International Policy Centre for Inclusive Growth
research brief June/2012 no. 24
The International Policy Centre for Inclusive Growth is jointly supported by the Bureau for Development Policy, United Nations Development Programme and the Government of Brazil.

Green Innovations: Reducing Energy Poverty and Inequitable Access

By Daniela P. Stoycheva, with contributions from Leisa Perch

The International Policy Centre for Inclusive Growth (IPC-IG) has issued this series of Policy Research Briefs in the context to Rio+20 to expand the debate on socio-environmental policy, especially the intersections between poverty, inequality and environmental degradation. Income poverty and inequality alone do not explain the continued challenges faced by poor and vulnerable people. Resource inequality—i.e. unequal access to key resources such as energy and water—is a significant barrier to inclusive growth and to inclusive and equitable development. The series also explores 'how' to address these development deficits as well as some of the emerging innovations in policy and social technology which are beginning to emerge as an answer to the combined effects of unequal access to resources and basic services, unequal access to income and finance and unequal burdens from environmental degradation. These Policy Research Briefs seek to understand the approaches which can help to restore the balance through benefits-sharing, burden-sharing and risk-sharing. Renewed attention on environmental sustainability provides a significant opportunity to explore the more fundamental and structural causes of poverty and inequality and Rio+20, the policy space to discuss true transformational change across the three pillars. The series also examines the opportunities and barriers to change through the lens of greening growth and some of the structural differences between countries. By tackling this cross-section of policy challenges, it seeks to both deepen and broaden the policy debate and add to the growing discourse on social sustainability. The series complements earlier publications in 2012 on social accountability. A special issue of IPC-IG's *Poverty in Focus* directs attention to the agriculture sector in Africa in the context of the above.

I. Introduction

Access to basic services is a universal human right, and access to a decent 'quality' of water, energy and food are key to sustainable human development. With them, people's capabilities, opportunities and basic freedoms can expand exponentially. This interconnectedness between the quantity and quality of resources is expressed in the definition of energy access by the UN Secretary General in his declaration of 2012 as the International Year of Sustainable Energy for All and the launch of the Sustainable Energy for All (SEE4ALL) initiative. Defined as "the physical availability of modern energy services, including electricity and improved end-use devices such as cookstoves, to meet basic human needs at affordable price" (Sustainable Energy for All, 2012), 'access' thus relates to more than availability; it also captures factors such as affordability and relevance. For poor people, this implies that the price of modern energy should be, to some extent, in line with their ability to pay and comparable to the cost and effort of accessing traditional fuels.

Beyond basic needs, energy access also encompasses the use of energy for development. Poor energy access and the low quality of traditional fuels aggravate poverty in developing countries and impede progress in virtually all foundational areas of development as outlined in the Millennium Development Goals (MDGs). At the same time, poverty perpetuates the lack of proper access to energy, creating a bi-directional nexus between energy and poverty. Investment in energy can create public goods with numerous positive externalities, including education, food safety, health and hygiene, to name a few. Thus, cost-effective improvements in energy efficiency which create affordable energy for poor people can have a considerable effect on equity as well as poverty reduction.

Multiple deprivations and a number of structural features of the energy economy currently define who has access to energy and in what form. This Policy Research Brief explores these issues and their intersection within the context of the three strands of sustainable development in understanding how energy access could potentially be a strategic area of catalytic change. One size cannot fit all. By focusing on the social inequity of current patterns of energy access, the document explores how and for what purposes people use energy, what amount of energy they need, and how green 'social' innovations can redress the imbalance between what is cheaper to produce and what people really need.

II. Where do Axes of Inequality Emerge in the Energy Access Debate?

The current state of energy inequity revolves around a number of axes of inequality. The level of access to energy varies widely both between and within countries. To achieve one of the three critical objectives of SEE4ALL—ensuring universal access to modern energy services—it is important to consider carefully the nature of these axes and how they help us to understand the ways in which people consume energy as well as the quantities of energy they need.

On a worldwide scale, rampant disparities exist **between developed and developing countries** not only in the amount but also in the type of energy services people use and have access to. Increases in the production of energy still largely favour developed countries and emerging economies. Today, more than 1.4 billion people in the developing world do not have access to energy (see Table 1). By comparison, in industrialised countries the number of people without electricity is around 3 million. At the same time, the majority of the global population lives in the developing world, and "90 per cent of the population growth is taking place in developing countries" (UNDP, 2000). Further increases in population will dictate the need for even more energy and, within the strict confines of finite and non-renewable resources, potentially further exacerbate existing disparities.

Modern forms of energy and electricity are essential for the development of industry, business and commerce, and for services of life-saving importance such as adequate healthcare, education, communications and transport, often in competition for available resources. Access to the latter forms of energy, which tend to be more socially driven in nature, is even lower than access to traditional fuels, with a negative multiplier effect on the quality of life and living conditions of poor people in developing countries.

Within developing countries, several axes of inequality are formed along the pairings of urban–rural areas, rich–poor people and women–men. **Urban–rural differentials in energy access** are markedly wide (see Table 1). In sub-Saharan Africa the gap is significant, with urban areas enjoying about 60 per cent coverage, while in rural areas it is only slightly above 14 per cent on average. With the current rate of urbanisation, energy resources will become even scarcer, likely resulting in rural populations falling even further behind their urban counterparts.

The axis of inequality in the context of **gender inequity of energy access** is also noteworthy. Men and women as users of energy differ significantly, and this should be recognised in the design of policies and programmes.

Fundamentally, in the developing world, women are the key energy providers and resource managers for the household, particularly in poor households. In energy-deficient areas it can take up to five hours per day (UN-Energy, 2005) to source fuelwood, often exposing women and young girls to significant physical insecurity. Economically, rural women spend much of their income on acquiring energy, which amounts to more than a third of household expenditures in some countries (Meisen and Akin, 2008).

For women engaged in remunerated activities, access to energy is critical, as it can make a qualitative and quantitative difference to their productivity, potentially leading to a narrowing of income and opportunity gaps.

While most of the attention is often focused on the macroeconomic reality of the energy gap, the highly nuanced nature of gendered energy poverty is revealed at much smaller scales and in informal labour markets within agriculture, food processing and tailoring.

Table 1
Electricity Access in 2009 – Regional Aggregates

	Population without electricity (millions)	Electrification rate (%)	Urban electrification rate (%)	Rural electrification rate (%)
Africa	587	41.9	68.9	25.0
North Africa	2	99.0	99.6	98.4
Sub-Saharan Africa	585	30.5	59.9	14.3
Developing Asia	799	78.1	93.9	68.8
China & East Asia	186	90.8	96.4	86.5
South Asia	612	62.2	89.1	51.2
Latin America	31	93.4	98.8	74.0
Middle East	22	89.5	98.6	72.7
Developing countries	**1,438**	**73.0**	**90.7**	**60.2**
Transition economies & OECD	**3**	**99.8**	**100.0**	**99.5**
World	**1,441**	**78.9**	**93.6**	**65.1**

Source: IEA, World Energy Outlook.

The Rural Energy Development Programme (REDP) in Nepal, for instance, reports that through the use of electrical mills women saved 155 hours yearly on time spent on agro-processing activities (UNDP, 2011a).

Finally, intra-country disparities between **poor and rich people in developing countries** are also remarkable. The energy consumption patterns of elites in many developing countries are similar to the general consumption in developed countries, while poor people in rural areas account for the vast majority (nearly 90 per cent) of all households without access to electricity. The difference is rather striking in some countries, even emerging economies where disparities have narrowed in other key areas. In South Africa, for instance, close to 100 per cent of the rich households have electricity, in contrast to 10 per cent of poor households (Gaye, 2007).

III. Understanding the Persistence of Energy Inequality

Analysing the reasons behind these axes of inequality is essential to design appropriate policies, shape investment, build relevant green technologies and expand access to them. The main barriers to providing modern, reliable and accessible energy in the developing world, primarily in rural areas, are predominantly structural in nature: difficulties of extending the grid, the remoteness of many areas, and the incompatibility of high or volatile energy costs with the limited economic capacity of poor people and the high volalitilty of their income streams.

Grid extension is a necessity in the developing world, particularly in urban, peri-urban and rural areas with high population densities, where it is often the least costly option. However, a singular focus on grid extension is not a viable alternative for very remote areas with disperse and small populations. For electricity providers, grid extension to such areas is not economically profitable, and as a result they are often reluctant to invest in these areas.

A study by the World Bank on rural electrification programmes placed the average cost of grid extension per km at between $8000 and $10,000, rising to around $22,000 in difficult terrains (Alliance for Rural Electrification, 2011).

Due to their technical characteristics, rural systems also have higher technical network losses and operating costs. Moreover, a poor regulatory and investment climate, low-quality infrastructure and communications and insufficient public spending often act as further disincentives to electricity providers for rural electrification.

Even when grid lines extend close to non-electrified communities, many families cannot afford connection costs without some form of government subsidy. Technologies available to them are typically inefficient or of low quality, which results in poor people paying more per unit of useful energy than consumers in developed countries, and a higher share of the household income spent on energy as compared to wealthier households. Additionally, the economic burden posed by unpredictable and small incomes on poor people in both urban and rural areas leads to their incapacity to adhere to long-term commitments and limits the sustainability of energy access.

IV. Equitable Energy Access as an Explicit Policy Focus

In the absence of economies of scale in rural areas, economic efficiency arguments are not enough. Expanding energy supply to poor and disadvantaged people requires a broader focus which includes social utility arguments.

A viable alternative, especially in the short term, is to address the existing challenges through decentralised, local, off-grid utility provision. Green, sustainable forms of energy can contribute in this context. Moreover, the urgency of concerns over climate change and environmental degradation together with the prospects of wider electrification in developing countries necessitates changing the dynamics and putting increasing focus on low-carbon energy mixes.

Falling costs and increasing investment in clean energy in recent years is yet another stimulus (especially in the context of low-income consumers). Small-scale renewable energy technologies are thus likely to be more cost-competitive than conventional options. Many developing countries have abundant renewable energy potential and could benefit from the positive economic spillovers generated by the development of renewable energy.

In providing energy services to poor people, sustainability is also a crucial element. Along with environmental sustainability, which is usually what is perceived as 'sustainability' writ large, other factors of sustainability need to be taken into consideration. 'Social sustainability' and 'suitability of technology' are two important but under-emphasised considerations for policy as well as development effectiveness (UNDP, 2011b).

On 'social sustainability', a community-based approach in which local communities are involved while designing and installing the product often increases the longevity and feasibility of rural energy services. The active participation of local communities is very important for their acceptance of and knowledge about the product, and finally its active use. Aligning the institutional set-up for energy projects within existing local governance structures can also bring about various benefits. Handing over the energy device/installation to the community only upon its completion risks alienating the community from the product or inefficient use of it.

The benefits of a community-based approach are highlighted by the REDP in Nepal, considered a particularly good practice for achieving high social sustainability. The REDP succeeded in introducing decentralised renewable energy services to the most remote populations of Nepal, which has one of the lowest rates of per capita electricity consumption in the world. By building micro-hydropower systems and delivering improved cooking stoves, the programme effectively provided reliable, low-cost electricity to rural communities and contributed to decreasing indoor air pollution (UNDP, 2011a).

Among the basic principles of the REDP model is ensuring representation from men, women and vulnerable groups, such as dalits (persons traditionally regarded as low caste), ethnic communities and poor households, and the formation of community organisations (UNDP, 2011b).

After construction, REDP's role is limited to facilitation, technical assistance and monitoring and evaluation. The programme is currently benefiting more than 1 million people in Nepal and has also supported the development of rural economies where it has prioritised women's participation and skills-building.

The REDP is widely recognised as a successful model for rural development, as it "called for community participation at every stage of the development process so that local communities would remain engaged and empowered in the decision making, implementation, benefits sharing and sustainability of the process" (UNDP, 2011a).

In addition, aligning product design with consumer needs and behaviour also plays an important role for high social sustainability. Consumption patterns vary across cultures, ethnicities, classes, castes; even religion may play a role in the ways in which people consume energy.

For instance, through its centralised battery charging stations in Vanuatu's remote island of Futuna, the company VANREPA Vanuatu, meets two specific features that the people demand: portability and pay-as-you-go. "This is compatible with traditional custom, where community houses (rather than individual households) serve as the centre of social activities and domestic chores that require portable lighting. In a limited cash economy, this also helps community members to pay a fee to recharge batteries as and when needed" (UNDP, 2011b). In general, innovations which are social in nature, or partially so, seem to better serve in accounting for habits and traditions and for social acceptance.

In considering the 'suitability of technology', in particular affordability for the end-user and the viability of the delivery mechanism, note must be taken of the limitations of commercialised models. Frequently, in this model, the private sector markets the product in a highly competitive market environment, in which poor people's capacity to compete and thus secure a significant share of access is much less than other groups'. Hence, this model is often directly incompatible with objectives to reach poor people and the poorest of the poor.

To effectively bridge this economic-social divide, the development of energy markets for poor people must blend viable private-sector involvement with a public goods approach—one that ensures long-term commercial viability, affordability, maintenance of infrastructure and quality of service.

Additionally, new renewable energy technologies must be robust, particularly in remote locations where servicing facilities may not be readily available and maintenance would be difficult.

Good practice analysis indicates that poor people are willing to pay a bit more for products with better quality. The StoveTec experience with improved cooking stoves shows, for example, that users want attractive and convenient stoves and are willing to pay for them as long as they meet their needs (UNDP, 2011b).

V. Emerging 'Green' Social Innovations to Reduce Inequitable Access

Some emerging 'green' social innovations have reflected both 'social sustainability' and 'suitability of technology' benefits and have been designed to address the particular energy needs of developing countries, marginalized communities and groups and hence need special attention.

One potential innovative solution to the problems of providing energy to poor households in remote areas, still in its testing phase in several developing countries, is 'Soccket'. Soccket is a soccer ball with a small generator integrated inside,[1] which harnesses kinetic (motion) energy when the ball is kicked during normal game play (Uncharted Play, 2012). The generated energy is stored in a capacitor to which one can connect small electrical appliances such as an LED lamp or a mobile phone. For example, 30 minutes of play would generate enough energy to power an LED light for three hours. Made of foam, so that it cannot deflate, the ball is robust and durable enough to last up to three years in play on the rough terrains of developing countries.

This new energy-generating device is a decentralised off-grid solution which can be applicable to the needs of many rural communities which do not need the constant supply of energy. The cost of the ball should be US$10 once launched on the market, making it an affordable solution for poor people. By connecting an LED lamp to it, it would extend daylight by producing the same amount of light as a kerosene lamp, allowing a few students to do their homework at the same time (Cohen, 2012).

One significant social benefit of the ball over kerosene lamps, however, is that it would prevent respiratory problems. According to statistics, living with the fumes from one kerosene lamp is equal to smoking 40 cigarettes a day (UNEP blog). In addition, 1.6 million people die every year from illnesses caused by exposure to kerosene lamps, diesel generators and inefficient biomass stoves (WHO in ITDG, 2004).

A further important benefit of the product is that it is aligned with consumers' behaviour, as playing with a ball is universal and does not require special training or a change in local people's habits. In the context of the issues discussed in this document, this type of approach, in which technology is designed for social purpose with environmental benefits, has also the important function of empowering local people, as it allows them to be the main actors in creating energy for themselves and in solving their own problems.

Gender issues have to be closely observed nevertheless, as the football game should not perpetuate existing nequalities between women and men where perhaps certain sports are seen to be the exclusive province of men, like football. From the outset, girls should be equally included in both creating the energy—i.e. playing—and using it.

Another innovative technology, applicable specifically to developing countries' necessities and suitable to their conditions, is the medical 'solar suitcase'. Designed as assistance to poor, remote communities, the suitcase is a mobile, decentralised form of energy, as essentially it is a portable, robust, complete solar electric kit.[2] The solar suitcase is critical for saving women and children's lives in many low-resource areas without reliable electricity where hospitals lack proper and sanitary conditions, many of which are afforded by consistent access to energy (We Care Solar website). In terms of its simplicity, the system is plug-and-play and can be installed without the need for an experienced solar technician. The suitcase can be a cost-effective solution for off-grid medical clinics, equipping them with solar power for medical and surgical lighting, walkie-talkies and essential medical devices such as a blood bank refrigerator.

The product was first designed in 2009 for a major municipal hospital in Northern Nigeria and is now accessible to clinics in 17 countries in Africa, Central America, Asia and in Haiti (We Care Solar website). As a recent innovation, there are no comprehensive data demonstrating its impacts, but testimonials of developing countries' healthcare workers speak of the significant potential of the solar suitcase to fulfil both of its functions: the social—to provide life-saving care to patients—and the 'green'—to provide energy from a fully renewable energy source.

VI. Conclusions and Further Research

The issue of energy access is as much an issue of lack of availability as much as it is the lack of appropriate technologies. Many of the technologies necessary for generating renewable energy in a socially sustainable way are either already available or just emerging.

The challenges lie in how to further improve these techniques, ensure their adaptability to specific local and cultural needs and expand their availability to improve people's choices. This document has argued that the debate on energy access should not be defined by macro considerations alone or by the economics of production. Instead, it points to the relatively important impact of smaller-scale and socially defined technologies which bridge the poverty and inequality gaps in fundamental and more sustainable ways. By identifying emerging and scalable 'green' social innovations, the paper also suggests that many elements are needed and not a 'one-size-fits-all' approach.

Many questions remain, particularly regarding how some of these new models can be effectively scaled up and adapted to different contexts in other developing countries and other social challenges and, in particular, how to attract business investment to make rapid expansion possible without losing the development effectiveness edge. Research for and by developing countries will be important in this context and should be prioritised in further encouraging critical innovations which are specifically targeted to their needs and to the needs of specific constituents within their societies.

From this brief review, it can be surmised that a 'social sustainability' check-up is an important element of the policy review process and the improved understanding of the efficiency and effectiveness arguments which shape the energy access debate. The following key questions should be considered ex-ante: Does the energy product/service improve the standard of living in the communities? Do disadvantaged segments and women benefit adequately? In addition, the 'suitability of technology' can be improved by answering the following questions: Does the technology meet the needs of end-users? Is the technology reliable, and can it be operated by them? Is it affordable to the end-user? Is the delivery mechanism viable?

Having these questions in mind helps us to deduce several important considerations and achieve a greater balance between the expansion of energy services and products with enhanced equitable access to them. Table 2 outlines some of the desirable conditions which should frame such considerations and potential benefits.

Table 2
Desirable Conditions for Energy Services/products to Achieve more Equity in Energy Access

Desirable conditions for energy services/products	Benefits
Decentralised, local, off-grid utility provision	Reaching remote and less populated areas; more affordable energy
Community-based approach	Facilitating acceptance and use of the product
Aligning products with consumer needs and behaviour	No need for major behavioural changes; products accepted more quickly and used more effectively
Including women and other disadvantaged groups in the conception of the product	Empowering these groups, addressing their needs, using their specific knowledge
Affordability of technology	Guaranteeing low prices and poor people's access to the energy services
Technology should be easy to operate, innovative and yet familiar	More effective use of the product; does not alienate customers
Robust with no need for frequent maintenance	Adaptable to remote areas and harsh conditions

Documenting further such non-mainstream innovations which blend the 'green' with the 'social' will also contribute to the wider recognition that innovations which help to address inequalities in energy access are possible and necessary.

Future research and innovations should also consider the options for green affordable energy products which would allow the expansion of economic activity in remote rural areas—for instance, through more advanced technologies for land fertilisation, irrigation, agro-processing and transport. More work will be necessary to better match innovations with relevant public policies and to expand public policy that supports and incentivises social innovations and social technologies. ■

1. Further information about the technical specifications of 'Soccket' is available at <http://www.unchartedplay.com/>.

2. Further information about the technical specifications of the solar suitcase is available at 'About the Solar Suitcase', <http://wecaresolar.org/solutions/solar-suitcase/>.

Daniela P. Stoycheva, Intern, Rural and Sustainable Development Team of the International Policy Centre for Inclusive Growth (IPC-IG). Master's in Governance and Development Policy from CERIS (Centre Européen de Recherches Internationales et Stratégiques), Brussels. *Email: d.p.stoycheva@googlemail.com*

This paper was produced with the supervision and guidance of the Team Leader, Rural and Sustainable Development, IPC-IG.

References:

Alliance for Rural Electrification (ARE) (2011). *Best Practices of the Alliance for Rural Electrification. What Renewable Energy Can Achieve in Developing Countries*. Brussels, ARE,<http://www.ruralelec.org/fileadmin/DATA/Documents/06_Publications/Misc/ARE_Best_Practice_2011.pdf> **(accessed 15 May 2012).**

Cohen, A. (2012). Personal interview with Abigail Cohen, VP of Social Development at Uncharted Play, on 16 March 2012.
Gaye, A. (2007). 'Access to Energy and Human Development', *Human Development Report Office Occasional Paper 2007/25*. New York, NY, UNDP, <http://hdr.undp.org/en/reports/global/hdr2007-8/papers/Gaye_Amie.pdf> **(accessed 15 May 2012).**

***Intermediate Technology Development Group (*ITDG) (2004). *Powering Poverty Reduction, ITDG Position Paper for Renewables 2004*. Rugby, ITDG.**

Meisen, P. and Akin, I. (2008). *The Case for Meeting the Millennium Development Goals Through Access to Clean Electricity*. San Diego, CA, Global Energy Network Institute (GENI), <http://www.geni.org/globalenergy/research/meeting-mdgs-through-access-to-electricity/MDG_Final_1208.pdf> **(accessed 15 May 2012).**

Sustainable Energy for All (2012). Sustainable Energy for All Website, United Nations Foundation, <http://sustainableenergyforall.org> **(accessed 22 April 2012).**

The Secretary-General's High-level Group on Sustainable Energy for All (2012). *Sustainable Energy for All: A Framework for Action*. New York, NY, United Nations, <http://www.sustainableenergyforall.org/images/content/SE_for_All_-_Framework_for_Action_FINAL.pdf> **(accessed 15 May 2012).**

Uncharted Play (2012). 'The Soccket', Uncharted Play Website, <http://www.unchartedplay.com/> **(accessed 22 April 2012).**

UNDP (2000). *World Energy Assessment: Energy and the Challenge of Sustainability*. New York, NY, UNDP, <http://www.undp.org/content/dam/aplaws/publication/en/publications/environment-energy/www-ee-library/sustainable-energy/world-energy-assessment-energy-and-the-challenge-of-sustainability/World%20Energy%20Assessment-2000.pdf> **(accessed 15 May 2012).**

UNDP (2011a). *Scaling Up Decentralized Energy Services in Nepal*. New York, NY, UNDP, <http://www.undp.org/content/dam/undp/library/Poverty%20Reduction/Participatory%20Local%20Development/Nepal_REDP_web.pdf> **(accessed 15 May 2012).**

UNDP (2011b). *Towards an 'Energy Plus' Approach for the Poor. A review of good practices and lessons learned from Asia and the Pacific*. Bangkok, UNDP Asia-Pacific, Environment and Energy, <http://web.undp.org/asia/pdf/EnergyPlus.pdf> **(accessed 15 May 2012).**

UN-Energy (2005). 'The Energy Challenge for Achieving the Millennium Development Goals', *UN-Energy Paper June 22, 2005*. UN-Energy Knowledge Network, <http://www.un-energy.org/sites/default/files/share/une/un-enrg_paper.pdf> **(accessed 15 May 2012).**

We Care Solar (2012). 'The Solar Suitcase', We Care Solar Website, <http://wecaresolar.org/solutions/solar-suitcase/> **(accessed 22 April 2012).**

Click and comment

International Policy Centre for Inclusive Growth
Esplanada dos Ministérios, Bloco O, 7º andar
70052-900 Brasilia, DF - Brazil
Telephone +55 61 2105 5000

E-mail: ipc@ipc-undp.org ▪ URL: www.ipc-undp.org