Module 8

Impact of different power sector reform options on renewables

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

CONTENTS

1.	MODULE OBJECTIVES	8.1
	1.1. Module overview	8.1
	1.2. Module aims	8.1
	1.3. Module learning outcomes	8.1
2.	INTRODUCTION	8.3
3.	IMPACT OF ELECTRICITY LAW AMENDMENT AND UNBUNDLING ON RENEWABLE ENERGY	8.5
	3.1. Electricity Law Amendment	8.5
	3.2. Unbundling	8.8
4.	IMPACT OF INDEPENDENT POWER PRODUCERS ON RENEWABLE ENERGY	8.13
5.	IMPACT OF CORPORATIZATION ON RENEWABLE ENERGY	8.19
6.	IMPACT OF MANAGEMENT CONTRACTING ON RENEWABLE ENERGY	8.23
7.	CONCLUSION	8.25
	LEARNING RESOURCES	8.27
	Key points covered	8.27
	Answers to review questions	8.27
	Exercise	8.28
	Presentation/suggested discussion topic	8.28
	Relevant case studies	8.28
	REFERENCES	8.29
	INTERNET RESOURCES	8.30
	GLOSSARY/DEFINITION OF KEY CONCEPTS	8.30
	CASE STUDY 1. Geothermal development in Kenya	8.35
	PowerPoint presentation: RENEWABLE ENERGY – Module 8: Renewable energy technologies	8.53

1. MODULE OBJECTIVES

1.1. Module overview

Power sector reforms were largely designed to increase the electricity generation capacity and to ensure profitability of the power sector. The promotion of the use of renewables in electricity generation was largely left out of this reform process.

However, various reform options present opportunities and/or barriers to the promotion of renewables.

This module will discuss how various reform options impact on the promotion of renewable energy, and will provide examples from both industrialized and African countries to illustrate the findings.

1.2. Module aims

The aims of the present module are:

- To highlight the positive and negative impacts of different power sector reform options on renewables. Specifically, this module focuses on the impact of the following reform options:
  - Unbundling (vertical and horizontal)
  - Electricity law amendment
  - IPPs development
  - Corporatization
  - Management contracting
- To provide examples, where relevant, of countries that have implemented the aforementioned reform options and the results achieved with respect to renewable energy technologies (RETs).

1.3. Module learning outcomes

The present module attempts to achieve the following learning outcomes:

- To understand the impact and potential benefits and drawbacks of the various power sector reform options with regard to renewable energy.
- To draw lessons from the case studies provided.

2. INTRODUCTION

As power sector reforms cover the whole energy sector and aim to (re)organize the very institutional structure of the power sector, these policies inevitably interfere with renewable energy policies. In general power sector reforms take place at a broader and higher level than renewable energy policies; whereas power sector reforms can be regarded as determining the institutional and market infrastructure of the power sector, renewable energy policies are instruments aiming to make the infrastructure work in favour of renewable energy.

Unsurprisingly, streamlining both sets and levels of policies is a true and multidimensional challenge. Power reform options were primarily designed to increase electricity generation capacity and to enhance the financial health of the utilities, rather than to promote renewables.

Renewable energy systems for electricity generation tend to be decentralized, small-scale in nature and located in rural and sometimes remote areas. Power system planners are generally used to and comfortable with centralized and large-scale electricity generation options, and remain largely unfamiliar with renewable energy options.

For example, the severe generation capacity shortfalls in several African countries did not trigger the potentially significant role for renewable energy in addressing the issue. Instead Independent Power Producers (IPPs) have been brought in to install relatively large power generation systems using fossil fuel-based thermal plants only. Consequently, renewables have not attracted significant level of investment.

However, various reform options present opportunities and/or barriers to the promotion of renewables. This module discusses the impact of different power sector reform options on renewables. It is structured into sections each describing a specific reform option in detail.

3. IMPACT OF ELECTRICITY LAW AMENDMENT AND UNBUNDLING ON RENEWABLE ENERGY

3.1. Electricity Law Amendment

Electricity Law Amendment is the first and basic step in which the framework and the key principles of the policy objectives are outlined. With regard to power sector reforms these could for instance include the rationale and the policy strategy behind the unbundling of the national integrated energy infrastructure, or the establishment, the definition of its role and financing of an independent energy regulator. As for renewable energy, the framework might include targets for renewable as well as the major principles to reach the target (e.g. socialization of extra costs, tailored tariff structures).

Overall Electricity Law Amendment should outline what the longer term policy aims are and who is expected to play which role. The details of how the according support instruments would then be implemented are to be further elaborated and described in downstream policy and regulation.

A review of amended Electricity Acts in several sub-Saharan African countries reveals that most of them do not explicitly mention or promote the use of renewable energy in electricity generation. Countries with vigorous renewable energy programmes have amended their Electricity Acts to explicitly promote renewable energy, including Ghana, Kenya, Namibia and Uganda. In these countries, the amended Electricity Acts have played an essential role in the promotion of renewable energy. The existing examples are discussed in some more detail below.

Renewable energy legally embedded in rural electrification strategies in Uganda

The Electricity Act in Uganda explicitly promotes the use of renewable energy for electricity supply, especially in rural areas. The Electricity Act stipulates that the Minister of Energy and Minerals should incorporate renewables in the “Rural Electrification Strategy and Plan” which is approved by the Cabinet. This requirement is further strengthened by the obligation for the Minister to annually report on the progress to the Parliament. Section 64 (2) of the Ugandan Electricity Act states that (Republic of Uganda, 1999):

> "The Minister shall, once in each year, submit to Parliament, an annual report on the progress and achievement of the [Rural Electrification Strategy and] Plan which shall contain, information relating to -
>
> ...
>
> *(c)* the renewable energy power generation for sale to the main grid and for mini-grids; and
>
> *(d)* the installation of solar photo voltaic systems for isolated settlements that cannot be economically connected to the grid."

Priority funding for renewable energy in Ghana and Uganda

The amended Electricity Acts give priority to the funding of renewables based electricity generation investments especially for rural electrification purposes. In Ghana, Section 42 of the Energy Commission Act stipulates that (Republic of Ghana, 1997):

> "Monies of the [Energy] Fund shall be applied as follows:
>
> ...
>
> *(b)* promotion of projects for the development and utilisation of renewable energy resources, including solar energy;"

The Ugandan Electricity Act is even more emphatic on the funding of renewables by stipulating that (Republic of Uganda, 1999; Section 66(2e):

> The Minister shall determine the criteria and the appropriate level of the [Rural Electrification Fund] subsidy, taking into account -
>
> ...
>
> *(f)* the extent to which the proposed activity makes appropriate use of renewable energy resources.

Light-handed regulation in Kenya, Uganda, Namibia and Zambia

The amended Electricity Acts in Kenya, Uganda, Namibia and Zambia appear to minimize regulatory requirements for investors interested in the installation of small-scale electricity generation power plants. This development aims to favour electricity generation from renewables, especially for own consumption.

In Kenya, renewables incorporated in a hybrid system not exceeding 1 MW at medium transmission voltage do not require to go through the rigorous licensing procedure. According to the Kenyan Electricity Act, an "authorisation" from the Minister of Energy is sufficient (Republic of Kenya, 1998). In Uganda, electricity generation plants not exceeding 0.5 MW only require registration with the Electricity Regulatory Authority (Republic of Uganda, 1999) while in Namibia, no generation license is required for electricity generation equipment below 500 kVA for own use (Republic of Namibia, 2000).

Environmental provisions in Kenya

Finally, amendments to the Electricity Acts have contributed to more environmentally friendly electricity generation. This is well illustrated in the case of Kenya's (see box 1 and case study 1 of this module[1]) geothermal installations by comparing the so-called Olkaria I plant—a pre-reform installation with Olkaria II and III plants, which are post-reform installations.

Box 1. **Impact of Electricity Act Amendment on renewable energy—Case of Geothermal energy in Kenya**

The environmental impacts of using geothermal power that are of concern include: air quality, water pollution, land disturbance, aesthetic or visual impacts, and noise emissions. Being within the Hale's Gate National Park (HGNP) means that the issue of human disturbance or resettlement did not arise. However, with regard to disturbance to the fauna and flora, the experience from Olkaria I showed a minimal impact on the flora provided that any disturbed sites were restored to as near as their original states as possible. Olkaria II and III have made major improvements in respect of possible disturbance to the flora in accordance to the Electricity Act of 1997, which clearly stipulates provisions for environmental assessments before construction. By piping and re-injecting all waste water rather than using open ditches as was the case with Olkaria I, the new approach in Olkaria II and III prevents new vegetation from colonizing the neighbouring areas. This issue is discussed further in the following paragraph.

The visual impacts associated with the power plant itself and the steam gathering pipes, of which there are considerable lengths, have been minimized by using a colour scheme that blends in with the surroundings. The purpose of this is to maintain the natural beauty of the Park. The EIA report indicates that this has not affected tourist activities in HGNP adversely. The socio-economic and environmental impact in this regard can therefore be considered neutral.

With regard to air quality, the gaseous emissions from geothermal power production that are of interest in this context are mainly carbon dioxide - CO_2 (96%), hydrogen sulphide - H_2S (~4%) and tiny quantities of hydrogen - H_2, methane - CH_4 and nitrogen - N_2. The most hazardous of these is hydrogen sulphide, of which the

[1]See module 9 "Regulatory and Policy Options to encourage the Development of Renewable Energy" - case study 1 "Geothermal development in Kenya" for more details.

ground level concentrations in the Olkaria area have been determined in the EIA for the Olkaria II and III projects to be below hazardous levels for workers and the local population. Further to this, the design for the Olkaria II and III projects will result in better dispersion of the gaseous emissions than was the case with Olkaria I.

The disposal of residual waters for Olkaria II and III project is by re-injection through re-injection wells into the geothermal reservoir, which is a vast improvement over disposal into gullies and natural water ways as practiced in the Olkaria I project. Re-injection ensures that the spent brine does not come into contact with surface water consumed by humans and livestock; further it cannot alter the natural composition of surface waters and upset the natural balance of the local ecosystem. A further advantage of re-injection is the recharge of the reservoir and maintenance of reservoir pressure and steam rates over a longer period of time.

These two cases serve to illustrate the major departure in the way electric power is produced and supplied in the two eras: with the Olkaria I project illustrating pre-reform practices and Olkaria II and III projects illustrating post-reform practices. It is apparent that the reform process has had a markedly different and positive impact on the environment.

Discussion question/exercise

Discuss the impact of electricity law amendment on renewable energy in your country

3.2. Unbundling

The rationale for unbundling is to enhance overall operational efficiency of the power sector by separating the core business units of generation, transmission and distribution into legally and operationally distinct and independent entities. As mentioned in module 4, there are two types of unbundling: vertical unbundling and horizontal unbundling. As there is limited implementation of horizontal unbundling, this section will largely discuss the impacts of vertical unbundling based on the available examples.

Power sector reforms do not directly impact on renewable energy policies, but rather provide a sector structure on which to build policies and regulation. With regard to renewable energy the process of vertical unbundling[2] typically resulted in:

- The creation of an independent energy regulator which is in charge of overlooking and monitoring the reform process. The regulator is usually a public or semi-public body;
- The creation of a Transmission System Operator (TSO), effectively keeping a monopoly on the transmission infrastructure;
- The creation of Distribution Network Operators (DNOs), usually with effective monopolies on the distribution network in their assigned territories;
- The liberalization of electricity generation and supply.

In European countries the policies encouraging renewable energy are built on this vertically unbundled organization of the electricity sector; i.e. the targeted share of renewable energy (in quota systems) and energy disclosure requirements are imposed most often on suppliers of energy, and guaranteed tariffs need to be paid for by the TSO or DNOs (in feed-in and guaranteed tariff systems). Electricity generators—existing or new—are usually encouraged to make use of renewable energy, e.g. through feed-in tariffs, quota systems, tax incentives, priority access to the grid.[3]

Figure 1 presents an overview of who generally does what with regard to renewable energy in a typical energy sector in Europe which has changed from a nationalised and integrated situation to the current (partly or fully) unbundled situation.

It should be noted that the above is primarily intended to give insight in the current situation in a lot of OECD countries, and in how unbundling has enabled renewable energy policies and regulations to be implemented. This situation is not proclaimed as being generally applicable or appropriate, as it is not at all straightforward how power sector reforms and renewable energy policies could or should be aligned; for example in Europe both are subject to fierce and ongoing debate—especially with regard to the creation of a single European energy market. The situation in different EU member states varies from fully liberalized and very competitive markets (e.g. United Kingdom and Nordic countries) to

---

[2]Vertical unbundling refers to the process of separating vertically integrated utilities into independent generation, transmission and distribution companies. See module 4 "The reform of the power sector in Africa" for more background.

[3]See module 9 "Regulatory and Policy Options to encourage the Development of Renewable Energy" for more background on Feed-in tariffs, quota systems and electricity disclosure, as well as the Case for more details on how these systems are organised.

national situations where the market is characterized by one or some dominating companies, or where still vertically integrated and/or nationalized companies exist (e.g. Belgium, France, Germany).

Accordingly no clear conclusions can be drawn on whether a similar sector organization is likely or appropriate in the African context.

Based on the limited examples available the impact of vertical unbundling on renewables in Africa is largely positive. One of the best examples to illustrate the positive impacts is found in Kenya. Following the unbundling of the power sector, KenGen was established to manage the generation component of the formerly integrated utility, largely comprised of large-scale hydropower plants. Prior to the aforementioned unbundling, the utility made it very difficult for entities with surplus renewables-based electricity to sell it to the utility at an economical tariff.

On several occasions, negotiations between the utility and sugar mills fell through largely because the utility was adamant not to offer an attractive tariff. The reasons given were that the fuel—bagasse—was a waste product and therefore, had little economical value. The fact that sugarcane was not available for crushing throughout the year (available only for 10 months) also led the utility to consider the potential electricity generated from the sugar mills to be "intermittent".

However, following unbundling and faced with severe capacity shortfall due to recurring drought, KenGen has been showing significant interest in renewables - an attribute that the formerly vertically integrated utility lacked. For instance, the utility has invested in the expansion of geothermal electricity generation capacity. In addition, KenGen has pledged to partner with the private sector and is willing to invest up to 50 per cent of the capital costs for attractive small-hydro and bagasse-based cogeneration projects. This is another attribute missing in the formerly integrated utility.

Therefore, based on the Kenyan case example, we can draw the following lessons pertaining to the impact of power sector reforms on renewables:

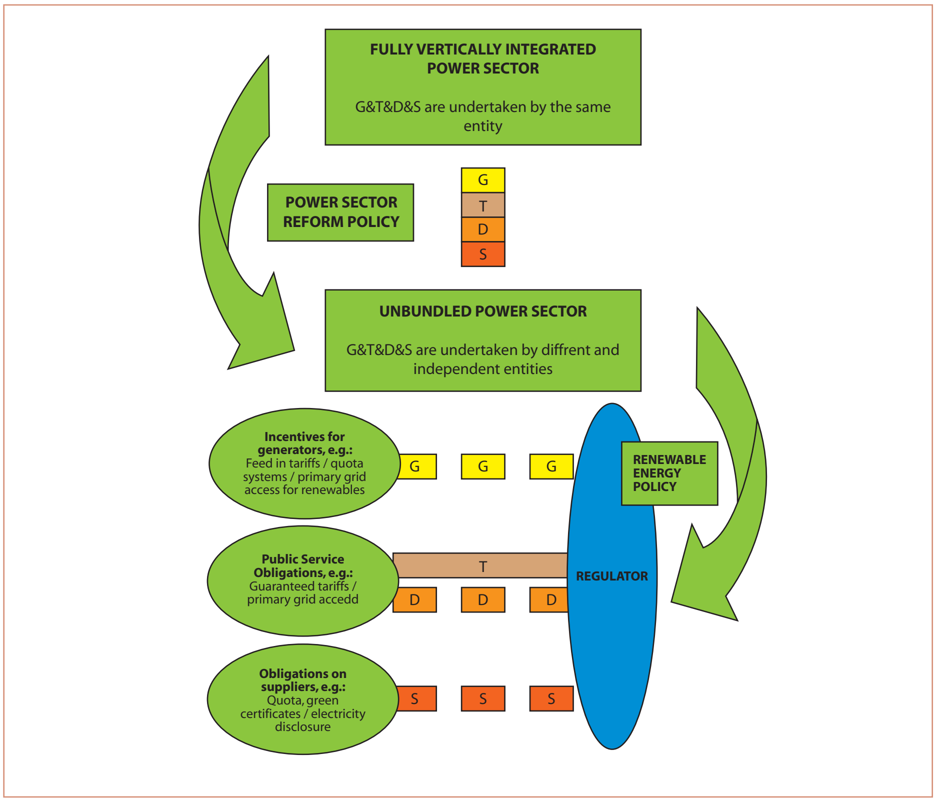
- Vertical unbundling opens up opportunities for sourcing electricity from renewables.
- Vertical unbundling also encourages the generation utility to make maximum use of least cost options as a way of ensuring profitability. In Kenya, geothermal generation is the least cost electricity generation option and hence making its exploitation is very attractive.

- This form of unbundling appears to encourage diversification of electricity generation options and the maximization of available resources in the country (including small-scale decentralized renewable energy generation options) to ensure generation utility meets its contractual obligations to the transmission and/or distribution companies.

A potential draw back of vertical unbundling is that the generation utility is largely designed to serve the interconnected grid system. Therefore, there is a likelihood of power system planners giving priority to large-scale centralized generation systems which invariably precludes renewables.

In countries where unbundling has been implemented parallel to a dedicated rural electrification programme, for example, Kenya, South Africa, Ghana, Namibia, Uganda, Malawi, and Zambia, there is a positive impact on renewables, especially small-scale renewables for electricity generation such as small-hydro and solar PVs. Renewables for rural electrification are attractive because their output relatively matches the low electricity demand levels in rural areas.

Figure I. Typical roles and functions in an unbundled power sector with regard to renewable energy



G: Generation; T: Transmission; D: Distribution; S: Supply
Source: IT Power

One way in which rural electrification programmes have promoted the use of renewables is by incorporating them in the programmes mainly as a pre-electrification option. Ghana's Off-Grid Solar PV Electrification project and UNDP/GEF/Renewable Energy Services Project (RESPRO) are good examples of how renewables can be incorporated in the rural electrification programme. Under the aforementioned projects, over 3,500 solar systems were installed in remote rural communities for domestic lighting, TV and radio operation, vaccine refrigeration and lighting in rural health centres, street lighting, battery charging and water pumping (Ahiataku-Togobo, undated; see also module 10 – case study 1).

Renewables have also been found attractive in the establishment of mini-grids in rural areas. For example, in Uganda, small-hydro systems have been utilized to supply electricity to rural northern parts of the country. In Kenya, the National Energy Policy provides for the anticipated Rural Electrification Authority to incorporate renewables such as small-hydro, wind, cogeneration, etc., for rural electrification. In Central Kenya, there are community-based small-hydro mini-grid pilot projects in operation.

Discussion question/exercise

Discuss the impact of unbundling on renewable energy in your country

4. IMPACT OF INDEPENDENT POWER PRODUCERS ON RENEWABLE ENERGY

As mentioned earlier, one of the drivers of power sector reforms in Africa was to increase electricity generation capacity through private investment. This means allowing independent power producers (IPPs) to generate electricity. IPPs have tended to be introduced in unreformed sectors, and can be regarded as a reform option which—in principle—could play a key role in triggering the vast renewable energy potential in sub-Saharan African.

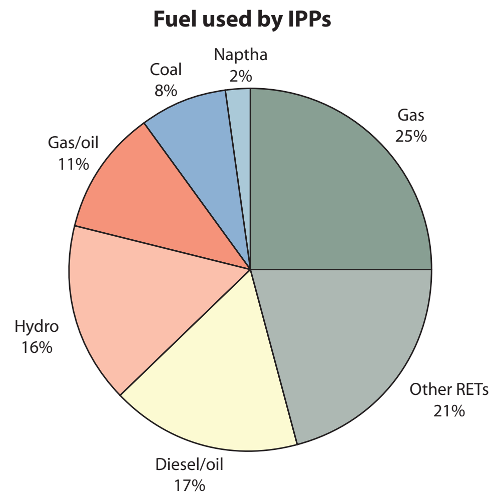
Although the majority of IPPs (implemented and proposed) turned out to be fossil fuel-based, still 37 per cent of the total installed capacity of all the implemented and planned IPP investments are using renewable energy-based electricity generation options such as hydro, wind, bagasse-based cogeneration and geothermal (based on recent estimates by AFREPREN—see figure 2). Hydropower accounts for 16 per cent of the total installed capacity while other renewables including wind, bagasse-based cogeneration and geothermal contribute 21 per cent. This indicates that the IPP option deserves further attention and encouragement, as it can play a catalyzing role in both power sector reform and renewable energy deployment.

In some OECD countries where the generation and supply market is still dominated by one or two companies, it was observed renewable energy policies activated independent initiatives, even using renewable energy based plants. The rationale behind these initiatives was to use renewable energy projects as a way into a still largely integrated power sector, and to build a client base by distinguishing themselves from the historically dominant utility. These initiatives could be in the form of relatively small scale projects through new companies, or as larger scale projects through joint ventures between small and an established national or foreign utility. Such initiatives can actually be regarded as sharpening competition as a result of renewable energy policies; in this case it could thus be stated renewable energy policies—to some extent—have supported the unbundling and liberalization policy—rather than the other way round.

Something similar in principle is possible in Africa; in cases where the integrated national utility—through its historical dominance and lack of competition—does not proactively consider renewable energy opportunities, encouraging new and independent players to step in could trigger the increased use of renewable energy sources. The introduction of IPPs could be considered a first step, leading the way towards more drastic reforms, e.g. in terms of unbundling integrated utilities.

Partially due to the opportunities presented by power sector reforms, some interesting new developments in sub-Saharan Africa are described in more detail in the paragraphs and boxes below.

Figure II. Proportion of installed capacity of IPPs by fuel used in Africa (2002)



Source: Karekezi et al, 2004

The agro-industrial sector especially in eastern and southern Africa appears to have generated a significant amount of interest in IPP development. For example, in Mauritius, the sugar industry over the past decade has evolved to become a significant IPP subsector through the sale of excess electricity generated from bagasse. Over 30 per cent of the firm installed capacity in the country comes from the sugar industry[4] (Deepchand, 2006). Following this success story, UNEP in collaboration with ADB and AFREPREN/FWD are working on a project to promote IPP development in the sugar industry in eastern and southern Africa (see http://cogen.unep.org).

A similar development is observed in the tea processing industry in eastern and southern Africa. Spearheaded by the East African Tea Trade Association and UNEP, the tea industry has indicated significant interest in developing small hydropower-based IPP projects. It is a well-known fact that the bulk of existing, albeit under-utilized, small-hydropower projects have traditionally been found in tea-growing areas. However, the now more liberal regulatory dispensation appears to be motivating the tea industry to revamp existing small-hydropower installations as well as invest in new power plants (see http://greeningtea.unep.org).

[4]A detailed case study on cogeneration development in Mauritius has been provided separately (module 2: case study 1).

Box 2. **Mini grids for rural electrification in Zambia**

The Zambian power sector is still largely dominated by the national and vertically integrated utility Zesco, with currently two fossil-fuel-based IPPs in place, both selling their electricity directly to Zesco.

However, the Electricity Act was amended with a clear angle towards the use of renewable energy, and an independent regulator is in place, aiming to establish a favourable framework in terms of tariff setting, licensing and technical support.

A pioneering and potentially promising example is the small hydro (700 kW) project at Zengamina in the north west of Zambia, which opened in July 2007 and which provides electricity through a mini grid to the hospital, school and individual households of the local community. This example proves especially interesting for the electrification of remote and rural areas—Zengamina is 380 kilometers away from the existing grid and is this not likely to be connected in the foreseeable future. Given the scale of the mini grids, generation, distribution and supply in the first instance would remain bundled, with the regulator overlooking and monitoring both tariff calculations and technical regulations. The long-term option in this scenario could still be for these mini grids to become part of the expanding central grid.

The situation needs to be assessed in light of the specificity of the Zambian situation; due to increasing electricity demand at both industrial (e.g. copper mines) and household level, substantial investments in the energy sector are needed to tackle looming power deficits. At the same time rural areas in Zambia are currently at only 3 per cent electrification rate. The national energy strategy 2030 (in progress) foresees an important role for renewable energy to address these challenges.

Electricity tariffs have been kept artificially low in Zambia over the last decades. A deliberate policy is now in place to (gradually) increase tariffs to cost reflective levels, and the Energy Regulation Board—the independent energy regulator in Zambia—principally supports tailored and cost-reflective tariffs for renewable energy-based mini grids.

Still, consolidation of announced measures (e.g. long-term policy objectives with regard to electrification and the establishment of a dedicated renewable energy agency) and further regulations (e.g. training and capacity-building for local staff and tax holidays for equipment) are needed to replicate this kind of projects and attract significant investment.

UNIDO as part of its efforts to help establish a favourable policy and regulatory framework for renewable energy in Zambia is in the process of developing three mini grids in different areas in Zambia, using small hydro power (1 MW), biomass (1 MWe) and PV (40 kWp), in cooperation with the Zambian government and GEF. All of these projects are expected to be operational by 2009.

Source: UNIDO Workshop on Tariff setting and Private Sector Participation in the Renewable Energy Sector in Zambia, Lusaka, November 2007

An important amendment of the electricity act in the few countries, which have adopted reforms, is the setting up of standard PPA. A standard PPA, in principle limits market uncertainty, which stands in the way of substantial investment in renewable energy-based electricity generation in the region. In Nepal, market uncertainty was overcome by instituting a “standard PPA”—a “standard offer” from the national utility to purchase all energy produced by specific renewable energy-based IPPs at a pre-announced price as described in box 3. The absence of such a “standard offer” inhibits the scaling up of small renewable energy investments in the power sector to their full market potential.

Box 3. Standard PPAs for Small Hydropower Development: Small Hydropower Development in Nepal

As a direct result of the liberalization in the power sector brought about by the Electricity Act (1992), international Independent Power Producers (IPPs) invested in two medium hydropower projects in 1995: the Khimiti Hydro Electric Project (60 MW) and Bhote Koshi HEP (36 MW). The PPAs for these projects were negotiated on a case-by-case basis between the utility and the IPP. In October 1998, the government of the time announced that the national utility, Nepal Electricity Authority (NEA), would purchase all energy produced by small producers (5 MW or below) at a standard “Power Puchase Agreement” (PPA). By early 1999, the first small hydro IPPs began to carry out feasibility studies and approach financial institutions with the standard PPA in hand. The first financial closure by local banks took place in 2000 and the Syange project (183 kW) was on line in January 2002 followed by the Piluwa Khola (3 MW) project by October 2003.

A “standard PPA” can to a certain extent be compared to a feed-in tariff, i.e. tariffs offering either a minimum guaranteed price for output or a premium on the market price for output. In either case, electricity utilities are obliged to allow generators to connect to the grid, and to buy all of a project’s output at a predefined (and cost-reflective) price. This and other instruments are described in more detail in module 9 “Regulatory and Policy Options to encourage the development of Renewable Energy”.

A possible way forward for power sectors in Africa—including the aspects as described above—is presented schematically in figure 3.

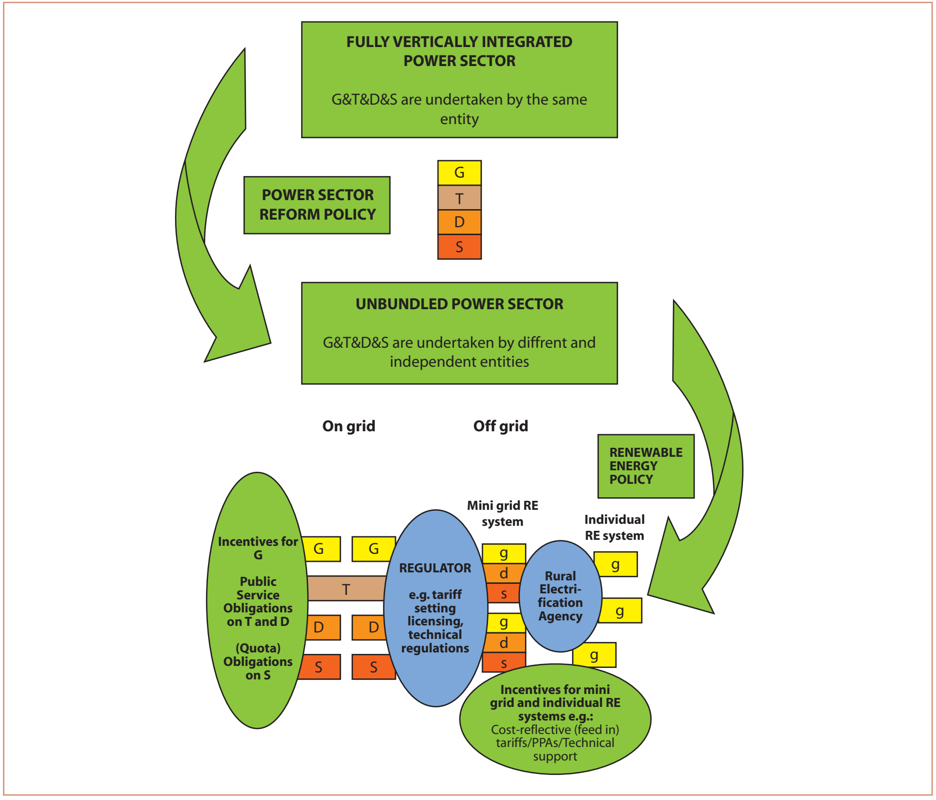
Food for thought

If examples such as those described in box 2 and box 3 for Zambia and Nepal became common practice, new questions could be raised; how in the longer term should mini grids be integrated in the expanding grid; how would and should this relate to unbundling in general, which party would ideally be in charge of which task in such a scenario? A typical mini grid in fact can be regarded as a "vertically integrated" entity, with distribution, supply and generation taken care of by the same organization. This makes sense given the small scale, but in the longer term different institutional and organizational setups are thinkable to streamline the operation of the central grid and an increasing number of mini grids, e.g. what would be the role of the national utility with regard to distribution (and transmission) in such a scenario and how does this relate to the role of the regulator's activities and the rural electrification agency.

Discussion question/exercise

Discuss the impact of independent power producers on renewable energy in your country.

Figure III. Power sector reform and renewable energy: possible way forward for Africa



G: Generation; T: Transmission; D: Distribution; S: Supply
Source: IT Power

5. IMPACT OF CORPORATIZATION ON RENEWABLE ENERGY

As mentioned in module 4, the rationale for corporatization is to ensure that the utility is run as a business, i.e. to be profitable. The reasons why the corporatization of utilities has contributed largely negatively on the promotion of renewable energy for electricity generation situation has occurred can be analysed as follows:

- The focus on profit making implies that corporatized utilities tend to avoid investments involving relatively high upfront costs. As, on a per kW basis, renewables tend to have relatively higher upfront costs compared to conventional systems, they appear to be less attractive. It is thereby forgotten to assess the costs over the full lifetime of the project—where for instance lower fuel costs can make the investment in renewables more attractive;
- Corporatization also encourages utilities to make investments in generation only when the IRR/payback period is attractive. However, power planners in the utilities erroneously have the notion that all renewable energy systems do not have attractive IRRs/payback periods. Most renewable energy sources are site specific and, therefore, certain sites can have very attractive characteristics. There is thus scope to train power planners with adequate and updated information on different renewable energy technologies, in order to enable them to make informed technology choices;
- The profit-making motive also contributes to the utility's desire to minimize their operational costs. One way of doing this is offering to buy electricity generated from renewables at below market value citing relatively low or no cost on the fuel used (e.g. small hydro, bagasse-based cogeneration, wind, etc). Another reason given is that some renewable technologies have "intermittent" electricity generation patterns. The unattractive price of electricity offered by the utilities discourages potential renewable energy-based IPPs, especially entities with excess electricity generation capacity such as sugar mills (using bagasse-based cogeneration) and tea factories (with small-hydro installations).

However, there are ways in which corporatization can positively impact on renewable energy (Kozloff, undated):

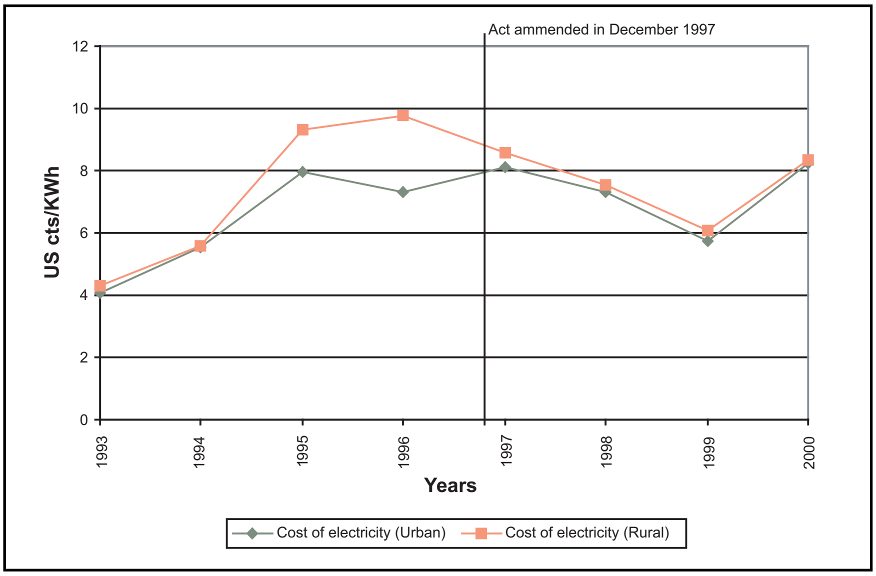
- Corporatization implies that the utility applies the principle of full cost recovery. Therefore, a corporatized utility can use renewables for electricity generation and charge a tariff that is commensurate to the cost of electricity supply. The following box uses the case of Kenya to demonstrate how the distribution utility is applying the principle of full cost recovery.

- Secondly, a corporatized utility is likely to identify and implement least-cost electricity generation options especially for rural electrification. As mentioned earlier, some renewables for electricity generation are located in remote rural areas and can be competitive in such locations over other options such as thermal generation. Therefore, a corporatized utility might encourage the development of renewables in such situations.

Box 4. The impact of full recovery of cost of electricity supply in rural Kenya

The figure below depicts the trend in tariff-related reforms in Kenya that took place prior to the amendment of the Electricity Act.[a]

Cost of electricity to the end-user in Kenya[b]



[a]As of November 1993, tariffs stood at 35 per cent of LRMC

[b]The end-user cost of electricity takes into account inflation at constant 1995 prices and foreign exchange losses.

Source: Computed using data from KPLC (1992, 1997, 2002); Kinuthia, 2003

As shown above, 1994 marks the year that the first major tariff reform was instituted to ensure full cost recovery i.e. to ensure cost recovery by bringing the tariffs closer to the long-run marginal cost (LRMC) levels. At this time, the cost of electricity for both rural and urban households was the same. However, the introduction of cost-reflective tariffs gradually increased the cost of electricity and during 1994 to 2000, rural households (generally poorer than urban households) were paying more for electricity than their urban counterparts (Karekezi, et al, 2005).

Discussion question/exercise

Discuss the impact of corporatization/commercialization on renewables in your country.

6. IMPACT OF MANAGEMENT CONTRACTING ON RENEWABLE ENERGY

Management contracting has been adopted in different economic sectors and therefore can have different meanings. In the energy sector it refers to outsourcing a number of the national utility's managerial functions to a private entity, with the government remaining the owner of the assets. It transfers responsibility for the operation and maintenance of government-owned businesses to a private entity.

Management contracts can take different forms but the simplest involve paying a private firm a fixed fee for performing managerial tasks. More sophisticated management contracts can introduce greater incentives for efficiency by defining performance targets and basing remuneration at least in part on their fulfilment.

Management contracts largely impact on the promotion of renewable energy in the same way as corporatization due to the following reasons:

- Consultants usually hired to manage the utility have the key task of making the utility profitable—the same objective as corporatization—and enhancing operational efficiency.
- Usually management contracts last for a relatively short period of about two years[5] to manage existing utility assets and any assets procured during their tenure. Therefore, management contractors have limited decision-making powers especially pertaining to investments in new generation.

However, the prescribed role of the management contractors appears to make their real impact on renewables neutral. This is because the targets of the management contractors usually revolve around enhancing operational efficiency of the utility especially in the distribution segment.

Secondly, management contractors have limited decision-making powers pertaining to the investment in new generation facilities. The decision mainly lies in the hands of the utility's Board of Directors and Government. Therefore, management contractors do not significantly influence the decision on whether or not to install new renewable energy-based power plants.

[5]An exception is the case of Côte d'Ivoire whereby management contracts of 15 years have been issued.

Discussion question/exercise

Discuss the impact of management contracting on renewables in your country.

7. CONCLUSION

In overall terms, power sector reforms are policies happening at a broader and higher level than renewable energy policies. As these reforms aim to change the institutional structure and organization of the whole energy sector, they inevitably influence (and in some cases even counteract) renewable energy policies. This is true not only in Africa, but also in most industrialized countries, where the interactions with renewable energy policies prove often complex and difficult to streamline.

When looking into the different impacts reform policies can have on renewable energy, it turned out that the potentially positive impact of most of the reform options was not or not fully exploited. For example, Amended Electricity Acts in most African countries generally do not explicitly promote the use of renewables for electricity generation, and the introduction of independent power producers (IPPs) could have been designed to have a more specific focus on renewable energy projects rather than on fossil-fuel based or large scale hydro projects.

Still the conclusion is that IPPs as well as (especially vertical) unbundling offer good opportunities for building support instruments for the promotion of renewables. It was presented how renewable energy policies are organized in a typically unbundled energy sector, and how some of these institutional aspects could facilitate and accelerate renewable energy deployment in the African context.

For instance, the case of Zambia is interesting and promising, with an Electricity Act amended towards an increased use of renewable energy, and an independent regulator in place who can establish a favourable framework in terms of tariff setting, licensing and technical support for renewables. Other countries with interesting examples of how to promote renewables in a reformed power sector include Ghana, Kenya, Namibia and Uganda.

LEARNING RESOURCES

Key points covered

- In general, power reform options were and are not primarily designed to promote renewable energy.
- However, various reform options appear to present opportunities to the promotion of the promotion of renewables. On the other hand some appear not to affect renewables in any way.
- The impact of vertical unbundling on renewables is largely positive, but can still be improved.
- Severe generation capacity shortfalls have urged several African countries to stimulate IPPs. This only partially triggered an increased use of renewables as these IPPs primarily installed relatively large power generation systems and have largely opted for fossil-fuel thermal generation options. Still the concept of IPPs can play an important role in the strengthening of renewable energy policies.
- A review of amended Electricity Acts in several sub-Saharan African countries reveals that most of them do not explicitly mention or promote the use of renewable energy in electricity generation. However, the few countries with vigorous renewable energy programmes appear to have the amended their Electricity Acts to explicitly promote renewable energy.

Answers to review questions

Question: Discuss the impact of unbundling on renewable energy in your country.

Question: Discuss the impact of independent power producers on renewable energy in your country.

Question: Discuss the impact of electricity law amendment on renewable energy in your country.

Question: Discuss the impact of corporatization on renewable energy in your country.

Question: Discuss the impact of management contract on renewables in your country.

NB: The questions provided above are all discussion questions and the answers are therefore, country specific. Trainees are encouraged to answer the relevant questions on the basis of their respective countries and/or countries whose reform process they are more conversant with.

Exercise

1. According to you, have power sector reform had an impact on renewable energy? Using relevant documents provide a 2–3 page essay of your response.
2. Different power sector reform options had different impacts on renewable energy development in Africa. Using examples from the region, discuss their impacts and separate those which had negative impacts from the ones with positive impacts.
3. In general, have energy sector reforms had impacts on the power?

Presentation/suggested discussion topic

See separate file:

RENEWABLE ENERGY – module 8: Impact of Power Sector Reform on Renewable Energy (Presentation)

Suggested discussion topic: In your opinion, have power sector reforms enhanced or impaired the electricity sector? What role do you see that renewables can play in enhancing the electricity sector? Which power sector reform option has contributed most to the improvement or deterioration of the electricity sector in Africa?

Relevant case studies

1. Case Study 1: Geothermal Development in Kenya

REFERENCES

1. Ahiataku-Togobo, W. undated. Challenges of Solar PV for Remote Rural

2. Electrification in Ghana. www.zef.de/fileadmin/webfiles/renewables/abstracts/Wisdom_Abstract%20_Bonn.pdf

3. Deepchand, K., 2006. Investments in Bagasse Energy Cogeneration in Mauritius, AFREPREN/FWD, Nairobi.

4. Karekezi, S. Kimani, J., Mutiga, A. and Amenya, S., 2005. Do the Poor Benefit from Power Sector Reform? Evidence from East Africa. AFREPREN Occasional Paper 25. AFREPREN, Nairobi, Kenya.

5. Karekezi, S., Kimani, J. and Amenya, S. 2004. 'An Overview of Power Sector Reform in Africa'. In: Marandu, E. and Kayo, D. (Eds), The Regulation of the Power Sector in Africa: Attracting Investment and Protecting the Poor. African Energy Policy Research Network, Nairobi and ZED Books, London, UK.

6. Kenya Power and Lighting Company (KPLC), 1997. Report and Accounts for the year ended 30th June 1997. KPLC, Nairobi.

7. Kenya Power and Lighting Company (KPLC), 2002. Annual Report and Accounts 2001/2002. KPLC, Nairobi.

8. Kinuthia, P., 2003. Kenya Country Data and Statistics Compilation. AFREPREN, Nairobi.

9. Kenya Power and Lighting Company (KPLC), 1992. Report and Accounts for the year ended 30th June 1992. KPLC, Nairobi.

10. Kozloff, K., undated. Electricity Sector Reform in Developing Countries: Implications for Renewable Energy.

11. Republic of Ghana, 1997. The Energy Commission Act, 1997. www.purc.com.gh/purc/energycomm541.htm

12. Republic of Kenya, 1997. Electric Power Act, 1997. Government Printer, Nairobi.

13. Republic of Namibia, 2000. Electricity Act, 2000. www.mme.gov.na/energy/acts/act-electricity-2000.html

14. Republic of Uganda, 1999. Electricity Act, 1999. UPPC, Kampala.

INTERNET RESOURCES

1. http://cogen.unep.org - "Cogen for Africa" Project website
2. http://greeningtea.unep.org - Greening the Tea Industry in East Africa Project
3. www.afrepren.org - African Energy Policy Research Network
4. www.reeep.org - Renewable Energy and Energy Efficiency Partnership
5. www.afurnet.org - African Forum for Utility Regulation
6. www.rerasadc.com - Regional Electricity Regulators Association of Southern Africa
7. www.ieiglobal.org - International Energy Initiative
8. www.wri.org - World Resources Institute

GLOSSARY/DEFINITION OF KEY CONCEPTS

Bagasse	The fibrous residue of sugar cane left after the extraction of juice and often used as a fuel in cogeneration installation.
Cogeneration	Simultaneous production of electricity and heat energy.
Complete government ownership	When the Government owns all the generation, transmission and distribution assets within a national utility.
Complete horizontal unbundling (provincial utilities which are vertically integrated)	When each province owns a utility that undertakes electricity generation, transmission and distribution in vertically integrated operations.
Complete private ownership	When all generation, transmission and distribution entities in the country are wholly owned by the private sector.
Complete vertically unbundling	When the generation, transmission and distribution entities are independent companies.
Corporatization	This is the act of transforming a state owned utility into a limited liability corporate body often with the Government as the main shareholder.

Developing countries	Countries which fall within a given range of GNP per capita, as defined by the World Bank.
Distribution	Delivery of electricity to the customer's home or business through low voltage distribution lines.
Direct access	The ability of a customer to purchase electricity or other energy sources directly from a supplier other than their traditional supplier.
Electricity/power sector reforms:	Deliberate changes in the structure and ownership of the electricity sector aimed at improving performance, efficiency and investment.
Electricity regulator	The agency in charge of monitoring the electricity sector.
Electrification:	This is the process of connecting additional households, institutions and enterprises to the national grid.
Energy Ministry/ Department	The Government body that provides policy directives with regard to the energy sector.
Energy services	The end-use ultimately provided by energy.
Energy sources	Any substance or natural phenomenon that can be consumed or transformed to supply heat or power.
Energy supply	Amount of energy available for use by the various sectors in a country.
Fossil fuel	An energy source formed in the Earth's crust from decayed organic material e.g. petroleum, coal, and natural gas.
Geothermal energy	Natural heat from within the earth, captured for production of electric power, space heating or industrial steam.
Geothermal plant	A plant in which the prime mover is a steam turbine that is driven either by steam produced from hot water or by natural steam that derives its energy from heat found in rocks or fluids at various depths beneath the surface of the Earth. The fluids are extracted by drilling and/or pumping.

Independent power producers (IPPs)	Privately owned power companies that produce electricity and sell it for a profit to the national grid or to a distribution utility.
Interconnected system	An integrated electricity generation, transmission and distribution network.
Isolated/self-contained system	A stand-alone electricity generation, transmission and distribution network serving a confined part of a country or region.
Legal and regulatory framework (LRF)	Combination of the laws, institutions, rules and regulations governing the operations of the electricity industry.
Levelized energy costs	The present value of the total cost of building and operating a generating plant over its economic life, converted to equal annual payments. Costs are levelied in real dollars (i.e. adjusted to remove the impact of inflation)
Liberalisation	The removal of restrictions on entry and exit of the electricity industry making it open to any prospective and interested players. Often implies reduced state intervention.
Licensing	The act of issuing licenses allowing investors to operate legitimately within the electricity sector, usually as IPPs or IPDs.
Management capability	Having adequate skills to efficiently and profitably run an electricity generation/distribution enterprise.
Management contract	The outsourcing of managerial functions of the utility to a private entity, with the Government after remaining the owner of the assets.
Modern energy	Refers to high quality energy sources e.g. electricity and petroleum products, as opposed to traditional energy sources such as unprocessed biofuels.

Micro hydro	Small-scale power generating systems that harness the power of falling water (above 100kW but below 1MW).
National grid	The network of electricity transmission and distribution cables used in the conveyance of electricity within a country.
National utility	An entity which undertakes electricity generation, transmission and distribution nationwide. It is usually wholly or partially state-owned.
Open access	A regulatory mandate to allow others to use a utility's transmission and distribution facilities to move bulk power from one point to another on a non-discriminatory basis for a cost-based fee.
Small hydro	Small-scale power generating systems that harness the power of falling water (1-15MW).
Small power producer (SPP)	This is a power producer who generates electricity using renewable energy (wood, waste, conventional hydroelectric, wind, solar, and geothermal) as a primary energy source.
Technical capability	Having adequate skills to operate and maintain equipment used in a power utility.
Unbundling	The process of breaking-up a vertically integrated public utility into either different entities of generation, transmission and distribution, or into regional companies within the country.
Utility	An entity partially or wholly involved in electricity generation, transmission, and/or distribution.
Vertically integrated utility	An entity that undertakes electricity generation, transmission and distribution.

Case study 1.

GEOTHERMAL DEVELOPMENT IN KENYA

CONTENTS

1. INTRODUCTION 8.37

2. BACKGROUND TO GEOTHERMAL ENERGY IN KENYA 8.38

3. MAIN DESCRIPTIONS OF GEOTHERMAL ENERGY IN KENYA 8.39
   3.1. History of geothermal resorce development 8.39

4. CURRENT AND FUTURE ROLE OF GEOTHERMAL ENERGY IN KENYA 8.41
   4.1. Theoretical potential of the geothermal resource 8.42
   4.2. Technical potential of the geothermal resource 8.43

5. FINANCING OF GEOTHERMAL DEVELOPMENT 8.44
   5.1. Current and projected investments 8.44
   5.2. Economic issues of geothermal energy 8.44

6. KEY SUCCESSES OF GEOTHERMAL ENERGY IN KENYA 8.46
   6.1. Potential for local assembly and manufacture of geothermal equipment 8.46
   6.2. Employment and job creation 8.46
   6.3. Useful uses of geothermal heat 8.48
   6.4. Favourable effects on external debt 8.48
   6.5. Reduced effect on environmental degradation and pollution 8.49

7. CONCLUSIONS 8.51
   7.1. The impact of geothermal energy 8.51

REFERENCES 8.52

INTERNET RESOURCES 8.52

1. INTRODUCTION

Kenya is the first country in Africa to tap geothermal resources for energy. The geothermal resource lies beneath the vast East African Rift Valley. The present production area of Olkaria covers 11 km^2 and has an estimated steam potential for 400 MW years. A total of 53 MWe of electricity is currently being generated from geothermal steam in the Olkaria area. This accounts for about 5.1 per cent of the nation's electricity consumption. A total of 301 MW is planned for generation by the year 2009.

The geothermal resource occurs in an area that has environmentally sensitive areas. The Olkaria field is in the middle of a game park and a highly productive farm area. Economic activities in this area have attracted a large human population. The exploration and exploitation of this resource should therefore be carried out with minimum negative impacts on the environment and the local communities. This case study is designed to assess the socio-economic and environmental impacts brought about by the development of the Olkaria East geothermal plant,[1] which has been in operation for the last 20 years.

The 15 years of the first power plant operation at Olkaria has shown that with proper management, geothermal energy production can go hand in hand with conservation. Analysis of geothermal hydrogen sulphide and carbon dioxide emissions shows that they are below the World Health Organization harmful levels. Geothermal brine cation and anions concentrations from the present geothermal wells in Olkaria are not very high to warrant environmental risk. Heavy metal concentrations in potable water are below acceptable levels and therefore geothermal fluid may not be hazardous to the environment. Noise levels vary from 32-44dB(A) away from the station and 50-60dB(A) around the power station.

Attempts have been made not to fence off migration paths of animals by burying pipes underground or elevating them to allow free movement of animals. Sensitive habitats for animals and birds such as breeding, feeding and resting sites have also been preserved.

No adverse impacts by the project on the local communities have been reported. Proper operational management by the geothermal plant operators is in place to stem any possible conflict with the surrounding community. This includes fencing off the plant premises to prevent injury to the community and their animals, and

[1]A geothermal plant is a plant in which the prime mover is a steam turbine that is driven either by steam produced from hot water or by natural steam that drives its energy from heat found in rocks or fluids at various depths beneath the surface of the earth. The fluids are extracted by either drilling and/or pumping (AFREPREN, 2004).

the holding of regular meetings between the project management and the community. KenGen, the power utility has made some attempts to provide the community with infrastructures such as piped water, transport, shops and schools. In addition, there has been increased sale of souvenirs to tourists at the cultural centre, and creation of a market for their animal products.

However, there are a few concerns that have been raised by the Maasai community. Out of the 500 people employed at the plant, only seven are from the local Maasai community. This is equivalent to 1.4 per cent of the total workforce at the plant. These seven comprise of one copy typist, one clerk, one driver, one office messenger and three watchmen. The community felt that the project should have economically empowered them by providing more employment opportunities.

2. BACKGROUND TO GEOTHERMAL ENERGY IN KENYA

Africa is endowed with 9,000 megawatts of geothermal potential (hot water and steam based). Using today's technology, Africa has the potential to generate 2,500 MW of energy from geothermal power (Karekezi and Kithyoma, 2005).

Table 1. Geothermal potential for selected African countries

Couyntry	Potential Generation in MW
Kenya	2,000
Ethiopia	>1,000
Algeria	700
Djibouti	230–860
Uganda	450
United Republic of Tanzania	150

Source: Karekezi and Kithyoma, 2005

Of this geothermal power potential, only 127 MW has been tapped in Kenya, and less than 2.0 MW in Ethiopia. These estimates of existing geothermal power generating capacity do not include direct thermal use of geothermal energy, which is widely practised in North Africa (Karekezi and Kithyoma, 2005).

Starting in 1981, Kenya was the first country in Africa to exploit geothermal[2] resources for electricity generation. After some inconclusive initial exploration at Olkaria in the 1950s, interest revived during the 1970s. A feasibility study carried out to evaluate Olkaria's potential for generating electricity found that the geothermal field covered 80 km2 with sufficient steam for 25,000 MW-years (with reinjection, this potential could be indefinite). The present area, covering 11 km^2, has steam for 400 MW-years. So far, 103 geothermal wells have been drilled in Kenya for exploration, production, monitoring and re-injection. Of these, 97 wells are in the Olkaria area and the rest in the Eburru field (Karekezi and Kithyoma, 2005).

Out of the total 127 MW of installed capacity, Kenya Electricity Generating Company, KenGen, Kenya's public utility company, has an installed capacity of 115 MW and OrPower 4, an independent power producer, has an installed capacity of 12 MW. Together, these plants meet 11 per cent of the national electricity supply, once again demonstrating the viability of the 10 per cent renewable energy target proposed at the 2002 WSSD conference (Karekezi and Kithyoma, 2005).

3. MAIN DESCRIPTIONS OF GEOTHERMAL ENERGY IN KENYA

3.1. History of geothermal resource development

With over 11,000 MW of installed geothermal power worldwide, geothermal energy utilization is a well-proven and mature technology. At Lardarello in Italy, one of the oldest geothermal plants has operated since 1904 in a cost-competitive manner. Countries such as Indonesia, Japan, Mexico, the Philippines and the United States of America have substantially exploited their geothermal energy resources (Karekezi and Kithyoma, 2005).

In Kenya, geothermal development was not included in the country's power plans until 1986, after the successful completion of Olkaria I geothermal power station. Since then, it features prominently in all major policy documents. In recent years, substantial amounts of money have been set aside for geothermal resource exploration (Karekezi and Kithyoma, 2005).

---

[2]Geothermal energy is the natural heat from the earth's interior stored in rocks and water within the earth's crust. This energy can be extracted by drilling wells to tap concentrations of steam at high pressures and at depths shallow enough to be economically justifiable. The steam is then piped to turbines to generate electricity (Karekezi and Kithyoma, 2005).

Exploration for geothermal energy in Kenya started in the 1960s with surface exploration that culminated in two geothermal wells being drilled at Olkaria. In the early 1970's, more geological and geophysical work was carried out between Lake Bogoria and Olkaria. This survey identified several areas suitable for geothermal prospecting and by 1973, drilling of deep exploratory wells commenced with funds from UNDP. Additional wells were thereafter drilled to provide enough steam for the generation of electricity, and in June 1981 the first 15 MWe generating unit was commissioned. This was the first geothermal power plant in Africa. The second 15 MWe unit was commissioned in November 1982 and the third unit in March 1985, raising the total to 45 MWe. Olkaria 1 (figure I) is owned and operated by KenGen. Since 1997, private companies have entered into the generation of electricity using geothermal resources. Currently Orpower 4 Inc. is generating 12 MWe with plans to generate a total of 64 MWe in the next few years in the Olkaria West field (Karekezi and Kithyoma, 2005).

A number of wells have been drilled at Olkaria NE field and connected to Olkaria II power station (figure II). Currently, the proven power from this field is about 80 MWe for 25 years using conventional condensing turbine and single stage steam separation. However, the field is capable of producing more than 100MWe from the 8.8 km2 site. The field was committed to the development of a 64 MW Olkaria II power station under public investment. The plant was commissioned in early 2004. So far, 103 geothermal wells have been drilled for exploration, production, monitoring and re-injection with depths varying between 180 to 2,600 metres. All these wells are in Olkaria and Eburru (Karekezi and Kithyoma, 2005).

Studies reveal that most of the medium and high temperature (1400C) geothermal systems in Kenya are located within the Kenya rift. Table 2 summarizes the exploration status for the various geothermal prospects. Currently only the Olkaria geothermal field is being developed (Karekezi and Kithyoma, 2005).

Figure I. The Olkaria I power station in Kenya

Figure II. Panoramic view of Olkaria II power plant in Kenya

Table 2. Exploration status of the geothermal prospects other than Olkaria and Eburru

Prospect	Reconnaissance	Surface studies	Wells sited	Wells drilled
Olkaria domes	Yes	Yes	3	3
Longonot	Yes	Yes	1	No
Suswa	Yes	Yes	3	No
Menengai	Yes	Partial	No	No
Badlands	Yes	Partial	No	No
Arus	Yes	No	No	No
Lake Bogoria	Yes	No	No	No
Korosi	Yes	No	No	No
Paka	Yes	No	No	No
Silali	Yes	No	No	No
Emuruangogolak	Yes	No	No	No
Namarunu	Yes	No	No	No
Barrier volcano	Yes	No	No	No
Lake Magadi	Yes	No	No	No

4. CURRENT AND FUTURE ROLE OF GEOTHERMAL ENERGY IN KENYA

The Least Cost Power Development Plan (LCPDP) in 2000 emphasizes that geothermal energy is recognized as an important energy source for the future (table 3). By 2019, geothermal energy is envisaged to have increased by 504 MW (Karekezi and Kithyoma, 2005).

If the plans in table 3 are actualized, the total installed electric capacity will stand at about 2,700 MW by 2020 (authors calculation). The geothermal resource would contribute about 631 MW, representing 23.4 per cent of the total national electricity supply. These figures include current installed geothermal capacity (Karekezi and Kithyoma, 2005).

As mentioned earlier, this study set out to examine the viability of geothermal energy contributing 5 per cent of power supply in Kenya. This sub-section summarizes the potential of geothermal energy resources (Karekezi and Kithyoma, 2005).

Table 3. Summary of additional planned power generation (2004–2019)

	MW			
Fiscal year	Hydro	Geothermal	Diesel	Total
2004	60	56		116
2005				
2006			40	40
2007		64		64
2008	80.6		20	100.6
2009		64		64
2010	140			140
2011		64	20	84
2012			80	80
2013		64	20	84
2014			100	100
2015		64	20	84
2016			100	100
2017		64	40	104
2018			150	150
2019		64	60	124
Totals	280.6	504	650	1434.6

Adapted from KPLC, 2001
Source: Karekezi and Kithyoma, 2005

4.1. Theoretical potential of the geothermal resource

For purposes of this case study, theoretical potential is defined as the preliminary assessed potential based on the surface geothermal manifestations considering the area where these manifestations have been observed and using the current available technology, mainly the single or double flash power method. On this basis, the theoretical geothermal potential has been estimated at 2000 MW across the whole Kenyan Rift valley, as shown in table 4 (Karekezi and Kithyoma, 2005).

Only Olkaria and Eburru have been drilled to establish their accurate power potential. In effect, this means that the full geothermal potential of the Rift valley may be significantly higher or lower than the figures in table 4 (Karekezi and Kithyoma, 2005).

Table 4. Geothermal energy potential in selected fields in Kenya

Prospect	Potential
Olkaria	520MW
Eburru	200 MW
Badlands	20 MW
Longonot	200 MW
Menengai	200 MW
L. Bogoria	20 MW
Korosi	100 MW
Chepchuk	20 MW
Bake	100 MW
Silali	300 MW
Emuruagolok	200 MW
Namarunu	20 MW
Barrier Volcano	100 MW
Total	2000 MW

Source: World Bank, 1983 and BCSE, 2003 in Karekezi and Kithyoma, 2005

4.2. Technical potential of the geothermal resource

The technical potential relates to the confirmed level of extractable power from a prospect that has been rigorously assessed through exploratory and production drilling from the standpoint of the best available technology at the time. From the literature review done in this case study, a technical potential to generate over 600 MW currently exists (author's estimates). This estimate was made while taking into account various constraints ranging from inaccessible prospect sites owing to difficult terrain, distance to the nearest transmission infrastructure, and prohibitive costs of development due to low geothermal fluid thresholds.[3] However, with the ongoing global advances in technology improvement, much higher technical potentials than those estimated here are likely to become evident over time (Karekezi and Kithyoma, 2005).

[3]Low levels of steam pressure at which geothermal resource exploitation is not economically viable.

5. FINANCING OF GEOTHERMAL DEVELOPMENT

5.1. Current and projected investments

The latest national power development plan anticipates an additional 504 MW from geothermal energy by 2019. To achieve this, investment would be required in geothermal resource identification and assessment and power plant construction and commissioning (Karekezi and Kithyoma, 2005).

Assuming a unit installation cost of $US 2,700 per kilowatt (KenGen, undated),[4] the associated investment cost would amount to about $US 1.3 billion. It has been estimated that it costs roughly $US 1.3 million to drill a geothermal well in the Rift valley setting irrespective of whether the well produces 1 or 10 MW of steam power (KenGen, 2002). Currently, the average production of wells at Olkaria generates between 1 and 3 MW. There are however, cases where a well produces as much as 10 MW, due to differences in subsurface conditions (Karekezi and Kithyoma, 2005).

In the past, geothermal projects were implemented in a multiple contract method where construction, procurement, design and project management contracts were separately awarded. The trend is gradually moving away from the multi-contract implementation method to the single turnkey engineering-procurement-construction (EPC) method. EPC is reported to allow more room for vendor innovations, thus reducing cost and overrun risks, as well as giving a single point responsibility and liability for plant performance (Karekezi and Kithyoma, 2005).

5.2. Economic issues of geothermal energy

The cost of geothermal energy is an important indicator of its economic viability. The cost includes direct capital costs, indirect costs and operation and maintenance. The direct costs relate to exploration, steam field development and power plant construction. Indirect costs relate to access to infrastructure, power transmission and distribution and expatriate fees. These costs vary depending on site-specific parameters and the level of development of infrastructure (Karekezi and Kithyoma, 2005).

[4]KenGen, undated. Installation of new, large-scale geothermal generating plant: Potential CDM Project. Project case study. Cost of Olkaria II's 64 MW geothermal project was $US 174 million, the cost per MW is approximately $US 2.7 million

According to the World Bank (www.worldbank.energy/geothermal/technology.htm), operation and maintenance costs of geothermal steam fields and power plants of various sizes generally range from 0.15 to 1.4 US cents per kilowatt-hour. This cost does not include the cost of new make-up wells, which are normally required over time to make up for the gradual production decline from the original wells. The rate of this decline varies depending on the nature and size of the field but ranges between 5 per cent and 10 per cent per annum. For instance, the Olkaria I field has experienced a 4 per cent annual decline (Karekezi and Kithyoma, 2005).

The levelized energy costs in Kenya varies depending on the source of power, even though the consumer tariffs are adjusted to cover the higher cost interconnected power. For example in the year 2000, the bulk tariff for hydropower and geothermal energy was Ksh. 2.36 ($US 0.03/kWh) compared to Ksh. 8.26 ($US 0.106/kWh) from fossil fuel-based electricity. The consumer tariffs are set on the basis of long run marginal cost (LRMC) principle. The use of LRMC commenced in 1994 when the average tariff was raised from 35 per cent to 55 per cent, then subsequently to 75 per cent in 1996 and finally to about 100 per cent of LRMC in 1999 (Karekezi and Kithyoma, 2005).

In terms of investment costs, a geothermal project in Kenya was found to cost about $US 2,700 per kilowatt, which is less than the $US 3,000 per kilowatt for fossil-based generation plants. In the case of geothermal, there are high initial capital investments followed by low maintenance and operation costs. The reverse is the case for fossil generated power, which among other things suffers unpredictable operational and maintenance costs (Karekezi and Kithyoma, 2005).

Geothermal energy option is thus associated with positive economic benefits above other conventional energy sources especially in cases where it replaces fossil-fuel generated power. These include (Karekezi and Kithyoma, 2005):

(a) Foreign exchange savings owing to the foregone fossil fuel that would otherwise be purchased for power generation;

(b) An availability factor of about 100 per cent, making it a stable and secure base-load power, which cannot be matched by other sources. It is neither susceptible to drought nor is it subject to the direct effects of the globally volatile fossil fuel prices.

6. KEY SUCCESSES OF GEOTHERMAL ENERGY IN KENYA

6.1. Potential for local assembly and manufacture of geothermal equipment

Construction of geothermal power plants requires heavy equipment. Table 5 shows the different types of equipment for various geothermal plants. This study found that at present, virtually all tools and equipment for geothermal resource exploration and development in Kenya are imported. However, with the increased attention to the development of geothermal energy, limited local assembly and manufacturing of power plant components, (up to about 10 per cent in the short and medium-term) is feasible since the basic technical capacity is already available. A recent market acceleration forum for geothermal energy in the East African region concluded that the economics of investing in local manufacture of geothermal energy exploitation hardware would be favourable considering the widening geothermal activity in the region. To achieve this, member countries agreed to formulate and implement deliberate enabling policies (Karekezi and Kithyoma, 2005).

The development of geothermal energy also triggers the proliferation of small and medium- scale service enterprises to provide goods and services for construction, maintenance and operation. Harnessing of geothermal energy resource would be accompanied by a creation of niche markets, especially on the aspect of direct geothermal energy applications, and therefore emergence of energy service companies to take advantage of emerging opportunities. This is also already taking place, albeit at a slow pace (Karekezi and Kithyoma, 2005).

6.2. Employment and job creation

The development of indigenous energy supply systems stimulates local economies by creating the impetus for increased enterprise and job creation. This is especially so where community interests and participation are incorporated in the project conception, implementation and operation (Karekezi and Kithyoma, 2005).

An accurate number of individuals directly employed in geothermal energy is not easy to determine, given that many service and specialist development companies that work in this field also work in related industries such as oil exploration and ground water management. Secondly, the demand for specific services tends to be cyclical because geothermal developments are not continuous. The

Table 5. Major equipment items for geothermal power plants

	Types of energy conversion system			
Equipment	**Dry Steam**	**Single Flash**	**Double Flash**	**Basic Binary**
Steam and/or brine supply				
Down hole pumps	No	No (Poss)	No (Poss)	Yes
Wellhead valves & controls	Yes	Yes	Yes	Yes
Silencers	Yes	Yes	Yes	No
Sand/particle remover	Yes	No	No	Yes
Steam piping	Yes	Yes	Yes	No
Steam cyclone separators	No	Yes	Yes	No
Flash vessels	No	No	Yes	No
Brine piping	No	Yes	Yes	Yes
Brine booster pumps	No	Poss	Poss	Poss
Final moisture separator	Yes	Yes	Yes	No
Heat exchangers				
Evaporators	No	No	No	Yes
Condensers	Yes	Yes	Yes	Yes
Turbine-generator & controls				
Steam turbine	Yes	Yes	Yes	No
Organic vapour turbine	No	No	No	Yes
Diesel-admission turbine	No	No	Yes	No
Control system	Yes	Yes	Yes	Yes
Plant pumps				
Condensate	Yes	Yes	Yes	Yes
Cooling water circulation	Yes	Yes	Yes	Yes
Brine injection	No	No (Poss)	Yes	Yes
Non-condensable gas removal				
Steam jet ejectors	Yes	Yes	Yes	No
Compressors	Poss	Poss	Poss	No
Vacuum pumps	Poss	Poss	Poss	No
Cooling towers				
Wet type	Yes (No)	Yes	Yes	Poss
Dry type	No	No	No	Poss

Notes: Yes = generally used, No = generally not used, Poss = Possibly used under certain circumstances.
Source: DiPippo R, 1999 in Karekezi and Kithyoma, 2005

equipment suppliers, such as turbine and pump manufacturers, pipe fabricators and control hardware companies supply these items only as part of their product range (Karekezi and Kithyoma, 2005).

A crude estimate of additional jobs related to geothermal energy was made on the basis of generating 504 MW by 2019. It is assumed that for the plant and infrastructure construction alone, 2,016 construction jobs could be created in fifteen years while a further 856 jobs would be created for the operation and maintenance of the plant (Karekezi and Kithyoma, 2005).

Currently, a workforce of 493 persons is deployed at the Olkaria power stations. This works out at about 4 jobs per MW. This number compares favourably with the labour estimates above, bearing in mind that some of the personnel are assigned to other exploration activities (Karekezi and Kithyoma, 2005).

6.3. Useful uses of geothermal heat

Whereas emphasis on geothermal energy use in Kenya has been on electric power generation, there are other potential uses that can have direct impacts on poverty reduction. For instance, a geothermal heat resource is being used at a low-level in a horticultural farm near Lake Naivasha to control nighttime humidity levels in order to alleviate the incidence of fungal diseases. Similarly, low-temperature geothermal steam is used in Eburru for the drying of pyrethrum flowers and for various domestic purposes including water for livestock, drinking and irrigation. Such local uses of low-temperature geothermal heat may yield tangible poverty alleviation benefits (Karekezi and Kithyoma, 2005).

6.4. Favourable effects on external debt

Imports of oil constitute one of the largest indirect determinants of external debt. The importation of petroleum products accounts for about 25 per cent of the national import bill and therefore has a direct relationship with the status of the national external debt. The outstanding external debt of Kenya was estimated at $US 6.56 billion at the end of 1999. The growing debt has forced the country to limit its external borrowing to only concessionary loans. The continued repayment of loans has led to reduced resources available for domestic development. The external debt burden thus constitutes a serious obstacle to growth and employment creation (Karekezi and Kithyoma, 2005).

The high dependence on hydropower, coupled with occasional droughts, affects the quantity and quality of power services and synergistically triggers other adverse macro-economic effects. During power crises, the natural fallback has been fast-tracked thermal power installations, but these have negative economic implications. Table 6 shows the fraction of the national budget that goes toward fossil fuel import. This study found that the quantity of fossil fuel used in power generation constitutes about 5 per cent of the fossil fuels imported (authors' estimates). This significantly contributes to the accumulation of the external debt (Karekezi and Kithyoma, 2005).

The supply of geothermal power is important as a replacement of imported fossil fuels and could result in significant foreign exchange savings. Ordinarily, part of the revenue proceeds from the sale of geothermal power is used in permanent debt servicing besides the normal plant operation and maintenance (Karekezi and Kithyoma, 2005).

Table 6. Relationship between national annual budget and fossil-fuel import bill

Financial year	Annual national import bill (Million Ksh)	Annual fossil fuel import bill fuel (Million Ksh)	Proportion of fossil import bill to national budget
1990/91	39,448	9,356	23.7
1991/92	43,598	9,564	21.9
1992/93	52,821	12,174	23.0
1993/94	65,462	24,493	37.4
1994/95	87,027	17,817	20.5
1995/96	96,842	19,054	19.7
1996/97	107,806	23,866	22.1
1997/98	123,258	28,998	23.5
1998/99	120,085	30,699	25.6
1999/2000	124,528	39,345	31.6
2000/2001	155,505	63,112	40.6
2001/2002	156,531	56,767	36.3
2002/2003	180,825	43,957	24.3

Source: Karekezi and Kithyoma, 2005

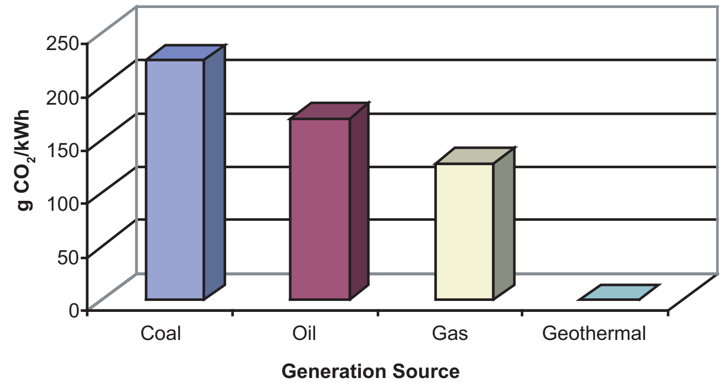
6.5. Reduced effect on environmental degradation and pollution

The promotion of environmentally clean energy is an important key to sustainable energy development. The environmental friendliness of geothermal power stands out against the conventional fossil fuel based power sources. Geothermal power plants have been reported to release negligible quantity of carbon dioxide compared to emission from oil-fired plants as illustrated in figure III (Karekezi and Kithyoma, 2005).

Assuming that 0.25 kg of carbon is avoided from fossil fuel generation for every kilowatt-hour of geothermal electricity supplied, and an availability factor of 98 per cent, Kenya's 127 MW installed geothermal capacity is already contributing to avoidance of about 272,567 tonnes[5] of carbon per year. Taking the value of

[5]Formula used is: 127 MW * 0.98 Availability Factor * 8,760 hours * 0.25 ton of carbon per MWh = 272,567 tonnes

Figure III. Comparison of CO2 emissions between geothermal and fossil-fuelled power generation in g per kWh



Source: Karekezi and Kithyoma, 2005

carbon to be $US 10 per ton, there would be an accruing certified emission reduction units (CERU) revenue stream worth $US 2.3 million per year, which Kenya could be earning within the framework of emissions trading arrangement under the Kyoto Protocol (Karekezi and Kithyoma, 2005).

Geothermal plants also have low sulphur emission rates. The newest generation of geothermal power plants are said to emit only 0.66 kg of sulphur dioxide per MWh of electricity generated. No combustion by-products such as nitrogen oxides are emitted. Geothermal facilities require limited land space for development. For instance, an average geothermal power plant uses 1–8 acres per megawatt compared to an average nuclear plant, which uses 5–10 acres per MW, or coal-fired plant, which requires 19 acres per MW (Karekezi and Kithyoma, 2005).

Geothermal energy development leads to reduced pressure on water resources to generate power and therefore makes more water available for other competing economic needs. In addition, provision of geothermal power has direct benefits for education and health. As more electricity is made available from geothermal plants, and with supporting policies, more rural schools and hospitals can be connected to the grid. In addition, geothermal-based enterprises provide employment opportunities for the local community (Karekezi and Kithyoma, 2005).

Even though geothermal energy is a relatively clean energy source, its development can have negative impacts, which if not mitigated, can make geothermal energy exploitation not environmentally viable. For example, geothermal energy utilization can cause surface disturbances, physical effects due to fluid withdrawal, noise and the emission of chemicals. At Olkaria, these environmental impacts have been mitigated by using several measures such as reducing the drill pad sizes, rehabilitating the opened areas by planting grass and trees, and putting in place monitoring programmes. These programmes assist in checking the unforeseen impacts that appear during the operational phase of a geothermal development. With the new Environmental Management and Coordination Act, KenGen has put in place an effective Environmental Management System (EMS) and is in the process of seeking ISO 14000 certification (Karekezi and Kithyoma, 2005).

7. CONCLUSIONS

7.1. The impact of geothermal energy

Significant environmental concerns associated with geothermal energy include those to do with site preparation, such as noise pollution during the drilling of wells and the disposal of drilling fluids, which require large sediment-settling lagoons (Open University, 1994).

However, geothermal power exploitation is preferred and has numerous advantages over other energy sources. Among the benefits of geothermal power are near-zero emissions (true for modern closed cycle systems that re-inject water back to the earth's crust), and very little space requirement per unit of power generated in contrast to other energy sources such as coal or hydro-dam based electric power (see also following table 7)[6] (Karekezi and Kithyoma, 2005).

Table 7. Land use requirements for different energy technologies

Technology	Land occupied (m2 per MWh)
Coal (including pit coal mining)	3,700
Solar thermal	3,600
Photovoltaic	3,200
Wind (land with turbine and roads)	1,300
Geothermal	400

Source: Karekezi and Kithyoma, 2005

[6] It has to be noted that table 7 refers to energy and not power produced. In order to get the space requirements per unit of power, the availability factor of the various technologies should be taken into account.

Geothermal plays a vital role in minimizing fuel imports by providing an alternative to thermal-based electricity and offers diversification in energy generation, thus strengthening energy security (Karekezi and Kithyoma, 2005).

Geothermal resource development and exploitation can create significant job and enterprise opportunities both directly and indirectly. In 2002, the 45 MW plant at Olkaria I (Kenya) had created 493 jobs: 15 scientists, 21 engineers, 82 technicians, 175 artisans/craftsmen and 200 support staff, which translates to 10.96 jobs/MW in operations and maintenance (Karekezi and Kithyoma, 2005).

Geothermal power has the combined environmental advantages of very low emissions (modern closed cycle systems re-inject the used water back into the earth's crust) and a very low land requirement when compared to conventional energy sources (Karekezi and Kithyoma, 2005).

REFERENCES

AFREPREN (2004) AFREPREN Occasional Paper 23: African Energy Data Handbook, Nairobi, Africa Energy Policy Research Network (AFREPREN).

Karekezi, S. and Kithyoma, W. (2005) Sustainable Energy in Africa: Cogeneration and Geothermal in the East and Horn of Africa – Status and Prospects, Nairobi, AFREREN/FWD and Heinrich Boll Foundation Regional Office for East and Horn of Africa (HBF)

Open University (1994), T521 Renewable Energy: A Resource Pack for the Tertiary Education, Milton Keynes, United Kingdom: The Open University

INTERNET RESOURCES

www.consumerenergycenter.org/renewables/geothermal/index.html

www.nrel.gov/learning/re_geothermal.html

www.nrel.gov/learning/re_geo_elec_production.html

www.eere.energy.gov/femp/technologies/renewable_geothermal.cfm

www.renewableenergyaccess.com/rea/tech/geothermal

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Renewable Energy

Module 8:
IMPACT OF POWER SECTOR REFORM OPTIONS ON RENEWABLES

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Module overview

- Unit aims and learning outcomes
- Introduction
- Impact of the following reform options on renewable energy:
  - Unbundling of utilities
  - Independent power producers (IPPs)
  - Electricity Law amendment
  - Corporatization
  - Management contracts
- Conclusions

Module 8

Module aims

- To highlight positive and negative impacts of reform options on renewable energy
- To provide examples of countries that have implemented the aforementioned reform options and the results achieved with respect to renewable energy technologies (RETs).

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Module learning outcomes

- To understand the potential benefits and drawbacks of the various power sector reform options with regard to renewable energy
- To draw lessons from the case studies provided

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Unbundling on RE

- Rationale for unbundling is to enhance overall operational efficiency of the power sector by separating the core business units of generation, transmission and distribution into legally and operationally distinct and independent entities
- This module mostly focuses on vertical unbundling as there is relatively limited implementation of horizontal unbundling
- The impact of vertical unbundling on renewables has largely been positive. One of the best examples to illustrate the positive impacts is found in Kenya

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Unbundling on RE (2)

- Unlike the formerly state-owned utility, the privately owned generation utility, KenGen, has been showing significant interest in renewables:
  - KenGen has invested in the expansion of geothermal electricity generation capacity
  - KenGen has pledged to partner with the private sector and is willing to invest up to 50% of the capital costs for attractive small-hydro and bagasse-based cogeneration projects

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Unbundling on RE (3)

- Based on the Kenya experience, the following lessons are drawn pertaining to the impact of vertical unbundling on renewables:
  - Vertical unbundling opens up opportunities for sourcing electricity from renewables
  - Vertical unbundling also encourages the generation utility to make maximum use of least-cost options as a way of ensuring profitability
  - Vertical unbundling appears to encourage diversification of electricity generation options and the maximization of locally available energy resources

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Unbundling on RE (4)

- Generally, where unbundling has been implemented in parallel to a dedicated rural electrification programme there has been a positive impact on renewables, especially for:
  - Small-hydro
  - Cogeneration
  - Solar PV
- Renewables for rural electrification are attractive because their output relatively matches the low electricity demand levels in rural areas

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Independent Power Producers on RE

- Increasing electricity generation capacity through private investments was one of the main drivers of power sector reforms
- Recent studies show that IPPs primarily favoured fossil fuel-based sources and large hydro
- IPPs based on renewable energy only played a secondary role

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Independent Power Producers on RE (2)

- The majority of the IPPs (implemented and proposed) is now fossil fuel-based. Nevertheless:
  - 37% of the total installed capacity of all the implemented and planned IPP investments are using renewable energy-based electricity generation options such as hydro, wind, bagasse-based cogeneration and geothermal
- Still IPPs offer good opportunities to stimulate renewable energy and reinforce renewable energy policies

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Independent Power Producers on RE (3)

- Although fossil fuel-based IPPs exceed renewables ones, the power sector reform has allowed for interesting new developments in the region:
  - Mauritius IPPs provide 33% of the country's installed power capacity and about half of this generation capacity is bagasse-supplied
  - UNEP in collaboration with ADB and AFREPREN/FWD are working on two projects to promote IPP development by the sugar industry and tea sector in eastern and southern Africa

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Electricity Law Amendment on RE

- A review of amended Electricity Acts in several sub-Saharan African countries reveals that most of them do not explicitly mention or promote the use of renewable energy in electricity generation
- However not surprisingly, countries with vigorous renewable energy programmes appear to have amended their Electricity Acts to explicitly promote renewable energy. Good examples are Ghana, Kenya, Namibia and Uganda

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Electricity Law Amendment on RE (2)

- First, the amended Acts explicitly promote the use of renewable energy for electricity supply, especially in rural areas. For example, in the case of Uganda the Act:
  - Clearly stipulates that the Minister of Energy and Minerals should incorporate renewables in the Rural Electrification Strategy and Plan which is approved by Cabinet
  - Provides for mandatory reporting on the progress achieved by the Minister to Parliament on an annual basis

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Electricity Law Amendment on RE (3)

- Secondly, the amended Electricity Acts in Kenya, Uganda and Namibia appear to minimize regulatory requirements for investors interested in the installation of small-scale electricity generation power plants. For example:
  - In Kenya, renewable generation incorporated into a hybrid system not exceeding 1 MW at medium transmission voltage are not required to go through the otherwise rigorous standard licensing procedure
  - In Uganda, electricity generation plants not exceeding 0.5 MW only require registration with the Electricity Regulatory Authority (Republic of Uganda, 1999)

Module 8

Impact of Electricity Law Amendment on RE (4)

- In Namibia, no generation licence is required for electricity generation equipment below 500 kVA for own use (Republic of Namibia, 2000).

- Thirdly, the amended Electricity Acts also give priority to the funding of renewables based electricity generation investments, especially for rural electrification
- Fourthly, amendments to the Electricity Acts have contributed to more environmentally friendly electricity generation

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Corporatization on RE

- The rationale for corporatization is generally to ensure that the utility is profitable
- Corporatization in Africa has generally had a negative impact on renewable energy due to its profit motive:
  - Utilities tend to avoid investments involving relatively high upfront cost
  - Utilities are pushed to minimize their operational costs
  - Utilities are encouraged to make investments in generation only when the IRR/payback period is attractive
  - Thereby sometimes overlooking the bigger picture:
    - Renewable energy projects generally have lower fuel costs
    - Renewable energy projects can have very attractive characteristics in specific sites

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

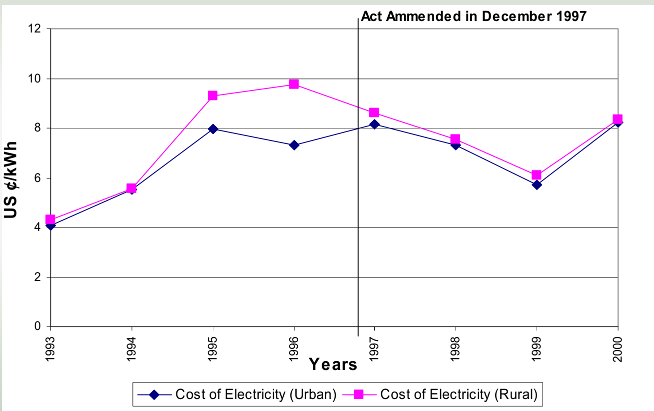
Impact of Corporatization on RE (2)

- Corporatization implies that the utility applies the principle of full cost recovery
- It can therefore use renewables for electricity generation and charge a tariff that is commensurate to the cost of electricity supply
- A corporatized utility is also likely to identify and implement least-cost electricity generation options especially for rural electrification

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Cost of Electricity to End-User in Kenya



Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Management Contract on RE

- Management contract transfers responsibility for the operation and maintenance of government-owned businesses to a private entity
- While the ultimate goal of management contract is the same of corporatization, i.e. making the utility profitable, evidence shows that the real impact of management contractors on renewables has been generally neutral. This is mainly because:
  - The targets of management contractors usually revolve around enhancing operational efficiency of the utility, especially in the distribution segment
  - Management contractors have limited decision-making powers pertaining to investment in new generation facilities. They do not significantly influence the decision on whether or not to install new renewable energy-based power plants.

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Case Study 1: Geothermal Development in Kenya - Targets and Incentives

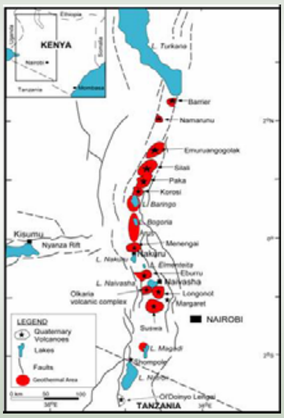
- Kenyan draft Energy Policy—by the year 2020, the installed capacity of geothermal is expected to account for a quarter of the total national installed electricity capacity. It currently accounts for 9.7%
- The draft policy provides the following incentives:
  - 10 year tax holiday for geothermal plants of at least 50 MW; 7 years for plants in the range of 30 - 49 MW; 5 years for plants between 29 - 10 MW
  - 7 year tax holidays on dividend incomes from investments from domestic sources
  - Duty and tax exemptions on the procurement of plant, equipment and related accessories for generation and transmission during project implementation. In addition, the procurement of spare parts would be made free of duties and taxes

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Case Study 1: Geothermal Development in Kenya - Kenya Geothermal Potential

- Kenya’s geothermal power potential is estimated at over 3,000 MW
- Most of Kenya's geothermal potential areas (more than 20 fields) occur within the Kenya Rift Valley
- Current installed geothermal power: KenGen 115 MW and IPP’s 15 MW
- Only a small fraction of the estimated resource has been harnessed

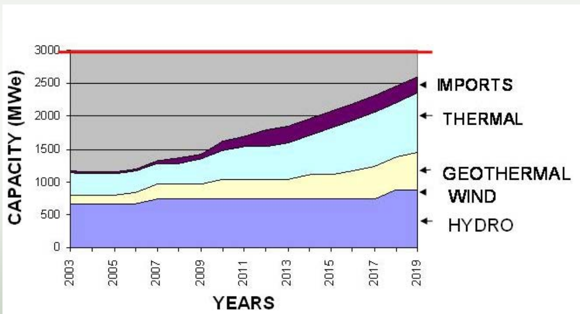


Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Case Study 1: Geothermal Development in Kenya - Kenya Planned Capacity Expansion

Geothermal can meet all Kenya’s capacity expansion requirements for the next 15 years



Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Case Study 1: Geothermal Development in Kenya – Medium Scale Option (Regional)

- Significant potential along the great Rift Valley (9,000MW—for steam/hot water only)
- About 1% of the estimated total geothermal resource is presently harnessed in Africa, largely in Kenya
- Potential for grid-connected electricity generation from geothermal also in Ethiopia, Tanzania and Uganda
- Significant potential for thermal use of geothermal energy

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Case Study 2: Standards PPA for Small Hydropower Development in South-East Asia

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Case Study 2: Standards PPA in South-East Asia - Background Nepal

- 1992: Electricity Act amendment
  - 1995 : 2 x IPPs (96 MW)
- 1998: Standard PPA announcement + technical support
  - Utility to buy all electricity ≤ 5MW
  - 50 feasibility studies
  - 20 PPAs signed
  - 10 projects reaching financial closure
  - 7 projects begun construction
  - Local investment = $US 47 million during the past 7 years only

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Case Study 2: Standards PPA in South-East Asia - Standard PPA in Nepal

- US¢ 4.2 per kWh for May÷Dec, 8 months “wet season”
- US¢ 5.82 per kWh for Jan÷Apr, 4 months “dry season”
- 6% escalation rate for 5 years from 1998
- Currently: **US¢ 5.90** per kWh (average) with no more escalation
- PPA valid for 25 years
- “Take or pay” for contracted energy

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Case Study 2: Standards PPA in South-East Asia - Background Sri Lanka

- 1994: Electricity Act amendment
  - Allowed IPPs of ≤ 10 MW
- 1997: Standard PPA announcement
  - Annual revision
  - Price based on utility's avoided cost
  - Price also indexed on international oil price
  - International oil price averaged over 3 years
- Projects (World Bank)
  - Energy Service Delivery (ESD)
    - 15 projects = 31 MW
  - Renewable Energy for Rural Economic Development (RERED)
    - 5 projects = 120 MW

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Case Study 2: Standards PPA in South-East Asia - Standard PPA in Sri Lanka

	Dry Season (Feb-April) USc/kWh	Wet Season (balance months) USc/kWh
1997	3.38	2.89
1998	3.51	3.14
1999	3.22	2.74
2000	3.11	2.76
2001	4.20	4.00
2002	5.13	4.91
2002	5.90	5.65
2003	6.06	5.85
2004	5.70	4.95
2005*	6.05	5.30

* Likely to increase due to continued high oil prices

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

CONCLUSIONS

- Different reform options appear to have different impacts on renewables, ranging from negative to positive.

However:

- The majority of the reform options have largely had negative impacts on renewables so far (corporatization, management contracts and IPP development)
- Unbundling of the power sector, especially vertical unbundling, appears to have had significant benefits and enhanced the promotion of renewables
- Amended Electricity Acts in most countries do not explicitly promote the use of renewables for electricity generation. But where they do, as in Uganda, Ghana, Kenya and Namibia, they provide good examples of how to promote renewables in a reformed power sector

Module 8

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Questions/Activities

1. Discuss the impact on renewables of the reform option(s) relevant to your country
2. How effective are the presented case studies for replication in your country?

Module 8