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Energy Access, Climate and Development

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Energy Access, Climate and Development

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The transition to a climate-constrained world is occurring at a time when nearly half of the world's population lacks reliable access to modern energy services. Consequently, the energy transition and climate vulnerability are much more closely connected than current analysis suggests, as the world's poor struggle over a dwindling resource base that is being further degraded by the impacts of climate change. There is an urgent need not only to greatly scale up support for energy access but also to link this support more closely to the climate agenda, to the revitalization of rural areas, and to better management of the urban and peri-urban development that has dominated the changing energy landscape of recent decades. This brief exposition provides an overview of the key issues that link the energy access challenge with the climate and development agenda.

The Energy Access Challenge

Access to energy is inextricably linked to improved welfare and human development since energy services have a direct impact on productivity, health, education, and communication. *Energy Services* refer to the benefits or end-uses of energy (as opposed to energy consumption *per se*), including cooking, lighting and mechanical power (UNDP, 2005). An estimated 2.5 billion people lack access to modern energy services, constraining their opportunities for economic development and improved living standards (UNDP, 2004). They rely on *traditional biomass* sources such as woodfuel, agricultural residues, and animal dung to meet their basic energy needs (WHO 2006). The use of these traditional fuels in open fires or with simple stoves is not only less efficient and more polluting than modern energy options, but they are also unreliable, not easily controllable, and subject to various supply constraints. The poor in developing countries therefore pay much more in terms of health impacts, collection time, and energy quality for the equivalent level of energy services as their counterparts in the developed world.

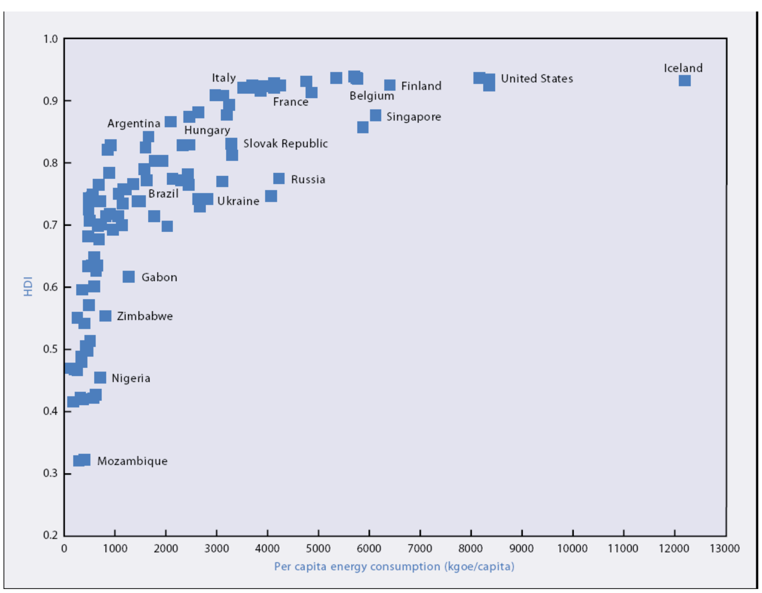

Figure 1 – Relationship to HDI and per Capita Energy use, adapted from UNDP, 2004.

Energy is the lifeblood of the modern economy and development has been historically linked to the widespread availability of affordable energy; no country in modern times has substantially reduced poverty without a massive increase in its use of commercial energy and/or a shift to more efficient energy sources that provide higher quality energy services (UNDP, 2005). The linkage extends also to the capacity to adapt to climate change, since those countries and regions with lower poverty, greater levels of human development, and greater energy access will have more options and greater adaptive capacity.

There is nevertheless significant variation in energy consumption for different development levels once countries have moved up the energy ladder and adopted modern energy forms over traditional biomass. Consequently, although developing countries fall along the sharply upward rising part of the curve, one finds that the developed countries are spread all along the flatter part of the curve (see Figure 1). In the later stages of a nation's economic development, reductions in energy demand and a subsequent decoupling between energy consumption and economic growth is achievable. Only a few highly developed (and smaller) countries such as Denmark have demonstrated clear evidence of decoupling, achieved through progressive policies to reduce energy consumption that generally include significant energy taxes (EUROSTAT, 2008).

Even in such cases, the issue of service vs. manufacturing complicates the question of true decoupling, since the energy consumption of imported goods is not included. There is no evidence that even moderately developed countries, much less Least Developed Countries (LDCs), can achieve such decoupling. Given the lack of evidence, it is unrealistic and unfair to expect LDCs to achieve any kind of decoupling between energy and economic growth and development. Aggressive energy taxation and similar policies are thus rarely appropriate in the least developed countries due to the importance of energy in supporting economic development and the already disproportionate share of income that the poor must devote to energy costs.

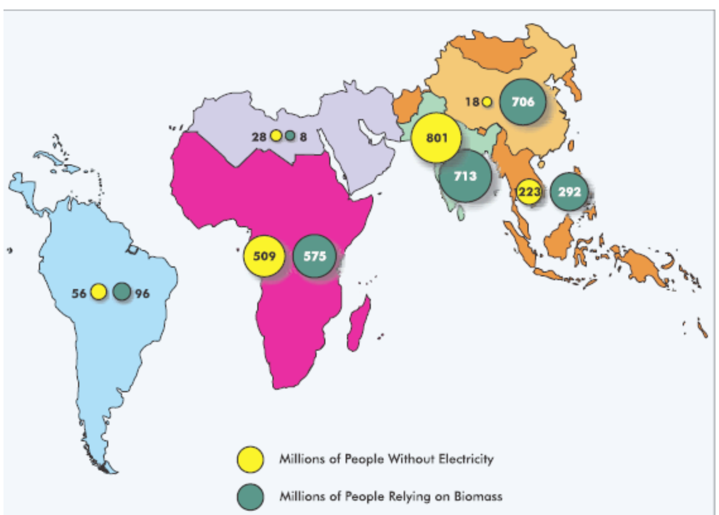

Figure 2 – Regional geography of energy and electricity access

The geographical locus of the energy access problem is primarily found in sub-Saharan Africa and South Asia where rural populations often rely exclusively on traditional biomass for their energy needs (Figure 2). Four out of five people without electricity live in rural areas of the developing world, mainly in South Asia and sub-Saharan Africa (WEO, 2008). Other regions have somewhat lower numbers of affected people and/or face different but no less important challenges, such as the difficulty of providing energy access within the complex island geography of Indonesia or to the vast reaches of the Amazon rain forest in South America.

Energy Services, Health, and Development in LDCs

In poor households in LDCs, cooking often accounts for 90% or more of total energy demand. Typically burnt on open fires or inefficient stoves, these fuels, when used indoors, produce levels of indoor air pollution (IAP) many times higher than international ambient air quality standards allow for, exposing poor women and children to a major public health hazard (Bruce et al. 2002). There is now consistent evidence that biomass smoke exposure increases the risk of childhood acute respiratory infections (ARIs), particularly pneumonia (Bruce et al. 2002).

Women exposed to indoor smoke are three times more likely to suffer from chronic obstructive pulmonary disease (COPD) than women who cook with electricity or gas (WHO, 2006). Indoor air smoke was estimated to be responsible for 1.6 million deaths and 2.7% of the global burden of disease in the year 2000 (WHO, 2007). Without systematic changes, household biomass use will result in an estimated 8.1 million Lower Respiratory Infection (LRI) deaths among young children and 1.7 million COPD deaths among adult women in sub-Saharan Africa alone between 2000 and 2030 (Bailis, Ezzati, Kammen, 2007, p 6).

In addition to the act of cooking itself, the task of gathering fuelwood also falls mainly on women and children. There are significant socio-economic impacts due to the opportunity costs of spending several hours per day gathering fuelwood. The possibility to use that time engage in income-generating and educational activities contributes to the stability and advancement of households and communities. There are also safety risks for women and girls that must travel log distances by foot alone or in small groups. Where fuel is purchased, spending money on large quantities of inefficient fuels severely constrains household budgets (WHO, 2006).

Access to energy for lighting is linked to economic and social development as it enables home study in the evenings, increases security, enables use of information and communications technologies (ICTs) and allows commercial activity to occur after dark (DFID, 2002). Without modern lighting, many community centres cannot be used in the evening, hindering the social development of villages and communities (UNDP, 2005). The tangible benefits of lighting have been documented in many case studies; an analysis in Bangladesh found that over 90% of recently electrified households reported improvements in children's study time, household security, and overall well-being (NRECA, 2002).

The productive use of energy is essential for poverty reduction. At the local level, access to energy facilitates economic development by improving productivity and enabling income generation through, for example, improved agricultural development (irrigation, crop processing and storage) to non-farm commercial activities, including micro-enterprise development (DIFD, 2002). By providing additional employment opportunities, energy services also enable farmers to diversify their income sources, and thus alleviate the inherent risks associated with agriculture-dependent livelihoods (UNDP, 2005). Access to mechanical power can improve the quality of life of women and girls by reducing the drudgery of hours of food grinding and threshing, thereby freeing young girls to pursue more regular schooling (UNDP, 2005).

The poor combustion and efficiency of traditional biomass systems leads to high pollutant emissions and exposures, resulting in high GHG and health impacts per unit of useful energy (Smith and Haigler, 2008). In areas with sensitive ecological systems or degraded lands, reliance on traditional biomass also creates additional pressures on the local resource base. There is a growing body of literature focusing on the potential public health and resource co-benefits that can be achieved by incorporating climate measures as upstream elements of energy systems and adaptive response mechanisms (Patz, Campbell-Lendrum, Gibbs, and Woodruff, 2008). For developing countries, dependent on traditional solid fuels for cooking and heating, there appears to be a high degree of co-benefit effectiveness for targeted interventions in the household energy sector (Smith and Haigler, 2008). The Japanese Development Agency has formulated a comprehensive framework for exploiting co-benefits by carefully assessing different elements of projects and programmes so as to combine climate initiatives with environmental management or pollution reduction elements that bring clear local and regional benefits (JICA, 2008).

Climate dimensions and policy synergies

Until recently, there has been a tendency to separate energy access from climate change issues—both mitigation and adaptation. In terms of scientific research about the causes of climate change, traditional biomass was not considered as an important contributor. In the domain of specific energy-climate projects, even where some mitigation benefits were identified, the costs of energy access interventions were generally considered high and the likelihood of success and/or sustainability were often thought to be low. In the international policy and donor communities, energy access and climate change have traditionally involved rather different actors and often at rather different levels.

This artificial separation is now changing in a number of ways. First, data and analysis on traditional energy use and its impacts have been improving. With traditional biomass estimated to account for almost 10% of global energy use, the impacts are more significant and widespread than realised (WEO, 2008). Second, the complex phenomenon of black carbon has been analysed in more detail and shows that incomplete combustion of traditional biomass and the carbonaceous aerosols they produce may be giving rise to a much higher level of radiative forcing than previously estimated and therefore posing a much greater relative set of GHG impacts (Gustafsson et al 2009).

Third, and perhaps most significantly, energy access and adaptation at the policy level appear to be much more amenable to exploiting synergies than mitigation and adaptation, which tend to involve very different institutions and actors (Klein et al, 2003). The increasing body of policy analysis and the greater political emphasis on adaptation has brought to the fore local and sub-national institutions that could help to facilitate synergies in designing policies and programmes to jointly address energy access and adaptive capacity. Due to the fact that both adaptation and energy access have strong local and sub-regional characteristics, there are many synergies yet to be exploited. Regions that could face more flooding or lower rainfall could build improved energy access policies into the same institutions that will improve preparations for changing climatic conditions and use these policies to strengthen the region's overall energy security.

In this sense, the energy access issue also naturally extends beyond household energy use to the issue of energy for transport, since improved mobility contributes to adaptive capacity. The availability of locally-produced biofuels such as ethanol suggests an option that can create a decentralised source of energy for household and transportation uses, thereby contributing to *local energy security* as well as making contributions to mitigation **and** adaptation.

In response to the dual problems of energy poverty and land degradation, the government of Senegal launched the national "Butanisation" programme in 1974, with the aim of substituting LPG for biomass cooking fuels, particularly charcoal. Through a series of energy sector reforms and fuel subsidies, LPG consumption was raised by an annual rate of 12% (Sokona et al, 2003) Moreover, by 2002, it was estimated that replacement with LPG led to avoidance of the production of 337,500 tonnes of charcoal and 40,500 ha of avoided deforestation (UNDP, 2005). The lower reliance on traditional biomass can reduce pressures on the already degraded resource base and improve the adaptive capacity of resource-dependent communities. Switching from a traditional biomass fuel source (i.e., charcoal) to a fossil fuel source (i.e., LPG) can often lead to net GHG reductions, a counterintuitive result. The reduction is due in part to the land use emissions from clearing (assuming that the land was used for non-forestry purposes after being cleared). The reductions in GHG emissions are even deeper, however, due to the contribution of soot or "black carbon" to the formation of atmospheric aerosols and subsequently into GHGs (Gustafsson, 2008).

Linkages to climate and development goals

The head of the IPCC, Rajendra Pachauri, recently lamented the "glaring neglect" in improving energy access for the world's poor in recent years, noting that "today energy remains the missing MDG" [Millennium Development Goal] (Reuters, 2009). Such comments are a reminder of the critical need for improving energy access even as energy consumption itself is under increased scrutiny for climate reasons; there is a danger that goals related to poverty reduction, health and education will not be achieved without significant progress in scaling up energy access in LDCs.

The increase in public attention to climate change during the past decade has thus sometimes obscured the need to *increase* energy consumption in developing countries in order to raise their living standards and thereby improve their adaptive capacity. This tendency has been countered by the recognition that developing countries and especially LDCs have the right to use their emission space in any future climate agreement for significant increases in energy consumption while developed countries rapidly decrease their emissions (GDR, 2008). There is also an increasing body of analyses aimed at identifying synergies between climate and development goals, but based on a "development first" approach for the LDCs (Davidson et al 2003).

Since most LDCs have resource-dependent economies and given the need to leverage different sources of development assistance and support, there is an urgent need to link energy-development strategies to efforts to improve adaptive capacity. The impacts of climate change will pose particularly difficult challenges to households and communities whose energy supplies are obtained directly from the ecosystem (IUCN, 2008). As both agricultural and forest systems face greater pressures in a changing climate, local communities will need other energy options and alternative livelihoods. Supporting development strategies that diversify energy sources is therefore an important part of improving adaptive capacity in many regions.

In recent years, many developing countries in tropical and sub-tropical regions have sought to take advantage of a comparative advantage as modern bioenergy producers. Bioenergy is rather special among all classes of energy resources in representing both synergies and conflicts with respect to both mitigation and adaptation goals. On the one hand, modern bioenergy offers excellent income opportunities and more sustainable development paths by replacing inefficient traditional biomass or non-renewable petroleum fuels. Some bioenergy crops can even be grown under certain conditions on degraded lands unsuitable for food production and can improve soil quality and return the lands to productive capacity, thereby contributing to both mitigation and adaptation efforts. However, when bioenergy crops encroach on valuable ecosystems or food crops, or when land clearing or transformation is used to obtain fast profits, there can be negative consequences for both mitigation and adaptive capacity.

For LDCs, it is important that they incorporate domestic uses into their bioenergy strategies so as to avoid the boom and bust cycle associated with high dependence on cash crops for export. Nevertheless, those LDCs wishing to significantly expand bioenergy and biofuels can greatly benefit from export markets due to the access to infrastructure and the economies-of-scale that it affords them in comparison to the generally small domestic market (Johnson and Matsika, 2006). Indeed, the development-oriented impulse to focus only on domestic markets for biofuels and ignore the export market can deny the local industry the chance to get off the ground, simply due to the high costs of small-scale operations in remote areas; some reasonable balance is needed in policy formulation between domestic energy security goals and the market access, investment and infrastructure from international trade that may be needed to improve competitiveness. In any case, detailed analysis is needed to sort out the climate and development implications of bioenergy expansion; there is "no one-size fits all" prescription for bioenergy (WB, 2005).

Implementation Strategies

Response capacity is often limited by a lack of resources, poor institutions and inadequate infrastructure, among other factors that are typically the focus of development assistance (Klein et al, 2007). The response to the climate-development challenge must address the root causes of low development levels but at the same time complement development assistance with new and improved measures for adapting to economic and environmental disruptions. Underdevelopment fundamentally constrains adaptive capacity, especially because of a lack of resources to hedge against extreme but expected events (Klein et al 2007; IISD, 2004).

A number of decentralised renewable energy technologies (DREs), sometimes in combination with each other, can support energy access as well as mitigation and adaptation goals; in addition to improving basic household energy supplies, the DREs contribute to key village-level services such as irrigation for water pumping and refrigeration for vaccines, thereby enhancing response capacity in terms of basic health and sanitation issues (Venema and Rehman, 2007). An example in Bangladesh that is well-documented illustrates how some village-level projects address energy access, mitigation, and adaptation all at the same time: the installation of biogas at poultry farms reduced the environmental hazards and turned them into an energy source, thereby also improving the economic feasibility of the farms in the longer term and contributing to cleaner water supply as well as reducing GHG emissions from methane (IISD, 2004).

Development assistance can only support joint climate-development strategies for LDCs to the extent that it incorporates the energy access challenge. The institutional framework and the financing opportunities available through development assistance will need to be upgraded in content as well as being upscaled. The upgrading in content needs to incorporate more evidence-based programme formulation, such as by analysing in more detail some of the product-specific attributes associated with the household energy problem at a local scale rather than generalising across socio-economic variables (Takama et al 2009). Scaling up could be accomplished regionally in some cases, such as the current policy process underway in the East African Community (EAC/GTZ/SEI, 2008) in which the energy access goals are incorporated into regional planning processes.

One clear lesson from the past few decades of energy access programmes is that electricity is not enough—other alternatives will be needed for many decades to come. Despite considerable effort to improve energy services to rural populations in the past thirty to forty years, the unserved population remains about two billion. Poor, rural populations in developing countries are often beyond the reach of the national grid and do not benefit from large scale, centralised energy systems (UNDP, 2004). There is now a strong case for alternative, decentralised energy delivery systems and technologies, as well as new policy frameworks to provide essential energy services to such dispersed populations. These will need to include both renewable options such as solar energy systems and non-renewable options such as liquid petroleum gas (LPG).

Regardless of the delivery method, reaching the energy targets needed for achieving the MDGs will require a substantial scale up of energy services to the poorest people of the world. However, the absolute amount of energy is not that large. The total amount of energy required was estimated at 900 TWh annually, comparable to the amount of energy Sweden consumes in 18 months (SEI, 2005). The total annual financing needed to achieve the MDG Energy Vision[1] was estimated at 45 Billion USD. This is much less than what OECD countries spend annually on agricultural sector subsidies and is a small fraction of the enormous bailout being provided to global financial markets after the financial collapse of 2008. The challenge will nevertheless be to package energy access programmes in a way that complements—and, in some cases, synergises with—climate financing, both for mitigation and adaptation.

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References

Bailis, R, Ezzatti, M, Kammen, D, 2007, Health and Greenhouse Gas Impacts of Biomass and Fossil Fuel Energy Futures in Africa, Boiling Point No. 54, p 3-8, HEDON: Bromely

Bauer, P., Athanasiou, T. and Kartha, S., 2008 "The Right to Development in a Climate Constrained World: The Greenhouse Development Rights Framework," Heinrich Böll Stiftung Publication Series on Ecology, Volume 1.

Bruce, N, Perez, R, Padilla, R, 2002, The Health Effects of Indoor Air Pollution Exposure in Developing Countries, Geneva: WHO

Davidson O, Halsnæs K, Huq S, Kok M, Metz B, Sokona Y, Verhagen J (2003) The development and climate nexus: the case of Sub-Saharan Africa. Climate Policy 3:97–113.

Department for International Development (DFID), 2002, Energy for the Poor: Underpinning the Millennium Development Goals, London: Crown

EAC/GTZ/SEI, 2008, "Scaling up Energy Access in the East African Community," EAC 2008.

EUROSTAT, 2007, "Panorama of Energy: Energy Statistics to support EU policies and solutions," European Commission. KS-76-06-604-EN-C.

Gustafsson, Ö, Kruså, M., Zencak, Z., Sheesley, R.J., Granat, L. Engström, E. Praveen, P. S. , Rao, P. S. P., Leck, C., Rodhe, H., 2009, "Brown Clouds over South Asia: Biomass or Fossil Fuel Combustion?," Science, Vol. 323: 495-498.

International Energy Agency (IEA), 2002, World Energy Outlook 2002, Paris: OECD/IEA

International Institute for Sustainable Development (IISD), 2004, Seeing the Light: Adapting to Climate Change with Decentralized Renewable Energy in Developing Countries, Winnipeg: IISD

JICA, 2008, "Co-benefits Approach to Climate Change and CDM in Developing Countries - Towards the Achievement of Co-benefits in Environmental Pollution Control and Climate

[1] In the absence of specific targets for access to energy services stipulated as part of the Millennium Declaration, a few initiatives have been taken to set targets for what type of energy services are needed to support the achievement of the Millennium Development Goals. One such initiative is the "MDG Energy Vision", developed and used as part of the Millennium Development Project (Modi, et al, 2006).

Change Mitigation," Overseas Environmental Cooperation Center, Japan, December. www.jica.go.jp.

Johnson, F. and Matsika, E., 2006, "Bioenergy Trade and Regional Development: the case of bio-ethanol in southern Africa," *Energy for Sustainable Development*, Volume X No. 1 March 2006.

Keam, S. and McCormick, N., 2008, "Implementing Sustainable Bioenergy Production; A Compilation of Tools and Approaches," Gland, Switzerland: IUCN. 32pp.

Klein, R.J.T., S. Huq, F. Denton, T.E. Downing, R.G. Richels, J.B. Robinson, F.L. Toth, 2007: Inter-relationships between adaptation and mitigation. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 745-777.

Leach, G and Johnson, F. (1999) "Modern Bioenergy," Renewable Energy for Development, Stockholm Environment Institute, May.

Modi, V., McDade, S., Lallement, D., and Saghir, J., 2006. *Energy and the Millennium Development Goals* . New York : Energy Sector Management Assistance Programme, United Nations Development Programme, UN Millennium Project, and World Bank.

NRECA, 2002, Economic and Social Impact Evaluation Study of the Rural Electrification Program in Bangladesh, report prepared by Human Development Research Centre, for National Rural Electric Cooperative Association (NRECA) International Ltd., Partners with the Rural Electrification Board of Bangladesh and USAID for the Rural Power for Poverty Reduction (RPPR) Program (USAID CA 388-A-00-97-00040-00).

Patz, J., Campbell-Lendrum, D., Gibbs, H. and Woodruff, R., 2008, "Health Impact Assessment of Global Climate Change: Expanding on Comparative Risk Assessment Approaches for Policy Making," Annual Review of Public Health, Vol. 29: 27-39, April.

Reuters, 2009, "Energy missing Millennium goal-U.N. climate chief," Jan 21, 2009. http://in.reuters.com/article/domesticNews/idINDEL27013420090121.

Smith, K.R. and Haigler, E., "Co-Benefits of Climate Mitigation and Health Protection in Energy Systems: Scoping Methods," Annual Review of Public Health, Vol. 29: 11-25, April 2008.

Sokona, Y., Thomas, J., Toure, O., 2003, "Development and Climate, Country Study: Senegal," Environnement et Developpement du Tiers Monde (ENDA-TM) http://www.developmentfirst.org/Studies/SenegalCountryStudy.pdf

Stockholm Environment Institute (SEI), 2005, Sustainable Pathways to Attaining the Millennium Development Goals: Assessing the Key Role of Water, Energy and Sanitation, Stockholm: SEI

Takama, T., Tsephel, S., Zuzarte, F., Debebe, M., Lambe, F., and Johnson, F.X., 2009, "Socio-economic and product specific factors to promote a clean cooking bio-ethanol stove in Ethiopia: A discrete choice model to understand the decision making factors of stove preferences," presented at International Choice Modeling Conference, April 2009.

UNDP (2004) "World Energy Assessment," United Nations Development Program, New York, ISBN: 92-1-126167-8, www.undp.org/energy.

United Nations Development Programme (UNDP), 2005, Energizing the Millennium Developing Goals: A Guide to Energy's Role in Reducing Poverty, New York, NY: UNDP

Venema, D. and Rehman, I.H., 2007, "Decentralized renewable energy and the climate change mitigation-adaptation nexus," Mitigation and Adaptation Strategies for Global Change, Volume 12, Number 5 / June, 2007.

World Health Organisation (WHO), 2006, Fuel for Life: Household Energy and Health, Geneva: WHO

World Health Organisation (WHO), 2007, Indoor Air Pollution: National Burden of Disease Estimates, Geneva: WHO