Module 15

Impact of different power sector reform options on energy efficiency in Africa

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

CONTENTS

1. MODULE OBJECTIVES

1.1. Module overview

Past studies on power sector reform in Africa reveal that power sector reforms were largely designed to increase the electricity generation capacity and to ensure profitability of the power sector and not to promote its efficiency per se. It is therefore, not surprising that energy efficiency is yet to gain significant foothold in the area of energy generation, transmission, distribution, and usage in Africa. This is in spite of the increased call by the international community for energy conservation and demand-side management.

The overall objective of this module is to provide a broad overview of the impact of power sector reforms on energy efficiency in Africa. In particular, the module discusses the impact of reform options on energy efficiency by focusing on five key options, which include: unbundling (also referred to as restructuring); management contracts, corporatization/commercialization; independent power producers (IPPs); and amendment of the Electricity Law.

The impact of these five reform options on energy efficiency in Africa has been elaborated under each option. It is important to note that the impact for each of the reform options is different from country to country depending on the manner, pace and the timing of reforms and, as a result, the module provides specific country examples under each of the options.

The final section of the module presents key overall conclusions on the impact of the power sector reform on energy efficiency, the key terminologies and references/websites used.

1.2. Module aims

The aims of the present module are:

- To highlight the positive and negative impacts of the five different power sector reform options on energy efficiency in Africa to date;
- To provide examples, where relevant, of countries that have implemented the above reform options and the results achieved.

1.3. Module learning outcomes

The present module attempts to achieve the following learning outcomes:

- To appreciate the potential benefits and drawbacks of the various power sector reform options with regard to the promotion of energy efficiency;
- To draw lessons from the case studies provided.

2. INTRODUCTION

Currently efficiency programmes are largely absent in most countries. With the exception of a few countries in sub-Saharan Africa, energy efficient systems development is often undertaken within an energy planning and policy vacuum. As a result, the development of energy efficiency systems often follows an ad hoc path with no reference to a coherent vision and plan. For example, in Malawi, the policy vacuum has meant that the majority of energy efficient system dissemination efforts have not only been ad hoc in nature, but operated largely as an informal activity outside the formal Government planning and budgeting cycle, thus failing to attract significant support from the national treasury and/or donor agencies (Kafumba, 1994).

Policies that are supportive of energy efficiency should therefore explicitly set the stage for the implementation of innovative institutional structures in the form of energy agencies which can help to promote energy efficiency in the region (Praetorius, B. and Bleyl, W., 2006). In Kenya, for, example, it is estimated that between 10-30 per cent of the primary energy input is wasted (IEEN, 2002).

In general, power reform options were not primarily designed to promote energy efficiency. The main objective of reforms was to increase electricity generation capacity and to enhance the financial health of the utilities.

Very few countries have included provisions in reforms to secure and enhance activities and resources for energy efficiency. In Africa, most reforms measures are generally seen to hinder the wider use of energy efficiency options. For example, requiring utilities to reduce consumer demand for electricity through energy efficiency is, in an ideal setting, expected to promote competition. However, in the majority of African countries where the monopoly of national utilities prevails with a static customer base, reduction in consumer demand might appear to affect profitability of the utility due to a reduction in sales. On the other hand, energy efficiency regulations may enable a utility to have more electricity available for distribution thereby encouraging it to seek more new customers to absorb the excess energy. However in practice, most national utilities consider promotion of energy efficiency to reduce consumer demand only during periods in which there is a shortfall in generation capacity. As soon as the generation capacity resumes to normal, promotion of energy efficiency peters out.

Other reform options however, appear to present opportunities and/or barriers to the promotion of energy efficiency.

This module discusses how various reform options impact on the promotion of energy efficiency and it provides examples from African countries to illustrate these impacts.

3. IMPACT OF UNBUNDLING ON ENERGY EFFICIENCY

The key objective of unbundling—separation of the core business units of generation, transmission and distribution into legally and operationally distinct and independent entities—is to enhance overall operational efficiency of the power sector. There are two types of unbundling: vertical unbundling and horizontal unbundling. Since the implementation of horizontal unbundling in sub-Saharan Africa is limited, this section will focus on the impacts of vertical unbundling.

Perhaps the most important positive impact of vertical unbundling is exposing the inefficient sections in the power system. Prior to unbundling, utilities facing high system losses—an indicator of an inefficient energy system—would cover for the losses by using part of the reserve generation capacity to dispatch higher amounts of electricity into the system. However, unbundling implies that the generation, transmission and distribution segments have to minimize electricity and financial losses to meet committed generation, transmission and distribution levels as well as economic performance. In each of these cases, the regulatory framework and tariff setting mechanisms can play an important role in driving utilities towards increased energy efficiency in all three segments.

Besides the aforementioned potential and desirable positive impact of vertical unbundling on energy efficiency, there are also some negative impacts to be considered. One of these is linked to the fact that the separation of generation and distribution segments means that the distribution utility is at liberty to obtain electricity from different sources. The general response by the distribution utilities to increases in electricity demand appears to be seeking additional suppliers of electricity rather than embarking on demand-side energy efficiency programmes.[1]

[1] In this regard appropriate regulation could reconcile the objective of distribution utilities to increase sales with that of improved energy/power efficiency. A major cause of the failure of the first DSM programme in Ghana was the fact that the distribution company was charged by the generation and transmission company only for energy supplied (kWh) and not for power demanded (kW). Under such arrangement the distribution company did not have any reason or incentive to care about power efficiency aspects such as consumers' power factor and harmonics. Besides charging distribution companies for power demanded, a possible way to address low efficiency could be that of allocating distribution utilities a "fixed" portion of available power generating capacity, for a certain period of time (e.g. 1-2 years). It would be then in the interest of the distribution utilities to attain for such power capacity the best possible load factor in order to maximize energy sales. It would also serve as an important incentive for improved efficiency if a parameter linked to the efficiency of the distribution was incorporated into tariff calculation formulae.

The need for additional electricity generation appears to have in turn encouraged a focus on large-scale thermal IPPs. As a result, opportunities for both energy efficiency through DSM and distributed generation (offered by renewables such as small hydro, cogeneration and geothermal) have not been fully exploited.

Another negative impact that power sector reforms seem to have had on energy efficiency is the fact that integrated resource planning has become less useful or relevant (IEA, 2000). Prior to unbundling, integrated resource planning was an important tool in the hands of the one utility, usually state-owned, mandated to manage and develop all sector-related activities: generation, transmission and distribution. Within a vertically unbundled power sector, various established autonomous entities would likely tend to carry out resource planning largely independently unless appropriate institutional and coordination mechanisms are put in place to ensure that integrated resource planning is to be used effectively.

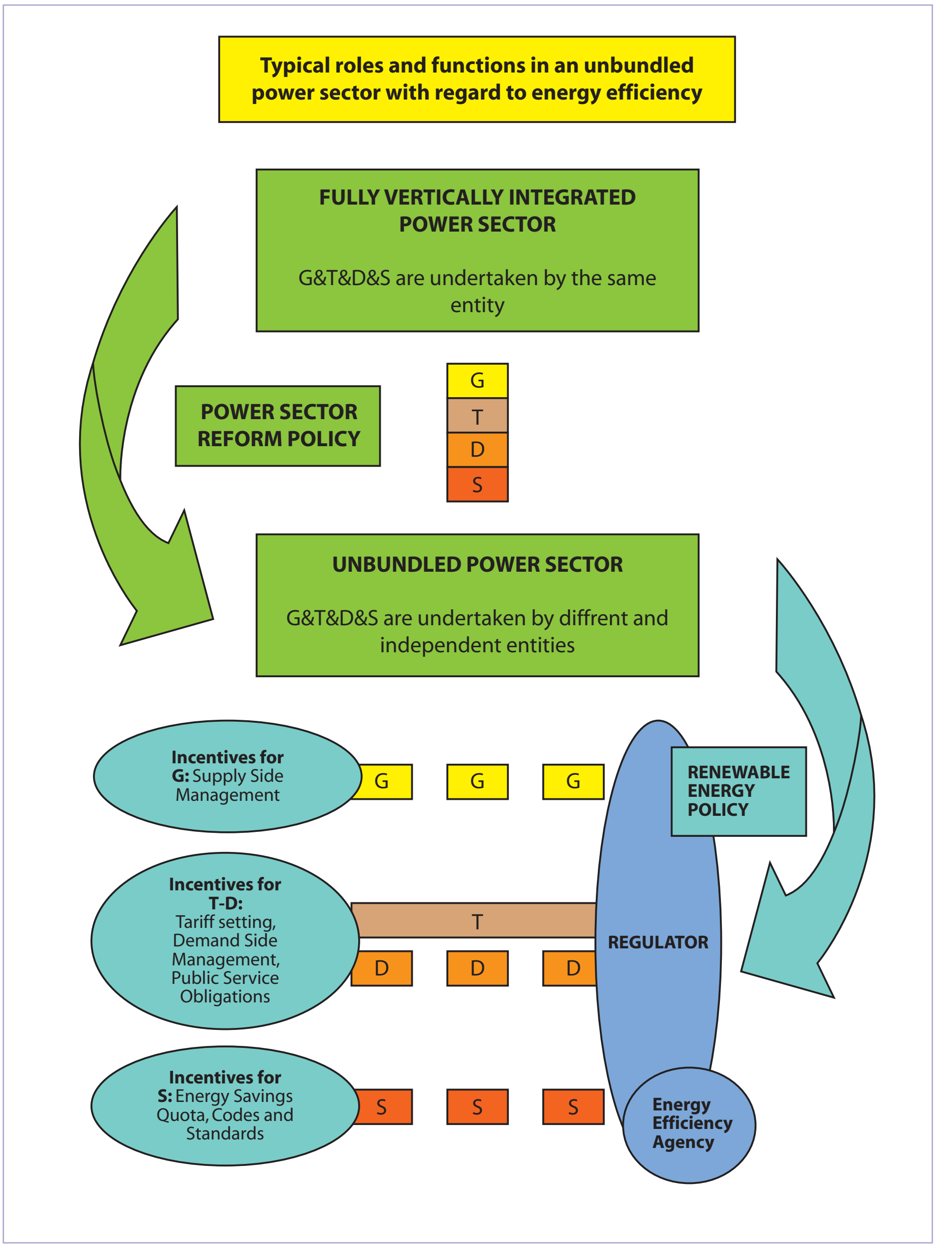
This includes any supply-side management (SSM) and demand-side management (DSM) programme would need to be initiated and monitored from outside the utility, i.e. by the independent regulator and/or supported by an Energy Efficiency Agency or Government ministries.

In most European countries the integrated approach including resource planning and security of supply tend to become responsibilities of regulators and governments, rather than of (national) utilities. This approach makes it easier to integrate the priorities of the national energy policy in the future development of the energy sector, as well as to make social and environmental corrections in the market. On the other hand it remains a difficult task as regulators often do not have all the information about resources and market player's strategies, and in addition the advice from regulators is not necessarily followed by the national government and parliament.

Figure 1 presents the organization and different roles with regard to energy efficiency in an unbundled power sector. SSM and DSM are further elaborated in modules 13 and 14, as well as in examples of how energy efficiency measures are implemented, e.g. in Denmark and Flanders.

Dedicated energy efficiency agencies are quite rare in both Africa and industrialised countries. Tunisia with its National Agency for Energy Efficiency (ANME) over the last two decades has been on the forefront of energy efficiency measures in the Mediterranean region. The background and roles of ANME are further explained in the Case study "National Agency for Energy Efficiency (ANME) in Tunisia" at the end of this module.

Figure I. **Power sector reform and energy efficiency: possible way forward for Africa**



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

4. IMPACT OF ELECTRICITY LAW AMENDMENT ON ENERGY EFFICIENCY

One important contribution of the amended Electricity Acts is that they stipulate the formation of the regulatory authority. However, with the exception of South Africa, few other regulators have made the preparation of integrated resource plans (IRPs) which include energy efficient systems—an important pre-requisite for licensing. In most countries of the region there are at the moment, no explicit and effective incentives or requirements in place for the promotion of energy efficiency or demand-side management.

A textual assessment of the newly amended Electricity Acts of most countries in East and Southern Africa reveals that the Acts do not explicitly promote energy efficiency i.e. they do not stipulate support for energy efficiency technologies nor do they provide for energy efficiency programmes or any targets. Consequently, the promotion of energy efficiency is left to the discretion of the Ministries of Energy and the respective energy/electricity regulatory agencies.

Mauritius is one of the few cases where the newly amended Electricity Act clearly supports the use of energy efficient technologies for electricity generation especially through bagasse-based cogeneration. The Act guarantees attractive tariffs for investors in energy efficient technologies as provided for in section 5 (3) of the Schedule to the Electricity Act 2005 (GoM, 2005):

> "Where the Authority imposes a requirement in terms of paragraph (2), the Authority shall ensure that the reasonable costs incurred by the licensee as a result of the requirement are recovered by the licensee."

Generally, where some mention of energy efficiency in the Electricity Act is made, it is not highlighted as a priority. For example, in several national Electricity Acts, energy efficiency is one of the many factors that might be considered in determining a tariff. In some cases, implementation of energy efficiency measures is provided by the Electricity Act as an elective and to the discretion of the Minister. For instance, this is the case of the Namibian Electricity Act 2000 whose excerpt from section 32 (2) is provided below:

> "…the Minister may, if the Minister considers it to be in the national interest… accordingly make arrangements or issue directives to the local authority for the promotion of the efficient utilization of electricity."

In order to ensure the substantial support of energy efficiency, a thorough revision of the Electricity Acts—the pillar of power sector reforms—is necessary.

Box 1 provides an example of what the institutional organization could look like under a legislation framework that has energy efficiency as one of its declared objectives.

Box 1. Energy savings obligation on distribution network operators in Flanders

The Electricity Law which sets out the liberalization process of the Flemish energy sector also contains provisions with regard to energy efficiency. Based on the Electricity Law further legislation was approved clarifying the obligations imposed on both electricity suppliers and distribution network operators (DNO) as part of their public service obligation.

Electricity suppliers only need to comply with the obligation to carry out a set of informative actions, such as including the source of the energy used to produce the electricity on every energy bill, as well as the evolution of the energy use of the consumer over the last three years in order to make people better aware of their (changing) energy consumption.

DNO are subject to obligations both in terms of informative actions as in terms of achieving effective energy savings results; the DNO need to save 1 per cent of primary energy of its distributed energy. For every kWh not being saved a penalty of 10 c€ has to be paid. In order to trigger the significant energy savings potential at household level the target for low voltage customers was increased to 2 per cent in 2004, and gradually increased to 2.3 per cent in 2007.

The DNO can choose which measures it deems most appropriate to achieve its target, and a plan—the Energy Savings Action Plan—describing the set of supportive measures needs to be submitted and approved by the Energy Agency. The extra costs for carrying out these actions and measures are allowed to be integrated in the distribution tariffs; the penalties are not. This is checked by the Energy Regulator.

Source: Flemish Energy Agency, 2008, www.energiesparen.be

For some further examples of Electricity Law Amendments which laid the basis for the energy efficiency measures (which are then described in full detail) reference is made to module 16 “Policy and Regulatory Options to increase Energy Efficiency”, notably for Japan, Korea and Flanders.

5. IMPACT OF CORPORATIZATION ON ENERGY EFFICIENCY

The rationale for corporatization is to ensure that the utility is profitable. The profit-making motive of corporatized utilities has contributed to this reform option having some negative impacts on the promotion of energy efficiency in Africa. There is no motivation for the utility to enhance demand-side energy efficiency as it requires an additional investment and could potentially lead to lower revenue levels that can negatively impact profitability. This is particularly true in the case where utilities have not increased their consumer base for a long time. As it is the case now, most of the utilities in the region have made very little progress in connecting new customers.

However, corporatization can also have positive impacts on energy efficiency. Two examples of these positive impacts[2] are discussed below:

- Corporatization of state-owned utilities leads to enhancing the utilities' competitiveness by driving them to reduce their cost of production in order to maximize profitability. This development encourages utilities to implement energy efficiency measures that minimize system losses, which in turn reduces the cost of power production.
- Peak load "shaving" in the power system thereby minimizing the need for huge investments to meet peak demand, which lasts for only a few hours in a day. For example, the peak load experienced in the mornings is often associated with water heating. Therefore, using energy efficient water heating technologies such as solar water heaters can "shave off" a significant amount of the peak load and also provide attractive returns to the end-user (see box 1).

[2]The potential for the stated positive impacts to materialize could be influenced significantly by the type of regulatory framework/electricity sector legislation that are in place. For example, it is legitimate to expect that a utility would pursue efficiency improvements and costs reduction under a price-cap regulatory system. On the contrary, under a rate-of-return (ROR) regulatory mechanism, a utility might not have any financial and economic interest in pursuing efficiency improvements unless an efficiency factor is accounted for in the ROR setting calculating formula.

Box 2. Case of solar water heaters in Ethiopia

Based on its storage capacity and who its producer is, the price of a locally manufactured solar water heater ranges from $US 400 to $US 625, while the price of imported ones range from $US 680 to $US 910. Studies undertaken by the Faculty of Technology, Addis Ababa University, indicate that with the current electricity tariffs, the investment cost of a solar water heater can be paid back within six months (source: Gashie, W., 2005). Given the plan to further increase the electricity tariffs (as required by the World Bank and other financial institutions) the installation of solar water heaters will become even more economically attractive in the future. A cost comparison study carried out by the Ethiopian Rural Energy Development and Promotion Center between solar water heaters and electric boilers indicates that the former has more advantages over the latter, especially for commercial purposes. Another comparative study made for a small hotel indicates the possibility of saving a minimum of $US 2,600, which translates to a payback period of about eight years.

Solar water heaters appear to be economically attractive in Ethiopia due to the escalation of the price of petroleum and electricity in the last past few years. This has been caused mainly due to price rise of petroleum price at global level and the removal of government subsidy from the end use supply of the two commodities. As the subsidy is removed, the price of oil and electricity will continue to rise, making solar water heaters more attractive.

This example is relevant in highlighting how the removal of subsidies for traditional energy sources (as a form of corporatisation) can facilitate the deployment of new and economically viable sustainable energy technologies. More information is available in the case study on Solar Water Heating in Ethiopia, which can be found as an annex to this module.

Source: Workineh, G. 2006

6. IMPACT OF INDEPENDENT POWER PRODUCERS ON ENERGY EFFICIENCY

The advent of independent power producers (IPPs) has had a positive impact on the promotion of energy efficiency in several ways. For example, IPPs have enabled utilities to retire old and inefficient generation power plants. Some of the inefficient power plants were kept in service longer than their useful lifetime due to inadequate electricity generation capacity and, at the same time, lack of capital to build new power plants.

The perceived profitability of IPPs appears to have convinced some industries whose core business is not electricity sales to implement energy efficiency measures to enable them become net electricity exporting entities in two ways. Firstly, some entities with embedded generation have embarked on "in-house" energy efficiency measures thereby consuming less energy. The resultant excess generation capacity leads to higher electricity sales to the grid. This is the case of the sugar industry in Mauritius, which currently contributes to 40 per cent of the electricity production in the country.

Secondly, industrial entities located near attractive small hydropower sites are developing the sites for captive power as well as for exporting the excess electricity to the grid. This is the case of the tea industry in Eastern and Southern Africa.

Another positive impact of IPPs on energy efficiency is that some utilities appear to encourage privately owned distributed generation in order to enhance energy efficiency and stability within the grid. A case example is in Zimbabwe where the national utility entered into an IPP agreement with a sugar mill in the Chiredzi area to foster energy efficiency and enhance stability of the grid in that part of the country.

The advent of IPPs has also had some negative impacts on energy efficiency. By definition, an IPP implies a certain amount of vertical unbundling, which complicates attempts to implement integrated resource planning (IRP) a key platform for promoting demand-side management (DSM).

Box 3 offers an example of how investments in more energy efficient equipment leading to both environmental and economic benefits. The IPP in this case is a public district heating company. In addition this example highlights the institutional set up of the utility as well as regulatory aspects like tariff structures and demand side management. Box 4 offers an example in Czech Republic where a combined heat and power (CHP) plant increases efficiency, and the use of sewage gas replacing natural gas.

Box 3. Modernization of the district heating system in Zhytomyr, Ukraine

The proposed project involves the rehabilitation and modernization of the existing district heating infrastructure, including modernization of the boiler houses and the replacement of pipes. In addition new residential apartment buildings in the City will be equipped with meters, and small co-generation plants will be installed. The Municipal District Heating Company "ZhytomyrTeploKomunEnergo" is a municipal enterprise wholly owned by the City of Zhytomyr in Ukraine.

The efficient institutional set up of the municipal utility will be supported by the following regulatory aspects:

- Tariff setting methodology: the project will include the implementation of a market-based tariff structure which aims at full cost recovery thus ensuring long term financial sustainability of the district heating sector in the city;
- Demand-side management: consumers will be billed according to actual consumption, motivating end-users to economize natural resources;

The change towards a demand-driven business strategy, the adoption of a least cost district heating strategy, shift to alternative fuels, recovery of waste heat and the introduction of heat pumps are expected to further increase efficiency and reduce emissions.

Economic and environmental benefits: The decreased heat consumption and a rational prioritization of further upgrades and renovations of the district heating system will reduce fuel consumption (economic benefit) and emissions (environmental benefit) from the heat production plants.

The project is not yet realized; at this stage it has passed the concept review for obtaining a loan from EBRD for 10 million euros. The total project cost is estimated at 12.6 million euros.

Source: Bank for Reconstruction and Development (EBRD), February 2008

Box 4. CHP plant using biogas in Otrokovice, Czech Republic

The sewage disposal plant is operated by private company Toma Inc. and takes care of both the industrial sewage from the local leather industry and the municipal sewage of the local town of Otrokovice.

When the sewage plant was enlarged two CHP units were installed in 1994 and 1996, and a third one was commissioned in 2005. Especially this third CHP unit was aiming to make more efficient use of the energy sources provided by the sewage system, i.e. to transform the sewage waste into biogas and use the heat for the operation of the plant, and secondly to generate electricity from the biogas production.

The project makes sense from a financial point of view; the excess electricity generation is fed into the grid, creating an important additional revenue stream as a fixed price is set by the Energy Regulatory Office. Secondly savings are generated at both heat and electricity level; instead of having to purchase about 86 MWh electricity per year, as much as 1,400 MWh is resold to the grid, in addition to covering the plant's own electricity needs. Similarly the CHP unit provides the heat requirements of the plant (about 1,700 MWh per year) thus avoiding the purchase of 180,000 m3 of natural gas.

In addition there are environmental gains; without using the biogas in the CHP the methane—which acts as a powerful greenhouse gas—would be lost into the atmosphere. Finally emission reduction in terms of SO_2, NO_x and CO_2 are realised through the avoided use of natural gas.

Source: CHP Projects in Czech Republic, Austrian Energy Agency, 2006, www.energyagency.at

7. IMPACT OF MANAGEMENT CONTRACT ON ENERGY EFFICIENCY

Management contracting has been adopted in different economic sectors, and therefore has different meanings. In the energy sector, it refers to outsourcing of the managerial functions of a utility 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.

If properly implemented, management contracting enables the following:

- It helps in determining, early in the process, what tasks the contractor should accomplish. The management contract provides specific statements of work that contain clearly stated, results-oriented performance criteria and measures.
- It engages the contractor expeditiously so as to meet demanding schedules. Where practical, contracts can be issued in advance so that contractors are available when needed.
- It minimizes cost while maintaining quality by:
  - Maximizing competition.
  - Using past performance information as a factor in awarding future work.
  - Using incentives to motivate superior contractor performance.

To a limited extent, management contract also impacts on the promotion of energy efficiency in the same way as corporatization because of 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, which last for a relatively short period of about 2 years,[3] 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 and new energy efficiency investments.

If, however, management contracts incorporate energy efficiency improvement targets, it can have a positive impact on the promotion of energy efficiency. For example, peak “shaving” can avoid large-scale investments in generation, which increase liabilities and reduce profitability.

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

8. CONCLUSION

Energy efficiency in Africa is generally given a low priority, both at the industrial and domestic level. The power sector reforms have not adequately supported the promotion of energy efficiency in the power sector. However different reform options appear to have different impacts on energy efficiency i.e. some have neutral impacts while others have positive and/or negative impacts.

Involvement of IPPs and the unbundling of the power sector generally appears to have significant benefits on energy efficiency. While some positive impacts of power sector reforms on energy efficiency have been registered, in overall terms, the impacts of reforms have largely been negative.

LEARNING RESOURCES

Key points covered

- In general, power reform options were not primarily designed to promote energy efficiency. The main objective of reforms was to increase electricity generation capacity and to enhance the financial health of the utilities.
- Very few countries have included provisions to secure and enhance activities and resources in energy efficiency. In Africa, reforms have created new challenges and are generally seen to contradict/hinder efficiency through regulations especially in cases where distribution utilities still enjoy a monopoly. For example, requiring a single distribution utility in a country to reduce consumer demand for electricity through energy efficiency is inconsistent with introducing competition as it might appear to affect profitability of the utility due to the reduction in electricity sales. Consequently, this may be viewed as a potential trade-off before enhancing energy efficiency and competition.
- Reforms have not adequately supported the promotion of energy efficiency in the power sector. However different reform options appear to have different impacts on energy efficiency i.e. some have neutral impacts while others have positive and/or negative impacts.

Exercises

1. According to you, have power sector reforms had any impact on enhancing energy efficiency? Using relevant documents, provide 2-3 page essay of your reaction.
2. Different power sector reform options appear to have had different impacts on energy efficiency. Using examples from the region, discuss their impacts.

Presentation/suggested discussion topics

Presentation:

ENERGY EFFICIENCY – Module 15: Impact of power sector reform on energy efficiency in Africa

ENERGY EFFICIENCY – Module 15: Case study 1 – Solar water heaters in Ethiopia.

ENERGY EFFICIENCY – Module 15: Case study 2 – Institutional framework and power sector reform working for Tunisia Energy Efficiency.

Suggested discussion topic:

Question: Discuss the impact of corporatization/commercialization on energy efficiency in your country.

Question: Discuss the impact of management contracts on energy efficiency in your country.

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

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

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

Question: What role do you see that renewables can play in enhancing energy efficiency in the electricity sector?

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.

Relevant case studies

1. Solar water heaters in Ethiopia

2. National Agency for Energy Efficiency (ANME) in Tunisia

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INTERNET RESOURCES

Renewable Energy and Energy Efficiency Programme: www.reeep.org

International Energy Agency Demand-Side Management Programme: www.dsm.iea.org

Rocky Mountain Institute: www.rmi.org

Energy Foundation: www.ef.org

American Council for an Energy Efficient Economy: www.amceee.org

Lawrence Berkeley National Laboratory: www.lbl.gov

"Cogen for Africa" Project: cogen.unep.org

Greening the Tea Industry in East Africa Project: greeningtea.unep.org

AFREPREN/FWD: www.afrepren.org

African Forum for Utility Regulation: www.afurnet.org

Regional Electricity Regulators Association of Southern Africa: www.rerasadc.com

International Energy Initiative: www.ieiglobal.org

World Resources Institute: www.wri.org

GLOSSARY/DEFINITION OF KEY CONCEPTS

Boiler	A device for generating steam for power, for heating purposes; or for generating hot water for heating purposes or hot water supply.
Cogeneration	Simultaneous production of electricity and heat energy.
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 vertical 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.
Distribution	Delivery of electricity to the customer's home or business through low voltage distribution lines.
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.
Emissions	Flows of gas, liquid droplets or solid particles released into the atmosphere.
Energy reserves	Estimated quantities of energy sources that have been demonstrated to exist with reasonable certainty on the basis of geologic and engineering data (proven reserves) or that can reasonably be expected to exist on the basis of geologic evidence that supports projections from proven reserves (probable or indicated reserves).
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.
Fossil fuel	An energy source formed in the earth's crust from decayed organic material e.g. petroleum, coal, and natural gas.
Global warming	An increase in the near surface temperature of the Earth due to increased anthropogenic emissions of greenhouse gases.

Interconnected system	An integrated electricity generation, transmission and distribution network.
Licensing	The act of issuing licences allowing investors to operate legitimately within the electricity sector, usually as IPPs.
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 biomass fuels.
Primary energy	Energy sources in their crude or raw state before processing into a form suitable for use by consumers.
Sub-Saharan Africa	All African countries north of the Republic of South Africa and south of the north African countries (Algeria, Egypt, Libyan Arab Jamahiriya, Morocco, Tunisia).
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.

Case study 1.

SOLAR WATER HEATERS IN ETHIOPIA

CONTENTS

1. BACKGROUND TO SOLAR WATER HEATING TECHNOLOGY

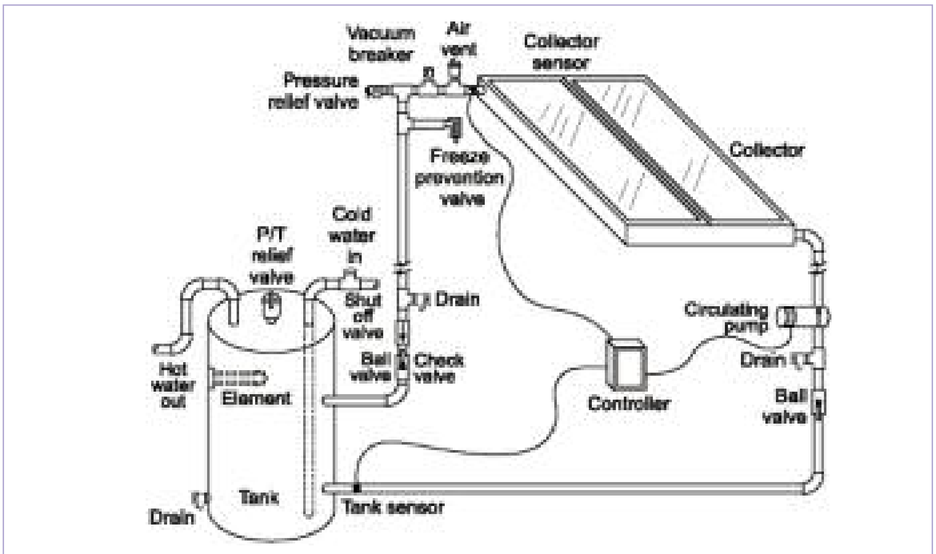
1.1. Introduction

Solar water heaters are an example of solar thermal technologies that have been disseminated in Africa. Other examples of solar thermal technologies include solar cookers (Kammen 1991; 1992), solar stills and solar dryers. This section concentrates on solar water heating, as it seems to be the most developed technology among the other possible solar thermal technologies currently being used or researched. Solar water heating has also found greater use than the other technologies in most countries with reasonable solar radiation. Solar water heaters (SWHs) for domestic purposes can be used either as stand-alone systems or as hybrid systems with electrical geysers. The fundamentals of the SWH technology are presented together with an assessment of the factors affecting dissemination of the technology.

1.2. Fundamentals of the technology

Solar water heaters, sometimes called solar domestic hot water systems, use the sun to heat either water or a heat-transfer fluid, such as a water-glycol antifreeze mixture, in collectors generally mounted on a roof. The heated water is then stored in a tank similar to a conventional electric water tank (see figure I). Some systems use an electric pump to circulate the fluid through the collectors.

Figure I. **A solar water heating system**



Source: www.kenital.com

Solar water heaters are made up of collectors, storage tanks, and depending on the system, electric pumps. There are three basic types of collectors namely: flat-plate, evacuated-tube and concentrating. Most commercially available solar water heaters require a well-insulated storage tank. Many systems use converted electric water heater tanks or plumb the solar storage tank in series with the conventional water heater. In this arrangement, the solar water heater preheats water before it enters the conventional water heater. Some solar water heaters use pumps to re-circulate warm water from storage tanks through collectors and exposed piping. This is generally to protect the pipes from freezing when outside temperatures drop to freezing point or below.

Solar water heaters can either be active or passive. An active system uses an electric pump to circulate the heat-transfer fluid, while a passive system has no pump. The amount of hot water a solar water heater produces depends on the type and size of the system, the amount of sun available at the site, proper installation and the tilt angle and orientation of the collectors.

Solar water heaters are also characterized as open loop (also called "direct") or closed loop (also called "indirect"). An open-loop system circulates household (potable) water through the collector. A closed-loop system uses a heat-transfer fluid (for example water or diluted antifreeze) to collect heat and a heat exchanger to transfer the heat to the water to be used.

Sizing a solar water heater involves determining the total collector area and the storage volume required to provide 100 per cent of a household's hot water during the summer. Solar-equipment experts use worksheets or special computer programs to assist in determining the size of a system. A small 100-litre system is sufficient for one to two people, a medium 150-litre system is adequate for a three or four person household, while a large 250-litre system is appropriate for four to six people.

A rule of thumb for sizing collectors allows about 1.5 square metres of collector area for each of the first two family members. The next size is 0.6 square metres for each additional family member in areas like central Zimbabwe with a daily average radiation of 5kWh/m2. A ratio of at least eight litres of storage capacity to 0.1 square metres of collector area prevents the system from overheating when the demand for hot water is low. In very warm, sunny climates, experts suggest that the ratio should be at least ten litres of storage to 0.1 square metres of collector area.

1.3. Benefits of solar water heaters

There are many benefits to owning a solar water heater. In terms of economics, solar water heaters compare favourably with those of electric water heaters.

However, its economics are not quite as attractive when compared to those of gas water heaters. Solar water heaters offer the largest potential savings, with owners saving as much as 50 per cent to 85 per cent annually on their utility bills over the cost of electric water heating. However, at low (subsidized) prices of electricity and other fuels, solar water heaters cannot compete favorably in some countries.

Payback periods vary widely, but one can expect a simple payback[1] of 3 to 5 years on a well-designed and properly installed solar water heater. Shorter payback periods are expected in areas with higher energy costs. After the payback period, one continues to accrue the savings over the life of the system, which ranges from 15 to 20 years depending on the system and how well it is maintained.

There is amble evidence to show that SWHs play a very crucial role in demand-side management (DSM) in many countries. SWHs can be used to flatten out the maximum demand curve for any utility. The technology can also be used to cut down the actual demand, and this can have various implications for a country. Depending on the circumstances, this can mean delayed investment in power generation or reduction of the import bill for those countries that import power or fuel.

The solar heating of water can also yield significant long-term benefits such as helping to cushion a country from energy prices shocks and shortages by reducing dependence on imported petroleum products/electricity/big hydro water resources. Solar water heating can also present significant environmental benefits.

When a 200-litre solar water heater replaces an electric water heater, the electricity displaced over 20 years represents more than 50 tons of the avoided carbon dioxide emissions alone (this figure is derived assuming the electricity supplied by the grid is generated from oil-based generation.[2]

1.4. Regional dissemination of solar water heaters

Solar water heater dissemination levels in selected African countries are shown in table 1. These capacities have been achieved in most cases due to national policies, which were deliberately supporting the use of SWH technology. Policies came either as laws, which stipulated that all buildings of a particular type must be fitted with SWHs or incentives to the suppliers.

[1] Simple payback is the length of time required to recover an investment through reduced or avoided energy costs.

[2] Estimates obtained from Powerhouse and Eco Business Links

Table 1. Estimated installations of domestic solar water heater (1991-2002)

Country	Installed capacity (1000 m^2)
South Africa	500,000
Egypt	400,000
Botswana	50,000
Mauritius	40,000
Kenya	40,000
Namibia	24,000
Zimbabwe	10,000
Malawi	4,800
Seychelles	2,400

Source: Karekezi, S., and Kithyoma, W. 2005

2. CASE OF SOLAR WATER HEATERS IN ETHIOPIA

2.1. Objective of the case study

The main objective of this case study is to assess the status and the contribution of solar water heaters to the power and rural energy sector in Ethiopia

2.2. Development of the solar water heaters in Ethiopia

In Ethiopia, after several years of total neglect, solar water heaters have recently begun being more widely disseminated. In the recent past, only two charity organizations, the Ethiopian Evangelical Mekane Yesus and Selam Technical Vocational Centers, were producing and disseminating solar water heaters. Since the year 2000, more than 10 private companies have entered the market as local producers and also as importers, mainly from China and India. Currently, it is estimated that more than 880 units of solar water heaters have been installed by these organizations. The potential users of the technology are limited mainly to higher income groups of people living in major towns particularly in Addis Ababa.

With rising electricity tariffs, increased incomes in urban areas and rapid technical capacity-building of local producers of the technology, the demand for the solar home heaters is expected to rise. Based on its storage capacity and who its producer is, the price of a locally manufactured solar water heater ranges from $US 400 to $US 625, while the price of imported ones range from $US 680 to $US 910. Studies undertaken by the Faculty of Technology, Addis Ababa University indicate that with the current electricity tariffs, the investment cost of a solar water heater can be paid back within 2.3 years (Gashie, W., 2005). Given the plan to further increase electricity tariffs (as required by the World Bank and other financial institutions), the installation of solar water heaters will become even more economically attractive in the future. A cost comparison study carried out by the Ethiopian Rural Energy Development and Promotion Centre between solar water heaters and electric boilers indicates that the former has more advantages over the latter, especially for commercial purposes. Another comparative study made for a small hotel indicates the possibility of saving a minimum of $US 2,600, which translates to a payback period of about eight years. A higher economic benefit is also noted for the manufacturers, i.e. with the current price, a net benefit of about $US 230 can be obtained on a single solar heater, which may take a single worker not more than three days to manufacture.

2.3. Impact of solar water heaters in Ethiopia

Solar water heaters appear to be economically attractive in Ethiopia due to the escalation of the price of petroleum and electricity in the past few years. This has been caused mainly by the rise in the price of petroleum at the global level and the removal of government subsidies from the end use supply of the two commodities. As the subsidy is further removed, the prices of the petroleum products and electricity will continue rise and will in turn make solar water heaters more attractive. As a result, the production and marketing of solar water heaters is expected to grow at a faster rate. Box 1 gives a simple demonstration of the cost-effectiveness of domestic SWHs.

Box 1. The cost-effectiveness of domestic solar water heaters

Mr Boja Galalcha is a dweller of Addis Ababa city and has six family members. He installed a 100-litre SWH in 2000. Before installing the SWH, Mr. Galalcha used a standard electric boiler system. When using the electric boiler, his average monthly electricity bill was about $US 23.30. However, since he started using the solar water heater, his electricity dropped to about $US 8.20 per month—a monthly saving of approximately $US 15.

Source: Gashie W., 2005

In addition to the economic benefits obtained by the users and producers, the introduction of solar water heaters has other advantages, which include (Gashie, W., 2006):

- Increasing the diversity of energy utilization;
- Avoiding risks associated with peak loads;
- Creating local employment opportunities for manufacturers and maintenance workers;
- Reducing deforestation and increasing agricultural productivity through reducing biomass fuel utilizations for water heating in the process of food cooking which in turn reduces women's and children's physical strain and time spent caused by fuel wood collection activities.

2.4. Financing

The production of solar water heaters in Ethiopia was initially begun by EECMY and STVC in early 1990s mainly for demonstration purposes. But with the increase in demand for hot water on the one hand and the rise in electric tariffs on the other hand, solar water heaters have gradually made inroads in markets as a commercial commodity. At present, more than five private companies are involved in the production of the technology, particularly in Addis Ababa. The production of solar water heaters needs at least three different skilled persons; machine technologists, welders and plumbers. A group of these skilled persons with two daily labourers can produce two solar water heaters in a day. For the production of the technology, the materials needed and their respective costs are depicted in tables 2 and 3.

Table 2. Fixed costs for establishing/equipping a SWH production line

No	Item	Unity	Qty	Unit price ($US)	Total price ($US)	Life time (year)	Cost per year ($US)
1	Shed construction	No	1	1,704.55	1,704.55	9	189.39
2	Sheet metal bending machine	pcs	1	909.09	909.09	8	113.64
3	Sheet metal rolling machine	pcs	1	198.86	198.86	8	24.86
4	Hand drill machine	pcs	1	1,022.73	1,022.73	2	511.36
5	Hand girding machine	pcs	2	200.57	401.14	2	200.57
6	Welding machine	set	2	409.09	818.18	5	163.64
7	Circular saw machine	pcs	1	363.64	363.64	4	90.91
8	Bench vice	pcs	1	397.73	397.73	4	99.43
9	Hand clamp	pcs	5	16.48	82.39	1	82.39
10	Different hand tools	set	6	26.14	156.82	2	78.41
11	Workers salary (5)	month	12	56.82	3,409.2	1	3,409.20
	Total						**4,963.79**

Source: Bereket, producer of solar water heaters, 2005

Table 3. Variable costs to produce a solar water heater with a capacity of 200 litres

No	Item	Unity	Qty	Unit Price ($US)	Total Price ($US)
1	Galvanized sheet metal	m	15	28.41	426.14
2	Black sheet metal 4mm thick	pcs	1.5	64.20	96.31
3	Galvanized pipe 1 inch	m	1	21.02	21.02
4	Galvanized pipe ½ inch	m	18	1.61	28.96
5	Pipe fittings	pcs	8	1.36	10.91
6	Insulation material	kg	5	1.93	9.66
7	Bolt and nut M10	pcs	22	0.06	1.25
8	Electrode diameter 2.5	pkt	0.5	2.73	1.36
9	Grinding and cutting disc dim.180mm	pcs	2	1.14	2.27
10	Two different paints	kg	2	2.84	5.68
	Total				**603.56**

Source: Bereket, producer of solar water heaters, 2005

At the present, the average price of a locally manufactured solar water heater with a capacity of 200 litres of water is about $US 740.00. A producer that has only one group of skilled personnel can produce about 600 solar water heaters per year. With these two estimations and from tables 1 and 2 one can easily determine the following simple calculation on an annual basis:

- Total variable cost = 600 x $US 603.56 = $US 362,136.00
- Total fixed cost = $US 4,963.79
- Total cost (sum of variable and fixed costs) = $US 367,099.79
- Total income = 600 x $US 740 = $US 444,000.00
- Benefit = 444,000-367,100 = $US 76,900.00
- Benefit per heater = $US 76,900÷600 = $US 128.20

2.5 Progress with implementation

There have been rapid technical advances in solar water heaters (SWHs) globally for the last 50 years due to benefits accruing to domestic, commercial, public services and for light industries. Following this worldwide trend, research activities have been carried out in Ethiopia for the last two decades to identify and then propose cost-effective locally manufactured solar water technologies. Nevertheless, the number of organizations involved in the process of production and dissemination of these technologies was very low until recent years. Prior to 2000, only two charity organizations; the Ethiopian Evangelical Mekane Yesus and Selam Technical Vocational Center were involved in the production and dissemination of SWHs, mainly for demonstration purposes. The two organizations disseminated only 67 SWHs. However, more than 10 private companies have entered into the market as local producers and also as importers mainly from China and India since the year 2000 (Workeneh, 2006). It is estimated that more than 1,562 SWHs units have been disseminated by these organizations at the present time. A comparison of the disseminated quantity in the year 2005 to any given year between 2000 and 2004 shows an increment of more than 177 per cent (see annex 1). This is a promising trend, and coupled with rising electricity tariffs, it can be expected that more private companies will enter the business. Due to increasing incomes in urban areas and rapid technical capacity-building of local producers of the technology, the demand for the solar water heaters is expected to rise.

Generally, the target groups of solar water heaters in Ethiopia can be categorized into four major groups. These target groups are urban domestic, urban commercial (hotels, restaurants, hostels, beauty salons, etc.), health institutions (clinics and health centres) and light industries. Among these target groups urban domestic and urban commercial are the largest users of the technology and hence this study has focused only on these two target groups. In the case of domestic users, even though SWHs have been widely introduced into larger cities of the country, Addis Ababa accounts for about 90 per cent of the total demand. Empirical analysis carried out by Getnet and Wogayehu (2004) to assess domestic market potential for SWHs in Addis Ababa, based on income levels, indicated that from the total number of households in the city, only 10 per cent can afford the initial cost of the technology. From this target potential of the technology 50 per cent already had electric boilers. Thus, the domestic market potential of SWHs is about 5 per cent of of the city dwellers, which is estimated to be about 27,500[3] households. This target group needs the technology mainly for bathing purposes. In addition to this, due to the continuous increase in electric tariffs through time, 10 per cent of those households with electric boilers (2,750) are expected to shift from electric boiler to SWHs, which in turn will increase the domestic market potential for solar water heaters by a further 10 per cent of to a total potential of 30,250 households (Getnet and Wogayehu, 2004).

2.6. Recommendations

Experiences indicate that NGOs have been instrumental in reaching grassroots communities with renewable energy technology dissemination programmes because of their flexibility and innovativeness. They have been instrumental in training and providing public education on renewable energy technologies through

[3] The current number of household in the city is estimated to be about 0.55 million.

workshops, training courses, newsletters, posters and calendars. In Ethiopia, NGOs such as ELVIA, GTZ, EECMY, SVTC and Menschen für Menschen, have been instrumental in the development of the solar water heaters. Therefore, NGOs should be widely involved in solar water heater development and promotion.

Advocacy is extremely important to provide Government authorities, potential producers, distributors and users with information on small and medium-scale renewable technologies and to develop interest in the respective areas of concern. Therefore, it is necessary to engage civil societies, community-based organizations, Government organizations, NGOs, etc., in coordinated advocacy efforts using existing multi-media. These advocacy efforts need to be a continuous initiative and reach all groups of the population.

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Case study 2.

INSTITUTIONAL FRAMEWORK AND POWER SECTOR REFORM WORKING FOR TUNISIA ENERGY EFFICIENCY

CONTENTS

1. CONTEXT

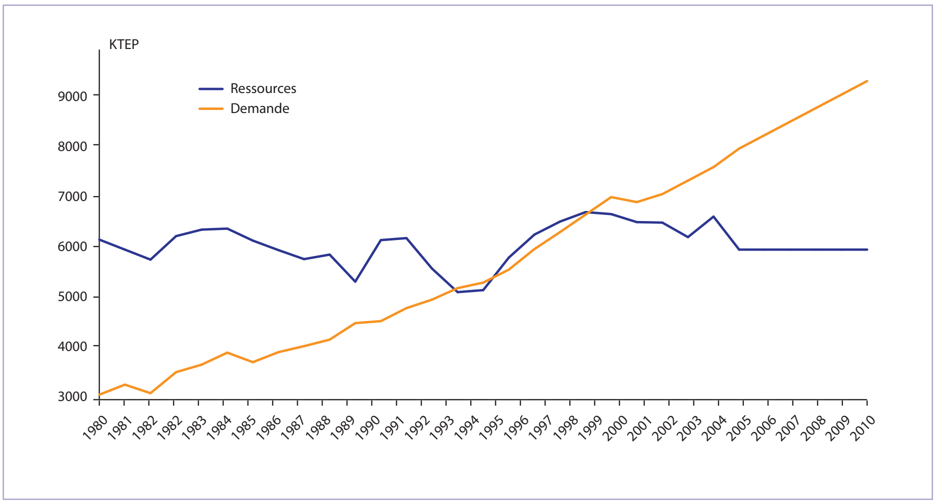
Due to its national oil and gas resources Tunisia historically enjoyed a favourable energy situation. The energy sector accordingly played an important role in the economic growth, representing 13 per cent of the national gross domestic product and 16 per cent of the national export in 1980.

However, as of the end of the 1980s, Tunisian authorities realized this favourable situation was about to change drastically. This shift was the result of two main factors:

- The stagnation of the national oil and gas resources; and
- The rapid increase of energy demand through economic and social growth.

This has led to a deficit on the energy balance as of the year 2000, and unsurprisingly, to a decreasing contribution of the energy sector in the economic growth of the country since 1986.

Figure I. **Evolution of primary energy demand (in red) against national energy resources (in blue) in Tunisia**



Source: ANME

This forecasted energy deficit urged the Tunisian government to develop a comprehensive sustainable energy policy, and Tunisia can be considered as being at the forefront of energy efficiency policies in the Mediterranean region since the 1980s.

This policy is further described in the following sections.

2. POLICY PRIORITIES AND TARGETS

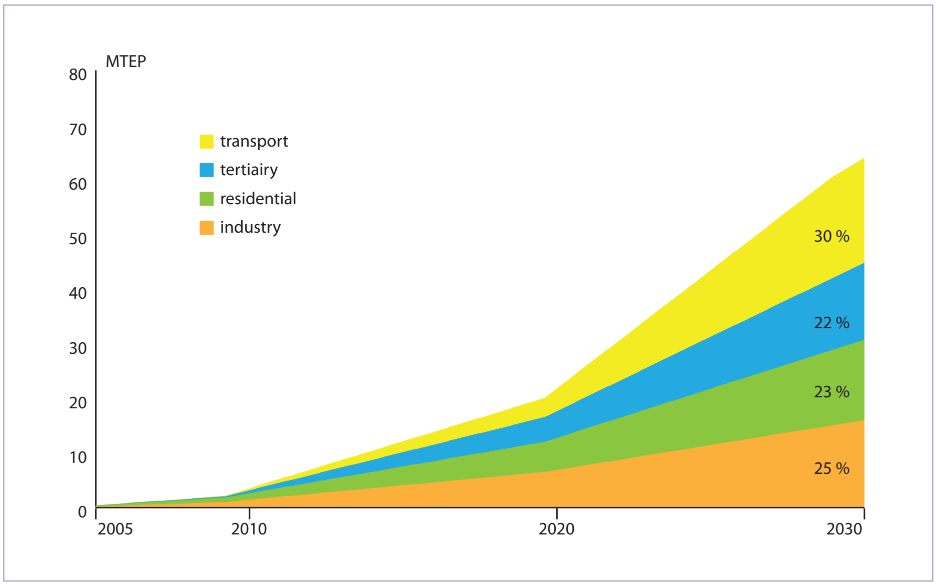
Since the beginning the energy conservation policy has been built around three pillars:

- Putting in place an institutional framework, with a dedicated national energy savings agency (ANME) in charge of policy implementation;
- The elaboration of a complete set of regulatory measures to promote energy efficient practices and techniques;
- The adoption of financial incentives, including subsidies for energy audits and investments as well as fiscal measures.

Recently an overall savings target of 640,000 toe[1] was set by 2010 and a decrease in energy intensity of 2 per cent per year. The objective is to save 940,000 toe and cut down state subsidies by about 155 million TND.[2]

The long-term opportunities and potential for energy efficiency were demonstrated in the strategic outlook towards 2030, and are shown in figure 2.

Figure II. **Energy savings potential per sector by 2030**



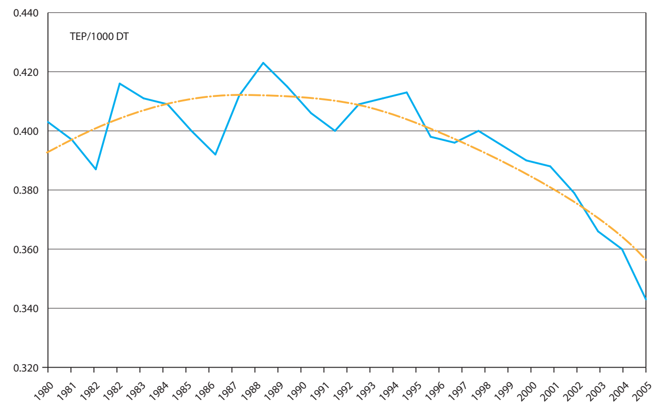
Source: ANME

[1]Ton oil equivalent
[2]The Tunisian dinar (TND) is the national currency in Tunisia; 1 USD = 1.16510 TND (23 May 2008).

3. RESULTS

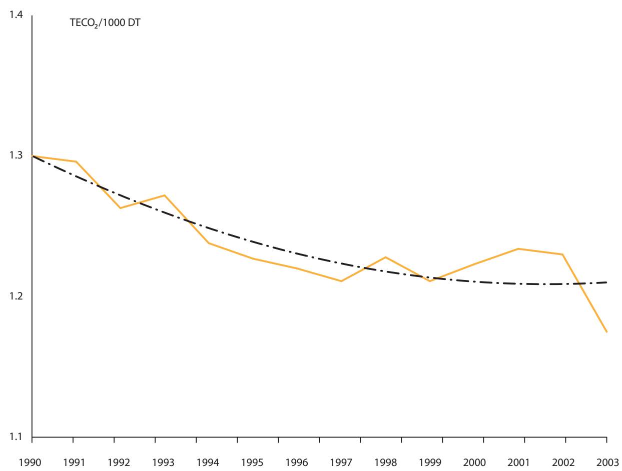
The series of policy measures related to energy conservation have led in 2006 to reducing energy intensity from 0.344 toe/1000TND (in 2005) to 0.332 toe/1000TND (in 2006), as shown in figure 3. This has helped achieve an aggregate reduction of energy consumption of 270,000 toe, of which 180,000 toe resulting from actions of rationalization of energy consumption and actions of renewable energy promotion.

Figure III. **Evolution of energy intensity (average in orange) in Tunisia**



Source: ANME

Figure IV. **Evolution of carbon intensity (average in red) in Tunisia**



Source: ANME

The simultaneous improvement of the energy and carbon intensity is remarkable, and is explained by the combined effect of four aspects:

- The impact of energy efficiency programmes especially in manufacturing industry;
- The improvement of energy consumption in electricity production plants, notably the introduction of combined heat and power (CHP);
- The modernization of the industrial complex;
- A shift to proportionally more tertiary services in the Tunisian economy.

In addition state subsidies in 2006 could be reduced by about 87 million TND, with 22 million TND due to actions of rationalization of energy consumption and of renewable energy promotion and 65 million TND due to actions of energy substitution in the industrial and residential sectors.

Finally the measures and support with regard to the use of solar thermal energy have led to the installation of 57,000 m^2 until 2006, with a target of reaching 620,000m^2 by 2010 (including a reduction of state aid of 2.5 million TND per year).

4. ELECTRICITY LAW AMENDMENTS

For the past two decades, public interventions via financial support from the State budget and the mobilisation of international financial resources have been decisive in the development of energy conservation in Tunisia.

The basis for the regulatory framework which had to be put in place in order to reach the formulated policy goals was laid down in a range of presidential decisions and national laws.

On 3rd May 2001 twenty presidential decisions were announced which would help to put in place the national energy efficiency strategy. These decisions included general updates of outdated legislation, the improvement of financial incentive regulations, and the introduction of a national energy efficiency day. In addition new frameworks were established with regard to the promotion of new sectors and technologies, e.g. the use of cogeneration, the mandatory use of solar water heating in new public buildings, the deployment of wind energy and the launch of energy services.

Recently, law N° 2005-82, dated 15 August 2005, instating a “energy conservation system”, has been a major asset ensuring support to effective implementation and sustainability of the actions aimed at rationalizing energy consumption, the promotion of renewable energies and energy substitution.

This system has developed into a “National Fund for Energy Conservation” (FNME), subject of law N° 2005-106, dated 19 December 2005, thus representing a quantum leap towards the choice of an extra-budgetary resource for financing the public support to energy conservation investments in Tunisia, and this based on the granting of allowances.

The rates and amounts of the allowances related to the actions concerned by this Fund, as well as the terms and methods of their granting are established by decree N° 2005-2234, dated 22 August 2005:

The sources of the fund are supplied by tax measures, including:

- A duty levied on the first registration of private cars in a Tunisian series, at a rate set by this Law at 250 to 1000 TND, for petrol-powered cars, and 500 to 2000 TND, for diesel-powered cars, with a certain number of exemptions stipulated by the Law;
- An import duty or local production duty, excluding export of air-conditioning equipments relevant to numbers set by the Law, at customs duties rates of 10 TND for each 1,000 thermal units.

5. ROLE OF THE ENERGY SAVINGS AGENCY

The actions and modalities of the National Fund are managed and implemented by the National Agency for Energy Conservation (ANME), which acts as the core component in the institutional set up of the Tunisian energy efficiency policy. ANME’s mission is defined as the improvement of the energy balance and the reduction of gas emissions form energy use. Particular tasks include:

- The development and implementation of national energy efficiency programmes; e.g. support the actions of mandatory and periodical energy audits, and signing of performance contracts with high energy consuming entities and the promotion of the use of energy-saving techniques and equipments for various activities such as:

- o Cogeneration;
- o Certification of household electrical appliances;
- o Thermal and energy regulation of buildings;
- o Rationalization of street lighting power consumption; and
- o Car engine check-ups;

- Setting out the legal and regulatory framework related to energy efficiency;
- The launch of awareness-raising campaigns, and organization of educational and training actions;
- Support research and development through innovative demonstration projects;
- The encouragement of private sector investment;
- Conducting prospective and strategic studies, e.g. the "Energy Efficiency in Tunisia towards 2030" as mentioned above;
- The design and administering of tax and financial incentives; these are described in detail in box 1 below.

Box 1. Financial incentives for energy conservation measures in Tunisia

- Subsidy for an energy audit: 50 per cent of the cost, up to a maximum of 20,000 TND;
- Subsidy for a demonstration project: 50 per cent of the cost; up to a maximum of 100,000 TND;
- Subsidy for energy conservation investments: 20 per cent, up to maximums which go up with the average yearly energy consumption of the organization in question;
- Solar water heaters for households: 20 per cent subsidy up to 100 TND per m^2;
- Energy substitution: Shift to gas in the residential (140 TND for a house and 20 TND for a flat) and industrial sector (20 per cent up to 400,000 TND);
- The installation of checkpoints for car engines: 20 per cent subsidy up to 6,000 TND;

In addition fiscal measures are put in place to complement the investment subsidies as described above.

Source: Energy Efficiency in Tunisia towards 2030, ANME, 2006

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SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Energy Efficiency

Module 15:
IMPACT OF DIFFERENT POWER SECTOR REFORM OPTIONS ON ENERGY EFFICIENCY IN AFRICA

Module 15

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Module overview

- Module aims and learning outcomes
- Introduction
- Impact of the following reform options on energy efficiency
  - Unbundling of utilities
  - Electricity law amendment
  - Corporatization
  - Independent power producers (IPP)
  - Management contracts
- Conclusions

Module 15

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Module aims

- To highlight positive and negative impacts of reform options on energy efficiency (EE).
- To provide examples where relevant, of countries that have implemented the aforementioned reform options and the results achieved.

Module 15

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 energy efficiency.
- To draw lessons from the case studies provided.

Module 15

Introduction

- In general, power reform options were not primarily designed to promote EE. The main objective of reforms was to increase electricity generation capacity and to enhance the financial health of the utilities.
- In Africa, reforms have created new challenges and are generally seen to contradict/hinder efficiency through regulations.
- Various reform options appear to present opportunities and/or barriers to the promotion of EE.

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Unbundling on EE (1)

- 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.
- Vertical unbundling has been the most adopted unbundling option in Africa. It had a positive impact as it helped in exposing the inefficient sections in the power system.
- The unbundled generation and distribution sections, therefore, engage in minimizing their losses which was not the case before reforms.

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Unbundling on RE (2)

- However, unbundling had the following negative impacts on energy efficiency:
  - In response to demand pressures, the distribution utilities seek additional sources rather than embarking on demand-side energy efficiency programmes.
  - The need for additional electricity generation appears to have encouraged focus on large-scale thermal IPPs.
- With unbundling integrated resource planning tends to become more difficult as several autonomous entities and the planning carried out by each is largely independent of the others.

Module 15

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Electricity Law Amendment on EE (1)

- A review of amended Electricity Acts in several sub-Saharan African countries reveals that most of them do not explicitly mention or promote EE
- Some mention EE but do not highlight it as a priority.
- They do not stipulate support for EE technologies nor do they provide for EE programmes.

Module 15

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Electricity Law Amendment on EE (2)

- A promising case is that of Mauritius where the new Act clearly supports the use of energy efficient technologies for electricity generation through bagasse-based cogeneration.
- In order to ensure the substantial support of energy of EE, a thorough revision of the Electricity Acts—the pillar of power sector reforms—is necessary.
- Example of how energy savings target for DNO in Flanders is organised; Energy Agency and Regulator manage the system, DNO and suppliers carry out Public Service Obligations
- More detailed examples are in module 16

Module 15

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Corporatization on EE

- Generally the rationale for corporatization is to ensure that the utility is profitable.
- Corporatization in Africa has generally had a negative impact on EE due to its profit motive which:
  - Implies that utilities tend to avoid investments involving relatively high upfront cost.
  - Contributes to utilities in minimizing their operational costs.
- There is no motivation for the utility to enhance demand-side EE as it could lead to lower revenue levels.

Module 15

SUSTAINABLE ENERGY REGULATION AND POLICYMAKING FOR AFRICA

Impact of Corporatization on EE (2)

- Corporatization of utilities leads to enhancing their competitiveness by driving them to reduce their cost of production in order to maximize profitability.
- It encourages utilities to implement EE measures that minimize system losses.
- Peak load "shaving" in the power system thereby minimizes the need for huge investments to meet peak demand (i.e. which lasts for only a few hours in a day).
- To "shave off" significant amount of the peak load, efficient water heating technologies such as solar water could be used.

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Impact of Independent Power Producers on EE (1)

- Increasing electricity generation capacity through private investment was one of the main drivers of power sector reforms and not to enhance EE.
- Recent studies showed that involvement of IPPs in electricity generation favoured more fossil fuel-based sources than non-fossil fuel sources which some are regarded energy efficient technologies.
- IPPs have enabled utilities to retire old and inefficient generation power plants.

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Impact of Independent Power Producers on EE (2)

- Some entities with embedded generation have embarked on "in-house" EE measures thereby consuming less energy.
- Industrial entities located near attractive small hydropower sites are developing the sites for captive power as well as for exporting the excess electricity to the grid.
- Some utilities appear to encourage privately-owned distributed generation in order to enhance energy efficiency and stability within the grid.
- IPP remains a potentially powerful tools to improve EE throughout energy and even other sectors (e.g. waste, agro-processing…)
- Ex. CHP in Czech Republic

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Impact of Management Contract on EE

- Management contract transfers responsibility for the operation and maintenance of government-owned businesses to a private entity.
- It largely impacts on the promotion of EE in the same way as corporatization because of the following reasons:
  - Consultants usually hired to manage the utility have the key task of making the utility profitable.
  - Management contractors have limited decision-making powers especially pertaining to investments in new generation.
- EE improvement targets on management contract can have a positive impact on the promotion of EE.

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Case Study 1: Solar Water Heaters in Ethiopia

- Solar water heaters are increasingly economically feasible due to:
  - Increase in oil prices and electricity tariffs.
  - Removal of end-use supply subsidy of oil.
- Since 2000, 10 private companies have entered the SWH market and installed more than 880 units.
- With current electricity prices, SWH investment cost can be paid back within 2-3 years.

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Case Study 1: Solar Water Heaters in Ethiopia (2)

- Advantages of SWHs compared to electric boilers:
  - Better durability
  - Lower bills
  - Low running costs
  - Low maintenance costs
- Disadvantages of SWH compared to electric boilers:
  - Not being able to get hot water especially at night (for those without a storage tank)

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Case Study 1: Solar Water Heaters in Ethiopia (3)

- Disadvantages of SWH compared to electric boilers:
  - Technical problems associated with locally manufactured SWHs (before improved standards). Initial installers were poorly trained plumbers who adversely affected the public reputation of the technology
- Challenges faced in SWH dissemination:
  - Prices
  - Low government and NGO intervention/involvement
  - Involving utilities—requires good data on the contribution of electric water heating to peak loads.

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Case Study 2: Institutional and regulatory framework for EE in Tunisia (1)

- Tunisia embarked on ambitious EE policies as of the 1980s basically because of
  - Stagnation of national oil and gas resources;
  - Rapid increase of energy demand through economic and social growth
- Set of measures was adopted and is still being improved

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Case Study 2: Institutional and regulatory framework for EE in Tunisia (2)

- Set of measures was adopted through Electricity Law Amendments leading to:
  - The impact of energy efficiency programmes especially in the manufacturing industry;
  - The improvement of energy consumption in electricity production plants, notably the introduction of CHP;
  - The modernization of the industrial complex;
  - A shift to proportionally more tertiary services in the Tunisian economy.

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Case Study 2: Institutional and regulatory framework for EE in Tunisia (3)

- Measures included:
  - Specific fund for EE
  - Tax incentives
  - Subsidies for E-audits, demonstration projects, fuel substitution,.
  - Long-term targets with respect to decreasing carbon intensity
  - Specific measures towards CHP and solar thermal
  - Covering industrial, public, tertiary, household and transport sector

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Case Study 2: Institutional and regulatory framework for EE in Tunisia (4)

- Specific Agency—National Agency for Energy Conservation (ANME)—established to implement and manage different policies and regulation, including:
  - Development and implementation of EE programmes; e.g. support mandatory and periodical energy audits, signing performance contracts with high energy consuming entities, promotion of energy-saving technologies for activities such as
    - Cogeneration,
    - Certification of household electrical appliances,
    - Car engine check-ups,…

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Case Study 2: Institutional and regulatory framework for EE in Tunisia (5)

  - Setting out the legal and regulatory framework related to EE;
  - The launch of awareness-raising campaigns, and educational and training actions;
  - Support research and development through innovative demonstration projects;
  - Conducting prospective and strategic studies, e.g. the “EE in Tunisia towards 2030”
- ANME is financially and technically supported by international and bilateral donors, e.g. Italy, Germany,…

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CONCLUSIONS

- Energy efficiency in Africa is generally low, both at the industrial, transport and domestic level.
- Different reform options appear to have different impacts on renewables i.e. some have neutral impacts while others have positive and/or negative impacts.
- IPPs and unbundling of the power sector seem to be the most appropriate tools to significantly improve on energy efficiency performance
- While some positive impacts of power sector reforms on energy efficiency have been registered, in overall terms, the impact of reforms has largely been limited, and sometimes even negative.

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Questions/Activities

1. Discuss the impact on energy efficiency of the reform options relevant to your country:
   – Unbundling of utilities
   – Electricity law amendment
   – Corporatization
   – Independent power producers (IPP)
   – Management contracts

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