Honoring air quality achievements

HAAGEN-SMIT
CLEAN AIR AWARDS

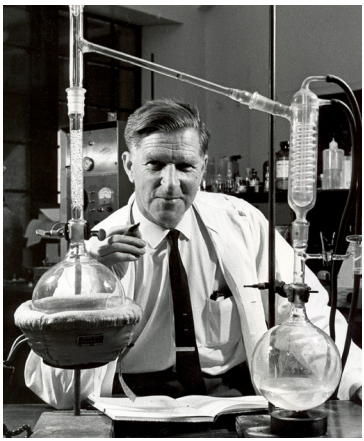
June 22, 2017

CalEPA Headquarters
Sacramento, California

The Haagen-Smit Clean Air Awards are given annually to scientists, policy makers, community leaders, and educators from California and around the world who have made significant lifetime contributions to the advancement of clean air and climate change science, technology, and policy, thereby furthering the protection of public health and prosperity for all.

"We should have learned by now that we cannot hope to change the laws of nature, but we can change human institutions. The road is not an easy one, but the reward ... is worth the effort."
– Dr. Arie Haagen-Smit

Dr. Arie Haagen-Smit



Dr. Arie Haagen-Smit, a native of the Netherlands, was a leader in developing air quality standards based on his research efforts. Known by many as the "father" of air pollution control, Dr. Haagen-Smit was a graduate of the University of Utrecht and a biochemistry professor at the California Institute of Technology in Pasadena for 16 years before beginning his air pollution research in 1948. At Caltech, Dr. Haagen-Smit studied the physiological aspects of natural products like rubber and pineapples. This work led to studies with his colleagues investigating the flavor components of wine, onions and garlic. His training and expertise in microchemistry, along with his natural curiosity, brought him to the forefront of air pollution research when he was asked by the county of Los Angeles to investigate the chemical nature of what we now call smog. Noticeably different from earlier accounts of haze and dust in London, which was caused by coal, the eye-irritating haze in Los Angeles was brown and almost odorless. Dr. Haagen-Smit applied his technique of studying plant chemistry in enclosed clear chambers exposed to sunlight to figure out what caused smog in the Los Angeles air basin.

Through a series of experiments, he concluded that most of California's smog resulted from photochemistry – when substances in the exhaust from motor vehicles and the smokestacks of industrial facilities react with sunlight to create ozone. This breakthrough provided the scientific foundation for the development of both California's, and the nation's air pollution control programs. In recognition of this contribution, Dr. Haagen-Smit received the National Medal of Science in 1973, the nation's highest scientific honor. He became the Air Resources Board's first chairman in 1968 after serving eight years as an original board member of Air Resources Board's predecessor, the Motor Vehicle Pollution Control Board. Dr. Haagen-Smit passed away in 1977, but his legacy lives on.

Since 2001, the Air Resources Board has annually bestowed the distinguished Haagen-Smit Clean Air Awards. The awards are given to extraordinary individuals to recognize significant career accomplishments in at least one of these air quality categories: research, environmental policy, science and technology, public education and community service. Over the years, there have been 44 acclaimed recipients. In light of the global connection between air quality and climate change, the scope of the program has now expanded to include an international focus and a focus on climate change science and mitigation.

Past Winners

Alphabetical Order by Last Name

Arey, Janet · 2011
Atkinson, Roger · 2004
Bates, David · 2004
Belian, Timothy · 2005
Billings, Leon · 2004
Blake, Donald · 2014
Boyd, James · 2006
Cackette, Tom · 2012
Carter, William · 2005
Chow, Judith · 2011
Denton, Joan · 2010
Edgar, Bradley · 2010
Farrell, Alex · 2008
Finlayson-Pitts, Barbara · 2013
Friedrich, Axel · 2006
Froines, John · 2010
Hansen, James · 2007
Hao, Jiming · 2015
Holmes, John · 2001
Hricko, Andrea · 2012
Johnson, Timothy · 2009
Lents, James · 2013
Lloyd, Alan · 2007
Loveridge, Ron · 2012
Moore, Curtis · 2005
Nichols, Mary · 2002
Oge, Margo · 2009
Ohno, Teruyuki · 2013
Pavley, Fran · 2007
Peters, John · 2009
Pitts, James · 2002
Prather, Kimberly · 2015
Prather, Michael · 2015
Sawyer, Robert · 2008
Seinfeld, John · 2003
Sharpless, Jananne · 2011
Sher, Byron · 2001
Smith, Kirk · 2014
Stedman, Donald · 2015
Wall, John · 201
Walsh, Michael · 2003
Wedaa, Henry · 2008
White, V. John · 2003
Winer, Arthur · 2006

2016 Haagen-Smit Clean Air Award Recipients

Chester J. France
U.S. EPA
Emission Control Technologies

Daniel Greenbaum
Health Effects Institute
Environmental Policy

Joyce E. Penner, Ph.D.
University of Michigan
Air Pollution Research

Veerabhadran Ramanathan, Ph.D.
University of California, San Diego
Climate Change Research

Anumita Roychowdhury
Centre for Science and Environment
International Air Pollution Policy

Chester J. France

Emission Control Technologies

Mr. Chester "Chet" France is being recognized for his leadership in developing and implementing advanced technology programs that have significantly reduced mobile source emissions and resulted in significant public health and climate benefits. Mr. France was the Director of the Assessment and Standards Division in the Office of Transportation and Air Quality at the U.S. Environmental Protection Agency (U.S. EPA) until he retired in June 2012 after more than 38 years of service with EPA. With a background in mechanical engineering and a Master's Degree in Business Administration, Mr. France not only spearheaded federal motor vehicle and fuel emission control programs, he was responsible for developing and maintaining national computer models that estimate the emissions of transportation sources.

Mr. France engaged the auto, engine, and oil industries, states, environmental and health experts, and foreign governments, to deliver environmentally significant programs with millions of tons of pollution reductions and trillions of dollars in benefits. Because of the programs that Mr. France has managed at the national level, today's cars and trucks are 99 percent cleaner than a decade ago through the establishment of the Tier 2 Vehicle and Low Sulfur Gasoline standards. Recently, Mr. France led EPA's efforts to put in place the first-ever joint U.S. EPA and Department of Transportation (DOT) control program to reduce greenhouse gas (GHG) emissions and improve fuel economy from cars. He participated in developing the historic agreement with 13 major automakers to pursue the next phase of improving cars and light-truck fuel economy to 54.5 miles per gallon by 2025. Following this agreement, Mr. France led the development of joint U.S. EPA and DOT rules that established more stringent GHG and fuel economy standards for model years 2017 through 2025. Additionally, he led the rule development of a joint U.S. EPA and DOT program that required medium- and heavy-duty trucks to meet fuel efficiency and greenhouse gas standards for the first time ever beginning in 2014. He also led a team that established the first ever manufacturer-run heavy-duty in-use compliance program.

Mr. France led the efforts to establish clean diesel programs for trucks, buses, and nonroad equipment (such as agricultural and construction equipment), resulting in stringent emission standards that dramatically reduced the sulfur content of diesel fuel. The fuel sulfur reductions enabled, for the first time, the application of exhaust aftertreatment to diesel vehicles and equipment. He has accomplished similar emission improvements for a myriad of other sources, including trains,

ships, recreational vehicles (such as snowmobiles), and lawn and garden equipment, and he was also a leading advocate for the nation's first requirements for the use of renewable fuels.

His ability to work with the auto and engine industry for cleaner standards translated well to even bigger sources of mobile emissions – ocean-going vessels. With the support of more than 160 nations in the International Maritime Organization (IMO), he established international consensus emission standards (MARPOL Annex VI) that dramatically reduced emissions from ships across the globe. Mr. France led the effort for the United States to become the first country to establish an Emission Control Area (ECA) protecting North American coastlines (United States, Canada, and French Island territories) and the Caribbean from ship emissions. The United States delegation, under Mr. France's direction, worked diligently with key countries and was able to achieve unanimous adoption of the ECA proposals within IMO.

Accomplishments such as these cannot be realized without being a personable, reasonable, and intelligent leader. Mr. France has been an active member for the American Society of Mechanical Engineers and the Society of Automotive Engineers, including serving as Chair and Co-Organizer for the Society of Automotive Engineers Government/Industry Annual Meetings. He has been a highly sought speaker and has given numerous presentations, speeches, and keynote addresses at forums such as American Petroleum Institute meetings and conferences, American Trucking Association conferences, National Petrochemical and Refiners Association conferences, Mobile Source Technical Review Committee meetings, National Academy of Science Committee meetings, and National Association of Clean Air Agencies meetings. He has maintained close, ongoing contact with the State of California, state environmental departments, environmental groups, and other nongovernmental organizations. Examples of these groups include the Environmental Defense Fund, Natural Resources Defense Council, American Lung Association, American Automobile Association, and Insurance Institute for Highway Safety. The strength of these relationships has frequently translated into broad support from these groups for the U.S. EPA rulemaking actions.

Mr. France has received many noteworthy awards throughout his career. He was awarded the Presidential Rank Award twice, for Distinguished Service in 2011, and for Meritorious Service in 2003. His integrity and willingness to walk the talk made him one of the most respected and accomplished public servants at the U.S. EPA. He received eleven Gold, Silver, and Bronze U.S. EPA medals and the U.S. EPA's prestigious Lee M. Thomas Excellence in Management Award.

On behalf of the California Air Resources Board, we commend his superior accomplishments and present to him a 2016 Haagen-Smit Clean Air Award.

Daniel Greenbaum

Environmental Policy

Mr. Dan Greenbaum is being recognized for his sustained leadership on air pollution health science, communication and policies at the state, national, and international levels. Mr. Greenbaum currently serves as President and Chief Executive Officer of the Health Effects Institute (HEI) based in Boston, Mass. The Health Effects Institute is a leading independent nonprofit research institute jointly supported by the U.S. Environmental Protection Agency (U.S. EPA) and the motor vehicle industry, with additional funding from other public and private organizations for specific projects or research topics. HEI provides public and private decision makers with independent science for regulatory and other public health and policy decisions. Dan earned both a Bachelor's and a Master's degree in City Planning from the Massachusetts Institute of Technology.

During Mr. Greenbaum's tenure as President, HEI has provided key science to inform decisions on national ambient air quality standards, air toxics, fuels and technologies and has undertaken several key challenges at the science-policy interface. In particular, during a period of active debate and low public confidence in the quality of the science used in regulatory decision-making, he led HEI's effort to reanalyze two major studies that were central to setting U.S ambient air quality standards for particulate matter, and ultimately, many international standards – the Harvard Six Cities and American Cancer Society Studies. HEI rigorously reviewed the individual studies, ensured their quality as a basis for national ambient air quality standards, and helped restore broader public trust in science-based decision making. After HEI restored confidence in these studies findings, they became the foundation for the EPA cost-benefit analysis that underpinned the national heavy-duty diesel rule.

HEI's Advanced Collaborative Emissions Study (ACES) demonstrated Dan's ability to provide leadership and perseverance in assembling and managing a remarkable coalition of regulators from U.S. EPA, U.S. Department of Energy, California, the heavy-duty diesel industry, and environmentalists to test the emissions and health impacts of 2007 and 2010 heavy-duty diesel engines. At that time, skepticism that diesel engines would be able to meet new national emission standards was widespread, and few organizations were seen as credible in assessing emissions and health effects. The careful and detailed analysis that ACES provided demonstrated remarkable progress that largely validated the regulatory and engineering approaches taken by

government agencies and industry, respectively. More importantly, the ACES results – that available technology combined with low sulfur diesel fuel work to reduce emissions significantly – serve as both a key proof of concept and a regulatory driver in developing countries, and have provided a path to adopting effective regulations in India, China and elsewhere.

Once an institute that provided science only on unregulated emissions from domestically operated motor vehicles, Mr. Greenbaum's leadership and vision have extended HEI's influence beyond U.S. borders, and HEI now provides trusted science for decisions on four continents. One example of the impact of HEI science produced under Mr. Greenbaum's leadership is the Public Health and Air Pollution in Asia (PAPA) program. PAPA brought together leading scientists from the developed world with fledgling air pollution scientists from developing Asian and Latin American countries to conduct the first ever coordinated time series studies in these key regions. The studies spanned India, China, Hong Kong and Thailand, and demonstrated that the vast body of air pollution science in the developed world is relevant to assessing effects in developing countries. The results of these studies are key drivers for regulatory decisions in Asia. This research effort significantly enhanced the capacity of Asian and Latin American scientists to conduct these types of studies, strengthening the foundation of air quality decision-making around the world.

Mr. Greenbaum has provided and communicated clear, credible and compelling scientific results on complex and controversial topics to national governments and policy institutions worldwide.

Under Dan's guidance, HEI, in collaboration with the Institute for Health Metrics and Evaluation, has become a key leader in the production of the air pollution estimates for the Global Burden of Disease (GBD), the gold standard for estimating mortality from air pollution related disease. Dan has been an effective and tireless communicator of GBD results, which estimate that worldwide air pollution is linked to more than 3 million premature deaths annually, as well as the importance of reducing emissions to protect public health and slow climate change. Patient and thorough explanations and hard-won personal trust have been vital in ensuring that that the GBD findings drive action to protect air quality worldwide.

Nearly three decades ago (1988-1994), Dan served as the Commissioner of the Massachusetts Department of Environmental Protection (DEP), under both Democratic and Republican administrations, a testament to his ability to build bridges across partisan divides in pursuit of environmental goals. In this position, he implemented regulations for all major environmental programs, from air and water to wetlands, Superfund sites and solid waste. While in office, the Department took the then innovative step of putting a moratorium on new incinerator construction, driving up the rate of recycling. Massachusetts was one of the earliest states in

the nation to begin the pivot toward "source reduction" measures (now more commonly called pollution prevention) as an operating principle, away from the more common "engineering" solutions to environmental problems (such as end-of-pipe controls). Under Dan's watch, the state Superfund program also pioneered an approach (controversial at the time) to reduce massive backlogs in agency approvals to remediate thousands of abandoned hazardous waste sites. To accomplish this, the agency brought together environmentalists, the development community and technical experts to establish a licensed site professional who would be trained to remediate less polluted sites without requiring full agency review.

This innovation greatly reduced the backlog of unremediated sites and freed DEP to focus on the sites that were the most polluted. As a result of these innovations, Dan was recognized with the Innovation in American Government Award.

Mr. Greenbaum's years as a leader at the state, national and international levels have led to regular and sustained invitations to lead or serve on prestigious national panels and organizations tackling the most challenging environmental, health and energy issues we face today. These include service as a member of the National Research Council's Board of Environmental Studies and Toxicology, Vice Chair of the Committee on Air Quality Management in the United States; and membership on both the Committee on the Hidden Cost of Energy and, more recently, Science for U.S. EPA's Future. He also chaired the U.S. EPA Blue Ribbon Panel on Oxygenates in Gasoline, whose recommendations concerning MTBE and groundwater contributed to its removal from the nation's fuel supply. He also serves as Chair of the Board of the International Council for Clean Transportation, a world leader in providing technical analysis and support to vehicle emissions regulators and others worldwide.

Throughout his career, he has provided and communicated clear, credible and compelling scientific results on complex and controversial topics to the U.S. Congress (invited by both parties), the European Parliament, the International Agency for Research on Cancer, and many domestic and international regulatory officials. In 2010, he received the Thomas W. Zosel Outstanding Individual Achievement Award from the U.S. EPA for his contributions to advancing clean air. We are honored to present a 2016 Haagen-Smit Clean Air Award to Mr. Greenbaum.

Joyce E. Penner, Ph.D

Air Pollution Research

Dr. Joyce Penner is being recognized for her pioneering air pollution research that has transformed our understanding of the diverse range of atmospheric aerosols associated with human activities, their interactions with clouds, and their role in climate change.

Dr. Penner is the Ralph J. Cicerone Distinguished University Professor of Atmospheric Science at the University of Michigan, where she is also Associate Chair of the Department of Climate and Spaces Sciences and Engineering. Dr. Penner earned her Master of Science and Ph.D. degrees in Applied Mathematics from Harvard University. She teaches and advises several undergraduates and graduates in earth science modelling and atmosphere sciences.

Over her career, Joyce Penner's innovative and sustained scientific contributions have demonstrated the full extent of aerosols' impact on the global atmosphere, their relationship to human activities, and their complex interactions with the climate system. Dr. Penner is well known internationally for her model-building and analysis techniques. Her quantitative comparisons of the contrasting roles of aerosols and greenhouse gases in climate have enabled us to attribute current climatic changes to human activities. She was one of the earliest scientists to estimate the global climatic effect of aerosols, and her early papers on radiative climate forcing by sulfate and carbonaceous aerosols have been highly cited in the academic field.

Dr. Penner's academic accomplishments have also led her to be a key contributor to the Intergovernmental Panel on Climate Change (IPCC). In 1999, Dr. Penner led the IPCC Special Report on aviation and climate and co-chaired the final government plenary where the results were accepted. She was the coordinating lead author for the aerosols chapter in the 2001 IPCC 3rd Assessment Report. She co-chaired an ad hoc working group of scientists initiated by the Secretariat of the United Nations Framework Convention on Climate Change to study the scientific evidence for attribution of greenhouse gas emissions to individual nations (named MATCH) and presented the findings at the 2007 Conference of the Parties. Dr. Penner's scientific contributions and her work on the IPCC assessments are fundamental to the scientific community's confidence that the observed climate change is attributable to human activities.

Dr. Penner's research has significantly expanded our scientific knowledge of the chemistry and physics of aerosols in the global atmosphere, including identifying their sources as natural or anthropogenic. Early aerosol work by colleagues revealed

the importance of sulfate aerosols (derived from burning of coal and oil) for reflecting sunlight, acting as a counter weight to greenhouse gases such as carbon dioxide and methane (also derived from fossil fuel combustion). In seminal papers, Dr. Penner greatly extended the range of anthropogenic aerosols being evaluated to include biomass burning aerosols, black carbon, and the interactions of organic aerosols and clouds. These papers have been cited extensively in the scientific community, and each represents an innovative thrust in aerosol science. Within the framework of global climate change, these papers, detailing the impact of aerosols, offered a new global perspective. She then shifted her focus to the role of aerosols in climate change in a critical paper that quantified climate forcing by anthropogenic aerosols. Perhaps her single most important contribution is a 1994 study (with her colleague) of the response of the climate system to aerosols. This paper demonstrated that the response of the climate system to greenhouse gases and aerosols is regionally heterogeneous, and that it does not just match the pattern of forcing. Their conclusion – that the temperature response was markedly different for carbon dioxide than for aerosol forcing and that it would be necessary to separate out the different components of the forcing to understand climate change – has driven much of the subsequent climate-aerosol research. For example, it laid the groundwork for the identification of the anthropogenic fingerprint of climate change patterns that could only be explained with both aerosols and greenhouse gases. It is now widely accepted that the combined effects of aerosols and greenhouse gases have changed our climate over the past century.

She was one of the earliest scientists to estimate the global climatic effect of aerosols.

Joyce Penner remains active, with her research group still publishing between 10 and 15 papers per year and receiving about 1,000 citations of her work annually. She has served on many committees related to atmospheric science and climate change, including the National Research Council's Committee on Earth Science and Applications from Space, which oversees NASA's program on earth science. She has been the lead editor and author for several reports relating to aviation, aerosols and the global atmosphere for the Intergovernmental Panel on Climate Change (IPCC). She was appointed a Fellow of the American Geographical Society in 1999, and a Fellow of the American Association for the Advancement of Science in 2009. For her work with the IPCC she shared the Nobel Peace Prize together with Al Gore in 2007. Most recently, she earned the NASA Group Achievement Award with the ACCRI Aircraft Cloud Effects Team in 2014.

Dr. Penner remains at the forefront of aerosol climate modeling and we are proud to bestow her with a 2016 Haagen-Smit Clean Air Award.

Veerabhadran Ramanathan, Ph.D.

Climate Change Research

Dr. Veerabhadran "Ram" Ramanathan is being recognized for his sustained and innovative contributions to understanding complex linkages between manmade emissions and climate change, especially the need for simultaneous and deep reductions of short- and long-lived climate pollutants in order to avoid the most catastrophic impacts of global warming. Dr. Ramanathan is the Distinguished Professor of Climate and Atmospheric Sciences at Scripps Institutions of Oceanography, University of California, San Diego, where he has taught since 1990. He earned a Master of Science in Engineering at India's Institute of Science before earning his Ph.D. in Planetary Atmospheres from the State University of New York at Stony Brook.

Dr. Ramanathan's historic research on climate and atmospheric science has been widely recognized around the world. Until the mid-1970s, scientists assumed that CO_2 emitted by the burning of fossil fuels and widespread deforestation were the primary forces that led to global warming. This understanding was permanently altered when Dr. Ramanathan discovered the greenhouse effect of chlorofluorocarbons (CFCs) and reported his findings in a 1975 paper in Science, one of the world's top academic journals. He demonstrated that one CFC molecule in the atmosphere has the same warming effect of more than 10,000 molecules of carbon dioxide. In this paper he also showed that if CFC concentrations were allowed to reach just a few parts per billion (as predicted by scientists based on the

Throughout his career, Dr. Ramanathan has succeeded as a forceful advocate for urgent action to slow climate change, including reminding the world of our moral obligation to act.

wide-spread use of CFCs), their greenhouse effect would rival that of manmade CO_2. This discovery is credited with opening the door to the examination of other trace gases for greenhouse potential. Within a year of the CFC findings, he published a study on the effect of stratospheric ozone depletion on the earth's energy budget. With these two publications for the first time atmospheric physics was linked to atmospheric chemistry, leading to a paradigm shift in the way climate scientists approached the problem of global warming.

In rapid succession, several other trace gases were added by other scientists and in response the World Meteorological Organization, the United Nations Environment Programme, National Aeronautics and Space Administration, and European agencies asked Dr. Ramanathan to lead an international study on the climate effects of nonCO_2 trace gases. The Ramanathan report, which was published in 1985, concluded that non-CO_2 trace gases (methane, CFCs and numerous other halocarbons, nitrous oxide, tropospheric ozone, and others) were contributing to the anthropogenic greenhouse effect as much as CO_2 itself. These findings were all confirmed by Intergovernmental Panel on Climate Change (IPCC) reports. For example, IPCC (2007) concluded that as of 2005, CO_2 was adding 55 percent to the manmade greenhouse forcing and nonCO_2 the other 45 percent.

In the 1990s, Dr. Ramanathan began research into brown clouds, which led to the discovery that absorption of sunlight by soot (black carbon) in the brown clouds caused dimming of sunlight by as much as 10 to 15 percent on the ground. He showed that the brown clouds could lower ocean temperatures, slow down monsoon circulation, and reduce seasonal rainfall. Later in 2008, Dr. Ramanathan led an observational/modeling study that concluded that black carbon (from fossil fuel and biomass combustion) was the second largest contributor, next to CO_2, to global warming. In the same study, he showed that mitigating emissions of black carbon from residential cooking would drastically reduce atmospheric concentrations of black carbon over much of South Asia. This finding eventually led to project Surya, which works to replace traditional stoves (the major emitter of black carbon) with improved cook stoves.

Using IPCC 2007 results, Dr. Ramanathan and a team of researchers concluded that human activities have already added enough greenhouse gases to warm the planet by more than 2°C and such a large warming is likely to be witnessed by the mid-21st century. He realized that fast near-term solutions are necessary to avoid near-term danger. He followed this with a modeling study in 2010 that showed that mitigation of emissions of four short-lived climate pollutants – methane, black carbon, ozone and HFCs – using available technologies was an effective and practical way to avoid reaching the 2°C threshold by 2050 and could reduce the warming trend in the coming decades by 0.6°C (about 50%) at mid-century.

Dr. Ramanathan's early work identifying that CFCs were powerful climate forcers played a critical role in the effort to phase down HFCs under the Montreal Protocol, a strategy that can avoid up to 0.5°C of warming by 2050. The effort to phase down HFCs under the Kigali Amendment to the Montreal Protocol is considered by many observers to be the single most significant international mitigation opportunity available in the near-term, and a critical contribution to the success of the Paris Agreement.

Throughout his career, Dr. Ramanathan has also succeeded as a forceful advocate for urgent action to slow climate change, including reminding the world of our moral obligation to act. His message has motivated some of the most powerful global figures to speak out and act more forcefully to slow climate change. Dr.

Ramanathan personally advises Pope Francis through his role on the Council for the Pontifical Academy of Sciences, His Holiness the Dalai Lama, and California Governor Jerry Brown, among many others.

He has more than 200 peer-reviewed publications and has made more than 40 contributions to books, reports, and testimonies. Dr. Ramanathan has received many honors. He has received a 2016 Revelle Medal awarded by University of California at San Diego, and a Lifetime Achievement Award from the National Council for Science and the Environment. In 2013, he was named Champion of the Earth Laureate for the Science and Innovation category by the United Nations Environment Program, its highest environmental honor. He was appointed to the Council of the Pontifical Academy of Sciences by Pope Benedict in 2012. In 2009, he received a Scripps Climate Science Pioneer Award and a Tyler Prize for Environmental Achievement. He received a Medal for Exceptional Scientific Achievement from NASA in 1989.

His contributions to the understanding of the role and the magnitude of nonCO_2 climate pollutants are fundamental to the way we now understand and seek to address climate change. The world of climate science and policy have benefited immensely from his research and insights, his unselfish dedication to the greater public good, and his energy and resolve to push the limits of our collective work to ensure a more livable global environment, especially for the poor and most vulnerable among us. Dr. Ramanathan pioneered scientific understanding of the critical role of nonCO_2 short-lived climate pollutants, and is a unique force in both climate science and climate policy. We are honored to bestow him with a 2016 Haagen-Smit Clean Air Award.

Anumita Roychowdhury

International Air Pollution Policy

Ms. Anumita Roychowdhury is being recognized for her notable work on a suite of clean air policies to mitigate severe air pollution in India. She currently serves as the Executive Director for Research and Advocacy at the Centre for Science and Environment in New Delhi, India. She earned a Master's of Philosophy in Economic History from Jawaharlal Nehru University, India. She has been a tireless advocate in the fight for the right to clean air for many people in her homeland and beyond.

Ms. Roychowdhury has a long list of success stories for clean air and public health in India. Her most recent policy victory was the national adoption of sweeping new emission standards for cars, trucks, buses, two-wheelers and three-wheelers coupled with a national mandate to a maximum fuel sulfur content of 10 parts per million. The so-called "Bharat Stage VI" emission standards were formally notified in September 2016 after a multi-year process in which Ms. Roychowdhury was a guiding force. The approach India is taking is unprecedented, since it will skip the Euro 5/V equivalent emission standards. This "leapfrog approach" will deliver emission reductions and health benefits faster than has ever been achieved given the scale of health impacts and the speed of this transition in India. Ms. Roychowdhury was an early advocate of this leapfrog approach, beginning with the 2006 publication of her book The Leapfrog Factor: Clearing the Air in Asian Cities. The Indian people will benefit from the accelerated shift to the cleanest vehicle emissions control technology and fuels, and countries outside of India will benefit by modeling their policy roadmaps after India.

Her leadership, determination, and equanimity have been crucial in delivering advances in public health and air pollution control in India.

Ms. Roychowdhury has long been an advocate for clean air. She created and has directed the air pollution control campaign for the Centre for Science and Environment (CSE) over the past twenty years. CSE is a non-profit public interest research and advocacy organization based in New Delhi that has long promoted sustainable development and science-based policies to improve the quality of life for all residents. While at CSE, she launched the 1996 campaign, Right to Clean

Air. The goals and motivation for the campaign were best captured in a book she published that same year and co-authored with Anju Sharma, called Slow Murder: The Deadly Story of Vehicular Pollution in India. This book put air pollution on the public agenda in India at a time when government officials, including the Health Minister, did not see air pollution as a significant health concern. Fuel sulfur content was at 10,000 parts per million (ppm), and no modern emission control system had yet been adopted. The odds were stacked quite significantly against Ms. Roychowdhury and her colleagues in those initial years.

Persistent technical work, communication through the media, and advocacy by Ms. Roychowdhury and her colleagues created the initial seeds for reform that remain important features of air pollution control in India today. The Minister of Environment and Forests took interest in the air pollution concern brought forward by CSE, and in January 1998 established the Environment Pollution and Prevention Control Authority (EPCA) for the National Capitol Region of Delhi. The Founding Director of CSE, Anil Agarwal, was given a seat on this new committee. EPCA put forward by mid-1998 a detailed plan to clean Delhi's air. This included the conversion of all three-wheelers, taxis, and diesel buses to CNG. The Supreme Court of India took notice and ordered this plan implemented, with specified timelines.

This initial model for air pollution control – Supreme Court orders based on citizen petitions – is a unique legacy from her work. The Supreme Court successfully ordered a conversion to natural gas-powered buses in the National Capital Region by 2001. It ordered the registration of all new vehicles in the NCR to meet Euro 2 emission standards by 2002. And it ordered cleaner fuel to supply these vehicles. All of these actions in and around Delhi through the Supreme Court opened the door for the nationwide adoption of cleaner fuels and vehicles that later followed.

The legacy of Supreme Court management of air pollution continues today with Ms. Roychowdhury's direct support and influence. In 2015, the Court banned the registration of all new diesel vehicles with engines larger than 2000 cubic centimeters (2 liters). It has ordered a 1% tax on the sale of these new diesel vehicles in exchange for lifting the ban. In 2016, it ordered a ban on the sale of firecrackers that have been associated with the greatest air pollution crisis in Delhi in 17 years. And its companion court – the National Green Tribunal – has ordered additional measures, including a ban on trucks entering Delhi produced in 2006 and earlier and a doubling of the environmental tax on all other trucks entering Delhi. These Supreme Court and National Green Tribunal Actions have spurred additional action by the local and central governments.

Ms. Roychowdhury's leadership in India is needed today more than ever. The World Health Organization in its 2016 database of air pollution in cities has found that 10 of the 20 most polluted cities in the world are in India. The Institute for Health Metrics and Evaluation estimates that approximately 832,000 annual premature deaths in India in 2015 were attributable to chronic ambient air pollution exposure, second only to China. And the Indian Institute of Technology based in Kanpur, India, estimates that 70 to 80 percent of ambient fine particulate matter in cities like Delhi is attributable to diesel engines.

Her work and advocacy spans core issues in her fight for the right to clean air. She poignantly highlights the need for sustainable urban development and planning including walkable urban centers. She urges the governments of India and elsewhere to carefully plan out mitigation strategies that account for regional differences, to accommodate rural and urban area situations, and the need for the plans to be carried out in a time-bound manner in order to enable action to save lives. She has worked to raise awareness that public health mitigation needs to be the central focus of air quality management. Although she rejoiced in the accomplishments of Dehli's pollution control, a 20 percent decrease in PM2.5 since 2014, she quickly turned her attention to new studies about heightened ozone and poor air quality standards elsewhere in India.

Ms. Roychowdhury's policy victories continue to deliver benefits, and the scale of impact of her efforts in India is tremendous. Ms. Roychowdhury remains a central force in air pollution control in India and throughout the developing world. Her leadership, determination, and equanimity have been crucial in delivering advances in public health and air pollution control in India. We are honored to bestow her with a 2016 Haagen-Smit Clean Air Award.

For more information, contact

Heather Choi
heather.choi@arb.ca.gov
916-322-3893
1001 I Street, Sacramento, California, 95814
www.arb.ca.gov/research/hsawards/hsawards.htm