project surya

Fighting Climate Change Now

MITIGATION OF GLOBAL AND REGIONAL CLIMATE CHANGE AND HEALTH IMPACT

February 23, 2011

EXPECTED OUTCOME

REGIONAL

Increase food and water supply, decrease mountain-glacier melt, decrease deforestation and aid in poverty alleviation.

GLOBAL

Contribute to the delay of the DAI threshold by up to few decades and saving 2 million lives yearly.

BACKGROUND

Global warming of more than 2°C is considered to be the threshold for dangerous anthropogenic interference (DAI).

Black carbon (BC) & non-CO_2 gases such as methane, ozone, halocarbons account for half of global warming and can be removed from the air 10x-100x faster than CO_2.

Biomass cooking (using dung, firewood, crop residues) is a major source of BC & ozone and leads to CO_2 emission by deforestation; it leads to severe air pollution which is the root cause of millions of cardiovascular & respiratory related deaths.

Surya will introduce cleaner cooking methods.

Photo Credit: Adam Ferguson, New York Times

GLOBAL POLICY

2020 - 2025
$20 Billion
Target: 3 Billion people worldwide

Funded and sustained by carbon credits, micro-financing, Global Environment Facility funds and foundations.

REPLICATION

2014 - 2020
$200 Million
Target: 10-20 Million people in Africa, Asia and Latin America.

PILOT PHASE

2009 - 2010
$ 0.8 Million
2,500 People

COMPLETED

DEMONSTRATION

2011 - 2013
$13.7 Million
Target: 50,000 people in North India

IMPLEMENTATION

Replace stoves in 10,000 homes with aid of multi-national team of scientists, engineers, health professionals and village leaders.

VALIDATION

Use data collected from cell phones, satellites and other cutting-edge technologies to quantify impacts on climates and health.
Develop metrics for carbon credits.

A Climate Mitigation Experiment Transforming Quality of Life and Environment in Rural Areas of Developing Nations

A Multi-Disciplinary Approach for Mitigating Unmanageable Changes in Climate and Air Pollution

A central concern for a rural woman in South Asia and other developing nations is to collect enough fuel for the fire over which she will cook for her family. The fuel she uses- firewood, dung, and crop residues (biomass fuels)- usually takes precious hours to collect each day. Not surprisingly, the toxic fumes from her mud-stove are also hazardous to her and her family's health. Roughly three billion people worldwide cannot afford to buy fossil fuels for their basic energy needs such as cooking, lighting and heating. Instead, this population is forced to burn solid biomass fuels and coal. Inhalation of the sooty smoke from these indoor fires is estimated to result in 1.6 million deaths each year.

Because of incomplete and inefficient combustion of fuels in the mud stoves, the sooty smoke contains particulates of black carbon (BC) and condensed organics, and pollutant gases such as volatile organics and carbon monoxide. The stove smoke escapes outdoors, undergoes numerous chemical transformations in the presence of sunlight and leads to vast plumes of Atmospheric Brown Clouds (ABCs) of particles and ozone gas. In Asia, the BC and other particles in ABCs can lead to an additional 500,000 deaths annually, while the ozone gas in ABCs leads to billions of dollars of crop damages each year.

More surprising, however, is that replacing these primitive stoves with cleaner burning technologies can mitigate global and regional warming in substantial and demonstrable ways. BC is the strongest absorber of sunlight and heats the air directly. In addition, it darkens snow packs and glaciers through deposition and leads to melting of ice and snow. Ozone and methane (released by burning of biomass fuels) in ABCs are major greenhouse warmers. Deforestation, resulting from firewood collection, leads to the release of carbon dioxide (CO_2), the major global warmer. Regionally, BC disrupts cloudiness and monsoon rainfall and accelerates melting of mountain glaciers such as the Hindu Kush-Himalayan glaciers.

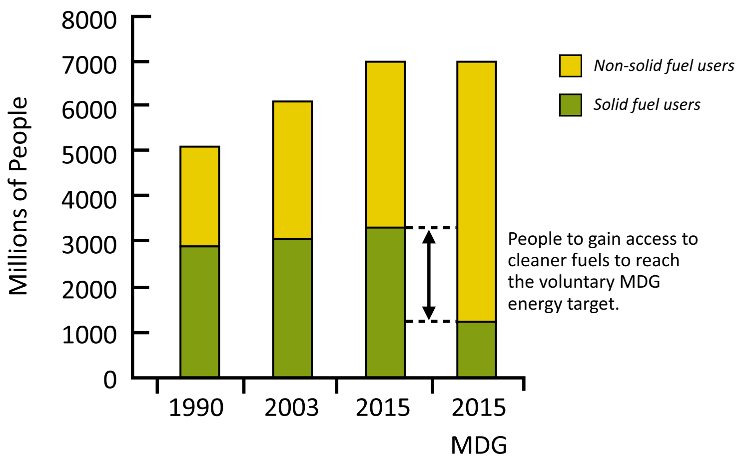
Elimination of BC, ozone, methane and CO_2 resulting from cooking and heating, can delay the onset of dangerous and unmanageable global and regional warming by one to three decades, but current estimates are subject to large uncertainties. *The primary goal of Project Surya is to provide convincing and incontrovertible data for reliably estimating the global and regional climate mitigation potential of reducing pollutant emissions from biomass cooking and heating.*

Cooking dinner on the stones in India

The most attractive human dimension side of this project is that the harmful effects on human health, agriculture and climate will begin to decrease within months to years of mitigation actions, which in turn can provide immense incentives for other actions for mitigating global climate change. Replacement of traditional mud-stove cooking with alternate cleaner technologies is also a major objective of UN's Millennium Development Goals (chart below), since it will alleviate poverty and reduce premature deaths in rural areas of developing nations.

Project Surya will provide 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. Surya has successfully completed a pilot phase in a North Indian village with a population of 2,500. It is now embarking on the demonstration phase in which it will adopt a rural area of approximately 100 square kilometers with around 50,000 people in the most densely populated Indo-Gangetic Plains of India. Within this area, Surya plans to replace traditional cooking methods with less polluting options that utilize renewable or cleaner fuels.

What distinguishes Surya from numerous other clean-cooking projects is its scope and evaluation. Surya will document the impact on climate forcing, regional air quality, and indoor and outdoor human exposure to toxics within a remarkably short period of three years by using advanced surface, balloon and satellite platforms. It will also pioneer the use of cell phones to monitor thousands of people on an individual basis affordably and accurately, and transmit this data to obtain carbon offsets for the villagers. After successful completion of this phase, the project expects to replicate the intervention in other regions that rely on burning solid fuels, such as Africa, Southeast Asia, East Asia and South America.



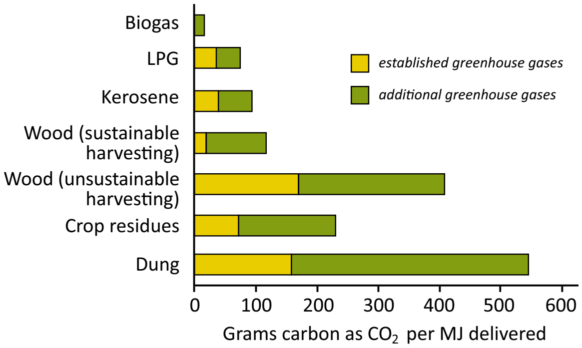
Data for 2015 are based on:

- *a business-as-usual scenario that applies to the observed annual increase in the number of people with access to cleaner fuels from 1990 to 2015;*
- *the voluntary millennium Development Goal (MDG) target proposed by the UN Millennium Project to halve the number of people without access to modern cooking fuels between 1990 and 2015.*

(Source: World Health Organization. Redrawn figure from Fuel for Life, WHO 2006)

Climate Change Mitigation - Now

Project Surya aims to mitigate the regional and global impacts of anthropogenic climate change by immediately and demonstrably reducing atmospheric concentrations of black carbon (BC), methane and ozone. BC is not a gas, but a particle in soot that gives it the brownish to blackish color. Together, BC, methane, and ozone from biomass and fossil fuels are responsible for 30 to 60 percent of the human effects on global warming. But unlike the greenhouse gas carbon dioxide (CO_2), which lasts over 100 years once released, these pollutants are short lived. Their effect on atmospheric warming and the retreat of the Arctic sea-ice and mountain glaciers such as the Hindu Kush-Himalayan (HKH) glaciers will diminish within months of reducing BC and ozone precursor emissions, and within decades of reducing methane emissions. Reducing the emission of one ton of BC can mitigate as much global and regional warming as obtained by reducing 250 to 3,000 tons of CO_2 thus providing a huge leverage for slowing down climate change on local to global scales.



20-year greenhouse gas emissions in grams carbon as CO_2 emitted per megajoule (MJ)

- *based on established greenhouse gases, carbon dioxide (CO_2), methane (CH_4) and nitrogen dioxide (N_2O);*
- *based on established and additional greenhouse gases, carbon monoxide (CO) and non-methane hydrocarbons (NMHC).*

Emissions from different fuel/stove combinations in India were systematically assessed using a standardized cooking test.

(Source: World Health Organization. Redrawn figure from Fuel for Life, WHO 2006); Adapted from: Smith KR, et al. Greenhouse implications of household stoves: an analysis for India. Annual Review of Energy and the Environment, 2000, 25:741-763)

Gathering biomass fuels is an hours-long task for many women.

Focusing on these culprits would allow mitigation efforts to have a noticeable impact in the short-term. Such fast-track actions have yet to be explored. But along with reductions in CO_2 emissions by as much as 50 percent, reducing BC, ozone, methane and other short lived green-house gases is essential for delaying the 2°C threshold beyond which global warming may reach unmanageable proportions. These goals are also in line with the limits on warming set by the Copenhagen Accord. Importantly, the technologies exist today, or can be feasibly and affordably developed within a few years to drastically reduce emissions of these pollutants.

Biomass fuel burning contributes to as much as 25 percent of BC emissions globally and is the focus of Project Surya. Firewood collection leads to deforestation and the release of CO_2. In addition, the smoke contains methane and the gases carbon monoxide and volatile organics, all of

In contrast to a traditional mud stove relying on wood, sticks, and dung (shown here), a clean-burning stove provided by Project Surya would cook an Indian family's meal with minimal health impacts.

which generate ozone, another potent greenhouse gas and life threatening pollutant. These pollutants trap infrared heat and exacerbate global warming.

Convergence of Climate Change, Air Pollution, Public Health and Economic Development

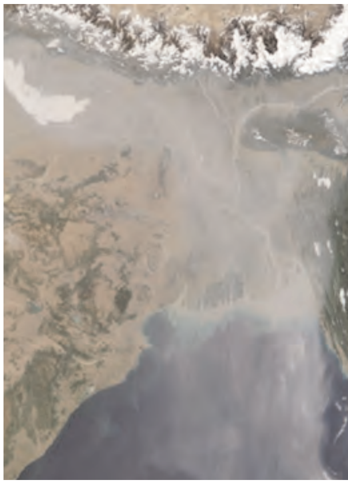
Domestic use of biomass fuels is one of the very few societal problems that impacts all of the four of the major challenges facing developing nations today: economic development, air pollution, climate change, and public health. Ultimately, Surya's aim is to steer the three billion people who depend on polluting solid biomass fuels towards cleaner, locally available renewable energy sources while using affordable, clean burning stoves.

The World Health Organization estimates (for 2004) that inhalation of indoor smoke, primarily through biomass fuel burning, is responsible for about 1.6 million deaths annually through respiratory and cardiovascular diseases. The BC and organic aerosol particles, carbon monoxide, volatile organics and other gases in the smoky soot also reduce air quality outdoors by contributing to Atmospheric Brown Clouds (ABCs), and heats the air impacting precipitation as well as accelerating the melting of snow and ice in the Himalayan glaciers. The ABCs lead to decreased agricultural yield through the production of ozone, which directly leads to crop damages, and through climate changes that decrease rainfall. Finally, women and children, the primary gatherers of these fuels, are forced to waste precious hours each day collecting these fuels rather than going to school or performing other tasks.

The major local benefits of reducing these air pollutants will include immediate and demonstrable improvements in air quality, public health, agricultural productivity, and economic development for the rural populations in developing nations.

How Surya is Different

Project Surya brings together an international team of energy technologists, air pollution and climate scientists, epidemiologists, computer scientists, rural economic development experts from NGOs, academic institutions and governmental organizations, to achieve three goals: 1) Replace existing lighting and cooking technologies by disseminating clean technologies, such as solar lanterns and energy efficient cooking and fuel



During the dry season from November to April, the brown sky seen over Nepal is typical of many areas in South Asia. Monsoonal winds carry this anthropogenic haze and spread it over most of the tropical Indian Ocean.

processing technologies to the target population; 2) Scientifically document the impact of cleaner stoves and kerosene lamps on local environments; 3) Design locally relevant practices to ensure sustained voluntary usage.

While there have been numerous cook-stove initiatives in the past, Surya is different from past projects in its rigorous analysis of the intervention using cutting edge technologies, its focus on locally relevant goals and capacity building, and its plan to scale the project to a global, sustainable level.

Unprecedented, Cutting Edge Data Collection

Surya's multi-disciplinary team will undertake the most comprehensive and rigorous scientific evaluation to date on the efficacy of reducing biomass fueled cooking on climate warming, air pollution, health and human well being. Surya's study methodology is unique because it aims to collect high quality, reliable data at every level: from the individual household, to the village, to the regional impacts of the project intervention.

Household data will be collected via cutting-edge sensor technologies and analytics installed in mobile phones distributed to participating households. These mobile phones will measure individual reduction in exposure to pollutants as well as adherence to the intervention in a distributed and scalable fashion that improves upon traditional data collection technologies.

Example of the mobile phone text-free activity interface.

Instrumented towers installed in each region will collect climate related metrics at the village level including concentrations of BC, carbon monoxide, and ozone, and will measure the resulting change in the solar heating of the air and the ground. Finally, these data will be combined with the most advanced data from NASA's A-Train satellite to measure the regional heating effects and probable cooling effect of other particles emitted when solid biomass fuels are burned.

Documenting and Evaluating the Impacts of the Intervention

During year one, background data will be collected without intervention. Deployment of new cleaner-burning and energy-efficient technologies will commence at the end of year one. Conceptually, Surya will create a BC hole in the intervention region within weeks of introducing the new technologies. In order to separate the 'signal' created by the intervention, the surrounding villages will be monitored using satellites and *in-situ* sensors. The height of the BC cloud, absorption of sunlight by the cloud, concentrations of ozone, nitrogen dioxide and sulfur dioxide, will be used in conjunction with high-resolution models to quantify the transport of smoke and air pollutants from areas outside the region of intervention. The analyzed data will be used as input to regional climate models to estimate the reduction in the global and regional warming potential of BC, methane, and ozone.

Locally Relevant Goals and Capacity Building

A primary strategy of Surya is to introduce these cleaner technologies in ways that are locally relevant, appropriate and ultimately sustainable through increasing participation of local populations.

Importance of Non-CO_2 Climate Warmers for Climate Mitigation

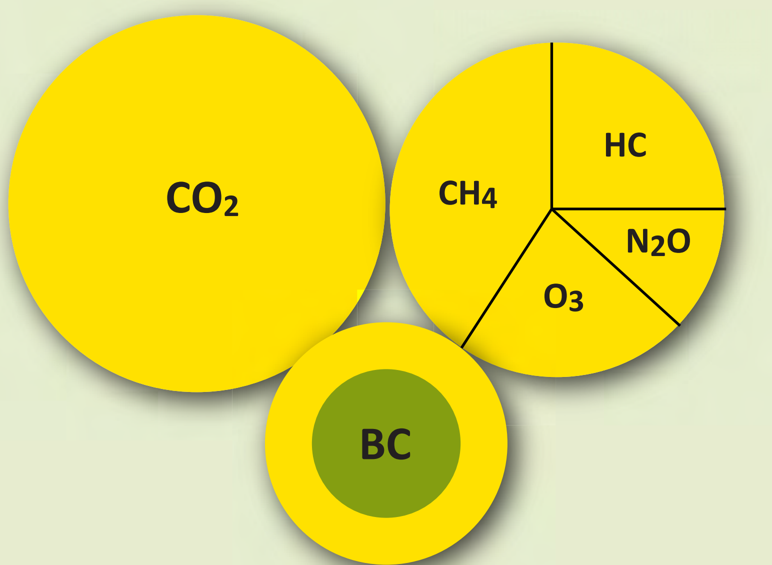
Human activities have added since pre-industrial times numerous manmade greenhouse gases (GHGs) including carbon dioxide (CO_2), methane (CH_4), halocarbons (CFCs; HCFCs; HFCs), nitrous oxide and ozone into the atmosphere. Ozone is a major pollutant leading to severe crop damage. Human activities do not directly emit ozone, but emit so-called precursor gases such as carbon monoxide, volatile organics and methane which lead to production of ozone. In addition, burning of fossil fuels and biomass fuels have added another climate warmer, black carbon (BC). BC, a major component of soot, is not a gas but a particle.

Roughly 50 percent of the global warming from pre-industrial era to the present is due to the non-CO_2 gases and BC (pie-charts below). The GHGs alone have trapped enough infrared heat to warm the planet by as much as 2.5°C. About 50 percent of this potential warming has been masked by other particles from air pollution (sulfates, nitrates and organics) which scatter sunlight and cool. As we clean up the air in the coming decades, the GHGs warming will be unmasked fast. As we unmask the GHGs warming, we have to make sure we draw down both the CO_2 and the non-CO_2 climate warmers.

According to the Copenhagen Accord signed by the heads of state of over 100 nations including the U.S., global warming should be limited to less than 2°C to prevent dangerous anthropogenic interference with the climate system.

Currently, through fossil fuel and biomass fuel burning, we are dumping about 36 billion tons of CO_2 into the air every year. Current climate mitigation actions, such as the Copenhagen Accord, call for as much as a 50 percent reduction in CO_2 emissions by 2050. Even if we succeed in this goal, we will still be putting 18 billion tons of CO_2 every year as of 2050. About 50 percent of the CO_2 we emit each year will remain for at least a century; about 20 percent will remain for 1000 years or more. As a result, even with 50 percent reduction, CO_2 concentrations will continue to increase and can add another 1°C warming to the already committed 2.5°C.

Clearly, while we must drastically reduce CO_2 emissions, we have to reduce non-CO_2 emissions to avoid unmanageable warming in excess of 2°C, as stipulated by the Copenhagen Accord . The current (as of 2005) contribution to global warming is about 1°C from non-CO_2 gases and 0.2 °C to 0.8°C from BC. The most attractive aspect of reducing non-CO_2 warmers is that their life times in the atmosphere range from days (BC) to a month (ozone) to a decade (methane, HFCs). As a result, their climate warming effects will diminish rapidly and offer near-term relief. Furthermore, technologies are available for large reductions (30 to 50 percent) in BC, ozone, methane and HFCs.

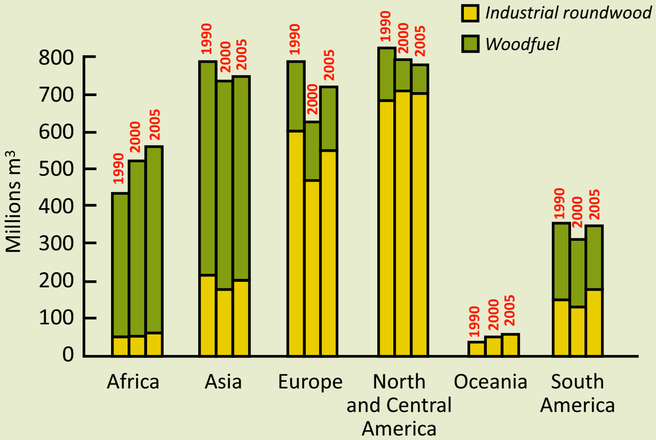


Heat trapped by CO_2, Non-CO_2 gases and BC particles as of 2005. The area of each pie-chart represents the magnitude of the heat trapped. The inner and outer circle for BC denote CO_2 is carbon dioxide; CH_4 is methane; HC is halocarbons; N_2O is nitrous oxide; O_3 is ozone.

Drastic reductions in CO_2 can prevent unmanageable changes in the long term (latter half of this century), while drastic reductions in non-CO_2 can delay such changes from occurring before 2050.

Why is a Surya-style Scientific Study Needed for Cook Stove Replacement?

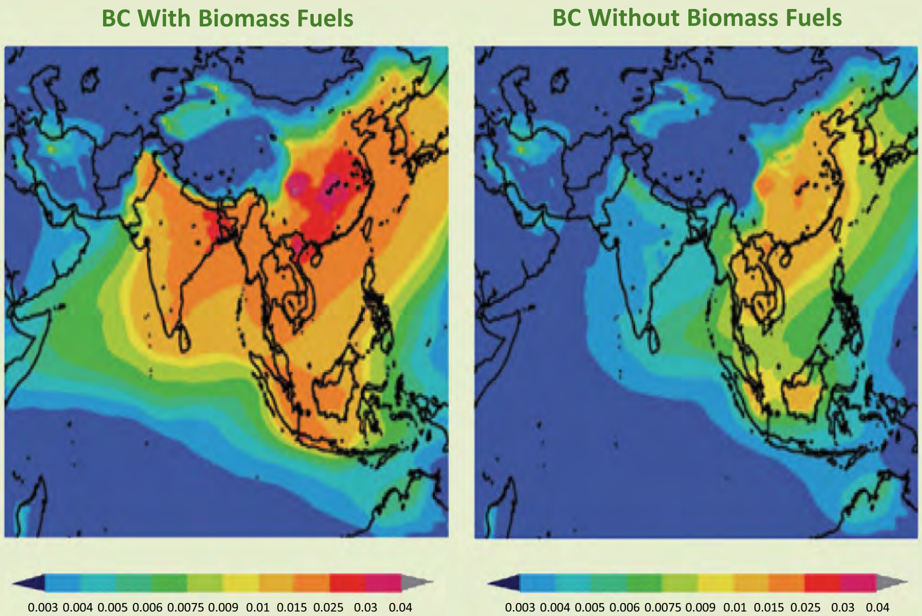
Inefficient combustion of fuels in primitive cook-stoves lead to emission of soot particles which consist of BC and organic carbon; they also emit carbon monoxide and volatile organic gases which lead to the formation of ozone, a major greenhouse gas. When firewood is used as fuel it leads to methane emission. More importantly, use of firewood for cooking often leads to deforestation – an important source of increased CO_2 emissions (see chart). Current estimates for the emission of many of these pollutants per pound of combusted fuel are subject to large (factors of 2 to 4) uncertainties. As a result, the human exposure to these pollutants is very uncertain. Furthermore, there is about a 4-fold or more uncertainty in our current understanding of the global warming effects of BC. The 4-fold uncertainty in BC forcing is from two sources: i) fossil and biomass fuel burning also puts out organic aerosols, some of which reflect sunlight and cool and we don't know the magnitude of this cooling effect; ii) when BC and other aerosols are entrained into clouds they can increase cloudiness in some locations and cool the climate or they can burn off clouds in some tropical regions and amplify the warming from BC. Model studies suggest that reducing BC emissions by 1 ton each year from now to 2050 can have the same mitigating effect on climate as reducing 250 to 3000 tons of CO_2. In South Asia, elimination of BC emissions from cooking is estimated to lead to significant reductions in BC (see map of simulated BC with and without biomass fuel cooking).



Wood removal trends from 1990-2005 in million m³.
(Source: Food and Agriculture Organization of the United Nations)

BC also has several regional climate effects. It warms the air directly and such warming in elevated regions of the Himalayas can lead to melting of the snow packs and glaciers. When BC is deposited over the snow packs, glaciers and sea ice, as has been observed, it darkens these bright surfaces and increases solar absorption and accelerates melting. The interception of sunlight by BC and other pollution particles leads to dimming of sunlight at the surface which in turn is estimated to reduce precipitation in South Asia, cause a southward shift of rainfall patterns in Africa and East Asia. BC in conjunction with other particles emitted by biomass combustion can nucleate more cloud drops, and suppress rainfall. Available model simulations indicate large impacts on regional rainfall and cloudiness. For example, in the Amazon region satellite data suggest complete disappearance of low level cloudiness in the presence of smoke plumes containing BC.

Surya's main goal is to get reliable observational estimate of the impact of traditional cook stoves on global warming, regional climate changes including precipitation and human exposure to soot and other pollutants.



Simulated BC column amounts with (left) and without (right) biomass fuel burning across Asia. (Ramanathan and Carmichael, 2008)

These efforts will include a priori and ongoing community surveys in order to select feasible cleaner-burning methods that take into account local customs, dietary needs and locally available fuel sources. We are working directly with manufacturers to select energy-efficient and BC-free (or nearly BC-free) stoves for general use. In addition, Surya will provide ongoing training in the use, maintenance and repair of the new stoves and mobile phones. Project Surya will develop a strong, locally accessible network of entrepreneurs for cooking technology service, repair, fuel supply, and stove marketing. It will also employ an adaptive technology dissemination plan in which there will be routine exchange of information between the women who cook with the stoves and the companies and cook-stove researchers. The stoves will be modified in response to user feedback.

Project Surya additionally builds research and development capacity in the target region by locating a majority of the implementation, research, analysis, and technology development in India. During the pilot and demonstration phases which take place in India, Surya has partnered with numerous prestigious Indian institutions such as The Energy and Resources Institute, Sri Ramachandra University, and Jawaharlal Nehru University. These institutions will lead the implementation effort. Collaboration and knowledge transfer will involve leading institutions in the United States, including the Scripps Institution of Oceanography at University of California, San Diego, University of California, Los Angeles, University of Iowa, University of Wisconsin - Madison, and NASA, among others.

A Sustainable Plan for Scaling-Up

Project Surya's timeline includes a pilot phase (already completed), a demonstration phase, a global replication phase and a global policy phase.

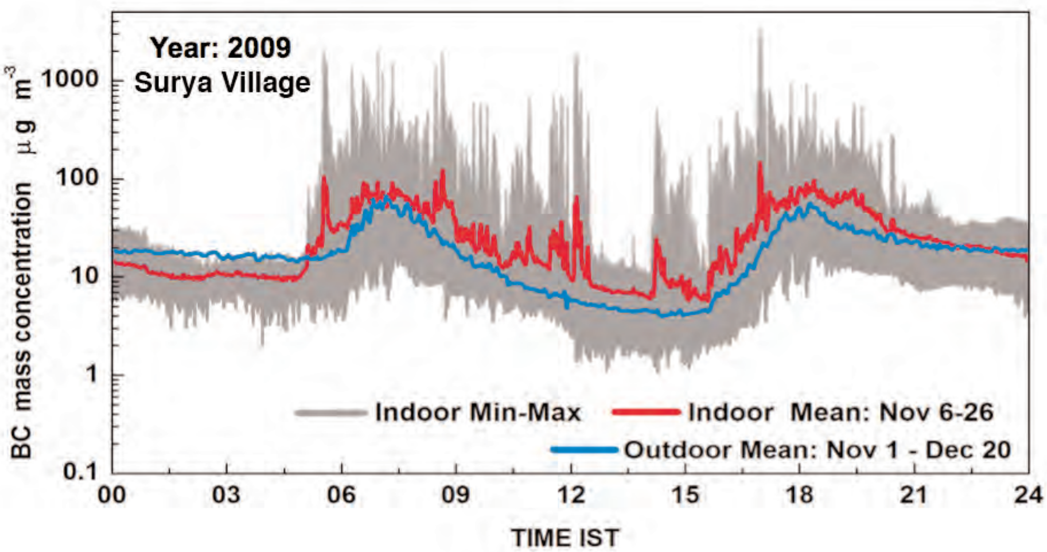
Initial Focus on India

Surya's pilot and demonstration phase will focus on India, where roughly 650 million rural Indians are currently burning solid biomass fuels due to economic hardship. A mass of scientific evidence suggests that biomass fuel burning contributes up to two thirds of BC and carbon monoxide emissions in South Asia. The sooty smoke from indoor cooking escapes outdoors and mixes with other pollution to form vast plumes of ABCs over most of the Indo-Gangetic Plains (IGP) which extend eastwards from Pakistan, across North India to Bangladesh. Since it provides the southern boundary of the Hindu Kush-Himalayan (HKH) region, the IGP is one of the major pollution sources for the effects of BC on the Himalayas, and is the major source region for BC, CO_2 and other pollutants. Model studies estimate that elimination of biomass fuel emissions can transform the brownish sky into blue skies in India. In addition, inhalation of indoor air pollution from biomass fueled fires and kerosene fueled lamps leads to more than 400,000 deaths annually among rural women and children in India alone.

Pilot Phase Successfully Demonstrated in 500 households

In order to field test our approach to stove deployment and data collection, we began with 500 households and a population of 2,500 people in a small village in the Uttar Pradesh state of Northern India. During Spring 2009 a leading and internationally recognized NGO in India, The Energy and Resources Institute (TERI), took the lead in the rural implementation.

Data on BC and other pollutants were collected outdoors and in over 40 individual homes for over nine months. We also tested the implementation methodology by replacing mud stoves with improved stoves in the entire village. We

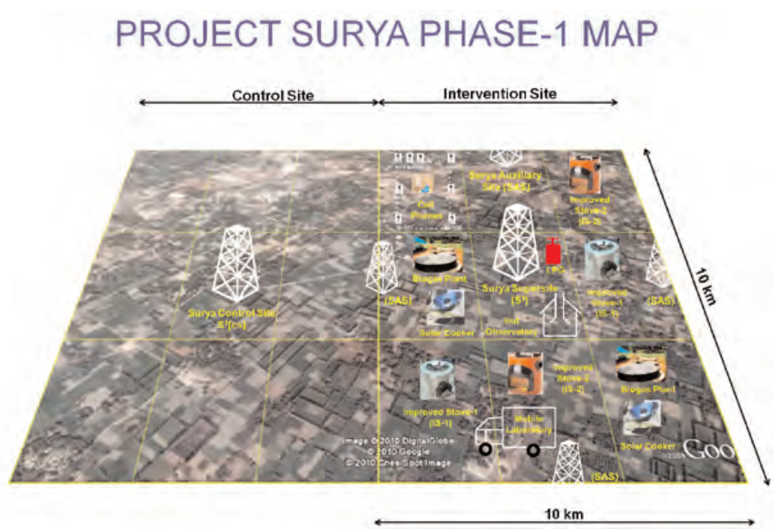


Dry season day-night variation of indoor and outdoor black carbon (4 month) concentrations at the Surya Village in 2009 during the Surya Pilot Phase study. The peak concentrations exceed the WHO limit by more than 3-fold.

identified suitable technology that fulfills the lighting and cooking needs of the project population from the existing battery of commercially available technologies for deployment. Data on both environment and human exposure were successfully collected by a team of engineers, climate scientists and epidemiologists. The experience and data gathered during this pilot phase are being used to design the demonstration phase.

Demonstration Phase in 10,000 households

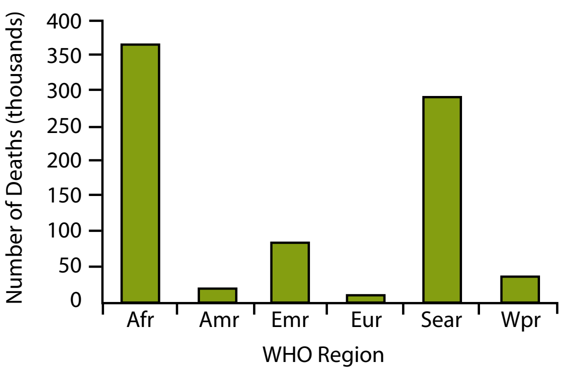
Surya is now positioned to embark on the demonstration phase, which requires an area that is large enough to be captured by satellite sensors (approximately 100 square kilometers) and a population of about 50,000 people to constitute a valid and viable test spanning approximately 40 neighboring villages. The design, which is explained in detail in the forthcoming Implementation document, includes observatories inside and outside the intervention



Surya Demonstration Phase map showing the intervention and the control sites. A BC "hole" will be created at the intervention site by deploying cleaner-burning stoves, solar lanterns, biogas plants and other energy-efficient burning technologies. Comparisons will be made with the control site using traditional mud stoves. Both of the sites within the region will be monitored daily by several satellites.

area, remote sensing sensors, 1,000 mobile phones, an array of NASA and commercial satellites, and air pollution and climate models. The demonstration phase will be located in the same rural region where the pilot phase took place, and will last 3 years. Year one will be used to collect data without the intervention. The deployment of the cleaner technologies will take place in the next six months. This phase will culminate in data collection of the impact of the new technologies for one year. Data on air pollution, climate impacts and health impacts will be gathered. Reduction in human exposure to BC and other pollutants, air pollution, and climate forcing will be quantified. In particular, we hope to quantify the equivalence between tons of BC emission reduction and CO_2 emission reduction, a key metric for carbon credits.

Replication Phase in Africa, Asia, and South America



Deaths in children aged under five years from pneumonia and other acute infections of the lower respiratory tract due to indoor air pollution, by WHO region, 2002.

WHO distinguishes between the following geographical regions: African Region (Afr); Region of the Americas (Amr); Eastern Mediterranean Region (Emr); European Region (Eur); Southeast Asia Region (Sear); Western Pacific Region (Wpr).

(Source: World Health Organization. Redrawn figure from Fuel for Life, World Health Organization 2006)

Building on expected successes in the demonstration phase, the goal is to scale up Project Surya in India, China, South America, Africa and other regions of the world where biomass fueled cooking is prevalent.

Global Phase

Surya is sponsored by the United Nations Environment Programme (UNEP). Surya aims to make its approach to climate mitigation a government policy through UNEP's policy wing. The Surya concept has been enthusiastically received by UNEP, the Swedish International Development Agency, an EU-India joint initiative, and the World Bank.

Carbon Credits - A Financial Model

A sustainable financial model is currently being developed to improve the adoption rate of the new technologies. This model will include the participation in a carbon credit or cap and trade program where villagers who adopt the energy-efficient stoves can sell carbon credits on an international market. Surya's accurate, reproducible climate data will quantify the equivalent CO_2 emissions saved by avoided deforestation, reduction in emissions of BC, methane and ozone producing gases. This data will then be used to secure carbon credits for the villagers. It is our expectation that the monetary returns to the villages and the villagers through these credits will be an important motivation factor.

International Linkages

The core Surya team is already linked with the following international initiatives related to air pollution, biomass fuels and renewable fuels:

- Chair: International Atmospheric Brown Clouds Program of UNEP (V. Ramanathan)
- Keynote speaker, the UN Foundation Initiative on Cook Stoves (V. Ramanathan)
- Director, World Health Organization Center for Environmental Health (K. Balakrishnan)
- Steering Committee, National Biomass Cook Stoves Initiative of the Government of India (I.H. Rehman)
- Steering Committee, International Forum for Biomass Fuels (I.H. Rehman)

National and International Recognition of Surya

- New York Times, By Degrees - *Third-World Stove Soot Is Target in Climate Fight* (April 16,2009); http://www.nytimes.com/2009/04/16/science/earth/16degrees.html
- International Herald Tribune, *The Threat in Village Soot* (December, 2009); http://www.projectsurya.org/storage/iht-copenhagen-12-2009.pdf
- PBS, Lehrer News Hour, In India, *Battling Global Warming One Stove at a Time* (December 17, 2009); http://www.pbs.org/newshour/bb/environment/july-dec09/india_12-17.html
- SBS Dateline, Australia, *India Hots Up* (December 2009); http://www.youtube.com/watch?v=yQ6beHAgxFg
- Scientific American, *Listed in 10 Important Atmospheric Science Experiments,* (April 7, 2009); http://www.scientificamerican.com/slideshow.cfm?id=10-climate-experiments&photo_id=7DCBAA0B-0E47-2566-48E7A91ADCA3188A
- Environmental Health Perspective, *Better Burning, Better Breathing: Improving Health with Cleaner Cook Stoves* (March 2010)
- USAID, Asia, *Black Carbon Emissions in Asia: Sources, Impacts, and Abatement Opportunities* (April, 2010) http://usaid.eco-asia.org/programs/cdcp/black-carbon-emissions-in-asia.html

Acknowledgements:

Funding Sources

The pilot phase was funded by private donors (Drs. E. Frieman, V. Ramanathan and D. Zaelke), Scripps Institution of Oceanography, University of California, UNEP, Swedish International Development Agency, QUALCOMM, the Vetlesen Foundation and the National Science Foundation. For the demonstration phase, we hope to approach major private foundations and federal funding agencies.

United Nations Environment Programme (UNEP)

Swedish International Development Agency (SIDA)

National Science Foundation (NSF)

QUALCOMM, Incorporated

The G. Unger Vetlesen Foundation

Development of Surya Concept

We thank the following for their help with the development of Project Surya: J. Fein (NSF), E. Frieman (SIO), E. Guarneri (Scripps), M. Gupta, T. Haymet (SIO), H. Hughes (SIO), C. Kennel (SIO), W. Martin (NIEHS), A. Middleton (SIO), J. Moss (EPA), R. Pachauri (TERI), D. Zaelke (IGES).

Participating and Interested Institutions

Scripps Institution of Oceanography (SIO)

University of California, San Diego (UCSD)

Center for Clouds, Chemistry and Climate (C4)

The Energy and Resources Institute (TERI)

The University of California, Los Angeles (UCLA)

Nexleaf Analytics

Sri Ramachandra University (SRU)

United Nations Environment Programme (UNEP)

Center for Embedded Network Sensing (CENS)

University of Iowa

University of Wisconsin - Madison

NASA (Goddard Space Flight Center)

Argonne National Laboratory

Jawaharlal Nehru University (JNU)

Project Atmospheric Brown Clouds (ABC)

Project Surya Core Implementation Team

Dr. Veerabhadran Ramanathan is a Distinguished Professor at the Scripps Institution of Oceanography, University of California at San Diego. He discovered the greenhouse effect of Chlorofluorocarbons (CFCs) and numerous other manmade trace gases and forecasted in 1980, along with R. Madden that the global warming would be detectable by the year 2000. He, along with Paul Crutzen, led an international team that first discovered the widespread Atmospheric Brown Clouds (ABCs). Dr. Ramanathan showed that ABCs led to large scale dimming, decreased monsoon rainfall and rice harvest in India and played a dominant role in melting of the Himalayan glaciers. He has testified in several congressional testimonies. He chaired a National Academy committee that called for a major restructuring of the U.S. Climate Change Science Program and it was received favorably by the Obama administration. He is a member of the 2007 Nobel Peace Prize winning Intergovernmental Panel on Climate Change. His numerous awards include the 2009-Tyler prize (considered the top environmental prize in the U.S.), the Volvo Prize and the Zayed Prize for pioneering studies in environment. He has been inducted to the American Philosophical Society, the U.S. National Academy of Sciences, the Pontifical Academy by Pope John Paul II and the Royal Swedish Academy of Sciences. Dr Ramanathan is the Chair of the Surya Project.

Mr. Hung V. Nguyen has been associate director of C4/SIO since 1991. In 1992, he served as executive secretary for the Science Team of the Central Equatorial Pacific Experiment (CEPEX) and in 1995-2000, as executive secretary for the International Steering Committee of the Indian Ocean Experiment (INDOEX). During 2002-08, he served as executive secretary for the UNEP-sponsored Project Atmospheric Brown Cloud (ABC). Since 2005, he has been working with V. Ramanathan to develop a leading unmanned aircraft-based climate research program, serving as mission for the Maldives Autonomous unmanned aircraft Campaign (MAC) in 2006, the Cheju ABC Plume - Asian Monsoon Experiment (CAPMEX) August-September 2008, the California Air Pollution Profiling Study (CAPPS) 2008-09, and since 2008, the Pacific Testbed Demonstration Project.

Mr. I.H. Rehman is the director of rural action division of The Energy and Resources Institute (TERI), New Delhi, the leading non-governmental organization in India on energy and environment. Mr. Rehman has spent over a decade on rural intervention programs in India. He is on the steering committee of the National Biomass Cook Stove Initiative and the International Renewable Energy Initiative, Switzerland. He leads the deployment of Surya in India

Dr. Nithya Ramanathan is a Computer Science research faculty member at UCLA and a founding president of Nexleaf Analytics, a non-profit that uses mobile phones to collect and analyze data for public health, climate change, and environmental applications. In Surya, Nithya will lead a team in the development of household black carbon monitoring and in the capability of using mobile phones for carbon credit validation and transfer.

Dr. Kalpana Balakrishnan currently serves as a Professor of Biophysics and the Head of the Department of Environmental Health Engineering at Sri Ramachandra University, Chennai. She also serves as the Director of the WHO Collaborating Centre for Occupational Health at her university and as the Director of the Center for Advanced Research for Environmental Health of the Indian Council of Medical Research, Govt.of India. Her primary research involvement has been in the area of exposure assessment and environmental epidemiology, and coordinates several research efforts in these areas. She serves on many technical task forces at the national and international level concerned with guideline setting for environmental standards. She serves as the Regional Editor, India for Environmental Health Perspectives, the official journal of the National Institute for Environmental Sciences, USA.

Additional Information

Quantitative backing for the facts given in this document can be found on the fact sheet on the Project Surya website at: *http://www.projectsurya.org*

Information expounding on the points made in this document, and including implementation details can be found in the Project Surya Implementation Plan document (In preparation).

Project Surya Contact Information

Contact Info/International Secretariat: Center for Clouds, Chemistry and Climate (C4), Scripps Institution of Oceanography, UC San Diego 9500 Gilman Drive #0221, La Jolla, California 92093-0221. Contact: V. Ramanathan, Director C4, vramanathan@ucsd.edu. Phone: +1 858-534-8815. Project Coordinator: H. Nguyen, Assoc Director, C4. Staff: S. Cole, T. Ahmed, J. Burney, R. Thomas. Alternate Contact: N. Ramanathan (UCLA and Nexleaf Analytics), Nithya@cs.ucla.edu.

International Coordinating Agency: United Nations Environment Program. S. Shrestha and M. Iyngararasan United Nations Environment Programme (UNEP), P.O. Box 30552 (00100), Nairobi, Kenya. Contact: S. Shrestha, Surendra.Shrestha@unep.org.

Regional Secretariat in India: The Energy and Resources Institute (TERI), New Delhi, India. Contact: I. H. Rehman, ihrehman@teri.res.in; Alternate Contact: A. Kar, akar@teri.res.in.

Core Institutions: UNEP-Nairobi (S. Shrestha, M. Iyngararasan); Scripps Institution of Oceanography (V. Ramanathan), University of California San Diego; The Energy and Resources Institute (I.H. Rehman); Center for Embedded Network Sensing, University of California, Los Angeles (N. Ramanathan); Nexleaf Analytics (N. Ramanathan); Sri Ramchandra University, Chennai, India (K. Balakrishnan).

Other Participating Institutions: University of Iowa (G. Carmichael); University of Wisconsin - Madison (J. Schauer); NASA Goddard Space Flight Center (R. Kahn); Jawaharlal Nehru University, New Delhi, India (U. Kulshrestha); Project Atmospheric Brown Clouds; Argonne National Laboratory (Y. Feng).

First published by Scripps Institution of Oceanography, University of California, San Diego in 2010.

This document should be referred to as: Project Surya Prospectus, 2010: V. Ramanathan, I.H. Rehman, N. Ramanathan, H. Nguyen and T. Ahmed.

Scripps Institution of Oceanography promotes environmentally sound practices globally and in its own activities. This publication is printed on 100 percent recycled paper. Our distribution policy aims to reduce Scripps Institution of Oceanography's carbon footprint.

project surya

Fighting Climate Change Now