

Development and Energy in Africa (DEA) project A case for Botswana

1.0 INTRODUCTION

1.1 Purpose of this paper

The paper presents an overview of development and energy in Botswana and discusses some energy interventions that have been carried out that might have had some positive impact on development in the country. Development here covers economic, social and environmental achievements that would result in better quality of life for Botswana. There is importance in understanding how energy affects economic development and communities in this case the poor and what decision makers such as government officials should do to ensure the energy needs and hence welfare of the poor are met without endangering the environment. This is with the recognition that access to energy (particularly modern energy) is an essential, though not sufficient, input in the process of development and poverty alleviation.

This is analysed in the context of the project Development and Energy in Africa (DEA) that is being funded under the European Commission's Intelligent Energy-Europe programme COOPENER and co-funded by the Danish International Development Agency (DANIDA).

1.2 Short introduction to the DEA project

DEA aims to support decision makers with the implementation of more sustainable energy policies in line with the key action VKA 11.1 of the COOPENER programme. The project identifies and quantifies where possible the elements of concrete energy interventions that contribute to sustainable development and systemizing this in an Assessment Framework which can enhance policy to promote energy for sustainable development.

The principal aims of the DEA project are (i) to identify and examine the developmental impacts of energy interventions linked to improving energy access and poverty alleviation and (ii) to use the information and insights gained to improve on-going and future energy interventions by energy policymakers and institutions in six Sub-Saharan African countries: Botswana, Ghana, Mali, Senegal, Tanzania and Zambia.

An energy intervention is here defined as an explicit project, policy or innovation – either technological or institutional – that affects energy demand and/or supply in a country. Better understanding of development-poverty-energy linkages, and its embodiment in an operational tool, can facilitate better planning toward energy interventions with higher development and poverty alleviation outcomes.

Box 1 summarises the overall and immediate objectives of DEA.

Box 1 Overall and Specific Objectives of The DEA Project

The overall objectives of the project are:

- that national energy policy is better informed to take into account the complex linkages between energy interventions and social and economic development, and
- that energy interventions are better designed to contribute to real development needs, especially poverty alleviation and income generation, and otherwise achieving the Millennium Development Goals.

The immediate objectives of DEA are:

- to establish and apply an Assessment Framework for evaluating development and poverty impacts of energy interventions, and
- to engage in a dialogue with energy policy makers and other stakeholders on the basis of the framework, with a view to incorporating these issues in energy policy.

1.2 Short introduction to DEA partner in the respective country

EECG is the DEA partner for Botswana and was registered in Botswana in 1993 as an energy research and consultancy organization. EECG has undertaken several energy projects for Governments (Botswana, Lesotho, South Africa and Zimbabwe; Ethiopia, Uganda, Ghana, The Gambia), multilateral organizations (World Bank, African Development Bank, EU/EC, United Nations Organizations (UNDP, UNEP, UN habitat; UNFCCC, UNFAO, IHDP); bilateral organizations (DANIDA; GTZ ;Sida USAID); utilities (Eskom and Botswana Power Corporation) and private organizations

EECG has also on several occasions collaborated in projects with Risoe National Laboratory of Denmark that is the lead organization for this DEA project.

EECG has special skills in energy policy analysis and development; energy planning, project evaluation, analysing energy reforms for the poor, analysing public-private partnerships in energy development. The organization has experience in doing energy projects related to most economic sectors-particularly water, agriculture, industry, transport, and power sectors.

In this DEA project EECG will be involved in the:

- Literature review that will feed into the development of the Preliminary Assessment Framework
- Contribute to the developing of catalogue energy interventions in Botswana that can be showcased and be used to test the Framework.
- Botswana stakeholder consultations on their requirements from this project and their inputs into the development of the Framework.

2.0 COUNTRY DEVELOPMENT AND ENERGY STATUS

2.1 Major challenges in relation to poverty reduction and development.

Botswana economy is largely still dominated by a non-renewable commodity-diamond in spite of efforts of the past 2 decades to diversify the economy. Diamonds earn 95% of foreign earnings and constitute 50% of Government revenue and 33% of GDP. Agriculture has declined from 50% of GDP in 1966 to 2.4% to date. Although agriculture makes such a low contribution it still remains important to the rural population. Economic diversification still remains an important national development goal.

2002/03 National statistics indicated an annual real growth in GDP of 5.03 per cent.¹ An encouraging development has been that while the mining sector especially diamonds was primarily responsible for this growth, non-mining GDP grew at an average 5.52 per annum over the same period. To eradicate poverty it is recognized that Botswana GDP growth rate must be 8% and investment should be at least 41% of GDP while now it is 32% of GDP.

Unemployment is on the high side and stands at 23.8% mostly affecting the age group between 15-29 yrs- who are the youth of the country.

HIV/AIDS is posing a challenge to the Government with an infection rate of 17% and has diverted a significant share of the national budget that could have been devoted to development where employment could be created.

Recent surveys have shown that there is a significant share of the population that lives below the poverty datum line (US\$1.23/day) of 37% in 2001. The figure is however declining from 47% in 1993/94 and 59% in 1985/86.

Lack of income (attributed to lack of employment, insufficient income earning opportunities and the low potential of traditional agriculture) is considered the major and immediate cause of poverty. Poverty is mostly associated with rural areas where incomes are low. Thus in energy terms people in rural areas suffer most from lack of access to energy. Recent data on Botswana (UNDP, 2002) support that poverty is higher and more severe in rural areas than in urban areas. Gender analysis of household income data shows that female-headed households are amongst the poorest in both rural and urban Botswana (EDRC/EDG/FAB, 2001).

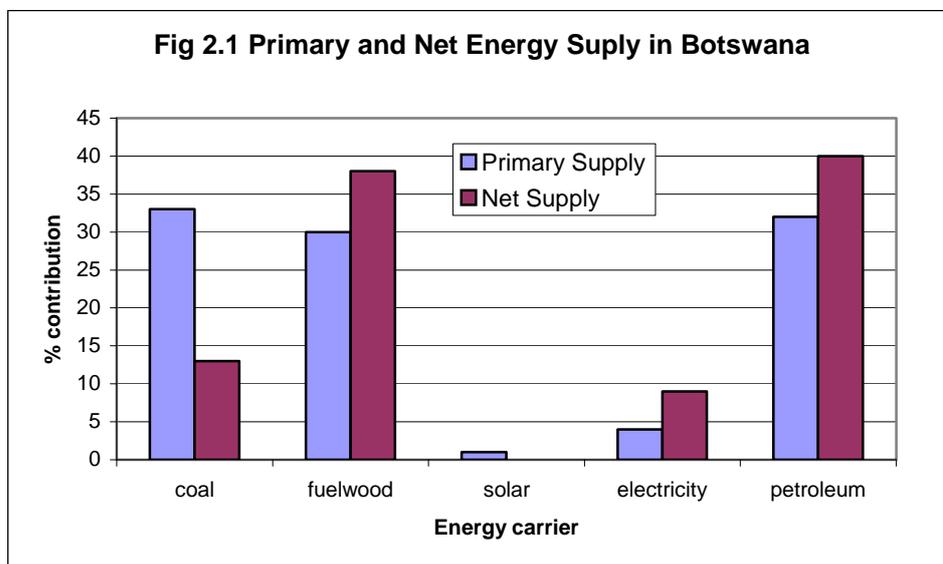
¹ Report on the Consultancy for the Review of the Revised National Policy on Incomes, Employment, Prices and Profits of 1990, Page 9

2.2 Brief description of the energy situation

2.2.1 Overview of the Energy Sector

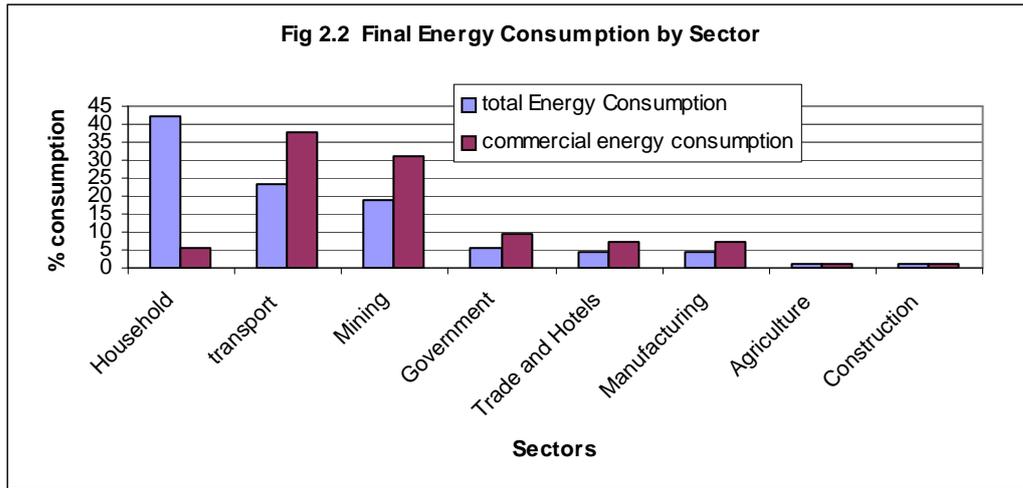
Botswana is endowed with biomass (mainly fuelwood), coal and solar energy sources. All petroleum products are imported. There is also small potential for wind energy and waste as energy source.

Coal is contributing the largest share of the primary energy supply followed by petroleum products and wood (Fig 2.1). Electricity primary supply is contributed in the form of imports. With the exception of fuel-wood, new and renewable energy sources are hardly used and solar, despite Government policy to promote it still contributes less than 1% to total Primary Energy Supply (Botswana Energy Statistics, DOE, 2002).



The net energy supply in the formal sector is dominated by petroleum products and wood followed by coal and then locally generated and imported electricity.

A similar pattern is maintained in the final energy consumption. Considering all energy sources used in Botswana, the household sector is still the largest consumer of energy when considering all sources of energy. The second largest is transport followed by mining. Government, Trade and Hotels and Manufacturing have similar consumption levels (Fig 2.2).

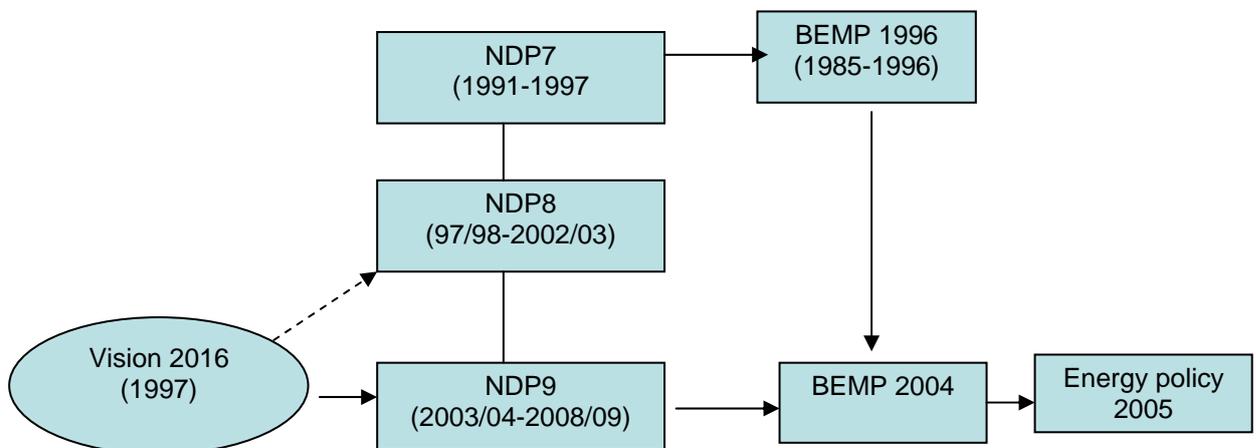


When only considering the commercial energy sources (i.e. excluding fuel-wood), the transport sector is the largest energy consumer followed by mining, Government, Trade and Hotels and Manufacturing. Household contribution to final energy consumption drops from 42% to 5.5% indicating its predominant dependence on fuel-wood. The Agricultural and Construction sectors consume the least- whether in terms of commercial energy sources or including fuel-wood.

2.2.2 Energy policy and implementation

The development of the energy policy in Botswana, like in other countries is guided by national development goals and these in the case of Botswana are stipulated in Vision 2016 and the National Development Plans. The Botswana Energy Master Plan contains energy policies that address contemporary development issues. The linkages of the Vision, Plans and BEMP and the energy policy are illustrated in Fig 2.1.

Fig 2.1 Energy Policy Framework for Botswana



Specific policy objectives stipulated in the current National Development Plan (NDP9) that might impact on the poor are as follows:

- Increase access to electricity and make it more affordable (*electrification of urban poor and continuation of rural electrification; continuation of RCS & Solar electrification finance scheme*)
- Ensure adequate supplies of fuelwood (*promotion of sustainable fuelwood management practices and appropriate combustion equipment; community management of natural resources*)
- Beneficiate coal and make it accessible and affordable
- Ensure the availability of appropriate energy sources to meet household needs and promote rational least cost choices (*Supporting introduction and use of other fuels and appliances; dissemination of information on available energy sources and use*)
- *Ensure adequate and affordable supplies of paraffin and LPG.*

The Botswana Energy Master Plan 2004 among other things emphasizes Rural Electrification using both grid and solar energy.

Botswana aims to achieve a balance between the import of electricity from the southern African power pool and its local generation. To date, the ratio of local electricity generation to import was 30:70 and the aim is to shift to 30:70. Such dependence on external sources makes Botswana insecure in terms of supply.

Responding to Vision 2016, BEMP seeks to translate the tremendous potential for solar energy to make Botswana a country of excellence in solar energy technology.

There is a policy to exploit Botswana's large coal reserves and apply coal beneficiation to improve the quality of coal for domestic, commercial and industrial use.

There is Government support for coal bed methane exploration and exploitation in the coalfields of Botswana. Coal bed methane is seen to have potential as an energy source in the power, industry, domestic and transport sectors.

2.3 Developmental Policies

Other development policies to consider in the context of energy and development are the Industrial Development Policy, the Revised Rural Development Policy, the National Master Plan on Arable Agriculture and Dairy Development (NAMPAADD), the National Water Master Plan and National Master Plan on Wastewater and Sanitation and the Forestry Policy.

The Industrial Development Policy promotes expansion of efficient support services and component manufacturers in the SMEs category including small-scale rural entrepreneurs.

The Revised National Policy for Rural Development provides for exploiting opportunities for enterprise building in rural areas availing productive resources, employment and other opportunities in rural areas to both male and female-headed households. Diversification from communal rain-fed agriculture based on current practices is promoted to improve rural incomes and hence alleviate/eradicate poverty.

NAMPAADD introduces a business-oriented scheme for agriculture compared to past schemes that were welfare oriented. Large farms of 150-1000 ha which can utilize mechanized equipment and new technologies are being proposed for the plan.

With respect to water, Botswana, as part of its National Water Master Plan would like to enhance water conservation and demand management. On the supply side opportunities for rainwater and run-off capturing are seen as means that could complement the conventional surface and groundwater resources.

The overall objective of the Master Plan is to evaluate the current scenario on wastewater generation and disposal, on site sanitation facilities, and their impact on the environment, and to develop planning and implementation strategies for regulating the generation, collection and disposal of wastewater in an environmentally friendly and acceptable manner.

3.0 ALIGNMENT TO DEVELOPMENT GOALS

3.1 Rural development Imperatives for Botswana

Consultation with development stakeholders in Botswana revealed that energy is well understood as a facilitator for both development and improving quality of life of people in rural areas.

In the rural context, the prevalent use of traditional fuels such as fuelwood is considered a threat to health through indoor air pollution and is a contributor to depletion of woody resources. This calls for alternative energy sources to alleviate the situation.

The stakeholders also view that transformation from backwardness in rural areas could be achieved among other factors through application of ICT facilities such as radios, televisions, telephones and computers as means of information dissemination and accessing information for informed decisions and improved performance.

Provision of modern energy sources in government institutions for lighting, water heating and powering of appliances facilitates delivery of services particularly in education, police and telecommunications centres/locations.

Energy in the rural areas is associated with saving of lives by powering the necessary clinic/hospital equipment e.g. in maternity wards and operating rooms where uninterrupted energy is needed thus reducing maternal mortality rates.

Energy is realized as crucial in improving productivity and efficiency. For instance rural water supply in Botswana being mostly of underground type requires energy for pumping and distribution. The use and maintenance of diesel engines is recognized as limited in capacity and expensive thus alternative sources of energy for such purpose are required.

Energy supply through the grid as part of Rural Electrification increases economies of scale in rural development sectors, which small supplies such as diesel generators cannot achieve due to their small-scale capacities.

The stakeholders however realize the threats posed by turbulence in fuel prices considering that all oil products are imported and the high electricity imports now standing at 70%.

In overall terms, energy is seen as creating opportunities for development in rural areas particularly for the youths and for community participation, reducing drudgery and adding value to rural products if they can be processed.

3.2 Achieving Millennium Development Goals

Box 2 presents the MDGs that are closely related to energy. Energy presents a number of opportunities to contribute to achievement of these MDGs as discussed below.

Box 2 Millennium Development Goals (MDG) with direct energy implications and target date of 2015 - Source DFID, 2002

- To halve population with extreme poverty and hunger
- To reduce hunger and improve access to safe drinking water
- To reduce child and maternal mortality and to reduce diseases
- To achieve universal primary education and to promote gender equality and empowerment of women
- Environmental sustainability
- Combat HIV/AIDS
- Develop a global partnership for development (same source)

In relation to poverty reduction, energy for cooking food, boiling dirty water, water pumping and treatment for drinking and food production can reduce hunger and improve access to safe drinking water.

Both grid and solar photovoltaic electricity and LPG/kerosene can be used to provide uninterrupted light, power for medical equipment and refrigeration of medicines. Solar water heaters are also used to provide hot water that is often required in health facilities. All these contribute to reducing maternal mortality rates and reduce incidences of diseases.

Provision of adequate energy services can reduce the time spent by women and children gathering energy fuels e.g. fuel wood, availing time for studying and access to information. In rural areas within Botswana women and children (particularly the girl child) have responsibility to collect fuel wood, fetch water, prepare meals and

tender the fields. Energy services that can lessen their burden will give them opportunities as their male counterparts e.g. to study and socialize. Providing lighting at rural schools has tremendous positive impact in the education sector.

The improved use of efficient and cleaner energy alternatives will achieve sustainable use of energy resources and improve health and natural environment. There is a general agreement that indoor air pollution resulting from traditional use of biomass is way above the WHO limits and is associated with deaths in children under the age of five-who are normally carried on their mother's backs while cooking. Reducing excessive use of fuelwood would also contribute to environmental sustainability.

Providing energy for use of ICT equipment contributes to combating spread of HIV/AIDS through propagation of information. Both home and health centre care for HIV/AIDS sufferers is also facilitated by use of modern energy

Box 3 presents how provision of adequate energy particularly modern energy would contribute to a number of global initiatives to combat poverty.

Box 3 Alignment of providing modern energy services and eradication of poverty and global initiatives

Improved energy service delivery to the poor is also in line with NEPAD agenda that has as its objectives- eradication of poverty, putting Africa on a sustainable growth and development path, and promoting the role of women in all activities. The WSSD of 2002 held in Johannesburg recognized energy as a driver behind MDGs and as a means to achieve poverty reduction, provide access to health, education, wealth and prosperity. The summit put emphasis on renewable energy as key in supporting sustainable development. The GVEP that was born out of the WSSD seeks to reduce poverty and enhance sustainable development through accelerated provision of modern energy services to those unserved or underserved. The PRSP concentrated in strengthening public action on alleviating poverty including specific national poverty reduction objectives and MDGs but initially ignored the importance of energy as a priority in PRSP and this is being revised. The importance of delivering adequate and reliable modern energy services to reduce poverty is widely accepted and is among SADC priorities to reduce poverty in the region, that is the pinnacles of the SADC Treaty and the Regional Indicative Development Strategic Plan (RIDSP).

In relation to meeting the MDGs, Botswana has made significant strides in providing rural electrification, providing telecommunications facilities, increasing access to safe drinking water, access to health centres and in education.

Some of the statistics available show that over 97% of Botswana have access to safe drinking water; 88% are within 15km of a health centre. Over 90% of children have access to primary education, 70% to JC Education and 51% to senior secondary (O-level).

4.0 ENERGY INTERVENTIONS IN BOTSWANA

4.1 Indicators on impacts of energy interventions

It is not easy to directly link an energy intervention with poverty alleviation. It will therefore be useful to develop proxies that would point to impacts on development and poverty alleviation.

There are a number of indicators that energy practitioners would use to examine if the objectives of a project have been met.

For instance if a energy project aims to electrify a village- the number of those with access to electricity by the end of the project are an indication of the project impact. There is an assumption that the electricity is used and eventually contributes to better welfare. There are also many ways the electricity could contribute to welfare e.g. use for ICT appliances, lighting for reading/studying or extending the day for income generating activities such as hair plating, sewing etc.

Some projects may create direct employment, e.g. introduction of a solar lantern could create people that market the lantern, sell and service the lantern.

If an energy intervention is applied in a development sector such as water pumping, the number served from the water facility could be a good indicator. The water will contribute in various ways- through safe drinking water, reducing drudgery of getting water from wells and hand pumps or production use.

In health, the impact of an energy intervention that works with equipment for awareness creation could be presented as people reached by the campaign.

Interventions could also have temporary, long term and spill over impacts e.g. employment during the life of the project is temporary, while employment in an established system e.g. mini-grid that continues to supply energy could be long term. Spill over could be business created upstream or down stream of the established system e.g. supplying spares. A clear combination of the development impacts (direct, indirect, short term, long term etc) ought to be established in the case of the Assessment Framework.

Table 4.1 indicates some thoughts on type of indicators that could be used.

Table 4.1 Possible Indicators for Impact assessment of Energy Interventions

Development sector	Possible Indicator	Development aspect
Energy	Additional access to energy type resulting from project	Clean and productive use
Water	Additional supplied	Safe drinking/productive use
Health	No reached or treated	Improved health
Agriculture	Improved yield	Food security/productive nation
Telecommunications	No connected/reached	Informed decisions
Education	No benefited e.g. from class lighting	Better education quality and educated nation
Wild Life/Tourism	New sites opened and No. Attracted to sites	Community/national income improved
Forestry	Quantity of products e.g. poles, fuelwood	Avoided deforestation Added building and energy resource

Often the impacts are realized if monitoring and evaluation is made part of project otherwise the impacts may not easily be recognized.

A select of energy interventions that have been carried out in Botswana are presented below with some indicators of their impacts (Table 4.2).

4.2 Examples of Energy Interventions implemented in Botswana

The selection of energy interventions has drawn from the energy specific policy objectives (NDP9) that relate to addressing energy for the poor, namely rural electrification, promoting sustainable fuelwood use through planting wood biomass and using alternative energy sources (coal and LPG), ensuring adequate and affordable supplies of paraffin and LPG, and availing least cost energy choices.

4.2.1 Rural Electrification

Under Rural electrification, both grid and a number of PV electrification interventions that have been carried out in Botswana have been considered.

Rural Electrification Collective Scheme (RCS)

The RCS is a financing policy that assists rural customers in form of a loan to reduce the burden of up-front costs of connecting to the grid. Potential consumers form groups of 4 or more customers when applying for connection to benefit from economies of scale i.e. share cost of extending the grid closer to their premises. This loan scheme requires potential grid electricity consumers to pay a deposit and make repayments over a period. The Scheme began in 1988 and has undergone several phases and modification with regard to deposits, repayment periods and loan interest rates (refer to Table 4.3).

Table4.2 – Examples of Energy Interventions Implemented in Botswana and their Impact on development

Policy Objective	Project/intervention	Type of Intervention	Target group	Initiator	Coverage	Application	Budget Pula	Spent Pula	Funder	Executor	Achievements	Development Impact
Rural Electrification	Rural Electrification Collective Scheme 1997-2001	Financing Policy	Rural and urban village consumers	EAD/BPC	Countrywide	Loan scheme for grid connections	?	?	Govt	BPC	Many households connected to grid	Infrastructure development Modern energy propagation
	Botswana National PV Rural Electrification Programme (NPVREP)	Financing policy for PV electrification	Rural 8 out of 10 districts reached	EAD	Countrywide	Solar home systems (43kW)	5.47million	3.34million	Govt	RIPCO	309 systems sold (43kWp) for lighting, appliances	Bars extended operation chicken farming Home quality life
	JICA Master Plan	Pilot project with fee for service financing	Rural villages	JICA/EAD	3 villages	SHS and Battery Charging systems	?	?	JICA/Govt	UNICO and Electric Power Dev. Of Japan	114 SHS systems and 41 battery beneficiaries	Quality home life
	Motshegaletau Central PV	Pilot Mini grid on fee for service	Rural village	BOTEC	1 village	Centralized PV system (5.7kW)		400,000.00	Govt	BOTEC and BPC	9h/hs, clinic a primary school, a bar connected	Options for rural electrification
	Suntainers	Mini-grids for remote Govt Institutions	Rural villages	MLG	3 villages	Hybrid-PV and diesel		500000/set	Govt	Solar International	3 suntainers distributed to MLG institutions	Rural transformation
	Solar Lantern and battery Lease Scheme	New PV tech on high purchase/rent to own	Rural Households	Solar International/ECN	4 villages in Central District	100 PV lanterns	186000 GEF	370769 Additional by ECN	GEF small grants and ECN	Solar International & village councils, Serowe North Dev Trust	109 lanterns distributed Community organization Training for service Rent to own financial mechanism	Improved quality of light, health, business opportunities in light.

											tested	
Sustainable Fuelwood Use and coal uptake	Alternative Energy Use	Fuelwood substitution policy in govt	Institutions & households	Govt/EAD	Countrywide	Promote use of coal, and coal beneficiation	?	?	Govt	Govt	Clean coal and reduced fuelwood use Larger LPG market 4%-40%	Improved coal and LPG markets
	Community Woodlots	Community afforestation projects	Rural communities	Min of Agriculture	Countrywide	Community Tree planting	?	?	Govt supported	Woodlot members with NGO and Govt support	Some wood products e.g. for poles	Additional woody resources and environmental preservation
Affordable Paraffin and LPG Supplies	LPG Propagation	Entrepreneur development	Small LPG distributors	LPG suppliers	Countrywide	Supporting LPG distributors	?	?	LPG industry	LPG industry	Many LPG distributors	Income generating and create employment
-Least Cost Choices-Efficient use of energy	Energy Conservation in households	Awareness building	Households	Somarelang Tikologo	10 households Gaborone	Educate on energy savings and CFL use	250000	189000	UNDP	ST with BOTEK as consultant	20% energy saved	Cost savings going to other required goods and services

Table 4.3 Evolution of the RCS

Year	Deposit (%)	Balance (%)	Repayment Period (years)	Interest rate %
1990	40	60	10	8
1995	10	90	10	9
1997 (standard costing introduced)	10	90	10	9
2000	5	95	15	Prime+0.5

Fig 4.1 below shows the response of the changes made to the RCS, indicated by the increases in percentage of rural households/customers that connected to the grid in 1996 and 2000.

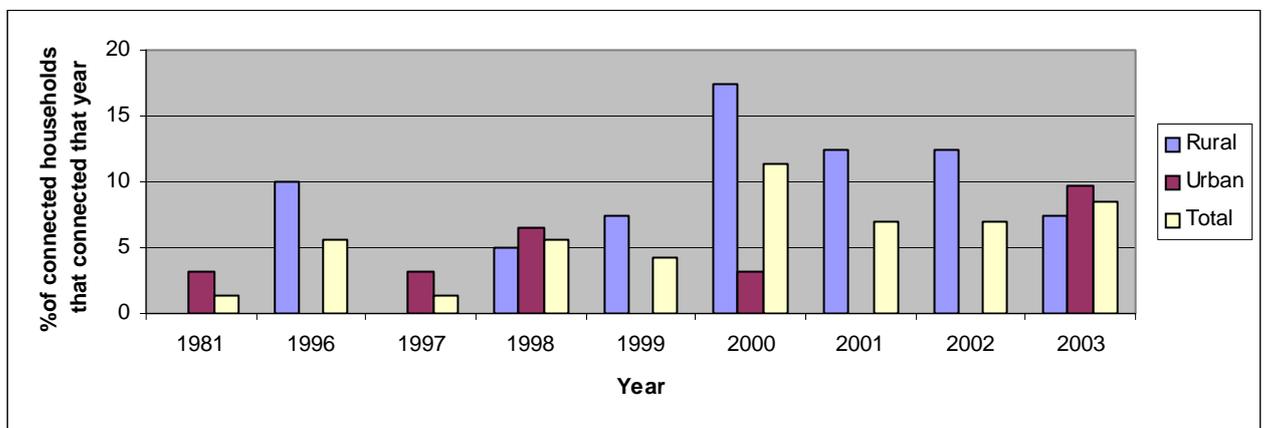


Fig 4.1 Rate of household connections by year for rural and urban households.

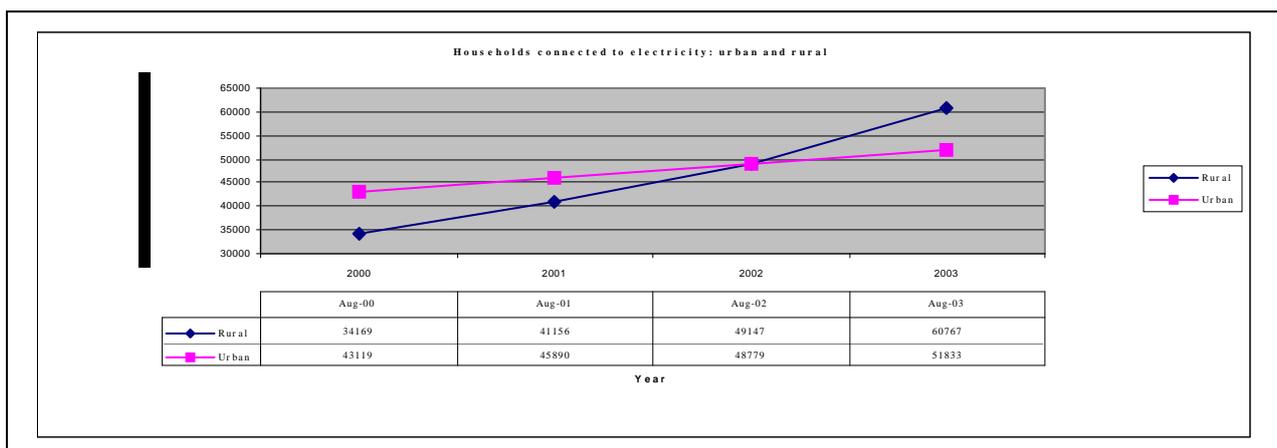


Fig. 4.2: Graph of electricity connection in rural and urban areas 2

It is also clear that rural electrification started acceleration after the 2000 policy adjustments to overtake rate of urban electrification (Fig 4.2).

However, despite all these encouraging gains, the poorest of rural consumers cannot afford connections. Even for those connected; loan repayments have been jeopardized by high default rates by consumers.

National PV Rural Electrification Programme

The loan scheme for the NPVREP was less attractive than for the grid as shown in Table 4.4

Table 4.4 Conditions of NPVREP loan scheme

Year	Deposit (%)	Balance (%)	Period (years)	Interest rate %
1997 (standard costing introduced)	15	85	4	Prime rate

Development benefits that were realized from both the Manyana Pilot Project and NPVREP are additional households doing more reading at night, school children performing better in school and households earning more income e.g. through plating of hair and sewing at night. The PV technology started appealing to potential consumers.

However, because incomes of most rural households are very low at worst or seasonal in nature at best, many could not afford the installations. The financial status in 2001 of the programme is as shown in Table 4.5.

Table 4.5 Photovoltaic System Uptake and Financial Status of Project in 2001

No of clients	Status	Disbursed Amount (Pula)	Budgeted Amount (Pula)
261	Active	2 834 301	
25	Repossessed systems	203 650	
16	Completed payments	154 588	
7	Deceased	143 951	
TOTAL		3 340 489	5 472 650

Source: NPVREP Report, 2001 & RIIC pers. comm. (2005)

The setback for NPVREP was that it was implemented in competition with RCS, which has more favourable loan scheme. The grid also provides a larger energy service than PV electrification. Hence the full loan committed to NPVREP was not obligated and collection of repayments is still incomplete. The setback is more institutional than technical with respect to administration of the project. With respect

to organization involved in PV consensus has been reached to allocate responsibility for both grid and PV rural electrification to the Botswana Power Corporation.

The programme was terminated in 2002 due to its economic unsustainability, although alternative institutional options of implementation are being considered. Since the end of the NPVREP in 2001, there has been no established financing scheme for PV systems in the country and financial institutions have not started financing energy projects. This was the expectation if the PV market was well established.

JICA Master Plan Project

Following a socio-economic survey in 10 villages in Botswana, JICA financed installation of PV solar home systems and battery charging stations in three rural villages of Kudumatse (Central- Mahalapye), Lorolwana (South District) and Mothlabaneng (Bobonong- Sub District). Botswana Power Corporation (BPC) was the implementing agency and the systems installed and current status of the deployed systems are as in Table 4.6.

Table 4.6 Status Of Systems installed On The PV Dissemination Project - August 2005

System Size	Kudumatse			Lorolwana			Mothlabaneng		
	Initial	Repossessed	Present	Initial	Repossessed	Present	Initial	Repossessed	Present
50Wp	30	8	22	35	21	14	23	5	18
100Wp	7	1	6	4	4	0	7	1	6
150Wp	2	1	1	1	0	1	1	0	1
200Wp	1	1	0	-	-	-	-	-	-
250Wp	-	-	-	-	-	-	3	0	3
Total	40	11	29	40	25	15	34	6	28
				Initial	Repossessed	Present			
Battery Charging at Lorolwana				41	17	24			

Both service technicians and repayment collectors were engaged in the project- being a form of employment.

Although this project made an incremental impact to uptake of PV electrification in rural Botswana about 40% of those who had initially benefited could sustain the repayments and their systems were repossessed (Table 4.6). The project is due for closure and more systems are still to be repossessed for the same reason.

Motshegaletau Centralized PV Systems

The Motshegaletau solar mini-grid of 5.7 kW was installed in 1998 and after one year of operation, ownership of the project was passed to the Central District Council (CDC), a government local authority that now acts as the service provider. Consumers are on a fee-for-service scheme. Customers wired their houses and paid a Pula 500 (90 \$) connection fee. The tariff charged is the same as that for grid

electricity, which is about 6 c/kWh for the domestic sector. This is a subsidy to allow the technology to ‘take-off’, otherwise the tariff would have been much higher. The Motshegaletau project has demonstrated the technical feasibility of solar PV mini-grid systems in Botswana but would need to be planned with grid and Solar home system projects in an integrated manner. To date, the grid has also reached the same village and consumers would probably prefer to connect to the grid in order to benefit from larger energy capacity.

PV Lantern Project

Over 100 solar lanterns were distributed through this project on rent to buy or high purchase (deposit and monthly installments). Indications of technology failure in some 30% of the lantern systems were established. It was also established that some of the household were not using the lanterns as often as planned in the project- about half to 1 hour per day averaged over all the systems. This could be a cultural acceptance problem.

The institutional arrangement using the Serowe North Development Trust worked well for distributing the lanterns because of their regular presence in the project area. For financial viable operation of a project in which users pay the actual costs of the lanterns, a well-organised system of fee collection, administration and after sales service is required. Currently, financial records are incomplete, incentives for fee collection at village level seem insufficient and the organisation’s response to complaints of users is slow or absent.

Many users are behind with instalment payments, probably due to insufficient encouragement to pay instalments and bad financial administration by the responsible people in the villages although the majority of the users have a disposable income of more than P800 per month.

Potential cost savings due to diminishing purchases of paraffin, candles, and torch batteries and reduced charging of car batteries by solar lantern users, are approximately P30 per month and this saving could be used for other household needs and constitute an income.

Suntainers²

The Ministry of Local Government has installed solar PV off-grid mini-grids in some instances hybrid with diesel generator sets. An example of where these have been tried in Botswana is the Rural Area Dwellers Programme in the following areas.

Central District Council: Mokgenene 52 km West of Dibete and Khwee 60 km SSW of Letlhakane where 20 panels of 300 Wp (6 kW) were installed in each settlement.

Ghanzi District Council: New Xade where 12 panels of 3600Wp each (42 kW) and a 3-phase diesel generator set were installed.

² These systems come in containers-hence suntainers-to reflect containers with solar kits.

These systems have adequate power for most energy requirements at rural government institutions including clinics, schools etc. The systems are maintained by the District Councils and Solar International installed the systems and beyond that only provides technical backstopping.

The investment costs for these technologies are high at about P400, 000 to P500, 000 and could prove to be the *barrier* to uptake as these special panels with 3-phase inverters are imported from the USA. Even with expected solar energy efficiency improvements, the technology cannot be sustainable without a subsidy. It is desirable if BPC would adopt such mini-grids pending arrival of the grid.

4.2.2 Sustainable Fuelwood Use

In biomass the Government would like to ensure adequate and sustainable supply of fuel-wood and community based resources management is being promoted as a reform that instils responsibility on communities to improve supply of fuel-wood.

Restriction on Biomass Use

During BEMP (1996), Government institutions were required to switch from fuelwood use so as not to compete with poor households that cannot afford alternative energy sources/fuels. There is recognized reduction of fuelwood use by urban government institutions but what is not certain is whether the energy poverty of households is being alleviated as a result of that switch. What is however indicated in Fig 4.3 is that LPG is increasingly taking over from fuelwood as a principal cooking fuel in households as well.

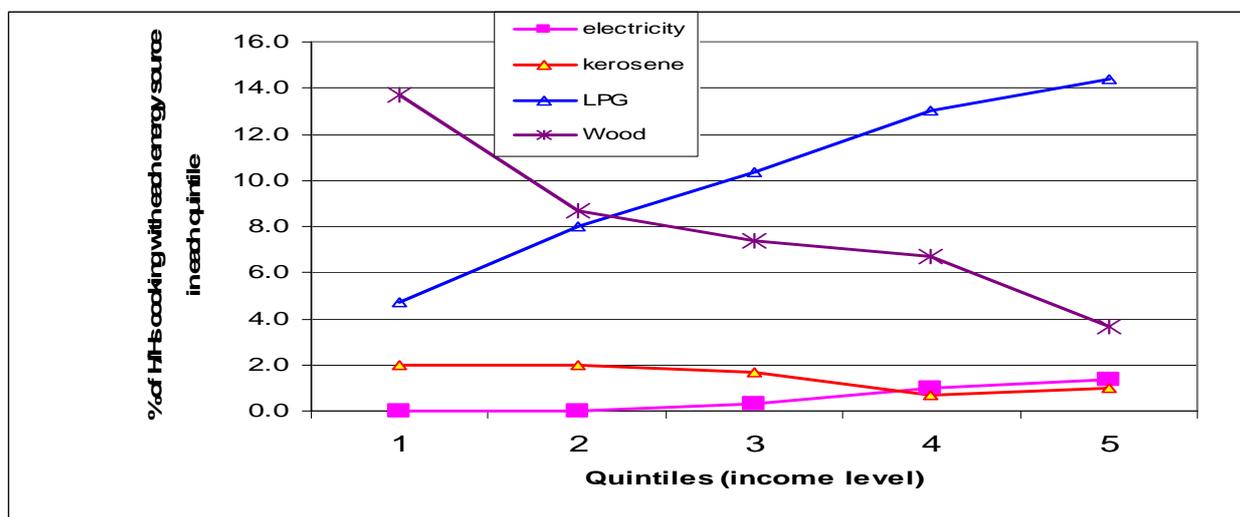


Fig 4.3 Proportion of households that cook with energy source/fuel as main source/fuel by household income quintile.

Community Based Natural Resources Management

The woodlots were to provide the involved community members with wood products such as poles and fuelwood.

An assessment carried by the Ministry of Agriculture in 2001, however indicated that the woodlot project yielded little success countrywide as communities have often failed to sustain woodlots on their own after project support is withdrawn. Often the woodlots fall in disuse. One of the main reasons is that trees take long to yield benefits and woodlots would then be a slow return business venture.

Since the previous policy to increase fuelwood supply through development of community woodlots was not successful, a new model of community based fuelwood resources management is now on trial. Projects that increase fuelwood supply through CBNRM have been recommended but not yet implemented.

4.2.3 Increasing Coal Uptake

Expanded Coal Utilization Project

The programme to promote uptake of coal has been underway since the mid-1980s and is intended to encourage the substitution of fuel-wood, imported coal and petroleum products with local coal. The Expanded Coal Utilization Project was initiated with Technical assistance from Germany (GTZ) and the project considered introduction of upgraded coal in public institutions such as hospitals, schools etc and the household sector.

The project recommended establishment of a distribution and marketing network for upgraded coal and the introduction of suitable coal stoves. A market for 100,000tonnes of beneficiated coal was estimated for industry and public institutions excluding households. What was to be addressed is availing the upgraded coal; suitable stoves and making potential users aware of the potential dangers- health and environmental that could result from using coal.

The uptake of coal by households remains minimal as is reflected in the 2000 Energy Balance (Botswana Energy Statistics- 1998, 1999 and 2000, DOE 2002). Only a few types of coal stoves/appliances have been designed and are being promoted on the market, e.g. through coal depots, but aggressive marketing is needed and other varieties of stove designs and quality are required.

Improved Distribution networks

Nearly two decades later, coal beneficiation is now being taken up and two coal distributors have been created through Government support and only operate in the large cities of Gaborone and Francistown. A few minor ones are in operation but are also limited in coverage and capacity. Reliability of coal supply in Botswana remains poor in terms of both coverage and efficiency of delivery.

Government has completed a feasibility study on coal beneficiation and the coalmine is taking up the project to beneficiate the coal. This may improve coal uptake in the future.

4.2.3 Adequate and Affordable Supplies of Paraffin and LPG

Price Control of Paraffin by Government

Rural households commonly use paraffin for lighting and cooking. The government therefore ensures that the price of paraffin is affordable by the rural households by controlling retail prices. Typical paraffin consumption by income is as indicated in the Table 4.7 below.

Table 4.7: Paraffin Consumption by households: 2001

Income/month	% Households with Income	% Of Households with Income using Paraffin
Up to P100	17.13	83.0
P101-P150	28.46	90.1
P151-P250	14.99	94.3
P251-P500	18.01	89.1
>P500	21.41	80.3
Total Sample	100.0	

Source: Report on Rural Energy Needs and Requirements in Botswana, 2001 EECG/RIIC, 2001

From the table, the usage of paraffin is higher among all rural income groups. Of significance is the 83% of the lower income group households with income of less than P100/month. Such a high level of consumption in terms of the proportion of this category that uses paraffin suggests that even the low-income households are benefiting from the controlled price of paraffin.

LPG Market Liberalization

The rural households are increasingly using LPG as a main fuel for cooking from 4% in 1996 to 17% in 2001 and 40.5% of rural households in 2003/04. The LPG, market remains liberalized. A technical committee on LPG was however established in 1998 under the auspices of the Botswana Bureau of Standards (BOBS) to develop operational standards for the LPG industry that can create a safe and friendly environment for LPG usage as well as a uniform code of practice for the LPG industry.

There is also recognition that LPG suppliers groom smaller LPG distributors in the industry and these are the ones that penetrate the remote market

The liberalized LPG market supported by safety standards has paid off in terms of LPG uptake. Increased LPG use goes hand in hand with growth in distribution and hence income generation particularly for the small vendors. Such LPG entrepreneurship is also easy to take up supported by the Government policy, the Citizen Empowerment Development Agency that supports Botswana that are interested in starting businesses.

5.0 LESSONS LEARNT AND WAY FOWARD

Many attempts to increase people's access to improved energy services have involved subsidies. Given the low purchasing power of poor people, subsidies remain an important instrument. Both grid and PV electrification interventions are indicated to only start off with government and or donor support in form of subsidy.

Assessment of past projects do not quiet reflect based on income levels whether or not the poor are benefiting from these projects/programmes. In fact present financing schemes tend to subsidize those that can already afford. This is apparent in the case of Botswana Rural Electrification Collective Scheme that the well-paid urban dwellers with investment in rural areas take advantage of the scheme. This is not totally negative, as rural investments will indirectly benefit the poor communities in those villages.

Despite the current schemes and subsidies provided by governments to connect, affordability remains an issue, as the poor appear not to be able to sustain repayments. The real poor without regular income may not be the appropriate market for the promoted credit financing schemes, although they should also be assisted to access modern energy. For the poor, innovative financing mechanisms and pro-poor policies are required and considering the need for lighting, water, and health and what difference modern energy can make in their lives, the price should not be too high to pay.

Past projects/programmes provide important lessons with regard to the potential capacity of community organization to manage and maintain their own interests. In some examples the community-training to provide installation, management and after-sale service is beginning to pay hence past and current initiatives are not a waste of resources, as they contribute incrementally to better understand how the poor can be assisted to access adequate, clean modern energy services in future.

It is hoped that the intended Assessment Framework will contribute to this learning curve.

UNEP FI Bulletin "As microfinance has shown that the poor are bankable, micro insurance is showing that they are insurable as well."

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www.afrepren.org African Energy Policy Research Network
www.gnesd.org Global Network on Energy for Sustainable Development
www.gdn.org The Global Development Network
www.gvep.org Global Village Energy Partnership
www.energia.org International network on gender and sustainable energy
www.ptfm.net Multifunctional Platform for poverty alleviation
www.sparknet.info/home.php Interdisciplinary Interactive knowledge network focussing on energy for low income households in Southern and East Africa.
www.enda.sn/english/index.htm; www.worldbank.org/poverty/strategies; www.worldenergyoutlook.org
Environment and development in the Third World
wbln0018.worldbank.org/esmap/site.nsf- ESMAP promotes the role of energy in poverty reduction and economic growth in an environmentally sustainable manner
www.developmentgoals.org- on the millennium Development Goals

ABBREVIATIONS AND ACRONYMS

AFREPREN	- African Energy Policy Research Network
AREED	- African Rural Energy Enterprise Development
AU	- African Union
BEMP	- Botswana Energy Master Plan
BOTEC	- Botswana Technology Centre
BPC	- Botswana Power Corporation
CDC	- Central District Council- Botswana
DANIDA	- Danish International Development Agency
DEA	- Development and Energy in Africa
DFID	- Department for International Development
EAD	- Energy Affairs Division
EDG	- Energy and Development Group of Cape Town
EECG	- Energy, Environment, Computer and Geophysical Applications
ERDC	- Energy and Development Research Centre now Energy Research SA
ESCO	- Energy Service Company
EU/EC	- European Union- European Commission
FAB	- Forestry Association of Botswana
FAO	- Food and Agriculture Organization of the United Nations
GDP	- Gross Domestic Product
GEF	- Global Environmental Facility
GNESD	- Global Network on Energy for Sustainable Development
GVEP	- Global Village Energy Partnership
HIV/AIDS	- Acquired Immuno Deficiency Syndrome
ICT	- Information and Communication Technologies
JICA	- Japan International Cooperation Agency
kWp	- kilo watt peak
LPG	- Liquid Petroleum Gas
MDG	- Millennium Development Goals
MLG	- Ministry of Local Government
NAMPAAD	- National Master Plan on Arable Agriculture and Dairy Development
NEPAD	- New Partnership for African Development
NPVREP	- National Photovoltaic Rural Electrification programme
O & M	- Operation and maintenance
PDL	- Poverty Datum Line
PRSP	- Poverty Reduction Strategy Papers
PV	- Photovoltaic
RCS	_ Rural Electrification Collective Scheme
REFAD	- Renewable Energy for African Development
RIIC	- Rural Industries Innovation Centre
RIDSP	- Regional Indicative Development Strategic Plan
RIPCO	- Rural Industries Promotion Company
SA	- South Africa
SADC	- Southern African Development Community
SME	- Small and Medium Enterprises
ST	- Somarelang Tikologo
SWH	- Solar Water Heaters
UN	- United Nations
UNDP	- United Nations Development Programme
US\$	- United States Dollar
WHO	_ World Health Organization
WSSD	- World Summit on Sustainable Development

