

The Use of Renewable Energy to Promote Sustainable Rural Livelihoods in the Remote Isolated Rural Areas

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ABSTRACT There are abundant sustainable renewable natural resources of all types spread all over South Africa including rural, remote, isolated areas which can be tapped to produce modern energy services for the rural poor. However, there is paucity of effort on the part of the stake holder to make sustainable energy available to the rural people hence impacting on provision and delivery of socio-economic amenities. Electricity is no exception. The standard of living condition in the rural locations is appalling and it is exacerbated by lack of modern energy. Rural poor continue to live in abject and chronic poverty because of lack of basic social economic amenities and services one of which is a lack of modern energy. This article examines the plight of historically disadvantaged people who live in the rural remote isolated areas and have problems accessing modern energy. This article submits that it is the responsibility of the government to make modern energy available but the energy that seems to be available is from fossil coal that emits carbon dioxide causing global warming and climate change. The article accentuates that even though it is desirable that modern energy should be made available in order to improve socio economic activities and standard of living, it should come from renewable sources. The article reveals that energy from these sources is sustainable and will alleviate poverty, promote a higher standard of living, create and promote socio-economic opportunities and it is environmentally friendly.

INTRODUCTION

The use of fossil fuel energy that emits carbon dioxide to the atmosphere is widely regarded as a major threat to humankind because it is causing different environmental and climate calamities and becoming less beneficial to humankind. Against this backdrop, energy would be seen to be beneficial to humankind if it is sourced from sustainable sources such as renewable sources which would invariably contribute to sustainable development, economic growth and a better standard of living of the people (Bazmi and Zahedi 2011). In order to achieve this, it is incumbent on any responsible government and its different institutions to roll out various implementable initiatives in forms of policy, strategy, measures and enforceable law to make this happen. It also requires taking positive steps to ensure that modern energy is affordable and accessible to the indigents and the poorest of the poor in the society. Various scientific reports and opinions have confirmed that sustainable renewable energy is the key to making this feasible because it is economically viable, does not emit carbon dioxide causing global climate changes, it is environmentally benign and does not lead to environmental degradation or destruction (Tobing et al. 2011). Nowadays, energy from renewable energy is now becoming the

current trend in providing modern energy to the people and various sustainable developmental initiatives are expected to be powered and driven by renewable energy as opposed to fossil fuel energy. South Africa is doing everything in order not be out of step in providing modern energy to foster economic growth and development, this is why the then Deputy Minister of Minerals and Energy, Shabangu (2003: i) asserted that:

“I am confident that in this dynamic new era of the African Renaissance and in the spirit of the World Summit on Sustainable Development, hosted by South Africa (2002), we shall see Renewable Energy taking its rightful place in the South African Energy Sector and playing a significant role in contributing towards sustainable development.”

In rural South Africa, modern energy is required for various domestic, economic and social activities and electricity particularly is the key to drive all these activities (Gaunt 2005). However, most of the rural areas do not have electricity for numerous reasons, one of which is the previous apartheid policy which excluded historically disadvantaged people from enjoying or accessing these basic amenities. In addition, some rural areas are extremely remote and isolated and the communities are scattered all over hence making it impossible and expensive

to connect them to the grids. It is against the backdrop of this that the ANC led government in 1994 proactively came up with the Reconstruction and Development Programme (RDP) to solve the problems of a lack of basic socio-economic amenities by implementing the programme to make these available to the disadvantaged people.

Sustainable renewable energy will speed up the provision of modern energy for electrification and power other basic social economic activities in the rural areas and at the same time fight climate change (Cherni and Hill 2009). This is the reason why it is incumbent on the government to promote sustainable development through policies and strategy that will seek to expand the poor's access to sound energy services (Karakosta et al. 2010). In South Africa, Eskom, the national power utility, accounts for 96 % of the country's electricity generation (Frederich 2004); about 93 % of this is from coal, representing a total generation capacity of 37,678 MW (Frederich 2004). However, the majority of this is used in urban centres of the country and by industry. Although some of the rural areas have been connected to the grid, the majority are still unconnected (Swilling 2006).

Rural people do not really need a large amount of electricity because there is little or no industrial activity there. However, they are in dire need of modern energy for basic socio-economic and domestic activities such as heating, lighting, small entrepreneurships, media and small scale businesses. In this context, two types of renewable energy would be significant in delivering these socio-economic services in the rural areas (Byrne et al. 2007). According to Visagie and Prasad (2006), solar water heaters (SWHs) and biodiesel have been identified as renewable energy which could make a significant contribution towards poverty alleviation in terms of improving the general welfare of households, as well as, developing productive activities to generate employment. South Africa has high levels of solar radiation and an established manufacturing infrastructure for SWHs. They can contribute to a reduction in greenhouse gas (GHG) emissions, and their manufacture and installation can contribute to job creation and skills development.

Objectives

The key objective of this article is to articulate that even though the people living in the

rural remote isolated areas have been deprived and denied access to virtually all basic socio-economic amenities for one reason or another, lack of access to energy by the rural poor is exacerbating the problem. While different reasons have been given for failure to deliver grid electricity to the rural people, the same reason cannot hold for stand-alone renewable energy which does not need to be connected to the grid before energy and in particular, electricity is made available to the people in the remote isolated areas. It is therefore submitted vehemently that renewable energy service is feasible in the rural isolated areas. This will drastically altered the present energy poverty plaguing the rural people and more importantly, the people will also be able to engage actively in social economic activities which will be beneficial to the community and also the country.

METHODOLOGY

The study used qualitative data gathered by examining and analysing previous studies relevant to the use of renewable energy for sustainable rural livelihoods. The study analyses the situation in South Africa and compares it with other developing countries in order to learn lessons from them on how best to make this approach workable and sustainable in South Africa. The study argues vehemently for the use of renewable energy but also points out that for there to be holistic sustainable development, both the role players and stakeholders should partner in order to make supply and demand sustainable.

RATIONALE AND MOTIVATION

In South Africa, despite huge financial commitments to providing modern energy to the previously disadvantaged people, many of them still lack access to modern energy thereby increasing the number of unemployed and causing them to migrate to cities to seek economic opportunities and a better standard of living. It is against the backdrop of this lack and the attendant poverty that is now prominent in the country, and in particular in the rural areas, that this study was embarked upon with the intent of offering solutions to the problem by advancing robust arguments for the use of renewable energy as a viable alternative to fossil fuel energy to

promote rural livelihoods and retain the rural population to continue to engage in useful productive economic and social activities. The development and use of renewable energy in the rural locations will help sustainable development through economic growth and pollution control. The overall benefit of this approach is that the replacement of fossil fuel by renewable and clean forms of energy would relieve the environment of serious types of pollution (Sagar 2005). The rationale for this study is that energy is not an end in itself; it is an instrument for the achievement of the socio-economic goal of sustainable development. Reddy (1991) observes that "this goal implies several criteria such as economic efficiency, equity/access (particularly for the poor, women and rural areas), empowerment/self-reliance, environmental soundness and peace." Rural people deserve all these socio-economic activities in order to have better and sustainable livelihoods.

LITERATURE REVIEW

It is generally accepted that energy, especially electricity, is universally recognized as one of the most fundamental inputs for social and economic development (Katuwal and Bohara 2009). According to Wazed and Ahmed (2009), "it is indispensable for securing a reasonable standard of living, as it fulfils basic human requirements by promoting health, education, employment, and infrastructure development." When assessing whether a particular country is developed or under developed, the country's per capita energy consumption is considered as one of the major determinants as well as being an indicator of the economic development of a nation (Katuwal and Bohara 2009).

Energy plays a significant role in humans' lives; hence it is a key input for meeting basic needs and for achieving social and economic development goals that include, among others, fuel for cooking, heating and lighting in households, power for industry and petroleum products for transportation (Reddy 2011). However, the use of fossil fuel for energy has been proven to be dangerous to human existence (Omer 2008). Thus, developing countries are at present faced with the need to increase their energy production to accelerate development and raise the living standards of their populations, while at the same time reducing energy production costs and

energy-related pollution (Haines et al. 2007). Increasing the efficiency of energy use to reduce its polluting effects and to promote the use of renewable energies must be a priority in any action taken to do this (Kaygusuz 2012). In order to make this happen, the attitude and idea of a "business-as-usual" approach has to change by shifting the current focus on energy supply to an end-use-oriented approach; thus contributing to the attainment of the sustainable human settlements development goals. Concerted action will be required at all levels to incorporate renewable energy sources into the national energy matrix, but success will primarily depend on the abilities of developing countries to support private renewable-energy investors through selective and well-targeted subsidies, fiscal and other forms of incentives and innovative venture capital schemes to speed up the commercialization of renewable energy technologies (Kamat 2007).

Scientific reports have confirmed that renewable energy can alleviate poverty in developing nations by providing the energy needed for creating businesses and employment (Karekezi and Kithyoma 2002). Sustainable renewable energy can be used for various domestic and economic requirements such as cooking, heating and lighting, powering schools and reducing the time that children spend out of school collecting fuel from traditional sources (Cabraal et al. 2005). It can eliminate health problems caused by pollution from burning traditional fuels indoors. It can improve health by providing energy to refrigerate medicine, sterilize medical equipment and to supply fresh water and sewage services needed to reduce infectious disease.

South Africa is a developing country with dual economies which are developed and developing, both of which exist side by side and are reflected in a highly unequal access to socio-economic amenities and services (Klasen 2000). The previously disadvantaged people are still living in abject and chronic poverty despite the demise of the Apartheid government in 1994 (Klasen 2000). Modern energy, especially electricity, is still a luxury despite various efforts of the government to make this available and accessible (Balachandra 2011). Where it is available, the poor are usually unable to afford it because their meagre income is used mainly to purchase basic needs such as food and wood for fuel to heat and cook. Despite the White

Paper on Renewable Energy Policy (May 2004) which announced a government commitment to provision by 2013 of 10 000 GWh of electricity from renewable resources (mainly biomass, wind, solar and small-scale hydro projects)-approximately 4 per cent of the country's estimated electricity demand (Pegels 2010), very little of this is being channelled to the rural, remote locations of the country. To date, there is no statistic stipulating specifically how much of the projected renewable generation based on the White Paper is allocated for rural areas in South Africa. Four out of five people without access to electricity live in rural areas of the developing world (Kanagawa and Nakata 2009) and South Africa is no exception. Saghir (2005:3) asserts that "*this deprivation in energy has enormous impacts on the lives of poor people. Strong links between the energy sector and poverty reduction through income, health, education, gender, and the environment, underscore the importance of the energy sector in social and economic development. They also underscore why it is important that policy makers and developers in the energy sector must work closely with colleagues in other sectors in tackling energy deprivation.*"

Realising that lack of modern energy is exacerbating poverty in the rural areas, even though there is no specific or quantifiable amount of renewable energy electricity to be provided to the rural people in the White paper on Renewable energy, the government is committed to this policy document which is intended to give a much needed thrust to renewable energy, particularly to rural areas. The policy also envisages a range of measures to bring about integration of renewable energies into the mainstream energy economy. This policy has been launched against the background of a massive campaign of electrification in South Africa and a liberalisation of the energy sector including the transformation of the electricity distribution sector into regional and rural electricity distributors. Some of the main benefits of the policy will be the provision of renewable energy for rural communities and remote schools and clinics which are far from the national electricity grid. There will be energy for rural water supply and desalination, and solar passive designed housing and solar water heating for households in urban and rural settings and commercial applications. Large-scale utilisation of renewable energy will

also reduce the emissions of carbon dioxide, thus contributing to an improved environment both locally and worldwide (Dincer 2000). Bradbrook and Gardam (2006) have expressed the same sentiment by accentuating that the poor's priority is to meet and satisfy basic human needs such as jobs, food, health services, education, housing, clean water and sanitation. Energy plays an important role in ensuring delivery of these services (Bradbrook and Gardam 2006). Most of the commissioned scientific reports and opinions by the international community have also confirmed the importance of the use of sustainable renewable energy for delivering energy services to the disadvantaged rural dwellers (Dalal-Clayton and Bass 2002).

For people to enjoy the benefits of sustainable energy development and services these must be provided on a daily basis (Winkler 2006). According to Cherni and Hill (2009) "energy provision is indispensable to the household survival." The provision of modern energy to rural people will increase lighting and power the machines being used for production and, more importantly, free women and children from the burden of collecting firewood (De Janvry and Sadoulet 2000). Confirming the durability and reliability of renewable energy systems, the Greenpeace report (2001) revealed that hundreds of thousands of renewable systems have been installed throughout rural areas of the developing world. All these measures are geared toward the Sustainable Livelihoods Approach (SLA) which "is a way of thinking about the objectives, scope and priorities for development, in order to speed progress in poverty elimination" (Ashley and Carney 1999).

There are health hazards associated with the air pollution produced when women in the rural areas use wood as fuel for cooking and heating. The most serious of these is infant mortality caused by acute respiratory illness associated with the inhalation of wood smoke. This calls for immediate intervention to develop efficient and safe technologies to relieve women from such a burden. The objectives of the Millennium Development Goals (MDGs) which were agreed to at the World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002, will become achievable if there is a substantial increase in modern energy service provision, especially affordable, reliable and adequate electricity. South Africa needs to do more

in this regard. The numerous service delivery protests and the public outrage that usually follows unemployment unrest bears evidence to how disgruntled and unhappy people are with the level of unemployment. If government can provide renewable energy, especially in the rural areas, this might restrain migration to already congested urban cities by people in search of better life. With energy in place, rural people can also engage in virtually all the socio-economics and domestic activities that are available in the cities (Malhotra 2004).

CASE STUDIES AND LESSONS TO BE LEARNT

The world is now shifting towards low carbon growth strategies; consequent upon this, the search for clean energy becomes critical and the backbone of positive change and sustainable economic growth and development (Grübler et al. 1999). Scientific evidence has proved that technological innovations and strategic investments in clean technology increasingly hold the key to many of the promises of a common future for both the developed and developing countries and particularly for vulnerable people living in rural isolated locations (Rao et al. 2010). As part of its effort at greening the rural areas, India has taken up biogas as a national programme for rural areas. As at 2010, more than 4.2 million family size biogas plants which use cow manure as feed material have been installed (Rao et al. 2010). In Nepal, one of the least developed countries in the world, the majority of the people live in scattered remote rural areas and are unable to access modern energy due to low levels of household income. In addition, linking these scattered remote rural areas to the national electricity grid is difficult. However, the government of Nepal has seen this problem as an opportunity to offer a viable solution to the energy needs of the people. Pursuant to this, the government initiated the production and distribution of several renewable technologies and micro-hydropower has become one of the most promising and widely adopted decentralized technologies to distribute electricity in rural areas (Gurung et al. 2011). In Cuba, even though the country continues to enjoy some of the highest and most steadily improving social standards among developing countries, the government is not relenting in pursuit of sustainable energy transformation. Cuba operates a social safety

net for purposes of alleviating poverty and this has translated into the eradication of poverty in the country (Cherni and Hill 2009).

However, the economic crisis of the 1990s brought severe socio-economic problems to the nation and the rise of a noticeable population who were more at risk than the rest, specifically in rural areas. This notwithstanding, the government promptly intervened and built over 200 hydroelectric plants mostly in isolated mountainous regions to power disadvantaged households. Similarly, wind energy was also being developed to add to the renewable energy services (Cherni and Hill 2009). The approaches adopted in these three developing countries to solve energy problems in the rural remote mountainous areas indicates that, with the proper political will, energy solutions can be arrived at that will address the needs and plight of the disadvantaged and vulnerable. Continuous massive investment is the key to the success thereof.

South Africa can learn a lesson from this. It is not enough to act and thereafter stop. This seems to be the approach of South Africa. After the roll out of the solar water systems for heating at the commencement of the democratic dispensation in 1994, there has been a paucity of information on what government is doing to continue to provide sustainable renewable energy to the rural people. It is not surprising that rural people are becoming ingenious at improvising various devices that are connected to the grid electricity in order to illegally tap and use electricity. Even though one can argue that this amounts to criminal activity, it must be recognised that the lack of access to energy and electricity and the inability to afford such services where available are some of the factors that lead to this criminal venture.

PROVIDING SUSTAINABLE RENEWABLE ENERGY IN THE RURAL AREAS

South Africa is a developing country and as such it continues to promote and pursue numerous initiatives that will foster economic growth and improve the standard of living of the people. This will continue to be the main driver of the government's initiatives because, at present, there is huge unemployment and many people who were gainfully employed have lost their

jobs. The fact that South Africa is endowed with fossil fuel in the form of coal makes it a very attractive option for the government to explore and utilise this resource for economic growth. The point is that fossil fuel is not the solution to unemployment because of its impact on the environment. Given that energy is the driver of the economy, there is a need for the country to source it one way or another in order to power industries and other socio-economic amenities and services, particularly in the rural areas. To do this sustainably and reasonably, sustainable energy systems, based on renewable energy resources, offer a wide range of opportunities to protect the environment and create economic growth. According to Visagie and Prasad (2006), "South Africa experiences high levels of solar radiation, with average daily solar radiation of between 4.5 kWh and 6.5 kWh per square metre. This resource is relatively predictable and well distributed throughout the country with some regional variations." The provision of hot water using solar technologies has the benefit of saving households money over the long term and mitigating GHG emissions associated with fossil fuel usage (Visagie and Prasad 2006). SWHs are also the least expensive means of heating water for domestic use on a life cycle cost basis because solar energy is free (Prasad 2007).

It is generally accepted that indigent people living in the rural areas face a major challenge in trying to achieve their development and social obligations because of acute lack of modern energy services (Davidson and Sokona 2002). They lack access to electricity hence they are constrained from engaging in viable and sustainable social economic activities (Mhone 2003). Even though this situation is worrisome and appalling, it presents an opportunity for various role players to find a viable solution to the problem in order to grow the economy, create jobs and be competitive economically. However, the government is aware that many of the poor will not be able to afford to pay for electricity no matter how it is supplied (Mapako and Prahad 2005). This is the reason why government intervened through its policy on free basic services such as water, sanitation and energy to poor households to alleviate energy poverty and, in particular, the electricity affordability problem of the poor (Mapako and Prahad 2005). In this respect the municipalities are tasked with the responsible for the implementation of the Free

Basic Electricity (FBE) policy for both grid and grid connections (Moatshe and Mbecke 2013). The poor benefit as follows, with regard to grid-connected households FBE means that they qualify for a free 50 kWh per month (approximately R18), off-grid electricity users are subsidised with R40 per month towards the R58 monthly service fee (Malzbender 2005). The R40 subsidy for off-grid users is paid directly to the service providers (ESCOs), meaning that households only have to make a cash-payment of R18 per month (Malzbender 2005).

Even though a lot still needs to be done by the South African government regarding access to energy especially for the poor people living in the rural areas, the government has recognised that household access to adequate energy services for cooking, heating, lighting and communication is a basic need. The government has also recognised that without access to electricity, human development potential will be constrained. It is against this backdrop that the government has committed itself to implementing legislative and other measures to realise, progressively, universal household access to electricity especially for the poor.

ENERGY POVERTY ALLEVIATION THROUGH PROVISION OF RENEWABLE ENERGY

Provision and access to electricity in developing countries has proved to be expensive and unrealistic, especially in rural areas (Mulder and Tembe 2008), thereby making it unaffordable to the poor and, as a result, poverty both acute and chronic continues in the rural areas (Urmee et al. 2009). Except where there is an intervention by the government to subsidise energy-electricity supply to the poor in the rural areas, generally speaking, the poor people pay a high price in cash or in labour for the energy they use (Sovacool 2013). The poor earn very meagre incomes and the greater part thereof is spent on domestic needs in the household especially for necessary and important items like energy. At the end of the day, the poor are left with little or no money to meet other needs, thereby becoming poorer. Confirming this assertion, Ahluwalia et al. (1979) state that "poverty is the most fundamental reality of developing countries – and the energy consumption patterns of poor people tend to add to their misery and aggra-

vate their poverty.” Poverty alleviation and development depend on universal access to energy services that are affordable, reliable, and of good quality in order to reduce and eradicate poverty (da Cunha et al. 2007). Energy is considered one of the major necessities to achieve this. This is because with access to modern energy, the poor can venture into any productive endeavours by using energy to power their machines or equipment for small scale enterprises (Savacool 2012). Provision of and access to sustainable energy can help to achieve this and numerous scientific reports from national and international agencies have confirmed that the lot of and standard of living of the rural poor have been improved tremendously (Acker and Kammen 1996). While Ahluwalia et al. (1979) stressed on the need to improve energy infrastructure in order to improve energy services to the indigents by emphasising that “a direct improvement in energy services would allow the poor to enjoy both short-term and long-term advances in living standards” (Ahluwalia et al. 1979:299). Job creation and creating an enabling environment to make people prosper are the major obligations of responsible democratic government; hence by making energy available to the rural poor, the government will be seen to be preventing destitution in democracies comparative to non-democratic regimes. This is why any policy intervention under well-institutionalised democratic politics is essential and can bring benefits to the poor as a whole by increasing their social solidarity at national and local level (Mehta 2003).

South Africa is the most industrialised country on the Africa continent and thus, in times of energy shortages, priority is given to supplying industries. Therefore, in those rural poor areas which are connected to the grid there are instances, particularly in winter when electricity usage is high, when these rural areas will be disconnected in order to allow the industries to continue operation. This is disadvantageous and discriminating to the poor and exacerbates poverty. This is why sustainable renewable energy is the best viable option for the rural disadvantaged people.

The only energy that will meet the needs of the poor and also benefit the environment is energy sources from renewables. The need to mitigate the adverse environmental impacts of fossil fuel usage, the volatility of fuel prices and

the enhancement of national energy security, have largely driven a phenomenal growth, around the world, in renewable energy (RE) generation (particularly grid-connected), over the past two decades (Sebitosi and Pillay 2008).

CONCLUSION

Energy is essential to human beings for various reasons as articulated; however, situations in which some people are excluded because of their social status or their geographical locations undermines numerous international strategic initiatives to make energy accessible. Numerous scientific reports have confirmed that the poor, living in the rural isolated mountainous locations are denied access to energy just because they are not within the mainstream urban centres. This should not be the case. It is therefore incumbent on responsible government to provide access to energy for the rural poor. Considering the fact that fossil fuel is expensive and dangerous to the environment, sustainable renewable energy will meet the energy requirement of the rural poor. What needs to be done is for government to create the infrastructure that will make this possible at a cost affordable to the rural people. To improve both the domestic and economic well-being of rural people, the government can create various incentives and subsidies for renewable energy usage in the rural areas. The benefits of this approach are many; rural people will be able to realise their socio-economic aspirations and venture into productive activities which will add to the gross domestic product, job creation will flourish and people will be productively engaged in the rural areas without necessarily migrating to the urban centres to look for greener pastures. More importantly, this will contribute immensely to emission reduction because green energy as opposed to brown energy will be used to perform these activities.

RECOMMENDATIONS

From all indications, it is important for the government to make sure that something is done to facilitate access to modern energy in the rural remote areas. Renewable energy is considered as the most viable and the best in the circumstance. Also, it is equally important to state that in order to implement this requires massive in-

vestment in infrastructure of all types. Even though the government might subsidise supply for a reasonable time whereby for rural users a moratorium will be placed on payment for energy used for productive ventures, it is desirable that as soon as the livelihoods and standards of the people are substantially improved, there should be an agreed mechanism on how they will start making payments for the use of the infrastructure that is supplying this energy. Consequent upon this, the rural people too will be seen to be performing their responsible civic duty by paying for services provided. Presently, in South Africa, beneficiaries of various renewable energies supplies are reluctant to make any meaningful commitment or contribution to repaying. To them, it is part of the national cake which must be shared and enjoyed. It is important to mention that a service that is delivered on the basis of perpetual gratis, that is freely, is unsustainable. For energy services to be sustainable, requires the involvement of all the parties concerned to act and do their part in order to make it a continuous venture.

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REFERENCES

- Acker RH, Kammen DM 1996. The quiet (energy) revolution: Analysing the dissemination of photovoltaic power systems in Kenya. *Energy Policy*, 24(1): 81-111.
- Ahluwalia MS, Carter NG, Chenery HB 1979. Growth and poverty in developing countries. *Journal of Development Economics*, 6(3): 299-341.
- Ashley C, Carney D 1999. *Sustainable Livelihoods: Lessons from Early Experience*. Nottingham, UK: Russell Press Ltd.
- Balachandra P 2011. Modern energy access to all in rural India: An integrated implementation strategy. *Energy Policy*, 39(12): 7803-7814.
- Bazmi AA, Zahedi G 2011. Sustainable energy systems: Role of optimization modeling techniques in power generation and supply—A review. *Renewable and Sustainable Energy Reviews*, 15(8): 3480-3500.
- Bradbrook AJ, Gardam JG 2006. Placing access to energy services within a human rights framework. *Human Rights Quarterly*, 28(2): 389-415.
- Byrne J, Zhou A, Shen B, Hughes K 2007. Evaluating the potential of small-scale renewable energy options to meet rural livelihoods needs: A GIS- and lifecycle cost-based assessment of Western China's options. *Energy Policy*, 35(8): 4391-4401.
- Cabraal RA, Barnes DF, Agarwal SG 2005. Productive uses of energy for rural development. *Annual Review of Environment and Resources*, 30: 117-144.
- Cherni JA, Hill Y 2009. Energy and policy providing for sustainable rural livelihoods in remote locations – The case of Cuba. *Geoforum*, 40(4): 645-654.
- da Cunha KB, Walter A, Rei F 2007. CDM implementation in Brazil's rural and isolated regions: the Amazonian case. *Climatic Change*, 84(1): 111-129.
- Dalal-Clayton DB, Bass S 2002. *Sustainable Development Strategies: A Resource Book*. London, UK: Earthscan Publications.
- Davidson OR, Sokona Y 2002. [B] *A New Sustainable Energy Path for African Development: Think Bigger Act Faster*. Energy Research Centre, University of Cape Town, Cape Town, South Africa.
- De Janvry A, Sadoulet E 2000. Rural poverty in Latin America: Determinants and exit paths. *Food Policy*, 25: 389-409.
- Dincer I 2000. Renewable energy and sustainable development: A crucial review. *Renewable and Sustainable Energy Reviews*, 4(2): 157-175.
- Frederich VH 2004. The Need for and Contents of a Life Cycle Management Plan for Eskom Transmission Line Servitudes. From <<https://ujdigispace.uj.ac.za/handle/10210/1978>> (Retrieved on 18 May 2013).
- Gaunt CT 2005. Meeting electrification's social objectives in South Africa, and implications for developing countries. *Energy Policy*, 33(10): 1309-1317.
- Greenpeace, 2001. Power to Tackle Poverty – Getting Renewable Energy to the World's Poor. From <<http://www.greenpeace.org/international/en/publications/reports/power-to-tackle-poverty/>> (Retrieved on 3 May 2013).
- Grübler A, Nakiaenovia N, Victor DG 1999. Dynamics of energy technologies and global change. *Energy Policy*, 27(5): 247-280.
- Gurung A, Gurung OP, Oh SA 2011. The potential of a renewable energy technology for rural electrification in Nepal: A case study from Tangting. *Renewable Energy*, 36: 3203-3210.
- Haines A, Epstein PR, McMichael AJ, Roberts I, Wilkinson P, Woodcock J, Woods J 2007. Policies for accelerating access to clean energy, improving health, advancing development, and mitigating climate change. *The Lancet*, 370(9594): 1264-1281.
- Kamat P 2007. Meeting the clean energy demand: Nanostructure architectures for solar energy conversion. *Journal of Physics Chemistry*, 111(7): 2834-2860.
- Kanagawa M, Nakata T 2009. Assessment of access to electricity and the socio-economic impacts in rural areas of developing countries. *Energy Policy*, 36(6): 2016-2029.
- Karakosta C, Doukas H, Psarras J 2010. Technology transfer through climate change: Setting a sustainable energy pattern. *Renewable and Sustainable Energy Reviews*, 14(6): 1546-1557.

- Karekezi S, Kithyoma W 2002. Renewable energy strategies for rural Africa: Is a PV-led renewable energy strategy the right approach for providing modern energy to the rural poor of sub-Saharan Africa? *Energy Policy*, 30(12): 1071-1086.
- Katuwal H, Bohara AK 2009. Biogas: A promising renewable technology and its impact on rural households in Nepal. *Renewable and Sustainable Energy Reviews*, 13: 2668-2674.
- Kaygusuz K 2012. Energy for sustainable development: A case of developing countries. *Renewable and Sustainable Energy Reviews*, 16(2): 1116-1126.
- Klasen S 2000. Measuring poverty and deprivation in South Africa. *Review of Income and Wealth*, 46: 33-58.
- Malhotra P, Neudoerffer RC, Dutta S 2004. A participatory process for designing cooking energy programmes with women. *Biomass and Bioenergy*, 26(2): 147-169.
- Malzbender D 2005. *Domestic Electricity Provision in the Democratic South Africa*. Pretoria, South Africa: University of Pretoria Press.
- Mapako M, Prasad G 2005. The Free Basic Electricity (FBE) Policy and Rural Grid-connected Households, Solar Home Systems (SHS) Users and Unelectrified Households. *Paper presented at the Domestic Use of Energy Conference*, Energy Research Centre, 29-31 March 2005, University of Cape Town, Cape Town, South Africa. [PDF]
- Mehta AK 2003. Chronic poverty in India: Incidence, causes and policies. *World Development*, 31(3): 491-511.
- Mhone G 2003. Democratisation, economic liberalisation and the quest for sustainable development in South Africa. In: Omano Edigheji, Guy Mhone (Eds.): *Governance in the New South Africa: The Challenges of Globalisation*. Cape Town, South Africa: University of Cape Town Press, pp. 18-67.
- Moatshe BH, Mbecke P 2013. The provision of basic services through indigent grants, is it equitable and sustainable in South Africa? *OIDA International Journal of Sustainable Development*, 5(9): 55-68.
- Mulder P, Tembe J 2008. Rural electrification in an imperfect world: A case study from Mozambique. *Energy Policy*, 36: 2785-2794.
- Omer AM 2008. Energy, environment and sustainable development. *Renewable and Sustainable Energy Reviews*, 12(9): 2265-2300.
- Pegels A 2010. Renewable energy in South Africa: Potentials, barriers and options for support. *Energy Policy*, 38(9): 4945-4954.
- Prasad G 2007. *Electricity from Solar Home Systems in South Africa*. Energy Research Centre, University of Cape Town, Cape Town, South Africa.
- Rao PV, Baral SS, Dey R, Mutnuri S 2010. Biogas generation potential by anaerobic digestion for sustainable energy development in India. *Renewable and Sustainable Energy Reviews*, 14(7): 2086-2094.
- Reddy AKN 1991. Barriers to improvements in energy efficiency. *Energy Policy*, 19(10): 953-961.
- Reddy AKN 2011. The potential of a renewable energy technology for rural electrification in Nepal: A case study from Tangting. *Energy and Social Issues*, 36: 3203-3210.
- Reddy AM, Williams RH, Johansson TB 1997. *Energy After Rio: Prospects and Challenges*. New York, USA: United Nations Publications.
- Sagar AD 2005. Alleviating energy poverty for the world's poor. *Energy Policy*, 33(11): 1367-1372.
- Saghir J 2005. Energy and Poverty: Myths, Links, and Policy. Energy Working Notes No. 4. Energy and Mining Sector Board of the World Bank Group, Washington, USA. From <<http://siteresources.worldbank.org/intenergy/resources/energyworkingnotes>> (Retrieved on 18 July 2013).
- Sebitosi AB, Pillay P 2008. Renewable energy and the environment in South Africa: A way forward. *Energy Policy*, 36: 3312-3316.
- Shabangu S 2003. *White Paper on the Renewable Energy Policy of the Republic of South Africa*. Pretoria, South Africa: South Africa Government Press.
- Sovacool BK 2012. Expanding renewable energy access with pro-poor public private partnerships in the developing world. *Energy Strategy Reviews*, 1(3): 181-192.
- Swilling M 2006. Sustainability and infrastructure planning in South Africa: A Cape Town case study. *Environment and Urbanization*, 18(1): 23-50.
- Tobing HLY, Boele N, Merson J, Prasad DK 2011. Renewable Energy Financing by Financial Institutions. Solar2011, the 49th AuSES Annual Conference, Sydney, Australia. From <http://solar.org.au/papers/11papers/11_34_Tobing.pdf> (Retrieved on 1 June 2013).
- Urmee T, Harries D, Schlapfer A 2009. Issues related to rural electrification using renewable energy in developing countries of Asia and Pacific. *Renewable Energy*, 34: 354-357.
- Visagie E, Prasad G 2006. *Renewable Energy Technologies for Poverty Alleviation South Africa: Bio Diesel and Solar Water Heaters*. Energy Research Centre, University of Cape Town, Cape Town, South Africa.
- Wazed MA, Ahmed S 2009. A feasibility study of micro-hydroelectric power generation at Sapchari Waterfall, Khagrachari, Bangladesh. *Journal of Applied Sciences*, 9: 372-376.
- Winkler H 2006. *Energy Policies for Sustainable Development in South Africa's Residential and Electricity Sectors*. Energy Research Centre, University of Cape Town, Cape Town, South Africa. [PDF].