cost effectiveness. Analysis, interpretations, compilation of information related to interventions taken to abate pollution levels, impacts of pollution, and future strategies. An **economic evaluation** of the suggested strategies was made to compare the cost effectiveness of the interventions.

National Report for United Nation Commission of Sustainable Development (UNCSD) 18 (2010) (MoEF)

The focus of the National Report is on 5 thematic clusters (i) Transport; (ii) Chemicals; (iii) Waste Management; (iv) Mining; and (v) Sustainable Consumption and Production Patterns. Involved in drafting the thematic chapter for Chemicals.

Report to People on Environment (2010) (MoEF)

The report presents state of the environment for the country and initiates public debate on their inclusion in issues related to environment management in the country. Worked on Air Pollution chapter for the report which includes air quality assessment, identification of key issues related air pollution in India, and devising strategies to mitigate.

Environment for Development- India & China (2009)- CCICED

TERI

This was a **collaborative project between India and China** funded by the China Council for International Cooperation on Environment and Development. The project aims at analysing the common environmental problems faced by the two developing economies of the world. My work was to draft the 'Air' chapter of the joint Indo-China project. It included assessment of scenario of air pollution in India, identification of key issues related to air pollution, and devising strategies to mitigate.

Environmental Impact Assessment - Himalayan Skiing Village (2007)

Project involves assessment of environmental impact of proposed skiing village near Manali. Work involved preparation of emissions inventory of the proposed project site, and carrying out air quality model runs **to predict addition impact on ambient air quality** of the region.

State of Environment- Delhi (2008) (Delhi Govt.)

Prepared the Air chapter for State of environment report for Delhi. Chapter includes drivers and resulting pressures on the air resource in Delhi, state of air quality, impact, interventions taken, and future strategies to curtail air pollutant levels in the city

Emission Inventorisation of Faridabad Town (HSPCB) (2006)

Project investigator-The study aims at **inventorisation of emissions** of different pollutants from various sources like vehicles, industries, power plants, domestic fuel burning, DG sets etc. My work involved preparation of activity data for different sectors, selection appropriate emission factors, and estimation of emission loads from various sectors.

Sustainable Development Indicators (2005) (ICEF)

Project involved development of indicators for tracking the path towards sustainability. My job was to **develop the indicators for air quality and waste** management for India and their pilot testing in the state of Maharashtra.

Teri Environmental Awards (2005, 2007, 2008)**TERI**

This is the annual event organised by TERI to give recognition to the efforts made by industries towards environmental protection. Work involved evaluation of case-studies and their comparative assessment in terms of innovation towards environment protection. *Due-diligence* visits were made in the selected industries.

Urban Clean Fuel (2004)**(ADB)**

The objective of project was to *estimate the environmental benefits* of introduction of CNG in 4 cities (Kanpur, Lucknow, Pune, and Faridabad), in terms of reduction in particulate matter concentrations and associated health effects. This involved emission inventorisation, dispersion Modelling using SCREEN model, air quality data analysis & interpretation

Solidification and Stabilization of sludge in Beverage facility (2005)**(Coca Cola)**

Project investigator-Studying the feasibility of *converting the waste into construction product* of economic value and thereby reductions in waste toxicity and improvement in the engineering properties of the stabilized material.

Green India (2006)-**TERI**

Drafted the 'Air' chapter of GREEN INDIA project. It included air quality assessment of 80 Indian cities based on secondary data analysis and interpretations, compilation of information related to interventions taken to abate pollution levels, impacts of pollution, and future strategies.

Green Gulf (2006)**Gulf Research Centre TERI**

Assessment of pressures, state and responses in terms of air quality in 6 GCC countries: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, UAE

TEDDY- 2003/04, 2004/05, 2005/06**TERI**

Compilation of data related to Environment (Air, Water & Solid waste) and drafting of 'Environment' chapter

Common Effluent Treatment Plant- Balotra (Rajasthan)-(Textile Ministry) (2006)**TERI**

The aim of the project was to assess environmental problems in textile clusters at Balotra-Rajasthan, and provide *consultancy for 50 MLD common effluent treatment facilities* in the region. Work involved project Management for construction of 50 MLD common effluent treatment facilities, Feasibility Report preparation, tender document preparation, floating and evaluation of tenders, supervision of construction activities, performance evaluation, and capacity building of local small scale industrialists for cleaner production.

Ganga Action Plan-II (JICA) Shriram Institute for Industrial Research (2003)

Project involved *pollution load assessment of river Ganga* at 4 cities (Kanpur, Lucknow, Allahabad, and Varanasi). Flow measurement at various drains, river/drain/households sample collection, carrying out pollution load surveys, overall assessment and interpretation were the major activities of the project

Integrated Coastal Marine Area Management (ICMAM)- Goa and Gulf of Kutch (NIO) (2003) Shriram Institute for Industrial Research

Objective of the project is impact assessment of coastal & mining regions of Goa and Gulf of Kutch. This involved filed surveys, collection, compilation, and interpretation of environmental and socio-economic data.

Sewage treatment plant(250 m³/d)- BEL , Sahibabad (Spans Envirotech) (2002)

BEL , Sahibabad

Project involved designing of sewage treatment plant at BEL-Sahibabad facility while considering various treatment options

Effluent treatment plant(200 m³/d)- Perfetti India Ltd., Gurgaon (Spans Envirotech) (2002)

Designing, Engineering drawings, Report Preparation

Research Publications:***Books***

- **State of Environment – Delhi, 2010**, Government of Delhi (Author -Air quality chapter)
- **Report to the people on environment and forests, 2010**, Ministry of Environment & Forests, GOI, (Author -Air quality chapter)
- **Towards sustainable growth 2010**, Ministry of Environment & Forest, GOI, (Co-author- Chemicals chapter)
- **TERI, 2010, Looking Back to Change Track- Green India**, The energy and resources institute, New Delhi (Author -Air quality chapter)
- **TERI, 2007, Looking Back to Change Track- Green India**, The energy and resources institute, New Delhi (Co-author -Air quality chapter)
- **GRC, 2006, Green Gulf Report**, Gulf Research Centre, Dubai, (Co-author -Air quality chapter)
- **TERI, 2009, TEDDY-2007-08**, The Energy and Resources Institute, New Delhi (Author -Environment chapter)
- **TERI, 2008, TEDDY-2006-07**, The Energy and Resources Institute, New Delhi (Author -Environment chapter)
- **TERI, 2007, TEDDY-2005-06**, The Energy and Resources Institute, New Delhi (Author -Environment chapter)
- **TERI, 2006, TEDDY-2004-05**, The Energy and Resources Institute, New Delhi (Author -Environment chapter)
- **TERI, 2004, TEDDY-2003-04**, The Energy and Resources Institute, New Delhi (Author -Environment chapter)
- **TERI, 2005, Cleaner is Cheaper**, The Energy and Resources Institute, New Delhi (Co-Author)

Journal Papers

- **Quantifying sources of particulate matter pollution at different categories of landuse in an urban setting using receptor modelling**, Sustainable Environment Research (Accepted 2013)
- **Simulation of air quality using ISCST3 dispersion model, 2008**, CLEAN - Soil, Air, Water, Volume 36, Issue 1 , Pages 118 - 124
- **Mapping progress towards a better air quality: Some indicators**, Indian Journal of Environmental Protection, Vol. 26, No. 4, April 2006
- **Urban air quality management- A case study of Pune**, Environmental Pollution Control Journal, Vol. 9, No. 5, July-August 2006

- **Indicators of waste management in India**, Indian Journal of Environmental Protection, Vol. 30, No. 8, May 2010
- **Wastewater management in textile sector**, Indian Journal of Environmental Protection, Vol. 31, No. 1, Jan 2011

Other papers/articles

- Sharma, S., OZONE- India hotbed for Ozone, The WEEK, September 2011
- Sharma S., Harmful Ozone Layer Forming Over Indian Cities, MIT Technology Reviews, June 2011
- Sharma S., Uniform air quality – A must- Auto Tech Review, March 2012
- Harmful Ozone Layer Forming Over Indian Cities, MIT Technology Reviews, June 2011
- An approach to measure sustainability: Comparative Evaluation of States of India, International conference of innovation and sustainability transitions in India, 9-11th Jan, 2011, Kuala Lumpur, Malaysia
- Regional air quality simulations of Ozone and fine particulates using WRF/CMAQ model across India, Indo-US Conference-cum-Workshop on Air Quality and Climate Research, Hyderabad, 14-16 March 2011
- Urban air quality management in Indian cities (with specific emphasis on particulate matter), Proceedings of Better air quality workshop 2004, Agra
- Air Quality: Status And Classification Of Cities Based On Indicators, Proceedings of Better air quality workshop 2004, Agra
- Sustainable Development Indicators, Proceedings of the High level conference on “Strategies for control of air pollution in Mumbai”
- Nitrogen pollution from industrial sector in India, INSA, March, 2006

Languages:

	<i>Speaking</i>	<i>Reading</i>	<i>Writing</i>
English	Very Good	Very Good	Very Good
Hindi	Very Good	Very Good	Very Good

I certify that (1) to the best of my knowledge and belief, this CV correctly describes me, my qualifications, and my experience; (2) that I am available for the assignment for which I am proposed; and (3) that I am proposed only by one Offeror and under one proposal. I understand that any willful misstatement or misrepresentation herein may lead to my disqualification or removal from the selected team undertaking the assignment



Sumit Sharma



Jessica Seddon Wallack
Founder, Managing Director
Okapi Research & Advisory
9A Coastal Rd, Chennai, India 600090
www.okapia.co

PROFESSIONAL EXPERIENCE

CURRENT AFFILIATIONS

- Co-Chair, Interdisciplinary and Global Working Group on Short-Lived Climate Pollutants**
Institute for Advanced Studies in Sustainability, Potsdam, Germany 09/2012 - present
- Head of Knowledge Management, Villgro Innovations Foundation** 8/2012 – present
Chennai, Tamil Nadu, India
- Adjunct Professor, School of Public and Environmental Affairs** 11/2011 - present
Indiana University
Bloomington, Indiana
- Senior Advisor, Indian Institute for Human Settlements** 6/2012 - present
Bangalore, India 11/2010 - 5/2011

ACADEMIC APPOINTMENTS

- Head of Research, Indian Institute for Human Settlements** 5/2011 – 5/2012
Bangalore, India
- Director, Centre for Development Finance** 2/2008 – 10/2010
Chennai, India
- Professor, Institute for Financial and Management Research** 2/2008 – 10/2010
Chennai, India
- Research Scholar, Global Information Industry Center, UCSD** 5/2008 - present
La Jolla, CA
- Visiting Fellow, Institute for Financial and Management Research** 3/2007 - 2/2008
Chennai, India
- Assistant Professor of Political Economy, UCSD** 7/2004 – 3/2008
La Jolla, CA

Research Affiliate, California Institute for Telecommunications and IT 3-2007 – 3/2008
La Jolla, CA

Lecturer in Public Policy, Stanford University 2001, 2003
Palo Alto, CA

CONSULTING AND POLICY WORK

Council on Foreign Relations International Affairs Fellow
Office of Air and Radiation, U.S. EPA 10/2010 – 8/2011
Washington, D.C.

Consultant, Google.org 3/2008 – 3/2009
Mountain View, CA & Bangalore, India
Working on the Inform and Empower Initiative

Strategic Advisor for the India Initiative, Calit² 3/2007- 3/2008
La Jolla, CA
Creating Public Technology Foundation of India, a government-corporate-NGO partnership to support research, development, and deployment of technologies for sustainable development.

Consultant, Prize Capital LLC 10/2005 – 11/2006
Del Mar, CA
Early stage venture capital firm with innovative financing model linked to inducement prizes for clean energy technologies.

Consultant, Asian Development Bank 1/2002 -4/2002
Manila, Philippines
Contributor to research report on economics and politics of preferential trade agreements.

Office of the Chief Economist, Inter-American Development Bank 9/1998 - 9/1999
Washington, DC
Member, research team for 1999/2000 *Economic and Social Progress Report*

Development Economics Vice-Presidency, World Bank 8/1997- 8/1998
Washington, DC
Researcher, reported to Joseph Stiglitz, Chief Economist of World Bank.

Consultant, Poverty Reduction and Economic Management, World Bank 8/1997- 8/1998
Washington, DC
Contributor to internal training and Knowledge Management System (KMS) on Public Expenditure and Decentralization. Fieldwork in Ethiopia and Venezuela.

ADVISORY/OTHER

Global Alliance for Clean Cookstoves 12/2010 - present
Washington, DC
Member of Working Groups on Finance, and Marketing, ongoing participation in Standards & Testing

Advisory Board, Prakti Design, Ltd. 10/2010 - present
Pondicherry, India

Engineering & design firm focused on improved biomass cookstoves in South Asia, Africa, Haiti.

Advisory Board, Wilderhill Global Clean Energy Index (NEX) 8/2006 - present
Encinitas, CA
Index and ETF tracking global clean energy industry.

Advisory Board, Janaagraha Ward Infrastructure & Services Index 12/2007- 12/2008
Bangalore, India
Index monitors quality of urban infrastructure and services in India.

EDUCATION

Stanford University Graduate School of Business 1999-2004
Stanford, CA
Ph.D. in Political Economy. Specialization: Macro Political Economy, Development Finance.
Dissertation: Essays in Data Quality, Investment, and Policymaking.
Awards: Bradley Foundation Dissertation Fellowship, Stanford Institute for Economic Policy Research.

Harvard University 1994-1997
Cambridge, MA
B.A., Magna Cum Laude, Political Science. Certificate in Latin American Studies.
Awards: Firth Prize for best thesis in Government Department; Hammond Prize for best undergraduate thesis on a Latin American topic.

LANGUAGES: Fluent in English and Spanish, learning Tamil and Hindi

PUBLICATIONS AND RESEARCH

2013. "Information and Ontologies: Challenges in Scaling Knowledge for Development," forthcoming, *Journal of the American Society for Information Science and Technology*. (with Ramesh Srinivasan)

2013. "Marketworthiness and Municipal Finance Reforms in India," forthcoming, Isher Ahluwalia and Ravi Kanbur, eds. *Urban Infrastructure*. Oxford University Press.

2012. "Moving India, Policies and Priorities in Transport Sector Reform" (with N.K. Singh), forthcoming, Noll, Roger, and T.N. Srinivasan, eds. *Indian Economic Reforms*. Cambridge University Press.

2011. "Inelastic Institutions: Political Change and Intergovernmental Transfer Oversight in Post-Independence India," (with T.N. Srinivasan). *India Policy Forum* 2011-2012

2010. "Outcomes Rule: Getting Development from Development Expenditure," (with Yamini Aiyer and Jay Chaudhuri). *India Review* 9(2).

2010. "Fire Alarms in Action: Making Sense of Large-Scale User Feedback on City Services in Karnataka," *India Review* 9(2).

2008. "Local-Global: Reconciling Mismatched Ontologies in Development Information Systems," (with Ramesh Srinivasan). *Proceedings of the HICSS*, January 2009.

2008. "India's Parliament as a Representative Institution," *India Review* v. 7(2).

2008. "India's Power Struggle," in Jagdish Bhagwati and Charles Calomiris, editors, *Sustaining India's Growth Miracle*. Columbia University Press.
2006. *Federalism and Economic Reform*. Cambridge University Press. (edited with T.N. Srinivasan).
2004. "Trade Liberalization and Intersectoral Labor Movements," *Journal of International Economics* v. 64(2), December, pp. 411-439. (with Romain Wacziarg)
2004. "Economic, Social, and Demographic Determinants of Political Participation in Latin America: Evidence from the 1990s," *Latin American Journal of Economic Development*, Issue 3, pp.151-182. (with Ugo Panizza and Alejandro Gaviria)
2004. "Political Institutions and Growth Collapses," *Latin American Journal of Economic Development*, Issue 2, pp. 147-184. (with Ernesto Stein, Ugo Panizza, Alejandro Gaviria)
2004. "Globalization and the Poor," *De Economist* 152(2): 251-272. (With T.N. Srinivasan)
2003. "Superficial Growth? Evaluating Indian Economic Reforms in the 1980s," *Economic and Political Weekly* (October 2003, pp. 4312-4316)
2003. "Asian Regionalism and its Effects on Trade in the 1980s and 1990s," *Journal of Asian Economics* 14(1): 91-129. (With Ramon Clarete and Christopher Edmonds)
2003. "Political Particularism Around the World," *World Bank Economic Review* 17(1): 133-143. (With Alejandro Gaviria, Ugo Panizza, Ernesto Stein)
2000. *Improving the Odds: Political Strategies for Institutional Reform in Latin America*. Latin American Research Network, Inter-American Development Bank. Washington, D.C. (with Merilee Grindle, Carol Graham, and Eduardo Lora)

EDITORIALS & POLICY WRITING

2013. "A Bottom Up Approach to Mitigating Climate Change," *Stanford Social Innovation Review*, Summer.
2012. "Market Dharma," *Caravan*. December 2012
2012. "Why You Can't Trust the Facts About India's Economy," *Bloomberg Businessweek*. February 29, 2012.
2012. Monthly columns in the *Financial Express*
2011. "Urban Interstices: Statistical Advocacy and Urban Infrastructure," in *Cityscapes*, October 1, 2011.
2011. "State-Level Policy Environments for PPP," (with Ashwin Mahalingam, Sujatha Srinivan, Thillai Rajan, Venkata Santosh). Policy report for the Department of Economic Affairs, Ministry of Finance, Government of India.
2011. "Answers to Policy-Relevant Science Questions," *Report of the Task Force on Hemispheric Transport of Air Pollution*, forthcoming, January 2011. (Contributing Author)
2011. "India's Catastrophic Landscape," *Harvard International Review*, forthcoming, January 2011
- 2010 - Monthly column in *Indian Express*.

2010. "The Soot Opportunity," *Harvard Business Review*. March 2010.
2009. "The Other Climate Changers," *Foreign Affairs* August/September 2009 (with V. Ramanathan).
2009. "A Tale of Two Transitions: From Public toward Private Provision of Infrastructure in India and Latin America," Background paper for Inter-American Development Bank (2010). *India: Latin America's Next Big Thing*. Washington, D.C.: Inter-American Development Bank.
2009. "The Full Climate Change Tale," *Mint* (India affiliate of the Wall Street Journal), September 23.
2009. "Politicizing Regulation: Not All Bad," in *Developing Infrastructure Through an Ideal Regulatory Framework*. New Delhi: CUTS. (with Parashar Kulkarni)
2009. "Urban Market-Worthiness: The Gaps in India" paper commissioned by the High-Powered Expert Commission on Urban Infrastructure, Government of India.
2008. "The Context of Poverty," *India & Global Affairs* April-June 2008. (with N.K. Singh)
- 2004 – 2008. Regular columns in national Indian newspapers: *Indian Express* and *Financial Express* (with N.K. Singh)
2006. "Electoral Systems and the Personal Vote: Update of Database of Particularism," (with Joel Johnson). Available at: dss.ucsd.edu/~jwjohnso/espv.htm
2000. *Development Beyond Economics: Economic and Social Progress Report 2000*. Washington, DC: Inter-American Development Bank. (Contributor)
1998. *Aspects of Decentralization*. Washington DC: EDI, World Bank. Author of subsections on Participation, Civil Service, and Economic Growth. (Co-editor, with Jennie Litvack)
- MANUSCRIPTS & WORK IN PROGRESS*
2013. "Resilient Governance: An Institutional Reform Agenda for India" (with N.K. Singh).
2013. "PPPs in Urban Infrastructure in India" (with Ashwin Mahalingam).
2012. Institutional Transformation in India: Infrastructure, Planning, and the Agenda Ahead (with N.K. Singh). Preliminary paper "Infrastructure in the 12th Plan presented at Stanford Centre for International Development Annual Conference on Indian Economic Development, October 2012.
2012. "Air Quality Management in a New Global Era: Networks vs. States," (with Terry Keating). Poster presented at *Planet Under Pressure*, London, March 2012.
2010. "User Innovation in eGovernance Design," (with Srikanth Nadhamuni). Awarded 3rd prize in MIT-sponsored "Hidden Successes" International Competition on Urban Reforms. Under review as book chapter for MIT volume.
2009. "Political Economy of Development in India: The Long View," (with T.N. Srinivasan). Prepared for the 10th Annual Stanford Centre for International Development Annual Conference on Indian Economic Reforms.

2008. "Power Politics: States and Electricity Sector Reform in India" (with N.K. Singh). Presented at the China-India Forum, Singapore, March 2008.

TEACHING

IIHS: Teaching on Municipal Finance, Infrastructure & Development, Urban Law and Governance.
IFMR: MBA course in **Nonmarket Strategy in the Indian Context**, curriculum development for MA/MBA in **Development and Sustainable Finance**.

UCSD: Taught masters courses in **Economic Policy in Latin America, Political Economy of Development in India, Policy Design, Project Management / Implementation Strategy**

GRANTS/ AWARDS

2010. Templeton Research Fellowship, Columbia University.

2010. International Affairs Fellowship, Council on Foreign Relations.

2009. Research grant from Australia Development Research Awards for *Making Markets Work for the Poor: Reducing Information Inefficiencies at the Bottom of the Agricultural Supply Chain*. (with Shawn Cole and Stefan Hunt)

2008. Awarded 3rd Place in global MIT-sponsored contest *Hidden Innovations: Urban Reforms* for "User Innovation and E-governance Design" (with Srikanth Nadhamuni)

2008. Term Membership, Council on Foreign Relations.

2007. Research grant from Center for Pacific Economies for various projects in India.

2006. Named a Next Generation Fellow by the American Assembly, Columbia University

2005. Research Grant for "Electoral Systems and Candidate Incentives," Academic Senate, UC San Diego

2004. Research Grant for "Federalism and Infrastructure Investment," Program on Energy and Sustainable Development, Stanford University.

2004. Harvard Academy Fellowship (Declined)

OTHER

Associate Editor (2008-present): India Review

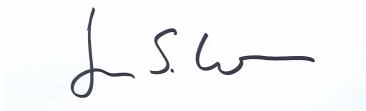
Reviewer, Journal of Economic Literature, Review of Economics and Statistics, Basil Blackwell Press, Cambridge University Press, Economics and Politics, World Bank Economic Review, India Review, Political Research Quarterly, British Journal of Political Science

Member, American Economic Association, American Political Science Association, Council on Foreign Relations (Term Member)

Board Member, Treasurer, Harvard Club of San Diego (2005-7).

I certify that (1) to the best of my knowledge and belief, this CV correctly describes me, my qualifications, and my experience; (2) that I am available for the assignment for which I am proposed; and (3) that I am proposed only by one Offeror and under one proposal. I understand that any willful misstatement or misrepresentation herein may lead to my disqualification or removal from the selected team undertaking the assignment.

Signed

A handwritten signature in black ink, appearing to read 'J.S.W.', is centered on a light blue rectangular background.

Jessica Seddon
June 28, 2013

ANNEX 3: WORK SCHEDULE

N°	Activity ¹	Months ²												
		1	2	3	4	5	6	7	8	9	10	11	12	n
1	Complete Contract Negotiation	X												
2	Sign Contract World Bank	X												
3	Preparation for UCSD/SIO workshop	X	X	X										
4	Confirm Participants		X											
5	Purchase Tickets (UCSD/SIO)			X										
6	Draft Background/Inception Report		X	X										
7	CARB Site Visit				X									
8	UCSD/SIO Workshop				X									
9	Purchase Tickets for India					X								
10	Interim Report Action Agenda					X	X	X						
11	Policy Conclave in Delhi, India							X						
12	Final Report Action Agenda							X	X	X				
13	Coalition Follow-Up										X	X	X	X
n														

- 1 Indicate all main activities of the assignment, including delivery of reports (e.g.: inception, interim, and final reports), and other benchmarks such as Client approvals, etc.. For phased assignments indicate activities, delivery of reports, and benchmarks separately for each phase.
- 2 Duration of activities shall be indicated in the form of a bar chart.