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Bridging Research and Policy on Short-Lived Climate Pollutants (SLCPs) in Asia

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Key Messages

- Asia could accrue significant air quality, public health, and climate co-benefits from mitigating short-lived climate pollutants (SLCPs) such as black carbon and tropospheric ozone (O_3). Realizing these co-benefits will require bridging a research-policy divide. This policy brief outlines four pragmatic steps to help narrow that divide in Asia.
- A conventional co-benefits approach often involves reducing GHGs in parallel with pollutant species that cool the atmosphere. The removal of cooling pollutants can unmask warming; mitigating SLCPs such as black carbon can compensate for the unmasked warming. A co-benefits strategy focusing on SLCPs can therefore complement one focused on GHGs. Researchers need to raise awareness of these complementarities among Asia's policymakers.
- Concentrating on the co-benefits from clean cookstoves would be a good starting point for awareness raising efforts in Asia. Clean cookstoves offer the single greatest climate change mitigation and air pollution abatement potential in Asia. However, a disregard for local ownership, community acceptance, and other on-the-ground intangibles has often blunted the performance of improved cookstove programs. Enhanced South-South sharing of experiential knowledge between community leaders, stove designers, gender specialists, and development practitioners could further boost the effectiveness of clean cookstove programs.
- Greater awareness of the climate co-benefits from non-methane precursors of O_3 would also pay dividends in Asia. Recent research has focused chiefly on methane (CH_4) precursors of ozone. In Asia, NO_x plays an underappreciated role in ozone formation. North-South exchanges designed to tailor NO_x controls such as vehicle inspection and maintenance programs (I&M) for freight vehicles to resource-constrained regulatory environments could help broaden and deepen collaborations on SLCPs in Asia.
- The recently established Climate Change and Clean Air Coalition (CCAC) could facilitate collaborative exchanges on clean cookstoves and diesel to illustrate complementarities between different co-benefit approaches and non-methane ozone precursors in Asia. It could also leverage these exchanges to help "softlink" regional air pollution and global climate agreements.

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1. Introduction

In the mid-1980s, scientists studying the impacts of a nuclear war cautioned that the large clouds of particulate pollution could disrupt climate systems. Over the next two decades, these studies revealed relationships between air pollution and climate change that might have escaped notice absent the nuclear threat. More recently, advances in this research have spurred calls for mitigating short-lived climate pollutants (SLCPs) to supplement insufficiently ambitious climate change strategies (UNEP 2010; UNEP/WMO 2011). Filling these "ambition gaps" will nonetheless require strengthening links between air pollution abatement and climate change mitigation.

Strengthening air-climate linkages can yield co-benefits. The term "co-benefits" refers to the multiple benefits accruing to policies and measures where at least one rationale for these actions is mitigating climate change (IPCC 2007). While the term co-benefits is often used to connote sets of benefits resulting from reducing long-lived greenhouse gases (GHGs) alongside conventional environmental pollutants, recently it has gained currency from those advocating reductions in SLCPs. Abating SLCPs such as black carbon and tropospheric ozone (O_3) can help stabilize climate systems, improve air quality, and boost crop yields. The potential for these concurrent gains is anticipated to be particularly sizable in Asia. But realizing this potential requires bridging a divide between research and policy on SLCPs. This policy brief outlines four steps that can help narrow that divide in Asia:

- A conventional co-benefits approach often involves reducing GHGs in parallel with pollutant species that cool the atmosphere. The removal of cooling pollutants can unmask warming; mitigating SLCPs with positive radiative forcing such as black carbon can compensate for the unmasked warming. A co-benefits strategy focusing on SLCPs can therefore complement one focused on GHGs. Researchers need to heighten awareness of these complementarities among Asia's policymakers.
- Concentrating on the co-benefits from clean cookstoves would be a useful starting point for awareness raising efforts in Asia. Clean cookstoves offer the single greatest climate change mitigation and air pollution abatement potential in Asia. However, a disregard for local ownership, community acceptance, and other on-the-ground intangibles has often blunted the performance of cookstove programs. Enhanced South-South sharing of experiential knowledge between community leaders, stove designers, gender specialists, and development practitioners could further boost the effectiveness of clean cookstove programs.
- Greater awareness of the climate co-benefits from non-methane precursors of O_3 would also pay climate and development dividends in Asia. Recent research has focused chiefly on methane (CH_4) precursors of ozone. In Asia, NO_x plays an underappreciated role in ozone formation. North-South exchanges designed to tailor NO_x control program such as freight vehicle inspection and maintenance programs (I & M) to resource-constrained regulatory environments could help broaden and deepen collaborations on SLCPs in Asia.
- The recently established Climate Change and Clean Air Coalition (CCAC) could facilitate collaborative exchanges on clean cookstoves and diesel to illustrate complementarities between different co-benefit approaches and non-methane ozone precursors in Asia. It could also leverage these exchanges to help "softlink" regional air pollution and global climate agreements.

The remainder of this brief is organized as follows. The next section highlights opportunities for co-benefits from black carbon and O_3. A third section discusses how the CCAC can draw additional attention to SLCPs in Asia. A final section offers concluding thoughts on how policy frameworks and institutional architectures can reflect advances in atmospheric science.

2. SLCPs and Co-benefits: An Opportunity for Asia

Co-benefits have become a familiar feature of the climate policy landscape in Asia. This started when the region's Designated National Authorities (DNA) developed criteria to evaluate whether Clean Development Mechanism's (CDM) projects both reduced GHGs and contributed to sustainable development. And it is likely to continue as the region's line agencies formulate "nationally appropriate mitigation actions (NAMAs) in the context of sustainable development." Outside of Asia, however, a different perspective on co-benefits has featured prominently in policy discussions. Rather than beginning with longer-lived GHGs, this alternative view takes mitigating species of air pollutants as its point of departure. Many air pollutants threaten climate systems as well as compromise more immediate development goals. The pollutants with the greatest potential to stabilize the climate and clean the air are black carbon and O_3.

2.1. Black Carbon

Black carbon is the solid fraction of particulate matter (PM) that is emitted during the incomplete combustion of fossil fuels, biofuels, and biomass in the residential, industrial, transportation, and agricultural sectors. Once emitted, it directly warms the climate by absorbing positive radiation. It also has indirect effects on the climate when deposited on glaciers and snow fields. By dulling these bright surfaces, it absorbs radiation that can further accelerate melting as it exposes darker groundcover or water. Another notable feature of black carbon is that its three to eight day atmospheric residence is far shorter than carbon dioxide (CO_2). The shorter lifetime is part of the reason that estimates of black carbon's global warming potential (GWP) are both significant and vary significantly between 190 and 2,240 GWP (Jacobson 2007). A related reason for the variation is that black carbon is often emitted with pollutants having their own unique warming and cooling properties. For instance, many sources of black carbon are co-emitted with organic carbon or sulphates that scatter sunlight and cool the atmosphere; the ratio of black to organic carbon determines the net radiative forcing of particular emission sources (Ramanathan and Carmichael 2008).

The varying cooling and warming impacts not only influence the net effect of SLCPs but have implications for an approach to co-benefits targeting longer-lived GHGs. For example, one of the most attractive opportunities from this GHG-centred perspective on co-benefits is shifting from coal-fired power plants to renewable energy installations. This shift is indeed important: it can reduce CO_2, the largest contributor to global warming, as well as sulphur dioxide (SO_2), the largest contributor to acid rain. But it is also warrants underlining that SO_2 emissions scatter and reflect sunlight, thereby cooling the atmosphere. The removal of SO_2 is therefore tantamount to pealing back a blanket of cooling. One way to compensate for unmasking this warming is to pursue offsetting reductions in SLCPs with positive radiative forcing—that is, black carbon or O_3. Doing so will require thinking about complementarities between a co-benefits approach focused on mitigating GHGs and SLCPs. Researchers need to make Asia's policymakers more aware of these complementarities.

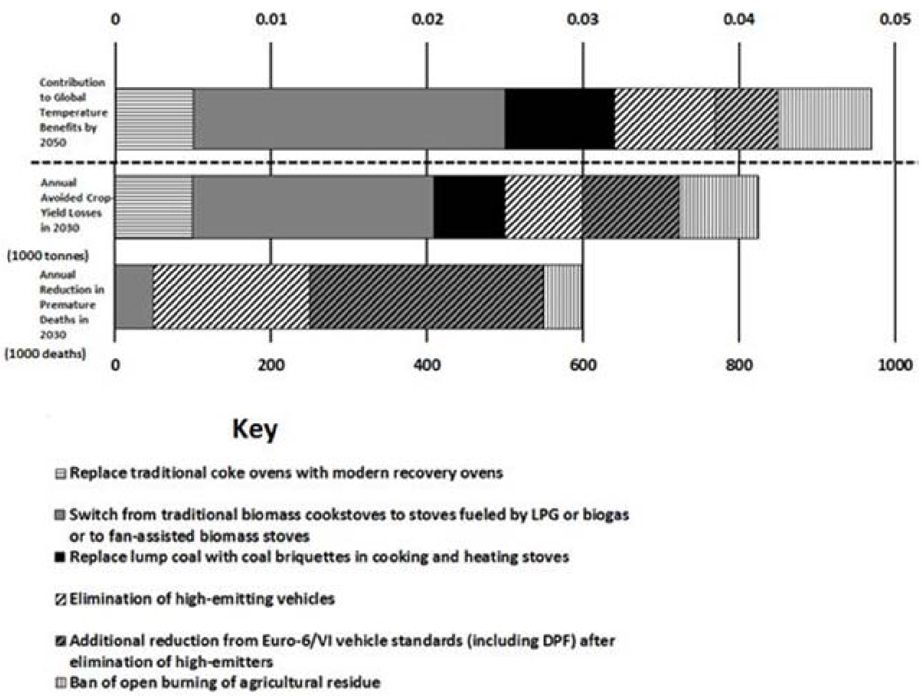
This need applies most readily to translating modeling results into implementable actions. The International Institute for Applied Systems Analysis (IIASA) Greenhouse Gas and Air Pollution Interactions and Synergies (GAINS) model identifies 16 priority measures for black carbon and CH_4 (as an ozone precursor) that can achieve between a .4C$^{\circ}$ to .5C$^{\circ}$ reduction in global warming by 2050. The modeling has drawn interest because it provides estimates of the benefits of discrete technical measures. These estimates can, in turn, inform what actions countries should include in abatement strategies. In the East Asia and Pacific region, the black carbon option with the greatest climate mitigation and air pollution abatement potential is cleaner cookstoves (UNEP 2011).

2.2. Clean Cookstoves

For much of developing Asia, cookstoves are an integral part of daily life. The stoves are not only used for preparing meals but heating homes in colder climates. Both processes typically rely on burning firewood, animal dung, and other biomass. When these fuels are combusted, they release submicron particulates that can easily lodge into cardiovascular and pulmonary systems. They are hence a major source of indoor and outdoor air pollution not to mention a serious threat to public health. This threat is particularly acute for women and children who spend disproportionately more time near the stoves. The size of the benefits of mitigating particulates is evident from the estimates in Figure 1; the public health benefits would be several orders of magnitude greater if indoor air pollution impacts were included in supporting calculations (UNEP 2011).

Clean fuels and technologies such as liquefied petroleum gas (LPG) and stoves equipped with fan-assisted vents could deliver these benefits at low or no costs. However, for many of the technical, financial, social, and institutional reasons listed in Table 1, the track record with cookstove programs has been disappointing. While it is difficult to isolate a single explanation for the lacklustre performance, a frequently cited impediment is a disregard for established use patterns and community needs (World Bank 2011). For many years, China's stove program avoided this pitfall by deliberately building support for locally manufactured stoves at the village level (Smith et al 2005). In recent years, many international organizations have sought to emulate this bottom-up approach—often with the support of international partnerships such as the Global Alliance for Clean Cookstoves (GACC). Enhanced South-South sharing of experiential knowledge between community leaders, stove designers, gender specialists, and development practitioners could further boost the effectiveness of clean cookstove programs.

Figure 1. Climate, Health and Crop Benefits from Black Carbon Measures in North East Asia, South East Asia and Pacific



Source: Data from UNEP 2011

Table 1. Clean Cookstove Barriers

Category	Barriers
Financial	High Initial Costs[1,2,3,4,5]
	High Fuel Costs[1,3,5,6, 12]
	Fossil Fuel Subsidies[3,4,6,7,8]
Social	Reluctance to Abandon Accepted Practices[4,6,7,9]
	Limited Awareness (Impacts, Alternatives, Government Programs) [3,4,10,11]
	Limited Stakeholder Engagement[4,12,13]
Technical	Poor Stove Design[6,12,13,14,15,16,17,20]
	Lack of Acceptability of Technologies[4,9]
	Lack of Repairs and Maintenance[3,5]
	Lack of Local Manufacturers[4,6,12]
Institutional	Bureaucratic Fragmentation[3,4,18]
	Lack of Capacity, Training, and Monitoring[4,8,19]
	Lack of Approved Suppliers, Entrepreneurs and Vendors[4]

1= Jones 1989. 2=Openshaw 1979. 3=Sinha 2002. 4=Barnes et al 2012. 5=Tahmid et al 2011. 6=Barnes 1993. 7= Kremer and Miguel 2004. 8=Er. Nawraj and Er. Sunil 2009. 9=Pandey 1991. 10=Er. Md. Lutfar 2010. 11=Howells et al 2010. 12=Openshaw 1982. 13=Openshaw 1986. 14=Barnes et al 1994.15=Hulscher, W. S. 1997. 16=Sinton et al 2004. 18=Smith et al 1993. 19=Ramakrishna 1991. 20=Shrestha et al 1991.

2.3. Tropospheric Ozone

Another SLCP deserving more attention is O_3. Unlike black carbon, O_3 is a secondary pollutant formed through chemical processes that transform emissions of primary pollutants into secondary ozone (also known as photochemical smog). In the case of ozone, this usually involves combining sunlight with methane (CH_4) or a mix of carbon monoxide (CO), non-methane volatile organic compounds (NMVOC), and nitrogen oxides (NO_x). The transformation of these elements occurs in the lower lying troposphere (between 9 km and 16 km above the surface) as opposed to the stratosphere where ozone acts as an important filter of ultraviolet radiation. Since tropospheric ozone is a secondary pollutant, measures aimed at limiting its harms tend to focus on mitigating its precursors—namely CH_4 or CO, NMVOC, and NO_x.

The work driving the recent interest in SLCPs has focused chiefly on CH_4 as an O_3 precursor. This is yet again an instructive focal point: CH_4 is both an ozone precursor and, by virtue of a relatively short lifetime, an SLCP in its own right. However, CH_4 is not the only precursor of O_3. NO_x, including nitrogen dioxide (NO_2), is both a conventional pollutant and an O_3 precursor that has received relatively less attention in recent SLCP research. In Asia, more attention is needed because many of the same power plants, industrial facilities, and motor vehicles that emit CO_2 and black carbon emit NO_x. Accounting for NO_x emissions is therefore critical to a regionally appropriate co-benefits strategy. Both researchers and policymakers need to be mindful of non-methane O_3 precursors in crafting such strategies for Asia (Akimoto 2012).

2.4. Clean Diesel

A fruitful area for cross-national cooperation on non-methane precursors are regulations of diesel powered freight and logistics vehicles. The freight sector not only makes up a large share of the vehicle population in Asia but is a significant source of NO_x and black carbon (see Figure 1). Advanced particulate filters could reduce these emissions. However, filters are expensive and require low sulphur fuels that are still a decade from reaching the 50 particles per million (ppm) standards required for effective operation in much of developing Asia. Prior to tightening standards, significant headway could be made by strengthening inspection and maintenance programs (I&M) to remove "superemitters" from the vehicle fleet. "Supermitters" are so-named because poor maintenance and old age typically lowers their operating efficiencies and increases emissions (Reynolds, Grieshop, and Kandlikar 2012). Yet, due to the difficulties of regulating small diffuse sources, these programs have struggled to live up to their potential. Similar to the case of China's cookstoves, the Tokyo Metropolitan Government has been an exception to that rule: it employed a gradual phased-in approach with caveat provisions for older vehicles that gave vehicle owners adequate time to adapt to the regulatory change (DieselNet 2012). The experience could also serve as a potentially valuable area for North-South exchanges through, for instance, city-to-city twinning arrangements. It is nonetheless critical that these collaborations focus on tailoring I&M programs to regulatory environments with fewer financial resources and more low-income drivers. Opt-in incentives and subsidized repairs for vehicle owners below certain income thresholds could be one way forward.

3. Raising the Visibility of SLCPs

The next logical question is how to increase the visibility of the recommended actions and collaborative exchanges. The "Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants Initiative" (CCAC) could offer a useful platform. The CCAC is a voluntary multilateral initiative launched in February 2012 to promote the development of SLCP national actions plans and finance SLCP mitigation projects. Over the past year, its membership has expanded to 21 countries and 14 non-state actors. For the time being, the only members of the CCAC in Asia are Japan and Bangladesh. In the near term, the CCAC could facilitate collaborative exchanges on clean cookstoves and diesel to illustrate complementarities between different co-benefit approaches and non-methane ozone precursors in Asia. China's cookstove program and Tokyo's vehicle programs are two of many experiences that could be meaningfully shared and disseminated through CCAC channels. These efforts could lay the groundwork for bringing more countries in Asia into the CCAC.

The CCAC could further use its status as voluntary initiative to enhance connections between existing air pollution and climate change processes. In Asia, air pollution agreements and monitoring arrangements—such as the Acid Deposition Monitoring Network in East Asia (EANET)—seem destined to regulate a fuller suite of pollutants but currently lack that scope and authority. At the global level, some countries have invoked SLCP mitigation in UNFCCC negotiations to narrow ambition gaps (see Figure 2), but reconciling most SLCPs chemical makeup and optical properties to the current climate regime promises to be an equally lengthy and contentious process. Using the CCAC as informal forum to discuss overlaps and gaps between NAMAs, CDM and air pollution control strategies, would be beneficial for both air pollution and climate agreements. It would also help fill a currently missing link between the air pollution and climate change community in Asia.

Table 2. References to SLCPs in Recent Climate Negotiations

Country	Summary of Reference	Additional Remarks
Norway[1]	Underlines importance of mitigating SLCPs based on UNEP/WMO integrated assessment	First country to make the link between enhanced ambition and SLCPs
Canada[2]	Suggests SLCPs should be part of a comprehensive climate plan	Participating in CCAC; pledged 10 million dollars to finance SLCP projects
United States[3]	Supports action on non-CO_2 climate agents	Founded CCAC
Micronesia[4]	Reducing SLCPs can slow the pace of climate change and halt sea level rice	Island state pushing for enhanced ambition

1 Norway, 2012; 2 Saint-Jacques, 2012; 3 Pershing, 2012; 4 Yatilman, 2011.

4. Concluding Thoughts

In closing, the brief's four recommended steps—1) seek complementarities between SLCP and GHG co-benefits; 2) promote South-South exchanges on cookstoves; 3) facilitate North-South exchanges on freight vehicles; and 4) showcase collaborative efforts in regional and global institutions—would be part of a more general reframing of co-benefits. This reframing would reflect the realization that atmospheric pollutants interact in ways that current climate regime, regional air pollution agreements, national development plans, and local pollution control efforts fail to appreciate. The proposed reforms could therefore not only contribute to making policy frameworks and institutional architectures more consonant with atmospheric science. They would help make these frameworks and architectures more consonant with each other. This may not be a sudden or seamless transition. Institutional changes tend to be incremental and piecemeal unless crises trigger a fundamental overhaul of the rules the game. But such a fundamental rethinking may also be possible. For just as a nuclear crisis brought to light linkages between air pollution and climate change nearly three decades ago, a climate crisis could bring to life more integrated approaches to atmospheric governance for decades to follow.

References

Akimoto, H. 2012. SLCF co-benefit approach: Asian perspective. Presentation delivered at international workshop on a co-benefits approach: a dialogue between policymakers and researchers. Hayama: IGES.

Barnes, D. F., K. Openshaw, K.R. Smith. and R. van der Plas. 1994. What makes people cook with improved biomass stoves? A comparative international review of stove programmes, World Bank Technical Paper, No. 242, Energy Series. Washington D.C. World Bank.

Barnes, D. 1993. The social impact of energy policies: energy and equity in developing countries. Draft Paper. Washington, D.C: World Bank.

Barnes, D. F., P. Kumar, K. Openshaw. 2012. Cleaner Hearths, Better Homes: New Stoves for India and the Developing World . Washington D.C.: The World Bank.

DieselNet. 2012. Tokyo retrofit program. http://www.dieselnet.com/standards/jp/tokyofit.php.

Er. Md. Lutfar R. 2010. Improved Cooking Stoves in South Asia, SAARC Energy Centre.

Er. Nawraj B. and Er. Sunil R. "Barrier for implementation of improved cookstove program in Nepal". Journal of the Institute of Engineering. 7(1): 1-5.

Grieshop, A. P., C. C. O. Reynolds, M. Kandlikar and H. Dowlatabadi. 2009. A Black Carbon Mitigation Wedge. Nature Geoscience. 2.

Howells, M., S. Jonsson, E. Kack, P. Llloyd, K. Bennett, T. Leiman, B. Conradie. 2010. "Calabashes for kilowatt-hours: rural energy and market failure." Energy Policy. 38: 2729–2738.

Hulscher, W. S. 1997. "Fuel ladder, stoves and health, women, wood energy and health." Wood Energy, 10 (2): 10.

Intergovernmental Panel on Climate Change (IPCC). 2007. Climate Change 2007: Mitigation of Climate Change. Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, edited by B. Metz, O. Davidson, P. Bosch, R. Dave and L. Meyer, United Kingdom and New York, NY, USA: Cambridge University Press.

Jacobson, M.Z. 2007. Testimony for the Hearing on Black Carbon and Global Warming House Committee on Oversight and Government Reform United States House of Representatives The Honorable Henry A. Waxman, Chair.

Jones, M. 1989. "Energy efficient stoves in East Africa: An assessment of the Kenya ceramic jiko program." Report to USAID, No. 89-01. Washington, D.C.: USAID.

Kremer, M. and E. Miguel. 2004. "The illusion of sustainability." NBER Working Paper No. 10324.

Openshaw, K. 1979. A comparison of metal and clay charcoal cooking stoves. Paper presented at the Conference on Energy and Environment in East Africa, Nairobi, Kenya.

Openshaw, K. 1982. "The Development of Improved Cooking Stoves for Urban and Rural Households in Kenya." Stockholm: The Beijer Institute, Royal Swedish Academy of Sciences.

Openshaw, K. 1986. Marketing of improved stoves. Paper presented at the Kengo Regional Stove Workshop, Nairobi, Kenya.

Norway. 2012. Submission to the UNFCCC Ad Hoc Working Group on the Durban Platform for Enhanced Action: Workplan on Enhanced Ambition, http://unfccc.int/resource/docs/2012/adp1/eng/misc01.pdf

Pershing, J. 2012. Enhancing mitigation. Presentation given at the UNFCCC Ad Hoc Working Group on the Durban Platform for Enhanced Action. http://unfccc.int/files/documentation/submissions_from_parties/adp/application/pdf/adp1_wsusa_21052012.pdf.

Pandey, S. 1991. "Criteria and indicators for monitoring and evaluation of the social and administrative aspects of improved cookstove programs." Washington, D.C.: World Bank.

Ramakrishna, J. 1991. India's national improved stoves program. Energy Sector Management Assistance Programme Draft Report. Washington, D.C.: World Bank.

Ramanathan, V. and G. Carmichael. 2008. Global and regional climate changes due to black carbon. Nature Geoscience 1:221-227.

Ramani, K.V., Heijndermans, E., 2003. Gender, Poverty, and Energy: A Synthesis. The World Bank, Washington, DC.

Reynolds, C.O., A. Grieshop, and M. Kandlikar, 2012. Reducing particulate matter emissions from buses and trucks in Asia: A framework to assess air pollution and climate change co-impacts in Low Carbon Transport in Asia: Strategies for Optimizing Co-benefits. Zusman, E. Srinivasan, A. and Dhakal, S. London: Earthscan: 68-94.

Saint-Jacques, G. 2012. Canada's Climate Change Mitigation Plan, Government of Canada. Remarks given at the UNFCCC Ad Hoc Working Group on Long Term Cooperative Action. http://unfccc.int/files/bodies/awg-lca/application/pdf/20120517_canada_1749.pdf.

Shrestha, G. R., G. Hari and K. Smith. 1991. The status of improved cookstove programs in Nepal. Draft ESMAP Report.

Sinha, B. 2002. The Indian stove programme: an insider's view—the role of society, politics, economics and education. National Institute of Science, Technology and Development Studies, CSIR, New Delhi 48, 23–26.

Sinton, J.E., K.R. Smith, J.W. Peabody, L. Yaping, Z. Xiliang, R. Edwards, and G. Quan. 2004. "An assessment of programs to promote improved household stoves in China." Energy for Sustainable Development. 8: 33–52.

Smith, K.R., G. Shuhua, H. Kun, and Q. Daxiong. 1993. "One hundred million improved cookstoves in China: How was it done?" World Development. 21(6): 941–61.

Tahmid A., A. Ashraf, G. Miller, A. M. Mobarak, N. Akter, A. M. Ali, M. Q. Sarkar, L. Hildemann, N. C. Dey, M. Rahman, P. Dwivedi and P. Wise. 2011. "Promotion of improved cookstove in rural Bangladesh." BRAC Working Paper 22. Dhaka: BRAC.

United Nations Environment Programme (UNEP). 2011. Near-term Climate Protection and Clean Air Benefits: Actions for Controlling Short-Lived Climate Forcers. Nairobi: UNEP.

United Nations Environment Programme (UNEP). 2010. The Emissions Gap Report: Are the Copenhagen Accord Pledges Sufficient to Limit Global Warming to 2° C or 1.5° C? Nairobi: UNEP.

United Nations Environment Programme (UNEP)/ World Meteorological Organization. 2011. Integrated Assessment of Black Carbon and Tropospheric Ozone: Summary for Decision Makers. http://www.unep.org/dewa/Portals/67/pdf/Black_Carbon.pdf.

Victor. D. Kennel, C. and Ramanathan, V. 2012. The Climate Threat: What It Is and How To Deal With It. Foreign Affairs. May/June.

World Bank. 2011. Household Cookstoves, Environment, Health, and Climate Change: A New Look at an Old Problem. Washington D.C.: World Bank.

Yatilman, A. A. 2011. Republic of Micronesia. Statement at the High Level Segment. 17th Conference of the Parties to the UNFCCC http://unfccc.int/files/meetings/durban_nov_2011/statements/application/pdf/111208_cop17_hls_micronesia.pdf.

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