

Energy, the Millennium Development Goals and the Key Emerging Issues



**environment
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ENERGY, THE MILLENNIUM DEVELOPMENT GOALS AND THE KEY EMERGING ISSUES.

This document contains information on emerging issues that may affect the future state of the environment. The purpose of this paper is to draw attention to issues in preparation for the next state of the environment reporting cycle.

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INTRODUCTION

The South Africa Environment Outlook identifies a number of key emerging environmental issues, among them climate change adaptation, atmospheric pollution, vulnerability, and environment mainstreaming (DEAT, 2006). These emerging issues dovetail directly with some of the United Nations-led Millennium Development Goals (MDGs), specifically MDGs 1,7, and 8 concerned with poverty, environmental sustainability and global development respectively. It can be argued that the mentioned key emerging issues are unlikely to be addressed without meeting the goals of the MDGs, and that achieving the goals of the MDGs is likely to greatly contribute to achievement of the context conducive to addressing the key emerging issues.

Energy has been recognised as being critical to the realisation of all the MDGs (UNDP, 2005) and, therefore, cuts across them, as does poverty in its various facets. Unfortunately, national development frameworks and monitoring fail to recognise the importance of energy and as a result it is treated in the context of large-scale infrastructure projects (UNDP, 2005). This leaves important linkages with productivity and cross-sectoral applications unaddressed. Development strategies also tend to focus only on electricity while ignoring issues such as fuel availability and rural energy development.

This paper discusses the energy issues relevant to the key emerging issues and related MDGs cognisant of the fact that climate change and global poverty have become major international topics. The high level of inequality in South Africa makes it necessary to place considerable emphasis on the poor.

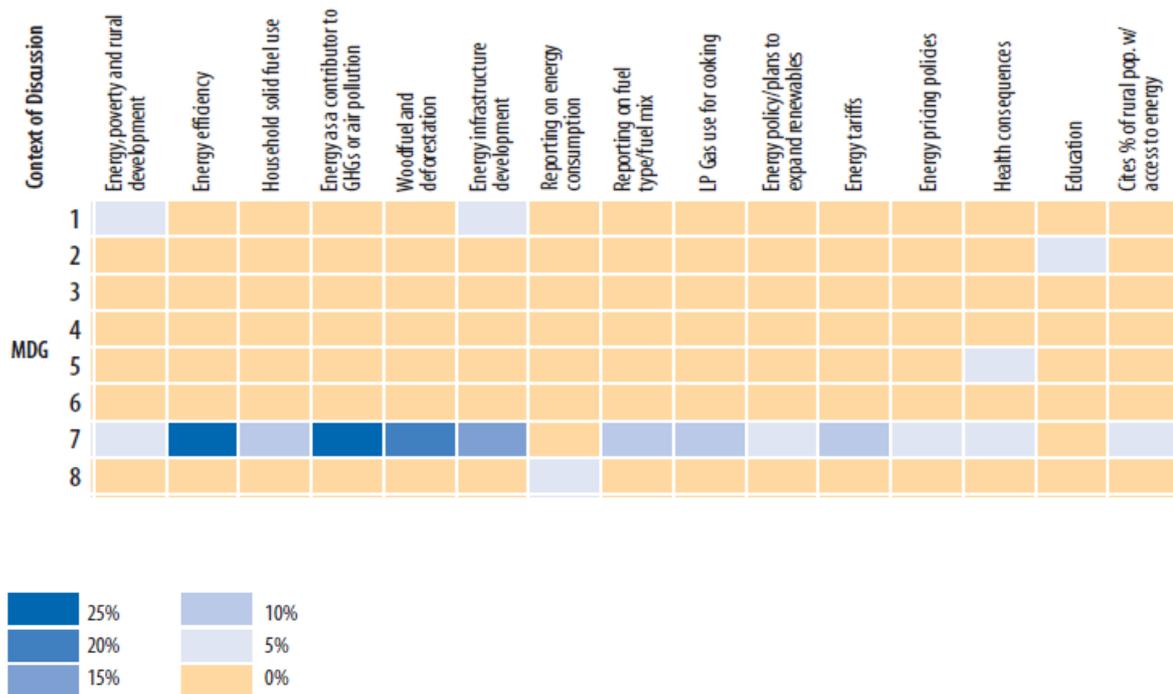
DISCUSSION

According to UNDP, energy issues are understated in national monitoring and reporting processes such as those found in MDG Country Reports. The eight MDGs are:

- 1: Eradicate extreme poverty & hunger
- 2: Achieve universal primary education
- 3: Promote gender equality & empower women
- 4: Reduce child mortality
- 5: Improve maternal health
- 6: Combat HIV/AIDS, malaria & other diseases
- 7: Ensure environmental sustainability
- 8: Develop a global partnership for development

The links between the MDGs and energy services are illustrated in detail in the Annex. The Annex provides examples of the potential contribution of energy services to addressing the MDGs. Only ten out of 80 MDG Country Reports mention energy outside discussions pertaining to environmental sustainability, largely ignoring the role that energy plays in reducing poverty as illustrated by the overwhelming emphasis on MDG 7 in Figure 1.

Poverty eradication has risen to become the most important crosscutting issue in development. Both the New Partnership for Africa's Development (NEPAD) and the Southern African Development Community (SADC) indicate that poverty eradication is their first priority and cuts across all programmes.



Source: UNDP, 2006

Figure 1. Percentage of National MDG reports that discuss energy

Energy and development

South Africa has a dual economy; the advanced first economy co-existing with a poor second economy where the majority of her population lives. The high level of inequality, with regards to income distribution, is demonstrated by South Africa’s relatively high gini coefficient¹ of 57.8 compared to corresponding United Nations figures for other countries. For example Norway 25.8, and Sweden 25.0 (among the world’s best figures), Australia 35.2, Cambodia 40.4, Uganda 43, Kenya 42.5 and Tanzania 38.2, Brazil 57, Paraguay 58.4 (these figures are towards the most unequal end of the list) (UNDP, 2007). Table 1 provides a summary of development indicators for selected countries in the region. The South African Government is making concerted efforts to address development and reduce poverty. Service delivery to the poor is currently one of the major thrusts. Progress has been made in this direction, with the national electrification level now in excess of 70% and rising.

¹ A measure of income inequality with low figures indicating the more equal distribution of income and the higher figures (maximum 100) indicating an unequal distribution of wealth.

The number of households with access to electricity was about 9.56 million in 2006, up from 4.47 million in 1995. By mid 2005, 232 287 households, 2 233 schools and 50 clinics had been electrified with solar photovoltaic systems under the off-grid electrification programme.

Table 1. Selected indicators for Botswana, South Africa and Zimbabwe.

	Botswana	South Africa	Zimbabwe
Area. km ²	600 370	1 221 037	390 757
Population (millions)	1.64	48.6 (2007 UN estimate)	13.01 (2005 estimate)
Population density (Persons/km ²)	3	39	33
GDP (PPP) Total Per capita	\$18.72bn \$14 700	\$663.9bn \$13 845	\$30 581bn \$2 607
Gini index (2000)	63 (high)	57.8 (high)	56.8 (high)
HDI (2007) HDI rank (out of 171)	0.654 (medium) 124	0.674 (medium) 121	0.513 (medium) 151
Electrification level %	39	70	34
Electricity consumption per capita. (% change, 1990- 2004)	UNDP includes this in SA data	0.2	-0.1
Electricity consumption per capita (kWh) 2004.	UNDP includes this in SA data	4818	924
Biomass/waste as % of total primary energy supply, change 1990-2005	33.1-24.1	11.4-10.5	50.4-61.9
% Population living on <\$1/day	28	10.7	56.1
% Population living on <\$2/day	55.5	34.1	83

Source: Compiled from UNDP, 2007.

Provision of modern energy services does not in itself cause development in the absence of other support measures including transport, communications, markets, and credit. In addition, electricity is not a basic need like food and shelter. To meet the needs of the poor, many other services need to be provided, including clean water, sanitation and health care.



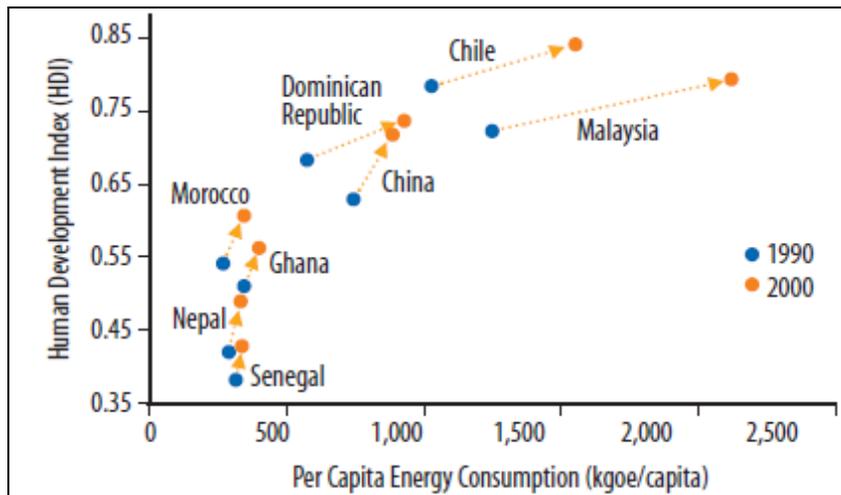
Source: World Bank, World Development Indicators 2004

Figure 2. Poverty Levels as % living below \$2/day, and GDP in USD per Capita by Region (2004)

Experience in South Africa's rural areas show that the impact of rural electrification on the use of fuelwood is minimal as about 80% of electrified rural households in rural parts of Limpopo and Eastern Cape provinces were found to cook with mostly wood, but also kerosene and liquefied petroleum gas (lpg), because they cannot afford to pay for electricity (ERC, 2004). This is not to deny the tangible benefits of electrification, including better domestic and public lighting and ability to use a wider range of appliances.

Figure 2 suggests that poverty correlates well with GDP per capita, with the poorest countries such as Ethiopia, Malawi, Mozambique, Burundi, Mali and others having most of their populations living on less than US\$2 per day, often with over 80% dependence on traditional biomass fuels.

Although South Africa seems to fare well on national average statistics though an evaluation of the rural population alone would show a very different picture. The extent of national access to electricity is an important indicator of national development.



Source: IEA; UNDP analysis

Figure 3. Energy consumption and the Human Development Index (HDI) among a selected group of countries between 1990 and 2000.

The majority of the populations of developing countries live in rural areas and these areas are often the poorest. To uplift rural livelihoods, many governments have dedicated rural energisation programmes. Figure 3 displays the relationship between a country's human development index (HDI- a composite index which combines economic, national income, indices for life expectancy and education) ranking and per capita energy use, with energy consumption used as a proxy for energy services. Energy is strongly linked to human development; as evidenced by the upward trend over the decade 1990 and 2000. The graph also illustrates that countries that develop over time do so in tandem with improvements in energy. In fact, no country in modern times has substantially reduced poverty without a massive increase in its use of energy and/or a shift to efficient energy sources (UNDP, 2005).

Impact of electrification on fuelwood use

It is desirable to reduce reliance on fuelwood and charcoal for households use, not only to reduce deforestation, but also the emissions (including indoor) associated with these fuels particularly when used in traditional ways. An indication of the significance of such emissions in Africa can be gleaned from Table 2.

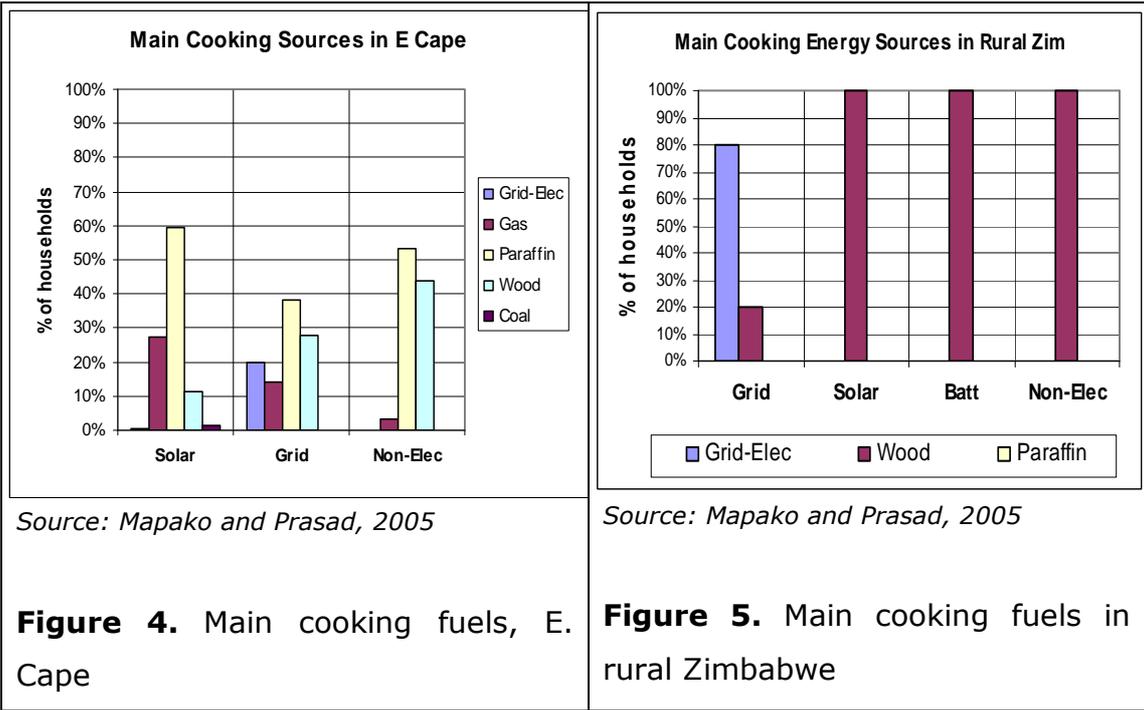
Table 2. Annually burned biomass, methane and carbon dioxide emission from burning in inter-tropical Africa.

Type of combustion	Annually burned biomass 10 ⁹ tons dm	Emission factor CO ₂ g/kg	Emission factor CH ₄ g/kg	CO ₂ emission 10 ⁹ t yr ⁻¹	CH ₄ emission methane 10 ⁶ t yr ⁻¹
Savanna fires	2.52	1370	1.65	3.45	4.14
Forest fires	0.13	957	6.94	0.12	0.90
Firewood burning	0.12	957	5.42	0.11	0.65
Charcoal making	0.11	641	21.00	0.07	2.31
Total for Africa	2.88			3.75	8.00

Source: Adam, 2009 quoting Delmas et al., 1991

While electrification constitutes the major component of rural energisation in most countries, its impacts can be limited by socio-economic status of the recipients. This can reduce the environmental benefits associated with reduced dependence on fuelwood and charcoal for cooking. Figures 4 and 5 show the main cooking fuels among rural households with access to different energy options, namely solar PV, grid electricity, automotive battery and non-electrified in South Africa and Zimbabwe.

Figure 4 shows that despite being grid-electrified, only 20% of the households in South Africa were found to cook with electricity. The major reason for this is inability to afford electricity. This is contrast to the situation in Zimbabwe where the majority, 80% of grid-connected households were found to cook with electricity.



The explanation is that in Zimbabwe rural households do not get a connection subsidy, the rural electrification programme in the country is focussed on rural service centres. Households wanting to connect to the grid bear the full cost. Consequently, only the wealthiest rural households can afford to connect to the grid, and can cook with electricity. (ERC, 2004).

It is also possible for fuel use patterns to regress from modern energy towards traditional biomass fuels in the face of socio-economic hardship. This has most recently been observed in Zimbabwe due to the current political and economic crisis.

Table 3 shows the respective figures for 1990 and 2005. It can be observed that minor reductions in reliance on biomass fuels have been recorded in the majority of cases, with only five countries (highlighted in red) showing increased reliance on biomass fuels. These are strongly dominated by Zimbabwe, which has relatively low biomass dependence has seen a rise of about 11% in reliance on biomass energy over the 15-year period. This is not surprising given that country’s serious economic problems and attendant power and liquid fuels shortages since the late

1990's. This situation suggests that biomass fuels remain a fallback position in adverse circumstances for populations moving to modern energy services.

Table 3. Biomass and waste (% of total primary energy supply)

HDI Rank	Country	1990	2005	% Change 1990-2005
163	Benin	93.2	64.7	-28.5
156	Senegal	60.6	39.2	-21.4
139	Congo	69.4	56.3	-13.1
124	Botswana	33.1	24.1	-9
172	Mozambique	94.4	85.4	-9
135	Ghana	73.1	66	-7.1
162	Angola	68.8	63.8	-5
148	Kenya	78.4	74.6	-3.8
152	Togo	82.6	79.4	-3.2
147	Sudan	81.7	79.5	-2.2
169	Ethiopia	92.8	90.6	-2.2
158	Nigeria	79.8	78	-1.8
119	Gabon	59.7	58.8	-0.9
121	South Africa	11.4	10.5	-0.9
159	Tanzania	91	92.1	1.1
144	Cameroon	75.9	78.6	2.7
165	Zambia	73.4	78.7	5.3
168	Congo (DRC)	84	92.5	8.5
151	Zimbabwe	50.4	61.9	11.5

Based on UNDP, 2009

For South Africa the lesson is that the proposed steep increases in electricity tariffs can reduce electricity use and increase fuelwood use among poor households, a trend already seen in Figure 4. Such a trend is likely to prove detrimental to the environment in poor areas through local deforestation hotspots as illustrated in the example of Malawi which follows.

Malawi: Biofuel production for local commercial and household use

Malawi's energy balance is dominated by biomass, which accounts for 97% of total energy supply. Fifty nine percent of this biomass is used in its primary form as firewood (52%) and residues (7%), the remaining 41% is converted into charcoal in inefficient traditional earth moulds with thermal efficiencies of 12% - 14%.

In December 2006, the government, alarmed by deforestation due to charcoal usage launched the four-year Promotion of Alternative Energy Sources Project to provide alternatives to charcoal. The alternatives include ethanol gel², LPG, improved wood and briquette stoves, and low cost electrification options. Malawi provides an example of sustained biofuel production for local use.

Drivers of deforestation: 1983-2007

- Population increased by 88%;
- Productivity of maize increased by only 9%;
- There was significant new planting of some cash crops e.g. tobacco 830% increase.

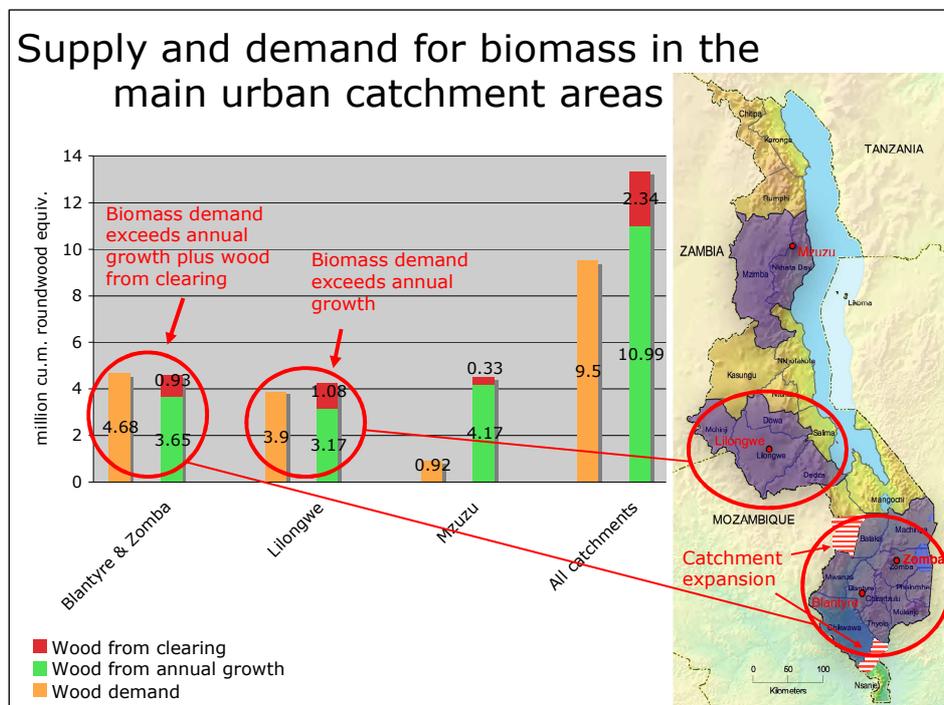
Therefore, the area under cultivation more than doubled. Nationally, clearing of land for farming is the main cause of deforestation, driven by a growing population in need of food and cash crops. In many areas, woodfuels are being sustainably cut or are a by-product of land clearing for farming. But there are *critical hotspots around Blantyre and Lilongwe* where woodfuels are being harvested unsustainably. These areas should be the focus of supply-side interventions under the Biomass Energy Strategy. (Ministry of Energy and Mines Malawi/EUEI/MARGE. 2008)

Local social and economic impacts

Charcoal burning and marketing at present requires only minimal financial and human resources. Wood is mostly obtained for free. Charcoal production, therefore, is a business of choice for the rural poor; it

² Malawi has two sugar mills Dwangwa and Nchalo capable of producing a total of 260,000 tons of sugar per annum from approximately 2,000,000 tons of cane.

contributes to their household income and provides a safeguard against food-shortages, unemployment and similar poverty-related risks (Ministry of Energy and Mines Malawi/EUEI/MARGE. 2008). The number of people engaged in the charcoal business is remarkable. By example, the estimated number of charcoal producers in Kenya (ca. 200,000) is as high as the number of people working in the educational sector. Approximately 500,000 people engage in downstream-processing and trade. With the number of dependents added, the charcoal business supports as many as 2.5 million Kenyans.



Source: Ministry of Energy and Mines Malawi/EUEI/MARGE

Figure 6. Supply and demand for biomass in the main urban areas

Their annual income nearly equals that of Kenya's tea industry. Similar figures are reported by other countries (e.g. Malawi, Niger). Such figures vividly underscore that promoting sustainable charcoal industries provides a first-rate means of poverty alleviation (Ministry of Energy and Mines Malawi/EUEI/MARGE. 2008)

Other findings from a regional study of energy and small rural enterprises (CSIR 2007)

There is growing consensus that focusing on economic activities in the provision of energy services is an effective way to reduce poverty (ESMAP 2000; UNDP 1997). The CSIR's Natural Resources and Environment unit conducted a small regional study that included a survey of energy issues among small rural enterprises in South Africa, Zimbabwe and Botswana. Rural power supply was reported to be generally unreliable regardless of country, even in the absence of power shortages currently plaguing the SADC region. It is not clear how these problems that occur at remote sites can be effectively dealt with. Decentralised power production may help but would be more costly than grid power. Policy and technical interventions to address this would be needed.

Electrification was seen to generally widen the scope of productive activities because there are activities that are not possible in the absence of electricity, for example electric arc welding and the operation of power tools. Electrification was seen as increasing employment opportunities. Considerable increases in the number of both enterprises and employees were reported in all countries following electrification. These observations lend weight to the view that provision of modern energy services does address poverty.

Respondents in the CSIR study mentioned the need for other *non-energy interventions* including skills training in bookkeeping for example to enhance the success of their enterprises. Most rural enterprises did not have any form of bookkeeping and, despite claims to the contrary would not know if they were operating profitably. This situation leads to failure of enterprises despite the provision of modern energy services, and it underscores the need for more integrated multi-sectoral rural development intervention packages.

It is necessary to consider the issues seen as problematic by the small enterprises that are the target of the electrification programme, including

affordability of the scheme, the speed of its implementation, and equipment supply constraints.

The dilemma facing policymakers in delivery of modern energy services

In a worldwide survey of solar PV systems, it was concluded that not enough information was available on the performance of solar PV systems (Niewenhout *et al.*, 2000), and also that there is as yet no sure recipe for the successful dissemination of solar PV systems (ESMAP 2000). More recently the Southern African Power Pool has pointed out that poverty and the consequent low consumption of electricity are among the key challenges that rural electrification faces in the SADC region

The dilemma faced by policymakers in trying to sustainably provide services including energy to the poor is summarized in Figure 7 with a focus on energy services. In this case the dilemma is between the need to maximize access to cleaner/modern energy services by the poor, and the need to ensure financial sustainability of the energy service delivery programmes. Framing the problem as this type of dilemma will help to bring out the hidden assumptions which are implied in the links (A,B,C,D) between the boxes.

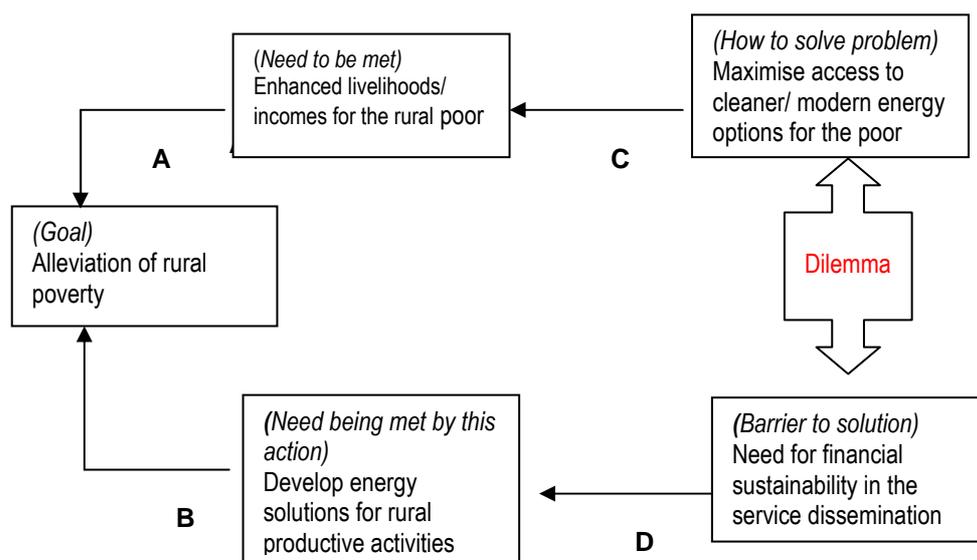


Figure 7. Illustration of the dilemma between financial sustainability and universal access

The approach also forces any identified policy options to be balanced because they will have to address both sides of the dilemma. C could be seen as project activities while D could be seen as policy analysis. Possible solutions can be identified from questioning the assumptions associated with each link. For example link B implies assumptions that can be questioned as indicated below:

- Is increasing the range of income generating activities for the rural poor the best option for rural poverty alleviation? This may suggest a multi-sectoral approach.
- Will the rural poor use cleaner energy if it is made available? This may suggest barrier removal.
- Is limited access to cleaner energy the constraint to rural poverty alleviation?
- Can the rural poor afford the costs associated with using cleaner energy? This may suggest appropriate financing mechanisms, poverty alleviation initiatives, targeting productive activities).

Possible solutions can come from such questions and some are suggested in the questions above.

CONCLUSIONS

The problem that this discussion focussed on is the need to adopt a holistic approach in addressing the key emerging issues identified by DEA. In the case of South Africa the inequality that exists makes it imperative that emphasis be placed on achieving the goals of the MDGs, with which the key emerging issues are closely aligned. Energy is recognised as being key to the realisation of all the MDGs. The challenge is to provide modern energy services to the poor, and it has been shown that upliftment will entail increased energy consumption.

The mere connection of households to modern energy such as electricity does not equate to access as long as low incomes prevent wider usage of that electricity. Again this points to the need to enhance opportunities for income generation. This paper has highlighted the considerable rural business opportunity that the processing and selling of biomass offers. This obviously needs to be appropriately regulated, without being stifled.

There is currently insufficient guidance for policymakers and implementers on how to successfully execute energy projects for the poor. Unfortunately there is no one-fits-all recipe for successful delivery of modern energy services because solutions are often context-specific. These issues need to be resolved in order to address the key emerging issues and the related MDGs since the production and use of energy is a major contributor to global pollution and climate change while limited access to cleaner energy by the poor continues to fuel the use of dirty traditional fuels with attendant localised deforestation.

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ANNEX: ENERGY AND THE MILLENNIUM DEVELOPMENT GOALS

GOAL	POTENTIAL ROLE OF MODERN ENERGY OPTIONS Some Direct and Indirect Contributions
<p>1) Extreme poverty and hunger</p> <ul style="list-style-type: none"> • To halve, between 1990 and 2015, the proportion of the world's people whose income is less than one dollar per day. • To halve, between 1990 and 2015, the proportion of people who suffer from hunger. 	<ul style="list-style-type: none"> • Access to affordable energy services from gaseous and liquid fuels and electricity can assist enterprise development. • Lighting can contribute income generation beyond daylight hours. • Electrically driven machinery can increase productivity and provide opportunities for income generation where none existed prior to electrification. • Local energy supplies can often be provided by small scale, locally owned businesses creating employment in local energy service provision and maintenance, fuel crops, etc. • Clean, efficient fuels can reduce the large share of household income spent on cooking, lighting, and keeping warm (equity issue - poor people pay proportionately more for basic services). • The bulk of (95 percent) staple foods need cooking before they can be eaten and need water for cooking. Provision of clean water for cooking often requires energy. • Post-harvest losses can be reduced through improved electric-powered preservation (for example, drying and smoking) and chilling/freezing. • Energy technologies such as wind pumps and treadle pumps can be used for irrigation in order to increase food production and improves nutrition.
<p>2) Universal primary education</p> <ul style="list-style-type: none"> • To ensure that, by 2015, children everywhere will be able to complete a full course of primary schooling. 	<ul style="list-style-type: none"> • Energy can help create more child friendly environment (access to clean water, sanitation, lighting, and space heating/cooling), thus improving attendance at school and reducing drop-out rates. • Lighting in schools can assist in retaining teachers, especially if their houses are electrified • Electricity can enable access to educational media and communications in schools and at home facilitate distance learning • Access to energy can provide the opportunity to use specialised equipment for teaching (overhead projector, computer, printer, photocopier, science equipment). • Modern energy systems and efficient building design can reduce heating/cooling costs and thus school fees thus contribute to enabling poorer families greater access to education.
<p>3) Gender equality and women's empowerment</p> <ul style="list-style-type: none"> • Ensuring that girls and boys have equal access to 	<ul style="list-style-type: none"> • Availability of modern energy services can free girls' and young women's time from survival activities (gathering firewood, fetching water, cooking inefficiently, crop processing by hand, manual farming work). The freed time can be productively used to generate more income or acquire education • Clean cooking fuels and equipment can reduce exposure to

GOAL	POTENTIAL ROLE OF MODERN ENERGY OPTIONS Some Direct and Indirect Contributions
primary and secondary education, preferably by 2005, and to all levels of education no later than 2015.	indoor air pollution and improves health. <ul style="list-style-type: none"> • Good quality lighting can facilitate home study and organization of evening classes. • Street lighting can improve women's safety. • Affordable and reliable energy services can broaden the scope for women's enterprises.
4) Child mortality <ul style="list-style-type: none"> • To reduce by two thirds, between 1990 and 2015, the death rate for children under the age of five years. 	<ul style="list-style-type: none"> • Every year, indoor air pollution is responsible for the death of 1.6 million people - that's one death every 20 seconds, mostly affecting children and women. • Gathering and preparing traditional fuels exposes young children to health risks and can reduce time spent on childcare. • Better energy services facilitate the provision of nutritious cooked food, space heating, and boiled water contributes towards better health. • Improved energy services can provide access to better medical facilities for paediatric care, including vaccine refrigeration and equipment sterilisation.
5) Maternal health <ul style="list-style-type: none"> • To reduce by three quarters, between 1990 and 2015, the rate of maternal mortality. 	<ul style="list-style-type: none"> • Improved energy services can provide access to better medical facilities for maternal care, including laboratory services, medicine refrigeration, equipment sterilisation, operating theatres and safer caesarean sections • Improved energy services can also assist in retention of qualified medical personnel in remote rural areas. • Modern energy services can reduce excessive workload and heavy manual labour (carrying heavy loads of fuelwood and water), which could adversely affect a pregnant woman's general health and well-being.
6) HIV/AIDS, malaria and other major diseases. By 2015, to have halted and begun to reverse: <ul style="list-style-type: none"> • the spread of HIV/AIDS • the scourge of malaria • the scourge of other major diseases that afflict humanity. 	<ul style="list-style-type: none"> • Electricity in health centres can enable provision of medical services during the night as well as assist in retaining qualified staff, and allows use of more advanced medical equipment (for example, sterilisation, medicine refrigeration). • Energy for refrigeration can facilitate vaccination and medicine storage for the prevention and treatment of diseases and infections. • Safe disposal of used hypodermic syringes by incineration prevents re-use and the potential further spread of HIV/AIDS. • Energy is needed to develop, manufacture, and distribute drugs, medicines, and vaccinations. • Electricity can enable access to health education media through information and communications technologies (ICT).
7) Environmental sustainability <ul style="list-style-type: none"> • To stop the unsustainable exploitation of natural resources; and 	<ul style="list-style-type: none"> • Increased agricultural productivity can be facilitated by the greater use of electric powered machinery and irrigation, which in turn reduces the need to expand quantity of land under cultivation thus reducing pressure on ecosystem conversion. • Traditional fuel use can contribute to erosion, reduced soil fertility, and desertification. Fuel substitution, improved efficiency, and energy crops can improve the sustainability of

GOAL	POTENTIAL ROLE OF MODERN ENERGY OPTIONS Some Direct and Indirect Contributions
<ul style="list-style-type: none"> To halve, between 1990 and 2015, the proportion of people who are unable to reach or to afford safe drinking water and sanitation. 	<p>the exploitation of natural resources.</p> <ul style="list-style-type: none"> Clean energy production can encourage better natural resource management, including improved water quality Cleaner, more efficient fuels can reduce greenhouse gas emissions, which contribute to climate change. Energy can be used to purify water or pump clean ground water locally; reducing time spent collecting it and reducing drudgery. Simple energy solutions such as low cost sterilization of drinking water can save many lives. Subject to socio-cultural barriers, innovative options such as bio-energy latrines could enhance sanitation and, at the same time, supply clean energy
MDG 8: Global partnership for development	<ul style="list-style-type: none"> Global and sub-regional partnerships are valuable for ensuring cross-border trade and exchange of skills in modern energy services as well as joint development of modern energy services such as transmission interconnections, hydroelectric power generation stations

Source: Adapted from United Nations Development Programme and World Health Organization.

