Clean Energy Access for All

Low Carbon Energy Technologies and Poverty Alleviation

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1 Development Context

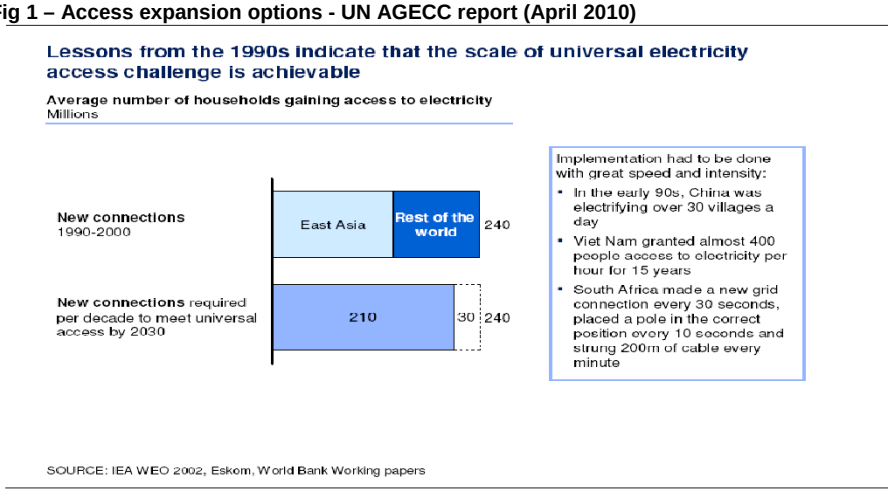
Energy access: the current situation

In the developed world energy is almost universally available and accessible: light at the flick of a switch, heat for cooking or comfort at the turn of a knob. In many parts of the developing world the picture is very different. Current estimates put the number of people still relying on biomass for most of their energy needs at 2.4 billion, some 1.6 billion people are still without access to electricity and many have only limited or no access to cleaner and more modern fuels such as kerosene, liquefied petroleum gas (LPG) or natural gas.

In real terms, that means millions of people - mainly women - spending much of their time in the arduous business of collecting firewood, animal dung or crop residues with which to cook or to heat their homes. Once they get their 'energy source' home the smoke produced from its combustion in traditional fires and stoves will expose them to pollutants that cause chronic respiratory and eye diseases. Once again, this is predominantly amongst the women, who do the cooking, as well as amongst the young children who spend much of their time indoors with their mothers. Over one and a half million deaths per year in developing countries are associated with inhalation of smoke from solid fuels.

Efforts have been made to improve this situation and access to electricity and other modern forms of energy have been successfully extended to over a billion people in the past decades, see Fig 1.

Fig 1 – Access expansion options - UN AGECC report (April 2010)



[1] This paper is an expanded version of the paper "Low carbon energy technologies and poverty alleviation" by John Christensen & Gordon Mackenzie in African Energy Yearbook 2010

But the glaring energy gap - between North and South and between the wealthier and poorer people in many countries - persists and may even be widening, in spite of the fact that governments and international organisations everywhere recognise that the multiplier effect of access to modern energy services is vital in underpinning efforts to improve health, education, clean water and sanitation services.

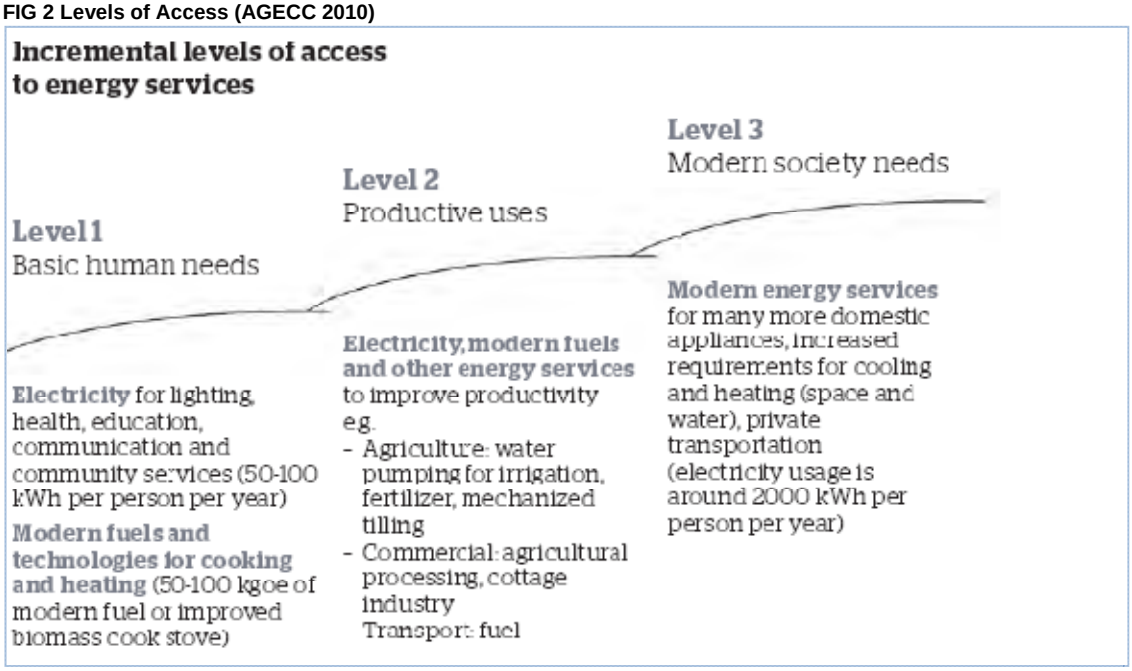
The UN Secretary General's Advisory Group on Energy and Climate Change (AGECC) in their recent report (AGECC, April 2010) advocates strongly for universal access by 2030 and in Fig. 1 the case is made that the effort required to do this will roughly be similar to the access expansion achieved in the nineties. The main challenge will be that the earlier progress was concentrated in a few countries and the remaining gap is spread over a much larger number of small countries.

In order to ensure that possible new initiatives are successful it is relevant to move towards a common understanding of what "access" really means.

The AGECC presents a balanced approach defining universal energy access as: "access to clean, reliable and affordable energy services for cooking and heating, lighting, communications and productive uses".

Even a basic level of electricity access that includes lighting and allows for communication, healthcare and education can provide substantial benefits to a community or household, including cost savings. AGECC does, however, suggest a broader definition than basic needs, and proposes that access to sufficient energy for basic services and productive uses is the appropriate level of energy access needed to improve livelihoods in the poorest countries and drive local economic development.

FIG 2 Levels of Access (AGECC 2010)



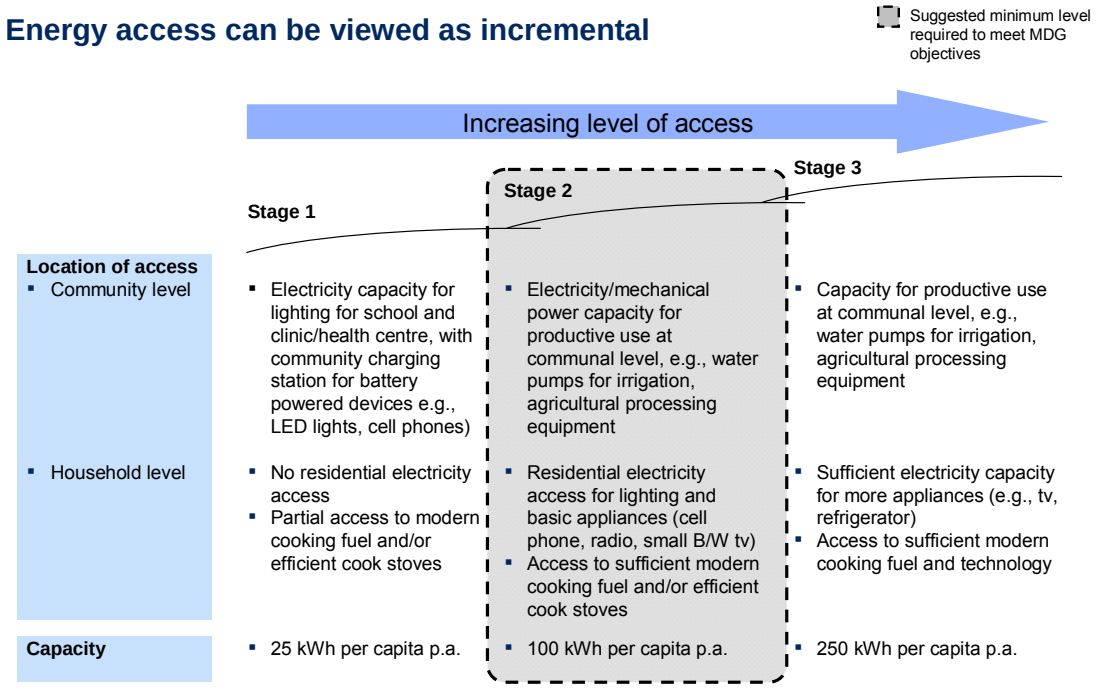
"Affordable" in this context means that the cost to end-users is compatible with their income levels and no higher than the cost of traditional fuels, in other words what they would be able and willing to pay for the increased quality of energy supply.

In practice, achieving universal access to modern energy services by this definition will entail providing affordable access to a combination of energy services that can be classified in three headings:

- Electricity for lighting, communication and other household uses.
- Modern fuels and technologies for cooking and heating.
- Mechanical power for productive use (e.g., irrigation, agricultural processing) could be provided through electricity or modern fuels (e.g., diesel, biofuels).

Including both basic social needs and productive uses in the access definition is an appropriate way of addressing the long term discussion about what comes first, or if one part can trigger the other. Social needs oriented access can deliver many benefits but often cannot be made economically sustainable while focus on productive uses only will not guarantee social benefits. So if access is to become sustainable, it will need to include both aspects.

FIG 3 Incremental Access provision (AGECC 2010)



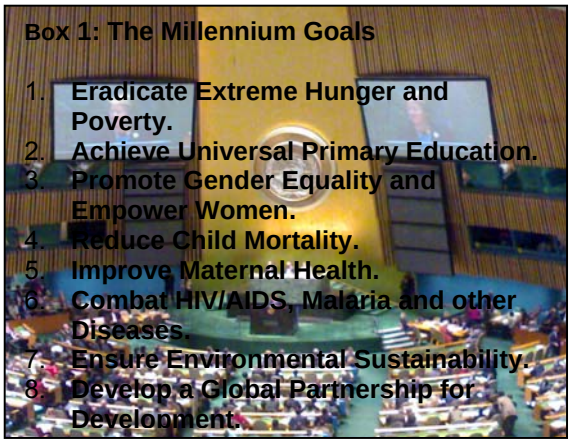
1 Applies UNDP 100 kWh per capita urban and 50 kWh per capita rural assumptions
2 Improved cook stove

SOURCE: WEO 2009, UNDP-WHO 2008 report, team analysis

Since financial constraints will make a universal access target difficult to implement in many countries it may be necessary to examine options for structured, transitional access programs with a gradual build up rather than trying to address all issues in one step. The AGECC has presented a three stage approach based on earlier work by the IEA and UNDP, suggesting one possible way of structuring a gradual build up of clean energy access. It should be noted that the first stage is not considered to meet the access definition above but could be a realistic first step in a longer process in areas with no formal services at present. The important aspect to underline is that this stepwise approach only makes sense, if it is does end up providing real access and does not stop after the first stage, as has been the case in many pilot activities.

The Millennium Development Goals – providing a new impetus

The Millennium Development Goals (MDGs) represent the international community's commitment to halving poverty in the world's poorest countries by 2015. The eight MDGs (see Box 1) address all of the dimensions of extreme poverty: income poverty, hunger, disease, exclusion and lack of infrastructure and shelter, while promoting gender equality, education, health and environmental sustainability.



Although the MDGs do not refer to energy as such, access to clean, efficient and sustainable energy services is recognised as being a prerequisite to attainment of many of the Goals. Indeed, this link was defined explicitly in the Johannesburg Plan of Implementation which emerged from the World Summit on Sustainable Development in 2002, calling on nations to:

'*Take joint action and improve efforts to work together at all levels to improve access to reliable and affordable energy services for sustainable development sufficient to facilitate the achievement of the MDGs.'*

Such a clear statement of the inherent link between energy and development sends a strong message to policy makers: that any planning of national development strategies must include energy and, if those strategies are to succeed, adequate energy services must be considered as a key condition for achieving the Millennium Development Goals.

The AGECC has proposed as part of the mentioned report that energy access is given prominence in the MDG review process and the MDG Summit taking place in September 2010.

Over the past decade or so, most developing countries have attempted to address the energy "gap" issue and the need to expand energy supply to meet growing demand. Many have introduced power sector reforms aimed at streamlining their energy sectors to make them economically viable service providers for all.

In doing so countries have generally attempted to replicate the model of most industrialised countries. That means concentrating on centralised generating systems, complex distribution grids, conventional energy sources and a focus on electricity. In many countries such an approach has failed to meet the needs of the poor, both in terms of access to basic services and opportunities to improve their incomes. This was largely because the particular problems of the poor were overlooked in a process of reform which assumed that greater economic efficiency would, of itself, extend access to everyone. This was one of the main finding by the UNEP facilitated Global Network on Energy for Sustainable Development in its first series of reports examining power reform impacts (GNESD, 2005).

Box 4: West Africa—abundant resources, low consumption

West African countries suffer chronic energy poverty, a prevailing circumstance that is partly responsible for current low levels of economic and social development.

The average per capita consumption of electricity in the 15 ECOWAS member countries is roughly seven and a half times lower than that of OECD countries.

However, even though ECOWAS countries consume very little electricity, they have significant energy potential (e.g. hydroelectric potential in Nigeria, Guinea, Ghana, Liberia, Côte d'Ivoire and Mali; and a year-round abundant solar resource throughout the region).

It is under-exploitation of these rich resources combined with inadequate policies, mainly in the area of electricity supply and distribution that has prevented access to electricity, particularly for the poor.

GNESD 2005

Rationale for a low carbon development path

One of a number of myths relating to energy and the poor is the common misconception that providing modern energy services to the currently unserved 1.6 billion people would dramatically increase the level of GHG emissions. However this is not the case, as has been demonstrated by the IEA who conducted an analysis of the potential consequences of roughly 2 billion households switching from wood fuel to LPG for cooking by 2030. The results show that such a shift would lead to an increase in world gas demand of only about 1% (WEO, 2006) and the increased contribution to GHG emissions would be an even smaller share.

Therefore the rationale of using climate arguments in an energy and development context has to be focused on the long term climate aspects. While the initial climate consequences of improved basic energy access based on fossil supply will be limited, the longer term commitment to increased GHG emissions as a result of increased economic prosperity will eventually mean increasing significance of GHG emission contributions from the countries that currently make very small contributions e.g. most of Africa, LDCs etc.

It would therefore clearly be "climate-wise" to lay the foundations for a low-carbon energy development path rather than embark on a business-as-usual fossil trajectory. In many cases it is, however, likely to be the auxiliary benefits – employment generation, reduced imports, local environment benefits, etc. - related to the use of low-carbon energy technologies that provide the national rationale for such a low-carbon development path. New international climate funds, as pledged by industrialised countries in connection with COP 15 in Copenhagen, may provide a needed stimulus to accelerate this process and the analysis by AGECC shows that meeting the access by all in 2030 can be done in a low carbon manner and that the a small share of the new international climate finance could facilitate this development.

The conventional approach to energy and power development, as described above, has meant that capacity expansion over the last decades has largely been based on increased use of fossil fuel resources. Renewable energy sources are, however, generally abundant in many developing regions and often well distributed – see Box 4.

Generally, many of the renewable technologies have matured over the last decades and moved from being a passion for the dedicated few to a major economic sector attracting large industrial companies and financial institutions. Renewable energy technologies such as wind power and solar photovoltaic (PV) devices have achieved major cost reductions over the last decades, which are expected to continue in the medium term as large global companies enter new energy markets for wind, solar and biomass technologies.

Renewable energy technologies (RETs) − in addition to being a tool for addressing the global carbon challenge - present a unique opportunity to break with the conventional patterns of energy development, which have failed to meet the needs of the poor so far.

With their environmental advantages over most conventional energy sources, their suitability for use in rural areas and their potential for local development of income-generating activities, RETs have the potential to make a significant contribution to local development and through this contribute to achieving the established Millennium Development Goals (MDGs).

2 RETs Barriers and options for overcoming them

In spite of the potential of renewable energy to make important contributions to meeting local energy service needs the progress is hampered by a number of different barriers preventing more widespread dissemination:

- Lack of policy attention and institutional framework for promotion of RETs,
- Financial institutions are risk adverse and unfamiliar with RETs requiring different financial packages than fossil systems due to high up front investments and low operational cost
- Lack of certification systems for the RETs often resulting in low quality, extending from the equipment itself right through to installation, operation and maintenance.
- Missing capacity at all levels from policy to manufacturing and installation
- Low awareness both in policy institutions and among potential users.

These barriers have been researched extensively over the last decades and although the way in which countries may choose to address them depends on their unique national economic, political and cultural situation, it is still possible to establish generic advice on how to overcome them:

- Integration of RETs into development policies and strategies aimed at poor populations, including focus on improving affordability.
- Creating an enabling policy environment with focus on:
  - Establishing stable and predictable market conditions
  - Use of, and adaptation to, market forces where relevant
  - Combining different policy tools rather relying on one “magic” solution

- Development of an institutional framework with a specific mandate to facilitate and promote RETs
- Development of capacity at all levels from policy through R & D and certification to production and installation
- Improving awareness at all levels about the potential and pros and cons of RETs.

This is only a short summary of the key action areas and there is a need for much deeper understanding of the specific barriers and different policy tools at the national level in order to device cost-effective approaches to RETs promotion.

Tapping the considerable renewable energy potential of developing countries is not mainly a problem of solving technological issues. It is, more fundamentally, one of putting in place an adequate institutional framework for the creation and implementation of policies that promote the use of truly accessible cleaner energy sources. There is no doubt that successful introduction and dissemination of RETs is, to a large extent, dependent on the existence of policies that create an enabling environment for their dissemination, and mobilize resources as well as encouraging private sector investment.

3 Successful low-carbon energy initiatives in Africa

Although the barriers to implementing low-carbon energy technologies in Africa are considerable, a number of success stories have emerged over the past decade. The UNEP-facilitated knowledge network GNESD has, for example, in its studies highlighted cases where barriers have been overcome and renewable energy and energy saving technologies are making a real contribution to providing energy service access and alleviating poverty (GNESD 2005, 2006, 2007, 2008). Two GNESD examples are provided below and supplemented by two examples from other UNEP programs on how low-carbon energy technologies for households are enter the market, in two quite different scales and settings, in Ghana and in South Africa.

Water pumping using animate power in East Africa

While a lot of global attention is focused on using RETs for electricity production the situation is quite different in many developing countries. Rural electrification levels in both Kenya and Tanzania are very low and where electricity is provided in rural areas, it is often unaffordable to the poor, who therefore cannot access it. With the bulk of the region's poor resident in dispersed rural settlements, conventional grid electrification is, in the near term, considered too costly. Non-electrical renewable energy technologies that operate on the basis of solar, thermal, mechanical and animate power can play an important role in these areas and these are not only affordable to the poor, but can also play a major role in national development in terms of job creation and income generation.

One specific example is the treadle pump, which is a relatively simple and inexpensive device that uses animate (human) power to raise water for irrigation. The reported impacts of treadle pumps on farming have been substantial and include:

- Increased land under irrigation;
- Reduced work time compared with bucket irrigation;
- Improved crop quality;

- Less strenuous irrigation work;
- Additional and new crops grown each season.

Figures for just one model indicate a dynamic nascent industry: 45 000 pumps in use by poor farmers, generating some US$37 million per year in profits and wages; 29 000 new jobs created; more than half the pumps managed by women entrepreneurs.

Still, it is considered to be only 10% of the estimated market of some 360,000 units, so it is clear that in spite of apparent success there are still barriers to overcome like lack of information; capital; inadequate promotional strategies; limited research and adaptation of new pumps; lack of clear policies on irrigation; land tenure, etc.

Options to promote further use and dissemination represent practical examples of the generic solutions outlined above and underline the need for adequate policies and institutional responsibilities:

- Providing access to adequate financing mechanisms like tax rebates and subsidies.

- Establishing a rural energy agency fund and development of policies specifically aimed at facilitating access to credit to small farmers.

- Developing capacity for pump operation and maintenance is recommended, through technical training, education and communication campaigns. Training of local end-users and communities on pump installation, repair and maintenance.

Domestic solar water heaters in South Africa

South Africa has established a renewable energy strategy setting a target of 10 000 GWh of RE (solar, small hydro, biomass and wind) to be achieved by 2013. For a heavily coal based economy this may be regarded as strange. But apart from the environmental and climate related benefits, it is seen as having the potential to assume a significant role in socio-economic development. Pursuing the 10 000 GWh target is expected to lead to more than 35 000 jobs, more than R5 billion would be added to the GDP and R687 million would be added to the incomes of low-income households. More jobs opportunities will be created as a result of RE technologies than in coal-fired power stations.

Among the RET options for achieving this target there are several that may provide significant benefits for the poorer part of the population, if properly implemented. One specific example is solar water heating (SWH) systems where all regions of South Africa have an excellent climate for SWH, with high annual radiation levels averaging daily between 4.5 and 6.5 kWh/m^2 compared to about 2.5 kWh/m^2 for Europe.

SWH systems are currently manufactured in South Africa and there is a well established SWH industry. The industry has recently formed an umbrella organization called SolarSure to assist in securing quality assurance, which is seen as crucial for future success, as many unqualified manufacturers previously have created a bad reputation for SWH systems

Until a few years ago SWH was not seen as a priority area by either the government or the dominating electricity company ESKOM, but with the situation that electricity peak

demand has increased more rapidly than power capacity has been added the situation has changed quite dramatically the last couple of years. Initially focus is on promoting SWH for households with power connections to lower the current peak demand, but this presents significant opportunities for a more widespread dissemination also for low income households, schools and clinics.

In order to ensure that poorer part of the population benefits from the new opportunities a number of measure have been identified to overcome current barriers, like:

- Current government policies to support increased RETs use should be targeted to ensure the poorer households can access the technology through dedicated financing or subsidy schemes.

- Financing schemes could be developed in cooperation between the banking sector and the manufacturers of SWH systems, potentially supported by elements of Government guarantees

- Information and awareness campaigns should be initiated to inform house owners and local authorities about the opportunities and benefits from SWH

- Training and education programmes should be established to strengthen the local industry and be combined with standards and certification systems to ensure high quality of local systems. Local employment effects of SWH production will be a major driver for government support for expanding the market.

A successful energy SME in Ghana

The difficulty of obtaining finance is a major barrier to the wider use of renewable energy and energy saving technologies in Africa. This affects both the producer of the technology and the consumer who is often unable to afford the up-front cost of devices. The case of Toyola, a company based in Ghana provides an interesting example. Toyola Energy Ltd. is an enterprise that fabricates and sells charcoal efficient cooking stoves mainly for peri-urban areas, and solar energy products such as lanterns in the rural market.

The owners of Toyola were among 78 informal sector artisans trained to produce energy efficient stoves under the Ghana Household Energy Project in 2003. Not all of these artisans were able to establish sustainable businesses. The difficulty of obtaining finance from normal bank sources to access materials and equipment was a major constraint. Toyola was identified as a potentially successful enterprise by the UNEP–facilitated Africa Rural Energy Enterprise Development (AREED) program and received financial assistance in 2006, through KITE – the Ghanaian AREED partner.

Toyola has since gone from strength to strength, increasing sales from 3000 to over 15,000 units per annum. By 2010 they had provided over 50,000 households in 6 regions of Ghana with improved energy-efficient stoves and expanded their market to neighboring countries as well as diversifying their products to solar lanterns. The production approach of Toyola has involved training unskilled jobless youths into producers, establishing rural production centres, and Division of labor and specialization in the manufacture of components.

The marketing strategy presents the product at the doorstep of the customer in rural and peri-urban communities, educates consumers on benefits of the improved stoves and uses satisfied customers to further promote the stove as ”stove evangelists”.

Toyola also provides credit to customers as a means of overcoming the significant up-front cost of purchasing the stoves.

The Toyola experience shows that:

- The poor can afford improved energy end-use equipment if:

    A. They are aware of the availability of the technology and practical benefits to their life, and
    B. They are given the necessary financial assistance to enable them pay in installments.

- Diversifying the target group to include commercial, institutional and domestic markets is a major factor in establishing a sustainable business.

Numerous other successful energy SMEs have been established in Ghana and other African countries through AREED and similar programmes. These successes make it easier in the future for potential energy enterprises to obtain the finance through conventional sources, and for consumers to obtain credit through such enterprises or through micro-finance institutions.

Kuyasa Low Cost Housing Upgrade Project, South Africa

One of the most successful and striking individual examples on the continent of renewable energy application at the household level is the Kuyasa Low Cost Housing Energy Upgrade Project in Kuyasa, a low-income housing settlement in Khayelitsha, Cape Town, initiated jointly by South-South-North and the City of Cape Town. The project involves the installation of solar water heaters, ceilings and ceiling insulation and compact fluorescent light bulbs (CFLs) in existing RDP (Reconstruction and Development Programme) houses in Kuyasa, Khayelitsha, Cape Town.

The project aims to alleviate energy poverty by providing the poor with access to renewable, and energy efficient technologies. GHG emissions are reduced and the thermal performance of the houses is improved, reducing the need for indoor space heating with fuels such as paraffin, which cause negative respiratory health impacts and fire-related risks. The project was the first registered CDM project in Africa and is the first Gold Standard project globally.

Essential to the success of the project is the interpretation of the CDM methodology such that the GHG reductions are calculated against a baseline of projected demand rather than current demand. The present low level of energy services of households is determined by their poverty. Rather than waiting for their energy consumption to increase using polluting energy sources, the carbon credits are calculated on the basis of “suppressed demand”. This provides a direct link between climate change and poverty alleviation. Combined with a micro-finance scheme and a reliable system of monitoring, the project design has led to a rapid uptake of the technologies.

Installations in 2309 houses are already complete, and there are plans to cover thousands more in the area. Moreover, the model can potentially be extended to the 2 million similar low-cost houses in South Africa.

Overall, 2.85 CO2 tonnes/household/year are avoided as a result of the project, but the other, local, benefits of the project are particularly noticeable. Savings in annual energy costs are estimated at over ZAR600 per household. The improved thermal performance and installation of ceilings provide significant health benefits, and the co-benefits of improved respiratory health among local residents further offset local, national government and state enterprise spending. Employment and capacity building has benefited local artisans, who will also be able to assist with maintenance. Regional and local job creation is also increased, due to the use of locally manufactured solar water heaters.

4 Conclusions

Successful examples of low-carbon energy development are emerging throughout Africa, but it is difficult to reach a general conclusion on this highly complex and evolving subject. Nevertheless, a few broad recommendations can be made:

- Action needs to combine different policies and approaches, addressing, wherever possible, both climate change and energy security issues.

- Long-term and predictable policy support is crucial for developing and sustaining markets and industries.

- Market forces should be used where appropriate, but solutions are often individual and context-specific.

- Political, economic and institutional barriers exist, as well as negative personal perceptions, so there is a strong need for enhanced awareness based on reliable information, credible data and real experience of successful technologies and policies.

International and regional collaboration is essential. International support for low carbon energy development must include:

- ✓ Systematic support to clean energy development within poverty reduction and economic development strategies.

- ✓ Commitment to long-term financing of low-carbon energy development as part of support to NAMAs.

- ✓ Increased global funding for programmes focused on increased access to clean and efficient energy services.

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