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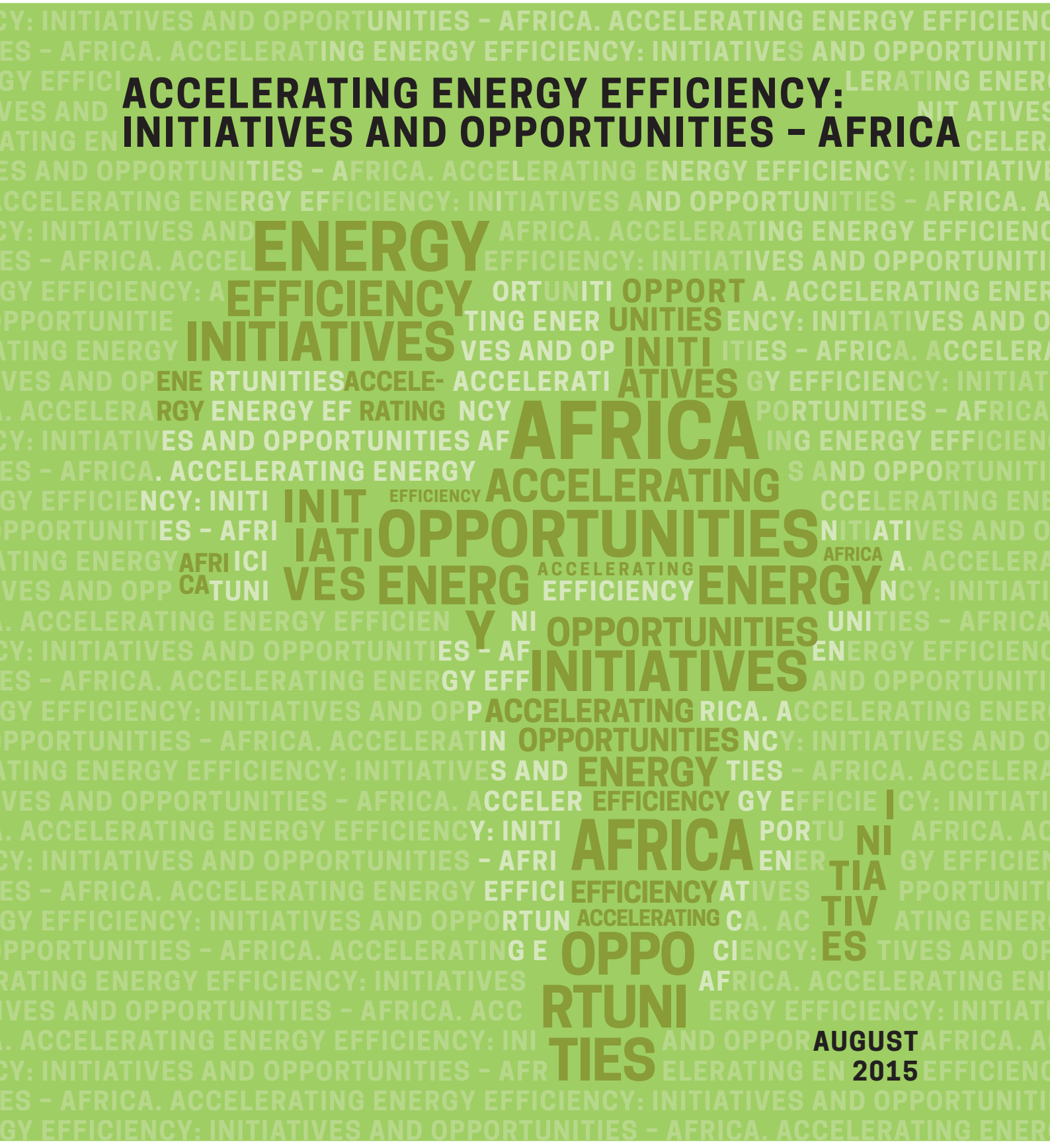
SE4ALL EE HUB

ACCELERATING ENERGY EFFICIENCY: INITIATIVES AND OPPORTUNITIES – AFRICA



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SUSTAINABLE ENERGY FOR ALL

University of Cape Town • Universiteit van Kaapstad • Yunivesithi yaseKapa

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Foreword

The Sustainable Energy for All (SE4ALL) initiative was launched jointly in 2011 by the UN Secretary-General and the President of the World Bank. The initiative has three global, interlinked objectives for 2030, to:

1. provide universal access to modern energy services;
2. double the global rate of improvement in energy efficiency; and
3. double the share of renewable energy in the global energy mix.

Meeting these ambitious goals will require the mobilisation and partnership of governments, private sector, civil society and other stakeholders, and numerous activities are under way in all three areas.

The Copenhagen Centre on Energy Efficiency (C2E2) was established in 2014 and serves as the Energy Efficiency Hub of SE4ALL. One of the core activities of the Centre is to analyse and promote opportunities for accelerating energy efficiency uptake globally. As part of this broad mandate the Centre has engaged four regional partners in a detailed assessment of current energy efficiency policies, priorities and opportunities in selected countries in each region with the dual objectives of identifying key opportunities for support and at the same time being able to share experiences and best practice examples.

The regional partners are:

- The Asian Institute of Technology in Thailand for the Southeast Asia Region;
- The Bariloche Foundation in Argentina for the Latin America and Caribbean Region;
- The Centre for Energy Efficiency (CENEf) in Moscow for Eastern Europe, the Caucasus and Central Asia; and
- The Energy Research Centre at the University of Cape Town in South Africa for the African Region.

This report, prepared by the Energy Research Centre at the University of Cape Town in South Africa, is devoted to the Africa region and provides assessment of existing energy efficiency policies and initiatives in 24 countries. The report analyses the barriers and opportunities and provides recommendations on future activities that would accelerate energy efficiency in these countries. Energy demand in the African region will rise significantly in the coming decades as a result of population growth, enhanced economic activity and increased energy access. It is therefore extremely important to ensure that energy efficiency opportunities are fully utilised.

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This report is co-authored by Andrew Hibberd and Dr Bothwell Batidziraifrom the Energy Research Centre at the University of Cape Town and Dean Lameck Musukwa from the Kafue Gorge Regional Training Centre in Zambia. Lucy Ellen Gregersen and Annahita Nikpour contributed to the layout and format of the report. Jacob Ipsen Hansen and Thomas Thorsch Krader have reviewed the report. We acknowledge all other contributors to this report. We would like to thank Thomas Thorsch Krader for coordinating the publication of the four regional reports. We are also grateful to Mette Annelie Rasmussen and Surabhi Goswami of the UDP Communication team for their professional help in publishing the reports.

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Abbreviations

CFL	Compact Florescent Lamp
DSM	Demand Side Management
ECOWAS	Economic Community of West African States
EE	Energy Efficiency (abbreviation)
ktoe	Kilo tonnes of oil equivalent
M&V	Measurement and Verification
Mtoe	Million tonnes of oil equivalent (= 41.8 PJ)
PV	Photovoltaic
SADC	Southern African Development Community
Wp	Watt-peak

Executive Summary

This report presents the results of a 2015 study of energy efficiency (EE) initiatives undertaken in African countries. This study, commissioned by the Copenhagen Centre on Energy Efficiency (C2E2), focuses on the areas of success, barriers encountered and improvements in access to energy for the general population. The aim of the study is to identify and suggest areas for future engagement in order to accelerate energy efficiency in the region.

Background

The continent of Africa is second only in population to Asia. In spite of this, Africa consumes only 6% of the world's primary energy. The potential for growth in energy consumption in Africa is rooted mainly in the need for improved access to energy for its people, and also in the continued economic growth of many of its constituent countries. On average 60% of Africans do not have access to clean, reliable energy, and 80% still use traditional biomass for cooking. This results in significant socio-economic, health and environmental disadvantages. Although the potential for improving the implementation of energy efficiency exists in all sectors of the African economy, it is often access to energy that takes priority. In reality, the two concepts are inextricably linked: improved EE frees capacity for improving access, while providing access in an energy-efficient manner is more cost-effective than retrofitting at a later stage.

Methodology

The methodology followed for this study was structured across four main tasks:

- First, country surveys were conducted to identify the main EE initiatives and efforts being taken to improve access in that country. This was done through a combination of desktop research and input from in-country experts. The data from this research were then analysed, and individual country reports were drawn up detailing the various initiatives, including successes, savings achieved and any barriers encountered.
- The second step included further investigation into the barriers noted in the country reports. The results of this investigation, together with details of the initiatives, were consolidated by region and presented in a table. This information was then further categorised into Policy, Technological, Behavioural, Financial and Cultural barriers.
- Thirdly, the country reports were analysed further in order to select four representative countries, one per region. Each country's initiatives and barriers were examined and expressed in terms of the assistance required in order to address the barriers. The level and type of assistance required, together with the potential for improved EE and access to energy, provided the basis for the selection of the four countries.

- The final step in the methodology was to draw up a brief profile of each of the four countries and to suggest possible future work or strategies for the acceleration of EE and access in each of them. As a wrap-up, suggestions were put forward for the continent as a whole for addressing the improved uptake of EE and access.

Summary of Key Findings

Availability of data was a major challenge for this study. As a result, only 24 of a total of 50 African countries are included. However, each of the major regions of the continent is represented in the results, and efforts to include more countries are addressed in future plans for engagement. The details of the initiatives for each country were then compiled into a database. From here they were further categorised under the broad headings of Policy and Regulation, Incentive Schemes and Voluntary Programmes. Each of these areas was then analysed in greater detail and initiatives identified in each of the countries along with achievements and barriers encountered. A summary of the key findings is provided below in Table i:

Table i Summary of Key Findings

Initiative	Achievements	Barriers	Countries
National EE Strategy	50% of the countries surveyed have a published strategy.	A lack of regular review and updating of the strategy when in place.	Botswana, Cameroon, Chad, Ethiopia, Lesotho, Malawi, Mauritius, Morocco, Sierra Leone, South Africa, Sudan, Zambia.
Standards and Labelling	Low implementation rate for countries but success achieved for cooking stoves in Malawi.	Lack of cooperation of stakeholders and lack of regulations enforcing compliance.	Egypt, Ghana, Malawi, Mauritius, South Africa.
Mass Rollouts of Technology	Have achieved success in most countries. Particularly CFLs and solar water heaters in South Africa.	Quality control on technologies (labelling) and monitoring (M&V). Sustainability of use is also questionable once rollout is complete.	Ghana, Mauritius, Morocco, Nigeria, Rwanda, South Africa, Tunisia, Zambia, Zimbabwe.

Initiative	Achievements	Barriers	Countries
Legislation	Outlawing inefficient technologies, such as incandescent lights	Affordability of efficient technology could impact on access for low-income groups	Algeria, Ghana
Subsidised Energy Audits	Schemes in operation in five countries. Mostly funded by external funding organisations.	The conversion of identified opportunities into actual savings is not known.	Algeria, South Africa, Kenya, Tunisia, Zambia.
Financing and Soft Loan schemes	Implemented in a number of countries using either donor funding or public (government) funding.	Lack of regulatory framework. Continuity of funding.	Botswana, Kenya, South Africa.
Awareness and Promotion	Countries have implemented awareness schemes to educate end users into making efficient choices.	Energy prices too low to provide incentive. Lack of institutional capacity. Monitoring of results.	Egypt, Ghana, Kenya, Tunisia, Mauritius, Zambia.

Therefore, the prioritisation of possible future assistance programmes has been assessed as follows:

- Resources and expertise, but with an emphasis on capacity building and training
- Assistance in drafting strategy and regulatory instruments
- Assistance with implementing standards and labelling programmes
- Raising funding and financing for the implementation of projects (one-off) and ongoing initiatives (soft loans)
- Assistance in the monitoring and reporting of results of initiatives
- Co-ordination of efforts at the country, regional and continent-wide levels

Co-Benefits

Increased access to clean energy is a stated goal of most countries in Africa. Cooking fuel in particular is seen as a major area where improvement is needed, with traditional biomass still being the dominant fuel source for cooking, with negative consequences for health and the environment. Initiatives in East Africa to improve the efficiency of cooking stoves have proved successful and have the potential to be replicated in other countries. Table ii shows the penetration of this technology comparatively in a number of African countries.

Table ii Dissemination of Improved Biomass Cookstoves in Africa

Country	Number Disseminated	% of households covered
Malawi	3 700	0.11
Zambia	4 082	0.14
Tanzania	54 000	0.54
Uganda	170 000	2.24
Kenya	3 137 000	34.9

(Source: IEA, 2014. Africa Energy Outlook)

To facilitate the wider deployment of this technology, the barriers of access to capital for SMEs, skills availability, consumer awareness and socio-cultural barriers need to be overcome. It has been shown that many programmes intended to increase the distribution of improved cooking stove technologies have failed due to a lack of understanding of the needs of those using the stoves.

Prioritisation for Assistance

In terms of prioritising those countries that would benefit most from assistance, the suggestion is that countries that have demonstrated a commitment to implementing EE initiatives but require more assistance to accelerate them could be targeted for support. Morocco, Ghana, Kenya and Zambia are countries that fall into this category. Other countries could play a role in coordinating efforts within regions, such as Egypt in North Africa and South Africa for the Southern African region.

Future Plans for Engagement

In order to better facilitate engagement in areas of EE and access to energy in the future, engagement with the countries in each of the regions through a “hub” is recommended. These hubs would ideally be based in the four identified countries, namely Morocco, Kenya, Ghana and Zambia for the regions of North, East, West and Southern Africa respectively. Should these countries be unsuitable or unwilling, alternatives are available in each region. These hubs would enable cross-country collaboration through formal workshops, as well as providing a forum for disseminating information and producing case studies of success stories to showcase as well as inspire further work.

This study has only begun to explore the initiatives and challenges of establishing and accelerating energy efficiency and improving access to energy in Africa. There are notable data gaps which need to be addressed through further work in this area. By establishing regional hubs of excellence and focus, sustainable long-term solutions can be explored to assist the continent of Africa to address these challenges.

Contents

1. Introduction and background

This report presents the results of a study of energy efficiency (EE) initiatives undertaken in African countries with a specific focus on the areas of success, barriers encountered and improvements to access to energy for the general population of the region. The study examines the continent's four main sub-regions, namely North Africa, West Africa, East Africa and Southern Africa.

The study has been commissioned by the Copenhagen Centre on Energy Efficiency (C2E2) as part of the UNEP DTU Partnership and was undertaken by the Energy Research Centre of the University of Cape Town.

The data for the study have been obtained through the compilation of individual country reports using a combination of desktop research and individual consultation with in-country experts. These individual country reports have then been consolidated into regional summaries. The original country reports are included in this document as Appendix B.

The regional summaries list the EE initiatives that have been implemented, highlighting the achievements of these interventions, as well as details of the barriers encountered. A study of energy efficiency on the African continent is not possible without also addressing the most pressing need in Africa, namely access to energy. The two issues are inextricably linked, and therefore, in addition to initiatives concerned with efficiency, those concerned with improving access to energy such as renewable energy programmes are also considered as part of this study.

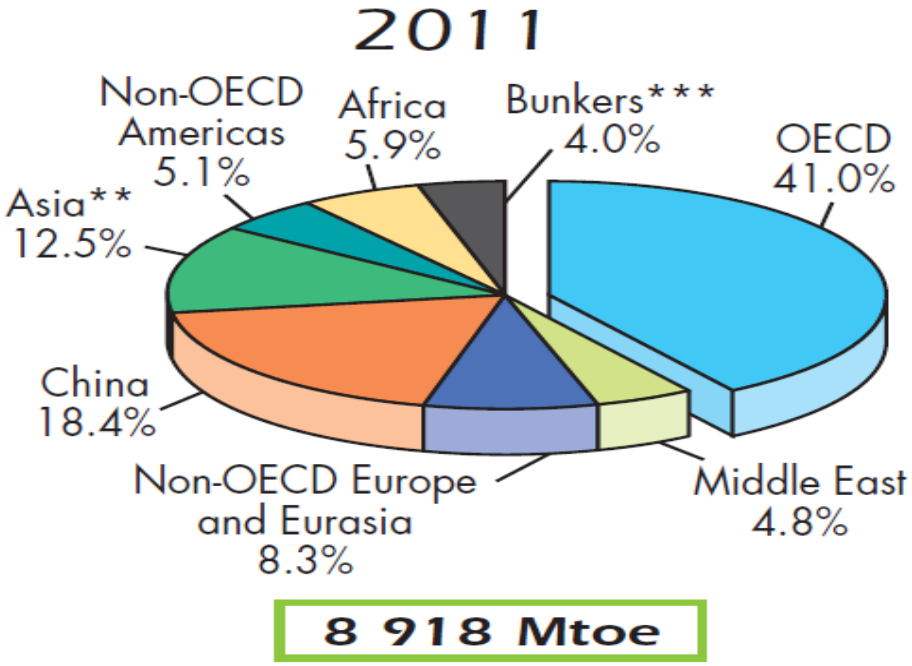
Further to the regional summaries, four countries representative of each of the regions have been selected for more detailed analysis in terms of possible future work or assistance to accelerate the implementation of initiatives, improving access and addressing or removing barriers.

2. Energy in Africa: Overview

The African continent is the second most populous after Asia. There are around a billion people living in 50 countries across Africa.

Looking at worldwide energy consumption, however, the picture is somewhat different. Africa consumes less than 6% of primary energy compared to 41% for the OECD countries, as shown below in Figure 2.1.

Figure 2.1 **World Energy Consumption**[1]



This figure shows the potential for growth in the supply and consumption of energy in Africa in the future. This potential for development means that more attention should be given to energy efficiency as a means of achieving sustainable access to resources for the greater population while at the same time fuelling economic growth.

Access to Energy

Access is considered one of the major energy-related problems on the African continent. Governments often see this as a more pressing issue than energy efficiency since you cannot save what you do not

[1] **Source:IEA, Key World Energy Statistics 2012 – http://www.iea.org/statistics**

have in the first place. Table 2.1 shows the situation with regard to the share of population with access to electricity in the countries throughout Africa.

Table 2.1 Share of Population with Access to Electricity[2]

Region	Population without electricity millions	National electrification rate %	Urban electrification rate %	Rural electrification rate %
Africa	**622**	**43%**	**68%**	**26%**
Sub-Saharan Africa	**621**	**32%**	**59%**	**16%**
Angola	*15*	*30%*	*46%*	*6%*
Benin	*7*	*28%*	*55%*	*6%*
Botswana	*1*	*66%*	*75%*	*51%*
Burkina Faso	*14*	*16%*	*54%*	*2%*
Burundi	*9*	*10%*	*34%*	*7%*
Cameroon	*10*	*54%*	*88%*	*17%*
Cabo Verde	*0*	*94%*	*100%*	*84%*
Central African Republic	*4*	*3%*	*5%*	*1%*
Chad	*12*	*4%*	*16%*	*0%*
Comoros	*0*	*45%*	*72%*	*35%*
Congo	*3*	*35%*	*52%*	*5%*
Côte d'Ivoire	*15*	*26%*	*42%*	*8%*
Democratic Republic of Congo	*60*	*9%*	*24%*	*1%*
Djibouti	*0*	*50%*	*61%*	*14%*
Equatorial Guinea	*0*	*66%*	*93%*	*48%*
Eritrea	*4*	*32%*	*86%*	*17%*
Ethiopia	*70*	*23%*	*85%*	*10%*
Gabon	*1*	*60%*	*64%*	*34%*
Gambia	*1*	*35%*	*60%*	*2%*
Ghana	*7*	*72%*	*90%*	*52%*
Guinea	*10*	*12%*	*28%*	*3%*
Guinea-Bissau	*1*	*20%*	*37%*	*6%*
Kenya	*35*	*20%*	*60%*	*7%*
Lesotho	*2*	*28%*	*55%*	*17%*
Liberia	*4*	*2%*	*3%*	*0%*
Madagascar	*19*	*15%*	*37%*	*4%*
Malawi	*15*	*9%*	*33%*	*5%*
Mali	*11*	*27%*	*55%*	*12%*
Mauritania	*3*	*21%*	*47%*	*2%*
Mauritius	*0*	*100%*	*100%*	*100%*

[2] **Source: IEA Africa Energy Outlook. International Energy Agency. 2014. Accessed at http://www.worldenergyoutlook.org/africa/**

Region	Population without electricity millions	National electrification rate %	Urban electrification rate %	Rural electrification rate %
Mozambique	*15*	*39%*	*66%*	*27%*
Namibia	*2*	*30%*	*50%*	*17%*
Niger	*15*	*14%*	*62%*	*4%*
Nigeria	*93*	*45%*	*55%*	*35%*
Réunion	*0*	*99%*	*100%*	*87%*
Rwanda	*10*	*17%*	*67%*	*5%*
Sao Tome and Principe	*0*	*59%*	*70%*	*40%*
Senegal	*6*	*55%*	*90%*	*28%*
Seychelles	*0*	*97%*	*97%*	*97%*
Sierra Leone	*6*	*5%*	*11%*	*1%*
Somalia	*9*	*15%*	*33%*	*4%*
South Africa	*8*	*85%*	*88%*	*82%*
South Sudan	*11*	*1%*	*4%*	*0%*
Sudan	*24*	*35%*	*63%*	*21%*
Swaziland	*1*	*27%*	*40%*	*24%*
Tanzania	*36*	*24%*	*71%*	*7%*
Togo	*5*	*27%*	*35%*	*21%*
Uganda	*31*	*15%*	*55%*	*7%*
Zambia	*10*	*26%*	*45%*	*14%*
Zimbabwe	*8*	*40%*	*80%*	*14%*
North Africa	**1**	**99%**	**100%**	**99%**
Algeria	*0*	*99%*	*100%*	*96%*
Egypt	*0*	*100%*	*100%*	*99%*
Libya	*0*	*100%*	*100%*	*99%*
Morocco	*0*	*99%*	*100%*	*97%*
Tunisia	*0*	*100%*	*100%*	*100%*

On average 60% of Africans do not have access to clean, reliable energy. While these figures are for electricity access, access levels to clean cooking fuels are even lower - 80% of the population still use traditional biomass for food preparation. This has significant socio-economic, health and environmental disadvantages. Modern wood fuel technologies including gasification are also a potential energy efficiency initiative since this will improve the sustainability of the sources of the wood fuels such as natural forests and vegetation.

Energy Efficiency

The potential for EE in Africa exists across all sectors. In industry, for example mining, agriculture and food processing there is often a technology gap with reliance on outdated, inefficient equipment. In the commercial sector, building efficiency is a key area, in particular the hospitality industry and given that the climate in general requires large amounts of space cooling. The domestic sector has particular challenges relative to the level of access to electricity and clean fuels.

Barriers to Energy Efficiency vary widely, but they generally fall within the same broad areas:

- Financial / access to funding
- Institutional resistance (policy)
  - Poverty, health care, food security take priority
- Behavioural resistance
  - Closely linked with access
  - EE sometimes seen as prejudicial to the poor
  - Can also be related to culture
- Lack of awareness and knowledge

Overcoming these barriers to enable the successful implementation of EE initiatives is a complex issue and not one that is confined to the African region. Some of the common themes in overcoming these barriers are:

- Education
- Incentive schemes
- Access to finance
- Benchmarks
- Policy changes
- Programmes
- Publication of successful case studies

3. Methodology

The scope of work for the study consists of four main tasks. To begin, energy efficiency initiatives, including projects to improve access, are identified. Secondly, the barriers to implementation are recognised and documented along with the initiatives in the form of regional summaries. Thirdly, four countries are selected for more detailed profiling and analysis. Finally a strategy is suggested for follow-up work to support and accelerate initiatives in these four countries.

This section discusses the method to be followed in each of these steps and the expected output from each.

Identification of EE and improved access initiatives

Task

The main objective of this task is to identify energy efficiency initiatives and initiatives to improve access to energy. This will include activities that have either already taken place, are currently underway, or are being planned both regionally and nationally.

Method

The method undertaken to complete this task is to perform a thorough desktop search of the available literature and published research, including journal articles, reports and conference proceedings.

Output

The output from this phase would be individual country reports, which will be further consolidated into a table of regional activities listing the following where available:

- A detailed description of the initiative
- The timeframe of the project, including any delays and the reason for them
- The budget or estimated budget
- The savings or improved access expected from the initiative
- The actual savings achieved, if available
- Challenges and barriers encountered or anticipated.

Summary of initiatives and barriers to implementation

Task

Identification and documentation of the barriers encountered in the initiatives listed under the previous section. A summary of these barriers is to be included under the main categories of initiatives.

Method

The barriers to the implementation of EE initiatives are identified in the previous step. However, in this phase of the study these will be analysed and described further. This will include the categorisation of the initiatives and barriers under these categories:

- Policy and regulatory
- Incentive schemes
- Funded Initiatives
- Voluntary initiatives

The barriers will be some combination of these categories, in which case they will be described and efforts made to determine possible inter-dependencies between them. For example, an initiative may encounter both financial and policy barriers, but on closer examination the financial barrier may be dependent on the policies, meaning that removal of these barriers may result in the financial constraints falling away.

Output

A summary of the initiatives, achievements and barriers will be produced. Details of these will form part of the individual country reports and will also be consolidated into a regional table as described in the previous section.

Selection of four case-study countries

Task

The prioritisation of four countries representing all of the regions based on the initiatives, barriers and suggested assistance required to address the impediments.

Method

Based on the barriers identified in the previous section, there may be some opportunities to improve existing programmes by addressing these barriers. Initiatives for improving access to energy, health and safety, and poverty alleviation are also to be considered in the selection.

Identification of the four countries for further analysis is to be based on:

- EE potential
- Improved access potential
- Government interest and support
- Commitment to accelerate EE / access
- Need for assistance

The criteria relating to government support and commitment will be largely qualitative, based on the ease of data collection and the results of initiatives already undertaken. The need for assistance will be assessed in the light of programmes already underway that are showing improvements but have perhaps been halted due to a lack of funding, expertise or other assistance.

Output

The output of this task will be the prioritisation of the countries of the region based on the data acquired in the previous steps. Once the four countries have been identified, a profile of each, drawing on the respective country reports, will be drawn up and the identification of further work included.

Identification of next steps

Task

Based on the findings above, further work and possible assistance strategies for the selected countries are explored.

Method

The proposal of future plans to be developed will grow out of the detailed examination of the collected data around the current, identified and proposed EE initiatives. This will include a critical analysis of each of the barriers identified, as well as the co-benefits of each initiative.

Output

The output of this task is the prioritisation of initiatives based on the largest gains available in the shortest time, with details of:

- Potential future action to be taken
- Type of assistance required:
  - Financial
  - Expertise
  - Resourcing
  - Policy development

4. Data Availability and Participation

A continent of the size and diversity of Africa presents challenges when attempting to obtain data. In many cases data are not published or not made easily available, though some good initiatives are being implemented. Local knowledge and good in-country contacts then become essential in order to incorporate this knowledge. Suffice it to say that, just because a country does not appear here, that does not mean that it does not have any EE initiatives in place; rather, the information was not readily available. In other cases, information was available, but only in the regional language, i.e. French or Portuguese.

Overall, information was available for 24 of the total of 50 African countries. A representative number of countries from each region – North Africa, West Africa, East Africa and Southern Africa – were obtained.

The countries for which information was received are:

Table 4.1 Countries participating in the study

Area	Country
North Africa	Algeria
	Morocco
	Tunisia
	Egypt
	Sudan
	Chad
West Africa	Burkina Faso
	Ghana
	Nigeria
	Cameroon
	Sierra Leone
East Africa (incl. central)	Democratic Republic of Congo
	Ethiopia
	Kenya
	Uganda
	Rwanda
	Madagascar
	Mauritius
Southern Africa	Lesotho
	Malawi
	Botswana
	South Africa
	Zambia
	Zimbabwe

These countries are shaded on the map of Africa in Figure 4.1 below.

Figure 4.1 Geographical representation of countries included in this study (shown as shaded)

5. Regional Summaries

The information received from the regions and the individual countries has been consolidated in this section, by region. This information is tabulated under the headings for the main initiative, a description of the initiative, or in some cases a further breakdown into sub-tasks, and then a listing of the countries included under the initiative. Further columns provide the envisaged time frames, the expected outcomes or achievements, and lastly a summary of the barriers encountered. This approach results from the diversity of data quality, as well as the data quantity obtained from individual countries, and provides a useful analysis of energy initiatives by region. The individual country reports are included in Appendices A and B.

The following are initiatives that are taking place on a regional scale in the four regions of the African continent. The initiatives included are for energy efficiency as well as improved access to energy. For the latter, this mainly includes grid connectivity projects, as well as renewable generation programmes.

5.1 East Africa

Table 5.1 East Africa Regional Summary

Main Initiative	Description of Initiative/s	Countries included	Time frame	Expected achievements	Summary of Barriers
Scaling up Access to Modern Energy Services Regional Strategy	Objective: to support the achievements of the Millennium Development Goals by enabling at least half the population to have access to modern energy services by the year 2015. Use of modern cooking practices by 5% of those who at present use traditional biomass for cooking, including reducing indoor air pollution to safe levels and increasing the sustainability of biomass-derived fuel production; Access to reliable electricity for all urban and peri-urban poor. Access to modern energy services such as lighting, refrigeration, information and communication technology, and water treatment and supply for all schools, clinics, hospitals and community centres.	Burundi, Kenya, Rwanda, the United Republic of Tanzania, and the Republic of Uganda	**By 2015**	This would enable 9.6 million more households and 23,000 extra localities to access modern energy services	Infrastructure and financial

5.2 West Africa

Table 5.2 West Africa Regional Summary

Main Initiative	Description of Initiative/s	Countries included	Time frame	Expected achievements	Summary of Barriers
Regional Energy Efficiency Policy	• To double annual improvements in energy efficiency by 2020 • To develop ECOWAS Regional Efficient Lighting Strategy (RELS)	Benin, Burkina Faso, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo and Cape Verde	Validated in 2012	Not specified	• Lack of the awareness of the benefits of efficient lighting • Lack of adequate regulatory and Institutional EE policies • Lack of a supporting incentive structure • Lack of capacities of public and private institutions • Limited local production of efficient lighting products • Absence of metering systems • Inadequate research and development • Market barriers • Financial barriers • User behaviour and awareness -
Regional Efficient Lighting Strategy	• To promote rapid uptake of efficient, high quality on-grid and off-grid lighting products while permanently removing any inefficient lamps from the market in the ECOWAS Region • Increase national and regional demand for high efficiency, high quality on-grid and off-grid lighting products. • In the medium term to achieve the strategy through local production, thus increasing economic growth in the lighting sector • Increase access to high-efficiency, high-quality on-grid and off-grid lighting products • To reduce the operating costs of lighting with particular positive interest on low-income households • To reduce greenhouse gas and mercury emissions from lighting-related electricity consumption by reducing consumption • Reduce life-cycle footprint of lighting-related products and usage	Benin, Burkina Faso, Côte d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo and Cape Verde	ongoing	Expected Savings: • Annual energy savings of about 2.43 TWh amounting to about 6.75% of total electricity consumption. The savings would be enough to supply total annual electricity consumption of a minimum of 2.4 million households, assuming household consumption of only 1000 kWh/yr. • A monetary regional annual savings of more than US$220 million at an average amortization time of only three months.	

Other regional initiatives	• Lighting Testing Facility – Nigeria, Ghana • Development of sustainable markets efficient off-grid lighting technologies e.g. LED (Lighting Africa program) - Ghana, Nigeria, Senegal • Consumer and retail education campaigns on LEDs (Lighting Africa programme) – Liberia, Ghana, Mali, Senegal • Distribution of off-grid lighting products to rural NGOs	Benin, Burkina Faso, Ghana, Liberia, Mali, Nigeria, Senegal	ongoing	Not specified

5.3 North Africa

Table 5.3 North Africa Regional Summary

Main Initiative	Description of Initiative/s	Countries included	Time frame	Expected achievements	Summary of Barriers
The Arab Maghreb Union's (AMU) initiatives	The AMU plans to: - Strengthen cross-border transport networks for electricity, natural gas and oil products. - Pool skills within specialized technology parks in the various segments of the energy sector, and with time reduce technological dependency. - Carry out common unifying projects in the electronuclear, solar and equipment production fields. - Create a permanent framework for consultation, coordination and discussion so as to stimulate integration of the sector, harmonize energy policies and propose cooperation strategies for the Maghreb or with other regions.	Algeria, Egypt, Libya, Mauritania, Morocco, Sudan, Tunisia	2020	The AMU has set the target of reaching a level of energy exchange in the order of 20% during the next two decades.	• The absence of policy and framework in some countries • Price distortions for renewable energy • The high cost of start-up investments • Weak technical command, as well as weak industrial development in the region • Lack of

The Euro-Mediterranean initiatives (for example: the Mediterranean Solar Plan [MSP])	The master plan involves the following key aspects: setting up favourable strategic and regulatory frameworks, strengthening financial support instruments; modernization of transmission systems and infrastructures; support for industrial development and job creation; improved capacity development and know-how transfer.	Algeria, Egypt, Libya, Mauritania, Morocco, Sudan, Tunisia	Ongoing	The MSP plans 20GW production from solar energy in North Africa by 2020, and the development of the Mediterranean interconnection network.	information concerning the sustainability of a regional renewable energy market • Lack of regional technical norms concerning renewable energy technology • Limited competencies in terms of developing bankable projects.
The Arab League's strategy for developing renewable energy	Improving energy security by diversification of energy resources. Using the abundance of renewable energy resources in the region and addressing the lack of water resources. Meeting national and regional development needs. Keeping oil and natural gas as strategic reserves. Contributing to solving environmental problems.	Algeria, Egypt, Libya, Mauritania, Morocco, Sudan, Tunisia	Ongoing	-	
The Africa–EU cooperation programme within renewable energy	The development of infrastructure and energy interconnections both within Africa and between Africa and Europe. The programme focus is both on renewable energy and energy efficiency. Activities to develop technical and professional skills, in cooperation with training.	Algeria, Egypt, Libya, Mauritania, Morocco, Sudan, Tunisia	Ongoing	-	

Regional Centre for Renewable Energy and energy efficiency (RCREEE)	Provides a knowledge base based on regional cooperation in the field of renewable energy and energy efficiency in the Arab region.	Algeria, Bahrain, Egypt, Iraq, Jordan, Lebanon, Sudan, Syria, Libya, Morocco, Palestine, Tunisia and Yemen	Set up in June 2008 in Egypt	-
Mediterranean Renewable Energy Centre (MEDREC)	Mobilization of resources, Exchange of information, Training, Development of pilot projects.	Algeria, Egypt, Libya Morocco and Tunisia	Set up in June 2004 in Tunisia	-

5.4 Southern Africa

Table 5.4 Southern Africa Regional Summary

Main Initiative	Description of Initiative/s	Countries included	Time frame	Expected achievements	Summary of Barriers
SADC Regional Energy Access Strategy	To harness regional energy resources to ensure, through national and regional action, that all the people of the SADC Region have access to adequate, reliable, least-cost, environmentally sustainable energy services.	Angola, Botswana, Democratic Republic of the Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe	2020 and ongoing	To halve the proportion of people without such access within 10 years for each end use and halve again in successive 5 year periods until there is universal access for all end uses.	Regulatory barriers Access to finance Lack of uniformity between governments and government departments
Drafting and implementation of national energy policies and strategies	Providing a framework for the implementation of strategies to : Improve access to modern energy sources Improve the efficiency of utilisation of existing resources Explore alternative, clean forms of energy	Angola, Botswana, Democratic Republic of the Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe	Ongoing		

The regional initiatives focus on collaboration between countries on matters of infrastructure and energy security. Individual countries' initiatives fall into the main categories of policy and regulation, incentive schemes, and voluntary schemes implementing EE strategies. These are discussed in the next section.

6. Summary of EE Initiatives, Achievements and Barriers

For the purposes of this report, EE initiatives are considered to be any efforts to improve energy efficiency undertaken by a country's government, public sector or private sector. This includes policy, strategies and programmes, as well as donor-funded projects. The aim is to evaluate the effectiveness of these initiatives in order to suggest ways of improving their effectiveness either by addressing the barriers encountered, or by extending successful initiatives nationally or regionally.

The EE initiatives of individual countries can be discussed under the following categories:

- Policy and regulatory,
- Incentive schemes,
- Funded interventions, and
- Voluntary initiatives.

For the purposes of this report, incentive schemes and funded interventions are combined since in most cases the incentives are partially or fully funded from external sources.

This section explores the key initiatives falling under these categories in the countries surveyed and discusses their successes and achievements, as well as some of the important barriers they encountered. Areas where co-benefits have been achieved, for example, improved access to energy, or improved health and safety, are also highlighted.

Policy and Regulatory Initiatives

The central policy initiative for energy efficiency is the country's ***national energy efficiency strategy***. This study established that twelve of the twenty-four countries surveyed have an energy policy in place. While it is difficult to provide any measure of what is achieved under a strategy document as broad as an EE strategy, it is true to say that without this framework many other initiatives will falter. This is borne out by examining the initiatives listed in the previous section and in individual country reports: the "lack of regulatory framework" and "lack of clear policies" feature often as barriers to EE implementation. A further consideration in those countries that have EE strategies is how current the policy is. Some of these strategies have been in place for twenty years (Ethiopia) without any evidence of ever being updated. South Africa's EE strategy's latest update is more than four years overdue. It is vital to update these strategies frequently to stay relevant in the ever-changing energy environment.

EE ***standards and labelling*** also feature in a number of the country assessments, but they are noticeably absent in many others. Egypt has standards for domestic appliances, but as compliance with the standard is voluntary, this is listed as a significant barrier to the success of the initiative. Ghana has implemented standards and labelling of household appliances, but lists the "lack of co-operation of major stakeholders" as a barrier to success. Malawi reports success with appliance standards in charcoal cooking stoves with an improvement in efficiency of 20% for stoves that pre-heat incoming air. Mauritius has implemented the labelling of appliances, but only as a guide for consumers. South Africa has published standards for buildings, as well as energy management systems and measurement and verification, and has made building codes mandatory for new buildings, but compliance with other standards is still voluntary. Appliance labelling in South Africa still has to be finalised.

Mass rollouts of technologies such as CFLs feature strongly as successful initiatives across the continent. Ghana reports savings of 124MW at peak load due to the distribution of 6 million CFLs. Mauritius reports savings of 14 MW at peak due to a subsidised CFL programme implemented in 2008. Morocco had installed 4.5 million CFLs by the end of 2010 but lists "weak monitoring and control" and the absence of a "quality label" on the CFL lamps as barriers to success. Nigeria, Rwanda, South Africa, Tunisia, Zambia and Zimbabwe all reported successes with CFL mass rollout campaigns. A general concern with mass rollouts is the sustainability of uptake. Follow-ups are required to ensure that inefficient technology is not being reverted to once the project is completed.

Legislation prohibiting inefficient technologies has been implemented in Algeria, which aims to prohibit the marketing of incandescent lights by 2020, and in Ghana, which has implemented legislation outlawing air conditioners and CFLs unless they meet the labelling and standards requirements. While other countries have debated this, such as South Africa, the affordability of these technologies is the main barrier. Purchase price is a driving factor in poor communities, and so subsidies would need to be increased to make more efficient technologies more affordable.

Incentive schemes

One of the most prevalent incentive schemes running across the continent is the ***subsidised energy audit*** programme. Algeria has implemented the co-financing of energy audits. South Africa has two schemes running currently, the UNIDO-funded subsidised energy audits run under the National Cleaner Production Centre (NCPC), and the Private Sector Energy Efficiency initiative (PSEE) funded by DFID. The Kenya Centre for Energy Efficiency and Conservation (CEEC) undertook audits in mainstream industries, SMEs and public institutions. A total of 171 audits yielded savings of approximately 14MW. In Tunisia, over 420 energy audits were conducted between 2005 and 2010. The Zambia Energy Efficiency Management programme (EEMP) has selected seven enterprises and performed energy audits, the next phase of the project being to provide training and to assist with obtaining finance for capital projects. Also in Zambia, the Zambian Association of Manufacturers (ZAM) audited approximately twenty companies. This initiative is also awaiting its next phase.

Information on the implementation of interventions identified in the audits is not reported, which is a concern. The potential savings have been translated into actual savings.

One of the largest barriers across the continent is reported to be access to finance for the implementation of energy efficiency projects. Where funding is available, whether through the government or outside funding organisations, a number of ***financing and soft loan schemes***, i.e. loans on very favourable terms, have been implemented. In Botswana, rural communities can purchase solar photo-voltaic systems on a loan purchase agreement to be paid back over four years. The main barrier to this scheme is cited as the lack of a legal and regulatory framework. Kenya has set up a global environment fund (GEF) assisted programme for the implementation and delivery of EE services. The GEF is a partnership of countries who collectively contribute funds to finance activities related to sustainable development, climate change and related environmental issues such as energy efficiency. The GEF operates through implementing agencies such as the UNDP, and it is through this mechanism that the programme in Kenya was facilitated.[1] [3]

The South African Demand Side Management (DSM) programme, implemented by the electrical utility Eskom, is seen as being the most successful of the finance schemes in Africa by providing subsidies to customers to implement verified electricity savings. The funding for this comes from a levy on the electricity tariff and is regulated by the national electricity regulation body, NERSA. The success achieved by this programme has resulted in average demand savings of 600MW between 2005 and 2013. Barriers to further savings are seen to be the recent reduction in the funding and the lack of penetration into the residential market, where it is believed more savings are possible. Tunisia has introduced a partial loan guarantee for companies contracting the services of an energy consultant or ESCo. This initiative has achieved a reported saving of 710 kilo tons of CO_2 in avoided emissions.

Voluntary Programmes

In this report, voluntary programmes are classified as initiatives which do not have an incentive or regulatory driver. For the main part these rely on the end consumer implementing EE because of the direct benefits to them, whether financial (savings) or from a desire to "do the right thing". The successes of and barriers to these initiatives are difficult to assess fully, as they are largely undocumented. However, for the purposes of this study, the programmes that seek to ***increase awareness and promote EE*** are included in this category. Egypt implemented a programme to promote the use of CFLs in 2005, but reported barriers in that energy prices were not yet at a level to encourage consumers to switch. In addition, there were also institutional capacity problems in the running of the programmes. Ghana implemented a campaign to provide information to consumers on purchasing efficient air conditioners and lighting (CFLs). The Kenyan NCPC instituted training and awareness programmes, as a result of which they continued to participate in drafting a number of

[3] **UNDP – GEF Accessed at http://web.undp.org/gef/index.shtml, July 2015.**

policy documents. Mauritius has developed a tool to assist end users to carry out their own energy audits, as well as material for providing training. Tunisia implemented an energy efficiency awareness scheme in industries, and although it is not clear what this entailed, it is claimed that 700 kton of carbon emissions were avoided.

Table 6.1 below shows a summary of the initiatives, barriers as well as the countries where these have been experienced.

Table 6.1 Summary of Initiatives and Barriers

Initiative	Achievements	Barriers	Countries
National EE Strategy	Half of the countries surveyed have a strategy in place.	Often outdated. Lack of regulation to enforce policy.	Botswana, Cameroon, Chad, Ethiopia, Lesotho, Malawi, Mauritius, Morocco, Sierra Leone, South Africa, Sudan, Zambia.
Standards and Labelling	Low implementation rate for countries, but has achieved success for cooking stoves in Malawi.	Lack of cooperation of stakeholders and lack of regulations enforcing compliance.	Egypt, Ghana, Malawi, Mauritius, South Africa.
Mass Rollouts of Technology	Have achieved success in most countries. Particularly CFLs and solar water heaters in South Africa.	Quality control on technologies (labelling) and monitoring (M&V). Sustainability of use is also questionable once rollout is complete.	Ghana, Mauritius, Morocco, Nigeria, Rwanda, South Africa, Tunisia, Zambia, Zimbabwe.
Legislation	Outlawing inefficient technologies, such as incandescent lights.	Affordability of efficient technology could impact on access for low-income groups	Algeria, Ghana
Subsidised Energy Audits	Schemes in operation in five countries. Mostly funded by external funding organisations.	The conversion of identified opportunities into actual savings is not known.	Algeria, South Africa, Kenya, Tunisia, Zambia.
Financing and Soft Loan schemes	Implemented in a number of countries using either donor funding or public (government) funding.	Lack of regulatory framework. Continuity of funding.	Botswana, Kenya, South Africa
Awareness and Promotion	Countries have implemented awareness schemes to educate end users in making efficient choices.	Energy prices too low to provide incentive. Lack of institutional capacity. Monitoring of results.	Egypt, Ghana, Kenya, Tunisia, Mauritius, Zambia.

To suggest future action to support these and other EE and access initiatives, it is appropriate to evaluate these further. In order to do this, representative countries from each region will be selected for further study. The criteria for selection and the profiles of the countries chosen are discussed in a later section. First it is useful to examine what co-benefits can be achieved when considering EE initiatives. This is discussed in the following section.

7. Co-Benefits

The anticipated co-benefits of the EE initiatives that are to be implemented were not well documented in the data received. However, most countries stated that access to energy for increased proportions of the population was a high priority when considering energy interventions. Renewable energy, distributed generation and energy efficiency measures are all considered as contributors to this goal.

Efficient cooking methods are often associated with improved health and safety, as well as reduced impact on the environment through reduced reliance on traditional wood-fuel cooking methods. Cameroon, Ethiopia, Malawi and Zambia all list this as being one of the aims of their alternative fuel-cooking programmes. We focus below on the co-benefits of efficient or improved cooking stove technologies (ICS).

Benefits of efficient cooking technologies

As indicated in section 2, about 70%-80% of final energy consumption in sub-Saharan Africa is from traditional solid biomass, making it is the largest energy source in the region. Of the estimated 280 Mtoe of solid biomass currently used in sub-Saharan Africa (outside of South Africa), 90% is used by households for cooking, almost all being firewood, charcoal or agricultural residues. According to IEA (2014).[4] About 730 million people out of a population of about 915 million in sub-Saharan Africa did not have access to clean cooking facilities as of 2012. By 2030, one billion Africans will depend on traditional biomass to meet their energy needs. This has many negative consequences for physical access to biomass resources, health, opportunity costs for households, etc. The deployment of efficient or improved cooking stoves (ICS) has the potential to improve access to biomass, with consequences for availability, cost and cleanliness.

In East Africa, initiatives to disseminate ICS have delivered significant benefits to both the urban and rural poor. ICS programmes have created many informal-sector jobs along the value chain, resulting in reduced fuelwood consumption. The Kenya Ceramic Jiko (KCJ) is probably one of the most successful stove projects in Africa. Its success can be attributed to the long-term commitment of both the private and public sectors in its development. Also, the KCJ piggybacked on the existing artisanal ICS industry, which reduced delivered costs.

In contrast, the penetration of ICS in other Sub-Saharan African regions has been largely limited. For instance, whereas over three million stoves have been distributed in Kenya, only four thousand units have been distributed in Zambia, as shown in Table 7.1.

[4] IEA, 2014. Africa Energy Outlook: A Focus on Energy Prospects in sub-Saharan Africa. International Energy Agency, Paris.

Table 7.1 Dissemination of Improved Biomass Cooking Stoves in Africa[5]

Country	Number disseminated	% of households covered
Malawi	3 700	0.11
Zambia	4 082	0.14
Tanzania	54 000	0.54
Uganda	170 000	2.24
Kenya	3 137 000	34.9

Some of the success factors that have been identified across East Africa in the ICS sector include:

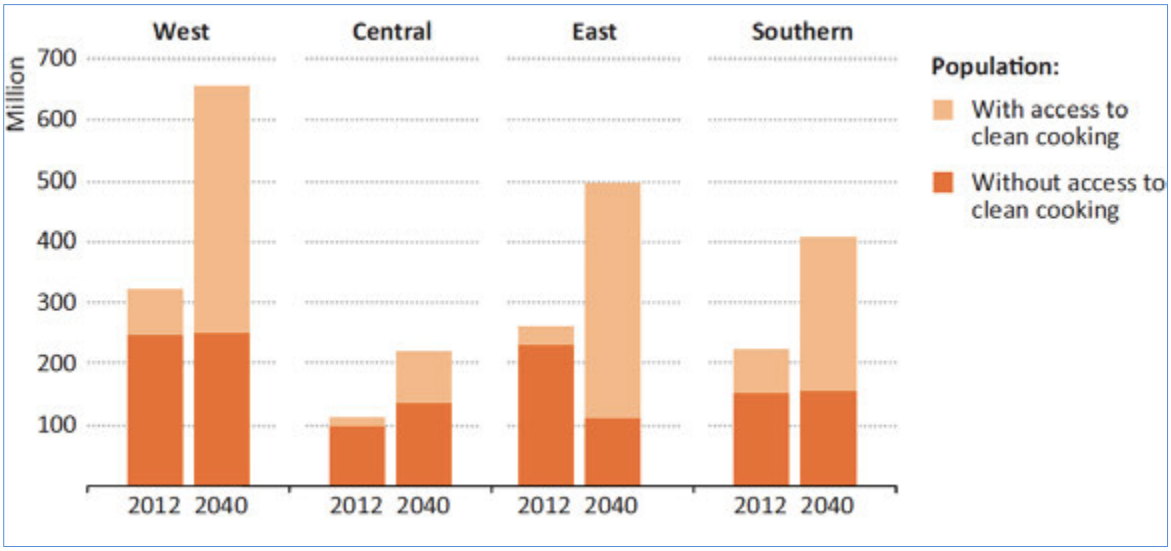
- availability of finance for both SMEs and end-users;
- cost of fuels;
- awareness creation and training;
- development and maintenance of standards;
- strong income-generating component;
- having local champions driving the sub-sector;
- limited natural resources in the form of dwindling forest resources; and
- health concerns.

Given the relatively low levels of dissemination of ICS technologies in many regions of Africa and the projected increase in the number of people relying on biomass (see Table 5.1), the future potential for ICS in Africa is significant in becoming a very important sector for a range of employment, health and environmental benefits, especially in southern Africa. There is also still the scope to capture a large percentage of households that are still dependent on traditional cooking technologies in East Africa, despite the wider deployment of ICS technologies in that region.

The IEA (IEA, 2014) estimates that East Africa will account for more than half of the 390 million people taking up improved biomass cooking stoves in Sub-Saharan Africa by 2040 (see Table 5.1). In 2040, the share of households without access to clean cooking technologies is projected to decrease to 37% from 80% in 2012. As shown in Figure 3, the potential market for ICS in Sub-Saharan Africa is 763 million people in 2030 and 653 million in 2040. In 2030 this is expected to cover 270 million people in West Africa (77% of the population), 128 million in Central Africa (88%), 199 million in East Africa (89%) and 167 million in Southern Africa (65%) in 2030.

[5] **(Source: IEA, 2014. Africa Energy Outlook)**

Figure 7.1 Projected Comparison of Population with and without Access to Clean Cooking Technologies in Different Regions of Africa in 2012 and 2040 [6]



To enable wider deployment of ICS technologies in Africa requires overcoming many barriers. According to the World Bank (2011),[7] many previous biomass ICS programmes have failed mainly due to a lack of proper understanding of the needs of those who use this technology. Other barriers include access to capital for SMEs and end-users, limited market development, limited skills, inconsistent quality, inputs costs, low consumer awareness and socio-cultural barriers. These are in addition to the many barriers identified in Section 7. Any programme that addresses these will therefore contribute to the general improvement of access to clean energy services in the region.

[6] **Source: IEA (2014)**

[7] **World Bank, 2011. Household Cookstoves, Environment, Health and Climate Change. The World Bank, Washington.**

8. Prioritisation for Assistance, and Selection of Representative Countries

The information presented in the preceding sections is further analysed to identify the countries that have achieved some success in initiatives, but have also encountered specific barriers preventing the full potential of these measures from being realised. Forms of assistance to overcome these barriers for each of these countries are listed in Table 8.1:

Table 8.1 Country Assessment of Assistance Requirements

Country	Assistance Required
Botswana	Resources and expertise.
Cameroon	Finance, skills.
Chad	Assistance in setting up regulatory framework.
Democratic Republic of Congo	Institutional capacity.
Egypt	Data and information, financial and capacity building.
Ethiopia	Assistance with locally developed solutions, training and experience.
Ghana	Ghana has implemented a number of initiatives, but cites lack of regulation as a barrier. This country could benefit from an Energy Efficiency Strategy in order to direct efforts in a more strategic manner.
Kenya	Awareness programmes. Dissemination of information and data from energy audits. Skills and capacity building. Assistance with standards and labelling.
Lesotho	Institutional support, assistance in awareness raising.
Madagascar	Funding and financing.
Mauritius.	Assistance in M&V of projects to assess savings
Morocco	Assistance in setting up of regulatory frameworks and policies. Standards and labelling.
Sierra Leone	Funding and capacity building.
South Africa	Co-ordination of efforts. Continuation of funding for the DSM. programme. Assistance with standards and labelling.
Zambia	Creating institutional capacity and monitoring of efforts.

Note: This does not mean that other countries do not have challenges and could not benefit from assistance. These barriers are simply what have been identified in this study of the region.

To focus future efforts better, one of the objectives of this study is to identify four countries, one from each region, as a target for possible assistance. The criteria used to make this choice mainly reflect the experiences uncovered in compiling this report, namely a demonstrated commitment to EE, evidence of gains made in this area, and existing structures within the country that can provide a basis for further support.

Based on these criteria, the four countries that would benefit most from further engagement are Morocco, Ghana, Kenya and Zambia. This is not to say that other countries do not deserve attention, but rather that these are typical of countries in the region that would benefit from further support in this area.

A detailed profile of each of these countries and references is included in Appendix A, but a discussion of the main criteria for selecting these countries follows below.

8.1 Morocco

Morocco has demonstrated a commitment to EE and to improving access to energy by implementing a mass rollout of 4.5 million CFL lights national, resulting in an estimated reduction in energy consumption of 25%. In addition, over 110,000 rural households were electrified using solar PV, making Morocco a world leader in this area. Support for these programmes by the government to electrical utilities is demonstrated, suggesting that any further assistance would result in further successes.

The barriers listed suggest that assistance in setting up regulatory frameworks and policies, particularly in the areas of mass rollouts of technology, would improve the uptake of programmes. Further work in setting up standards and labelling for new technologies would also show benefits. In the areas of solar PV and rural electrification, Morocco shows very advanced progress, this being an area from which other countries in the region could benefit.

8.2 Ghana

Distribution of six million CFLs and the regulation against the import of inefficient technology such as used refrigerators and air conditioners demonstrates a commitment to energy efficiency in Ghana. It is estimated that the CFL mass roll out alone saved in excess of 124MW in maximum demand. The ministry of energy in Ghana is supportive of these programmes and there is an existing support structure in place.

Further input into regulation strategies, as well an overall energy efficiency strategy, would benefit Ghana. The initiatives of the mass rollout of CFLs and the decision to prohibit the use of inefficient

refrigerators and air conditioners is an area that could be developed further, with the lessons being disseminated across the region.

8.3 Kenya

The establishment of an Energy Efficiency and Conservation Agency in Kenya, with the specific aim of promoting energy efficiency, demonstrates a clear commitment in this area. Along with the Kenyan Cleaner Production Centre which has carried out more than 450 training events and 200 cleaner production audits, there is certainly sufficient support to be able to make use of further assistance.

Kenya would benefit from establishing educational programmes to improve consumer awareness. Capacity building programmes to improve technical skills in the areas of energy utilisation would also be beneficial, as would assistance in setting up standards and labelling. As Kenya has achieved success in carrying out energy audits, dissemination of results information from these energy audits would incentivise uptake, and lessons learned could be shared across the region.

8.4 Zambia

Major energy efficiency initiatives implemented include the rollout of three million CFLs, resulting in estimated demand savings of 150MW, a programme to install 350,000 solar water heaters from 2014 to 2017 for projected savings of an additional 150MW, and an Efficient Energy Management programme targeting seven enterprises for energy audits and additional training in energy management. These programmes have had mixed success, but with the support of the local electricity utility, ZESCO, and the government's department of energy, it is felt that assistance in these areas would result in a positive improvement in results.

Zambia has implemented a number of initiatives achieving success, but without their being adequately monitored and verified. Assistance in this regard would be beneficial to the country as well as the region. Also of benefit would be the establishment of capacity building programmes, particularly at the institutional level.

9. Suggested Plans for further engagement

It is evident that the geographical scale of the continent makes a central project effort to engage with countries impractical. The suggested way forward is to engage with institutions at the regional level of respectively West Africa, East Africa, North Africa and Southern Africa. Setting up a “Regional EE Hub” in each of these areas would make information-sharing and the development of relevant action plans more fluent and efficient. There can still be interaction between the hubs.

The most logical location for such a hub for each of the regions would be the countries identified in Section 8 above. Alternative locations might be the following countries:

West Africa: Nigeria

North Africa: Egypt

East Africa: Ethiopia

Southern Africa: South Africa

Engagements specific to the selected countries are discussed in Section 8 above. Many of these would also be relevant to other countries in the regions. The suggested method of addressing these engagements would be through workshops and setting up project and mentoring teams. The emphasis would be on cross-country collaborations rather than on “importing” expertise from developed nations, although this would still be an option where no regional skills exist. There would be overall collaboration between regions (i.e. continent-wide) in order to co-ordinate efforts, exchange information and transfer knowledge. Quarterly reporting both by region and overall would include measurement and verification of efforts in order to better assess successes and challenges, as well as disseminate results. An important aspect of this collaboration would be to publish best practises and success stories from the African region.

10. Concluding Comments

A study such as this one invariably omits more than it includes. The challenges of compiling information across a continent as large as Africa, with its diversity of cultures, languages and levels of development, confirms this. There are notable omissions from the data. Countries such as Tanzania, Mozambique and Angola, among others, would need to be incorporated. The authors envisage this being an iterative process, perhaps even the first step in an action plan to accelerate EE in Africa.

11. References

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Annexes

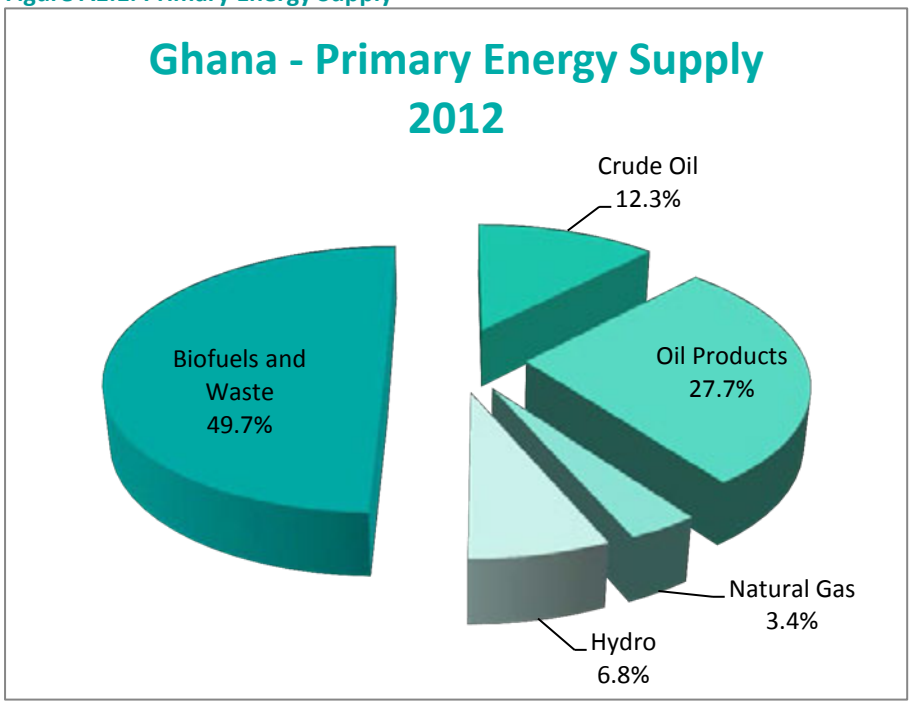
ANNEX A. Country Reports: Representative Countries

A1. Ghana

Overview of the Energy Sector in Ghana

This overview of the energy sector examines the primary energy supply, the breakdown of electricity production, and the proportion of final energy consumption per sector. To provide a context for this, a discussion of the figures for access to electricity is included.

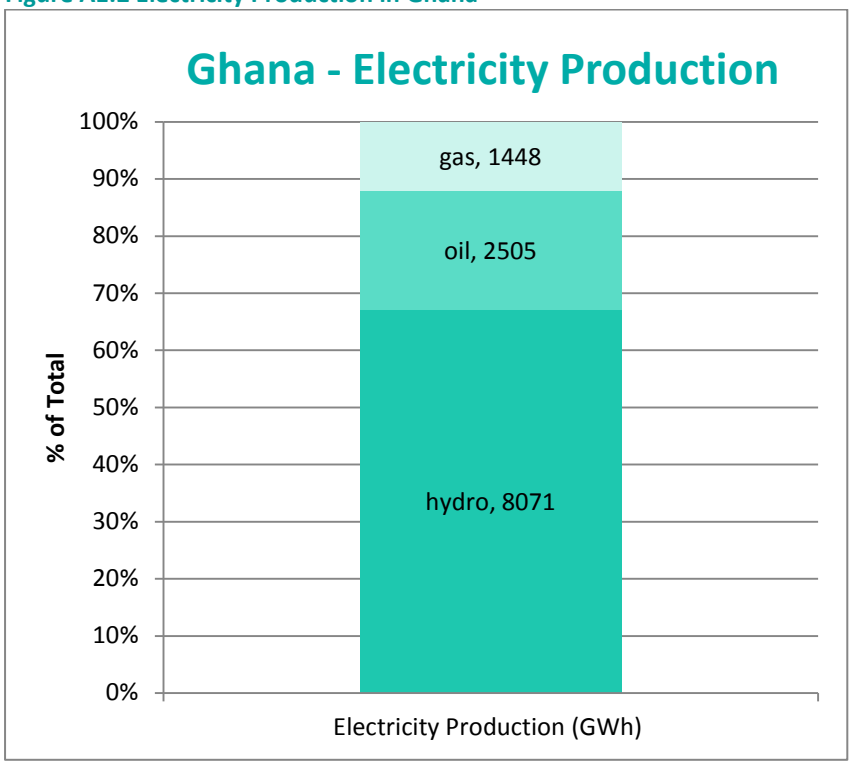
Figure A1.1. Primary Energy Supply [8]



Ghana's main primary energy is biofuel, followed by oil products, i.e. petroleum and diesel. Ghana also utilises hydro and a small proportion of natural gas. When looking at the production of electricity, it can be seen that none of the biofuel is converted, which suggests it is an end-use fuel, most likely firewood for cooking.

8 source: IEA statistics online 2015

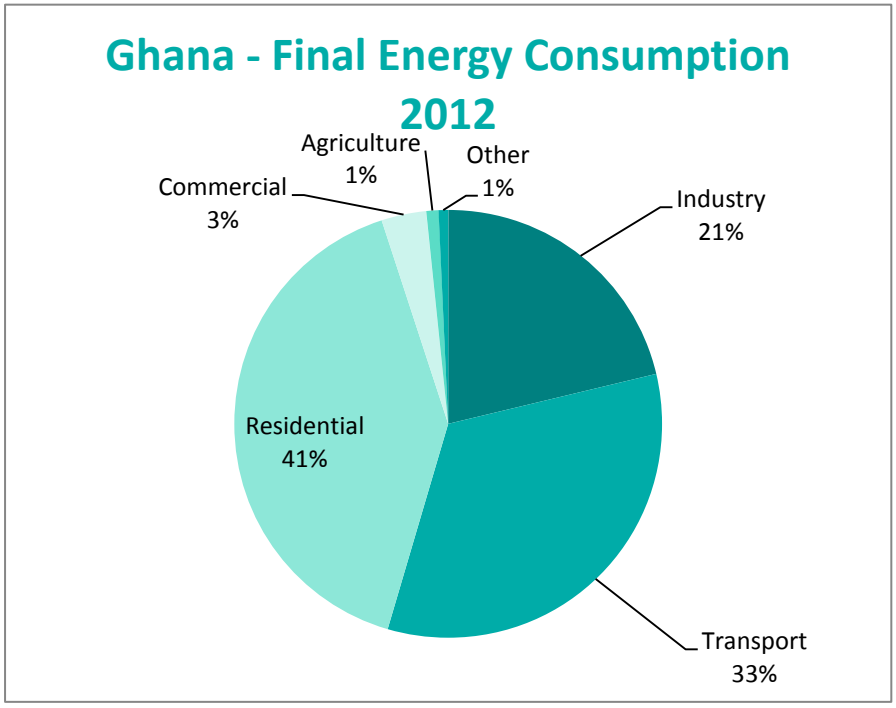
Figure A1.2 Electricity Production in Ghana[9]



The majority of Ghana's electricity (68%) is generated using hydropower. This is good from an environmental point of view, but it is highly seasonal, and during periods of drought there is a severe shortage of generating capacity. When we look at the consumption of energy, we see that it is mostly consumed in the residential sector.

[9] : IEA statistics online 2015

Figure A1.3. Final Energy Consumption in Ghana[10]



These figures include biomass and show that a reduction in the use of biomass would need to be countered by an increase in other energy sources for residential use. Most likely these would be electricity, liquid petroleum gas or natural gas.

The electrification rate for Ghana is 72%: 90% in urban areas and 52% in rural areas (IEA, 2014). The challenge for Ghana is therefore to improve these levels of access by increasing generating capacity within the constraints of the primary resources available.

10 International Energy Agency (IEA) Statistics online. http://www.iea.org/statistics Accessed July 2015

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Ghana are listed in the table below.

Table A1.1 Energy Efficiency Initiatives in Ghana

Initiative/Activity/Programme/and Sponsors	Brief outline and planned dates (whether past/present/or future)
Energy Efficiency Initiatives promoted by Energy Commission of Ghana	Date: April 2014 **Objectives:** ➢ Prescription of Energy Efficiency Performance Standards for non-ducted air conditioners, compact fluorescent filament lamps and refrigerators. Thus, appliances that do not meet the minimum energy performance standards are subject to restricted entry into the country (ECG 2013).
The National Compact Fluorescent Lamps (Cfls) Exchange Programme. Sponsors: Ministry of Energy.	Date: 2007 **Objectives:** ➢ The distribution of six million CFLs for free distribution to all households in the country in exchange for incandescent bulbs. ➢ To serve as an emergency policy intervention measure to reduce peak electricity supply in order to resolve the power crisis, caused by low rainfall affecting hydro-electricity supply.
Legislative Instruments for Energy Efficiency in Ghana (LIs) (ECG 2013). ➢ Energy efficiency standards and labelling regulations, 2005(LI 1815). ➢ Energy Efficiency by Prohibition ➢ Energy efficiency standards and labelling.	Date: 2005 **Objective:** ➢ Reduction of energy consumption through the implementation of Energy Efficiency Standards and Labelling in Household and Refrigerating Appliances. As stated in Regulations, 2005(L1815). Date: 2008 **Objective:** ➢ To reduce load demand by prohibiting the manufacture, sale or importation of incandescent filament lamps, used refrigerators, used refrigerator-freezers, used freezers and used air conditioners. See Regulations, 2008(LI 1932). Date: 2009 **Objective:** ➢ To reduce energy demand through standards and labelling in household and refrigerating appliances. As stated in Regulations, 2009(1958).
Performance and Efficiency Standard for **Compact Fluorescent Lamps (CFL)** **Sponsors:** The Energy Foundation, the Energy Commission and the Ghana	**Date:** April 2003 **Objectives:** ➢ To save energy in order to further protect sub-standard and unreliable CFLs, through the removal of import duties and VAT on Compact Fluorescent Lamps to make them affordable to the general public as a

Standard Board	measure.

The barriers identified in these initiatives that need to be addressed are shown in Table A1.2 below:

Table A1.2 Barriers to EE initiatives identified in Ghana

Initiatives/projects/programmes	Barriers (at both regional and country levels)
General Challenges	**Challenges and barriers encountered** ➢ Lack of cooperation of major stakeholders in the planning and implementation of the exercise, due to the emergency nature of the intervention. ➢ The oversight of environmental issues in the disposal of dead CFLs and the handling of the broken CFLs ➢ Inadequate training for programme implementation team ➢ Inadequate awareness creation on CFLs technology for household beneficiaries [11].

[11] **ECG 2009. Energy Commission of Ghana 2009. Final Report-CFL Exchange Programme Impact Assessment. Available: http://www.energycom.gov.gh/files/CFL%20Report%20final.pdf [02 December 2014]**

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impact, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table A1.3 below:

Table A1.3 Co-benefits of EE initiatives in Ghana

Initiatives/projects/programmes	Co-benefits to Energy Access
Expected national savings from the EE initiatives ➢ It was expected that the programme would save the nation about **200-220MW** of peak electricity supply (ECG 2009).	**The savings achieved from the initiatives** Major achievements of the CFLs exchange programme: ➢ $C0_2$ savings of about 112,320 tons per annum ➢ Delay in thermal generation expansion investment of US$105 million ➢ Mean household income savings of about GH¢31.00 in 25 districts nationwide over six months ➢ At an average crude oil price of US$ 105 per barrel recorded between the period October 2007–October 2008, the energy cost savings is estimated at US$ 33.3 million per annum[12].

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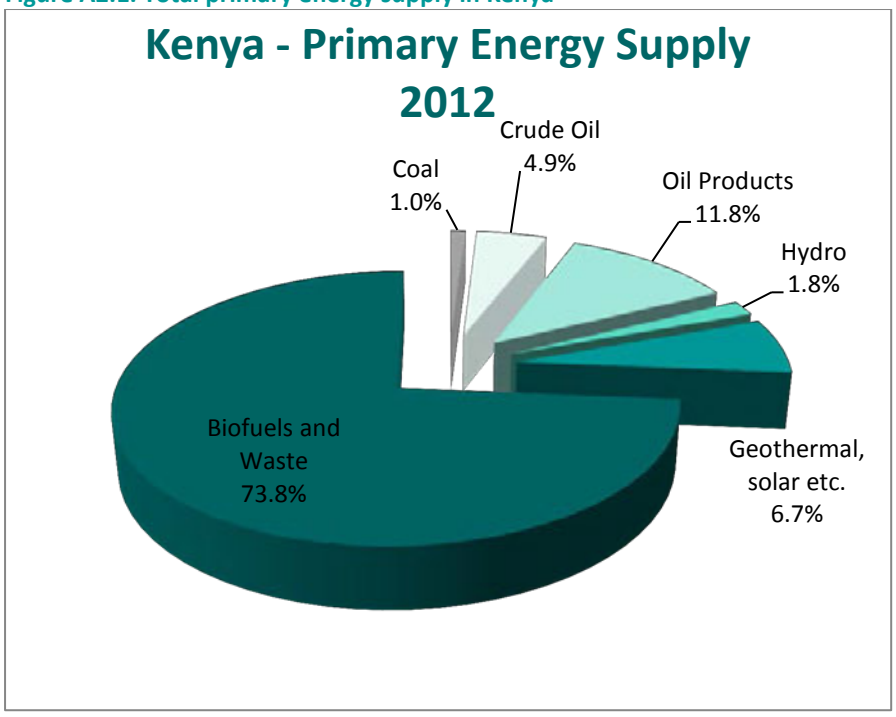
12 ECG 2009

A2. Kenya

Overview of the energy sector in Kenya

The primary energy sources in Kenya include biomass, geothermal, coal, oil and hydro, with biomass representing the largest share of the total supply. The following illustration shows the total primary energy supply in Kenya in 2012.

Figure A2.1. Total primary energy supply in Kenya[13]

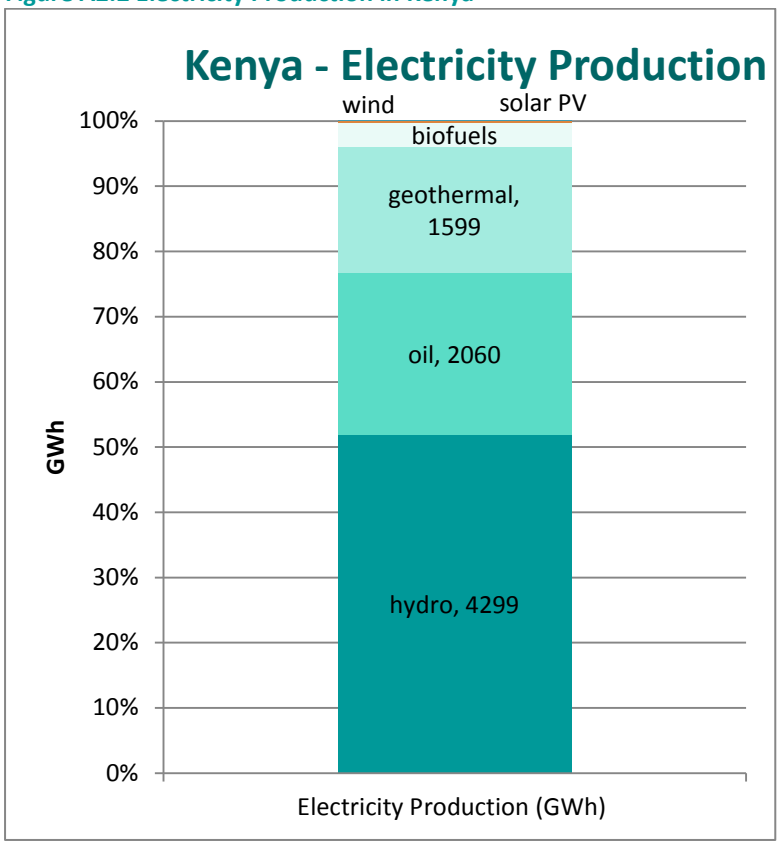


Kenya's main primary energy is biofuels and waste at 74%, followed by oil products i.e. petroleum and diesel. Kenya also exploits geothermal energy, hydro and a small proportion of coal. When looking at the production of electricity, only a small percentage of biofuel is converted, which suggests it is predominantly an end-use fuel, most likely firewood for cooking.

13 Source: IEA www.iea.org/statistics

The main source of electricity generation is from hydro (50%), followed by oil and geothermal at approximately 20% each. Hydro-power is often seasonal, putting a strain on generating capacity during the dry months and drought periods. The challenge is therefore to increase generating capacity using other sources.

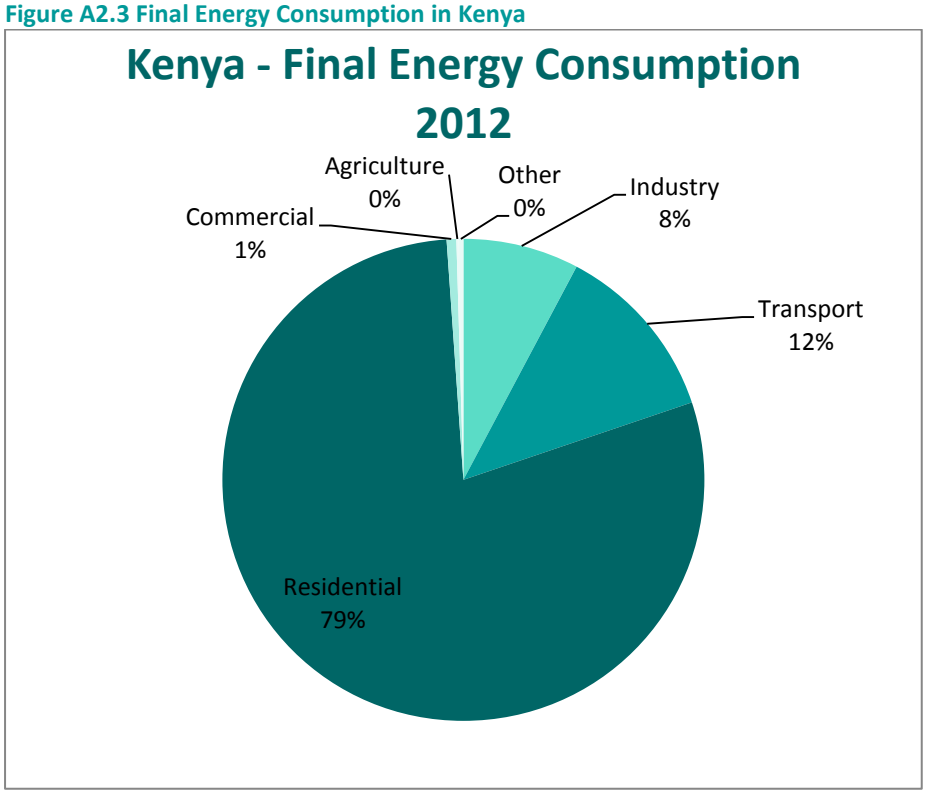
Figure A2.2 Electricity Production in Kenya [14]



Looking at overall energy consumption for Kenya in Figure A2.3, it is evident that the residential sector is the largest user. This suggests a high degree of biofuels (wood) for cooking and heating. This is consistent with a national electrification rate of 20%: 60% urban but only 7% rural (IEA 2014).

[14] **IEA statistics online 2015**

Figure A2.3 Final Energy Consumption in Kenya



Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Kenya are listed in the table below:

Table A2.1 Energy Efficiency Initiatives in Kenya

Initiative/Activity/Programme/and Sponsors	Brief outline and planned dates (whether past/present/or future)		
	Short-term (2014-2018)	Medium-term (2014-2023)	Long-term (2014-2030)
1. Recognize energy efficiency and conservation as a high-priority energy resource.	✓		
2. Promote energy efficiency and conservation initiatives in all sectors, including schools.	✓	✓	✓
3. Enhance the provision of energy audits and advisory services in the counties.	✓	✓	✓
4. Promote the establishment of laboratories for energy efficiency testing.	✓	✓	✓
5. Disseminate information on energy efficiency and conservation to consumers.	✓	✓	✓
6. Provide for incentives and penalties to reduce high losses in generation, transmission and distribution systems.	✓	✓	✓
7. Provide appropriate fiscal and other incentives to enhance uptake of energy optimisation technologies.	✓		
8. Review energy intensity in all sectors and international best practices so as to enable process improvement.	✓		
9. Establish an energy efficiency and conservation agency as a fully-fledged national public entity.		✓	
10. Introduce the concept of green design in buildings. This includes solar water-heating, natural lighting, ventilation and open office design, among others.		✓	✓
11. Promote the development of standards and codes of practice for energy efficiency and conservation.	✓	✓	
12. Develop and enforce standards for fuel economy through speed limits, efficiency of motor vehicle engines, and adopting good driving and maintenance practices.	✓	✓	✓
13. Promote mass transportation of passengers and cargo so as to encourage economies of scale and the attendant fuel efficiencies.	✓	✓	
14. Promote the introduction of new and			✓

efficient technologies such as hybrid engines, fuel cells and electric vehicles.			
15. Prepare a National Energy Efficiency and Conservation Plan in consultation with relevant stakeholders.		✓	
16. Promote efficiency in oil refining in line with modern practices which minimize wastage and encourage heat recovery.		✓	
17. Promote efficiency and improvements in conservation, generation, transmission distribution and consumption of energy, including incentives to encourage the assembly and manufacture of energy efficient equipment.		✓	
18. Promote research and development in the fields of energy efficiency and conservation	✓	✓	✓
19. Support preparation of education curricula on efficient use of energy and its conservation for education institutions, and coordinate with them for the inclusion of such curricula in the syllabus.	✓	✓	✓
20. Implement international co-operation programmes relating to the efficient use of energy and its conservation	✓	✓	✓
21 Provide financial incentives for investments to replace or increase capital investment to improve energy efficiency	✓	✓	✓
Energy Efficiency and Conservation Agency (EECA)	**Objectives:** ➢ To promote energy efficiency and conservation. ➢ To improve the energy security		
Global Environmental Fund-Kenya Association of Manufacturers (GEF-KAM) Industrial Energy Efficiency Project	Date: Ended in 2005 **Objectives:** ➢ Awareness – public and government support (Function of public institutions) ➢ Capacity building – confidence building, enabling industry to take action, accrediting professionals (private and public involvement) ➢ Realizing the benefits. Implementation and delivery of EE services, financing		

	mechanisms, ESCO development ➢ Policy and institutional support – creating national structures and legal framework (private/public).
Centre for Energy Efficiency and Conservation (CEEC)	**Objectives:** ➢ To continue where the *GEF-KAM project* left off ➢ To undertake, on behalf of the Ministry, energy audits in mainstream industries, small and medium enterprises (SMEs) and public institutions, capacity building in energy efficiency and conservation, public education and awareness activities, as well as administer the Energy Management Awards (EMA) annual events.
Kenya National Cleaner Production Centre (established in 2000)	**Objectives:** ➢ Training ➢ Awareness raising, in-plant cleaner production (CP) assessments ➢ Environmental audits, environmental impact assessments and policy advice.

The barriers identified in these initiatives that need to be addressed are shown in Table A2.2 below:

Table A2.2 Barriers to EE initiatives identified in Kenya

Initiatives/projects/programmes	Barriers (at both regional and country levels)
Global Environmental Fund-Kenya Association of Manufacturers (GEF-KAM) Industrial Energy Efficiency Project	➢ Financing mechanisms not established; financial sector not fully involved, and ESCO concept still slow ➢ Energy standards and labels not widely applied ➢ Absence of incentive mechanisms
Energy Efficiency and Conservation	➢ Inadequate awareness of the potential benefits from the efficient use and utilization of energy efficiency and conservation practices, technology and appliances. ➢ Consumer apathy. There is a tendency for consumers not to embrace energy efficiency and conservation best practices as long as there is good supply of energy for current use. ➢ Limited use of available conservation tools / new technology with increased efficiency leads to energy wastage. ➢ High technical losses in the generation, transmission and distribution systems. ➢ Limited technical capacity, training and expertise in energy management and conservation. ➢ Lack of comprehensive, reliable energy audit data and information covering various sectors and sub-sectors. ➢ Slow adoption of conservation opportunities and measures due to socio-economic factors. ➢ Inadequate financing owing to challenges in sourcing funds and credit mobilization for energy efficiency and conservation projects as impediments to investment in this area. ➢ Insufficient standardized equipment and appliances that would benefit from tax rebates and fiscal incentives. ➢ Low awareness of existing fiscal, legal, regulatory incentives.

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table A2.3 below.

Table A2.3 Co-benefits of EE initiatives in Kenya

Initiatives/projects/programmes	Co-benefits of Energy Access
Centre for Energy Efficiency and Conservation (CEEC)	Energy audits undertaken on behalf of the Ministry up to 2013 totalled 171, indicating a savings potential of KShs.5.94 billion and 14 MW equivalent. Assistance from DANIDA to CEEC also saw the completion of a further 99 energy audits, translating into indicative savings of KShs. 6.92 billion and 20 MW equivalent.
Kenya National Cleaner Production Centre	By mid-2010, the Centre had conducted more than 450 training and awareness-raising events, almost 200 cleaner production assessments and environmental audits had been carried out, and the Centre had also participated in the drawing up of five policy documents.

Additional energy efficiency potential across various sectors in Kenya is as follows.

Table A2.4 Identified Energy Efficiency Potential across Sectors in Kenya

Sector	Energy Efficiency Potential
Utility Power Generation	Solar PV projects have the potential to play a role in the development of the overall power sector in Kenya. Vision 2030 targets development of 300MW of solar PV by 2030.
Building	➢ **Grid-connected and power back-up** for households and small businesses. This sector is already relatively active, with thousands of inverter/battery systems operating as grid back-ups for businesses in Kenya. It is also relatively common to find solar connected to these systems for battery charging. ➢ **Building integrated solar**: This sector is undeveloped, but of interest to project developers. Early movers are starting projects already. ➢ Development and commercial-based net-metering opportunities

Agriculture (In 2011, agriculture contributed 24% to Kenya's GDP, the highest individual sector contribution to the GDP)	➢ Use of solar PV to off-set power requirements on existing farms ➢ Use of solar PV to provide power (and primarily irrigation pumping) as off-grid or back-up/separate power solutions on existing farms ➢ Use of solar to provide power for out growers (coffee, tea, cashew, horticulture) who do not have access to the main grid.
Tourism (Kenya is known as a world-class safari destination)	➢ Solar PV systems for **off-grid camps and lodges**, either in the form designed stand-alone systems or hybrid mini-grid systems ➢ Grid-connected solar to help off-set electricity costs in **lodges and sites,** particularly where there are sites using high levels of air conditioning

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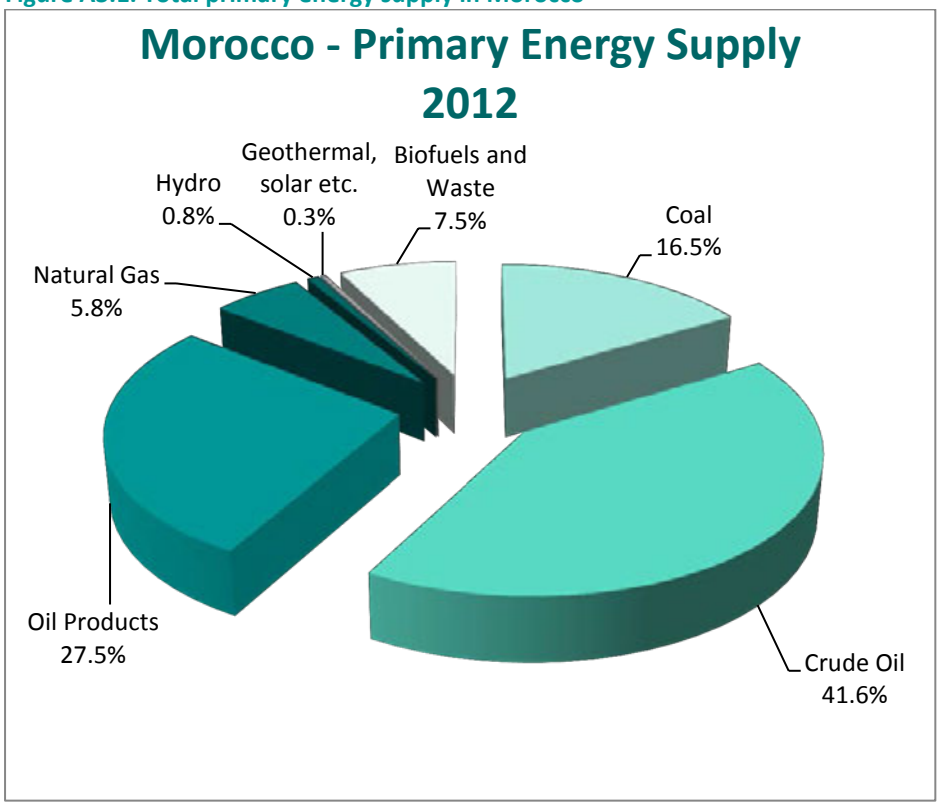
A3. Morocco

Overview of Morocco's Energy Sector

Morocco's electrical power supply is generated, distributed and transmitted by the state-owned utility known as l'Office National de l'Electricité (ONE). An increase in population and economic development caused the Moroccan government to put privatization measures into effect in the country's power utility, liberalizing the electrical power sector. This resulted in both the public and private sectors being accountable for electrical power provision and the initiation of a number of programmes to help broaden Morocco's energy generation mix.

Morocco imports coal from the United States, Colombia, Poland and South Africa. The imported coal is used to power the country's two largest electrical power stations at **Mohammedia** and **Jorf Lasfar**. There used to exist a small coal mine at **Jerada**, which closed in early 2010 due to a decline in reserves.

Figure A3.1. Total primary energy supply in Morocco[15]



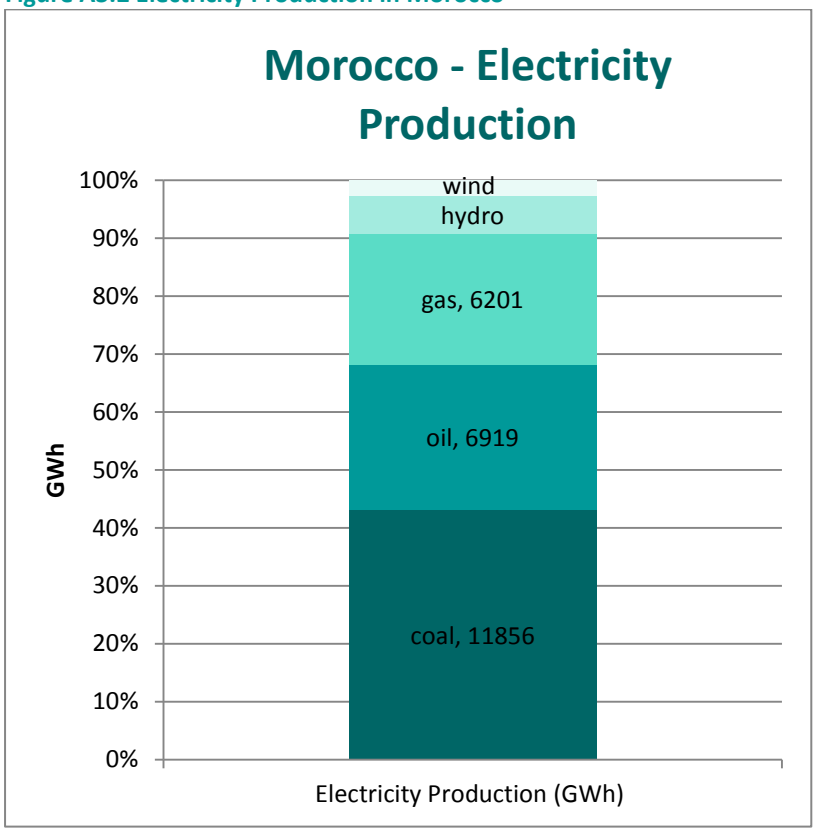
In 2011, the amount of electricity produced by ONE and the three independent power producers (Jorf Lasfar Energy Company, Energie Elec Tahaddart and Compagnie Eolienne du Detroit) totalled 24,363 GWh (45% by ONE, 55% by the other producers). Thermal power generation accounts for

[15] ***IEA* www.iea.org/statistics**

87% of national electricity generation, hydropower for 8.2 % and wind power for 2.8 %. Although power production has shown a growth in past years, there is a concern that it will not be able to meet the increasing demand for electricity.

Currently, these companies produce electricity mainly from coal, oil and gas, with the balance coming from hydro and wind. The following figure illustrates estimated power production from these sources.

Figure A3.2 Electricity Production in Morocco[16]

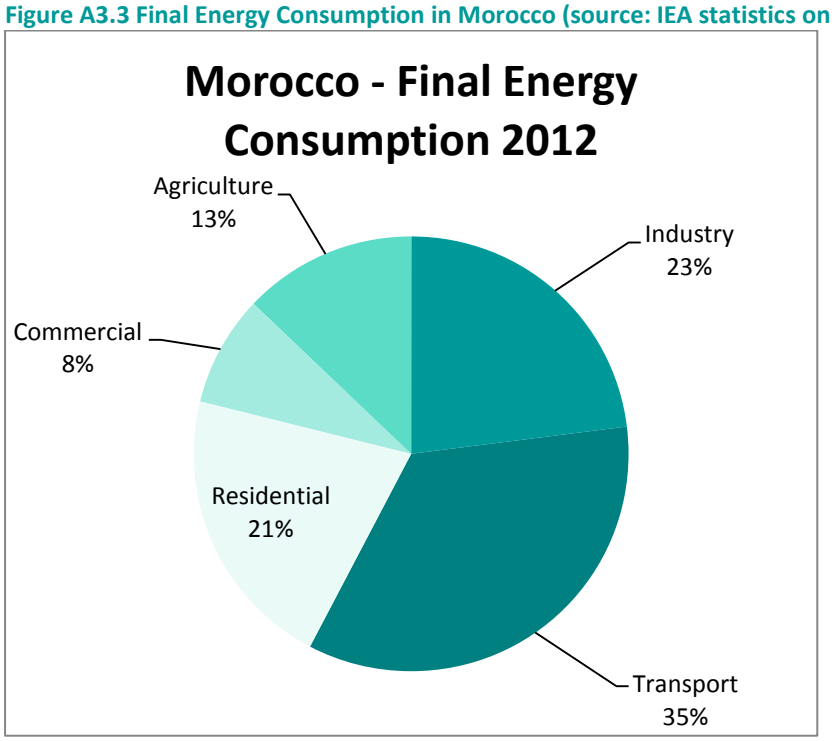


From the above figures, it is evident that Morocco relies mostly on electricity produced from coal sources (42% in 2012), electricity produced from oil sources (26% in 2012) and very little on electricity produced from wind hydropower sources (9 % in 2012).

Final energy consumption in Morocco mainly takes place in the transport and industrial sectors, followed by residential energy use. The breakdown is shown below in Figure A3.3.

[16] **IEA statistics online 2015**

Figure A3.3 Final Energy Consumption in Morocco (source: IEA statistics online 2015)



Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Morocco are listed in the table below.

Table A3.1 Energy Efficiency Initiatives in Morocco

Initiative/Activity/Programme/ and Sponsors	Brief outline and planned dates (whether past/present/or future)
National Plan of Priority Actions (NPPA) in energy efficiency.	Dated 2008 **Objectives:** ➢ The government of Morocco has adopted the short-term National Plan of Priority Actions (NPPA). ➢ To ensure the adequate supply of electricity to meet projected demand. ➢ To decrease power consumption by 25% and power load by 15% by the end of 2012. ➢ To implement measures to reduce demand for electricity, such as the distribution of 23.4 million of CFLs, which will reduce the peak load by 900 MW.
ONE - Electrifying Rural Moroccan Households Programme	**Objectives:** ➢ To increase access and reduce poverty in peri-urban areas through adopted solutions, including demand side management projects ➢ Improve rural local conditions to decrease rural–urban migration ➢ Develop rural economies ➢ Increase use of renewable energy ➢ Provide affordable and sustainable rural electrification
Morocco – renewable energy	Dated 1990. In 1990, ADEREE launched a programme to evaluate wind energy resources. The first phase of the programme (1991–1994) was devoted to the assessment of wind resources in the coastal areas of Dakhla, Tangier and Tetouan. The second phase (1995 -2000) looked at the North Eastern provinces (Taza and Nador), the province of Essaouira and those in the south of Morocco (Tarfaya and Laayoune). Data collected for the solar and wind energy evaluation programme of ADEREE confirm that Morocco has several areas with excellent wind energy potential and a large potential of solar resources.

The Chourouk initiative on solar energy **Stakeholders:** The Moroccan Agency for Solar Energy (MASEN) **(Implementers)**	Date 2007 About 44 719 households were equipped with solar panels. ONE launched the Chourouk initiative, which aims to develop 500MW of solar generation by 2015. **Objectives:** ➢ To install 1400 micro PV power stations of 0.5–1 kW ➢ **Chourouk Solar PV** to equip ONE's clients (households and corporate) with 200,000 PV kits through a hybrid scheme (grid and PV), with the option of injecting excess energy into ONE's grid at an improved tariff structure. ➢ **Chourouk Generation** aims to develop 150MW solar power plants through independent power projects (IPPs). ***The Moroccan Agency for Solar Energy.***
	➢ To install 2000 MW capacity from solar energy sources from 2009 to 2020.
The Sahara Wind Project **Sponsors:** NATO Science for Peace and Security Programme	Date 2001 Sahara Wind has conducted wind surveys and investigated the possibility of building a high-voltage power transmission line between Morocco and Western Europe. **Objective:** ➢ To supply energy to Europe.

The EnergiPro initiative	Launched in 2010 ➢ To increase the share of renewable energy by 2020 through the generation of 1000MW . ➢ To develop a database of potential wind sites in the north and south. ➢ EnergiePro-team was established to act as an interface between project developers and the employees responsible for grid connection within ONE to simplify procedures. ➢ **Hydro Power** ONE operates 26 hydro-power stations with a total combined installed capacity of 1,360 MW. In 2008, 1,360 GWh were produced from hydro-power alone. Some of the hydro-power comes from a 464 MW pumped storage power plant in Afourer, near Beni Mellal. In Oued Oum Er Rbia, a micro–hydro-power station is in construction.

The barriers identified in these initiatives that need to be addressed are shown in Table A3.2 below:

Table A3.2 Barriers to EE initiatives identified in Morocco

Initiatives/projects/programmes	Barriers (at both regional and country levels)
National Plan of Priority Actions (NPPA)-in energy efficiency.	**Implementation Challenges** ➢ Inconsistent statistical data: customs statistics group CFL and neon tubes under the same classification. ➢ The presence of CFLs in the market is not a sign of real impacts on consciousness regarding energy conservation or public support. ➢ Little effective control of CFLs quality: counterfeit (50%) and poor quality even on security standards. ➢ Purchase price of CFLs still high compared to incandescent lamps (at least six times more expensive): difficult to generalize CFLs, especially for poor people. ➢ Limited choice in terms of shapes and color temperature. **Barriers due to Policies** ➢ Lack of regulatory framework to encourage the adoption of CFLs. ➢ Lack of a road map for the phasing out of incandescent lamps on the national market. ➢ Weak regulatory framework for standards and quality control of CFLs. ➢ Absence of a policy regarding the collection and recycling of CFLs at the end of life. **Technological and Information Barriers** ➢ Absence of minimum performance and security standards regulations. ➢ Absence of local testing capacity. ➢ Weak monitoring and control of CFLs imports. **Communication and Information Barriers** ➢ Lack of mass communications regarding the benefits of CFLs and quality. ➢ Absence of a “Quality Label” for CFLs.

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table A3.3 below.

Table A3.3 Co-benefits of EE initiatives in Morocco

Initiatives/projects/programmes	Co-benefits to Energy Access
National Plan of Priority Actions (NPPA) in energy efficiency	The benefits of the initiative include; ➢ 4,5 million installed CFLs by the end of 2010 ➢ 650,000 households ➢ 2010 market research resulting in global satisfaction rate of 84% ➢ 65% of customers experienced a decrease in their monthly electricity bills due to the use of CFLs.

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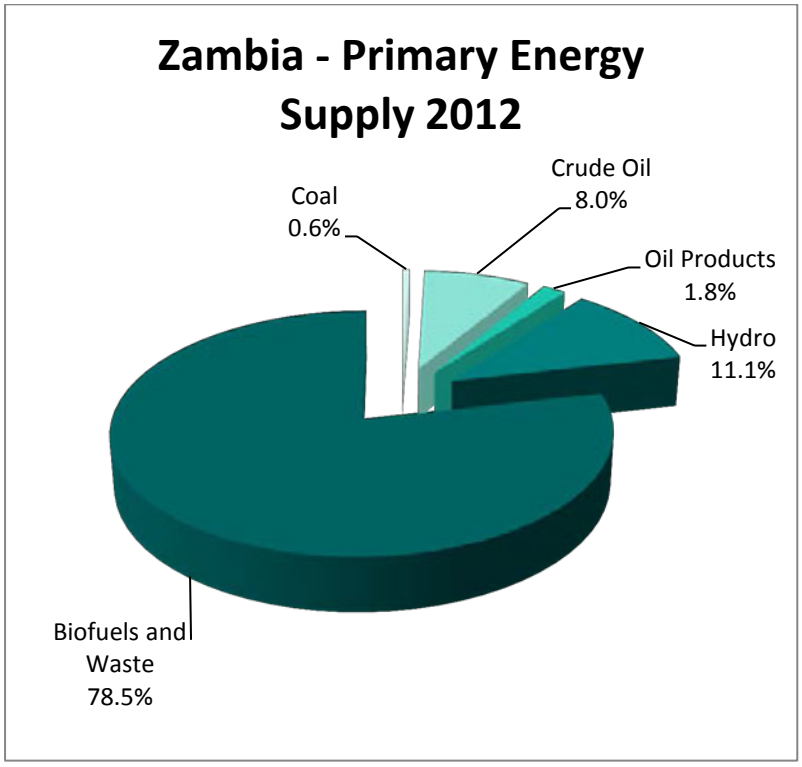
A4. Zambia

Overview of Zambia's Energy Sector

According to The Zambia Development Agency (ZDA) Energy Sector Profile (June 2013), Zambia has about 6,000 (MW) megawatts unexploited hydropower potential, while only about 1,985 MW has been developed. This comes from the scenario that Zambia possesses vast water resources in the Southern Africa (SADC) region. Suffice it to mention that there are currently new power generating projects under construction to increase electricity production.

Figure A4.1 Total primary energy supply in Zambia [17]

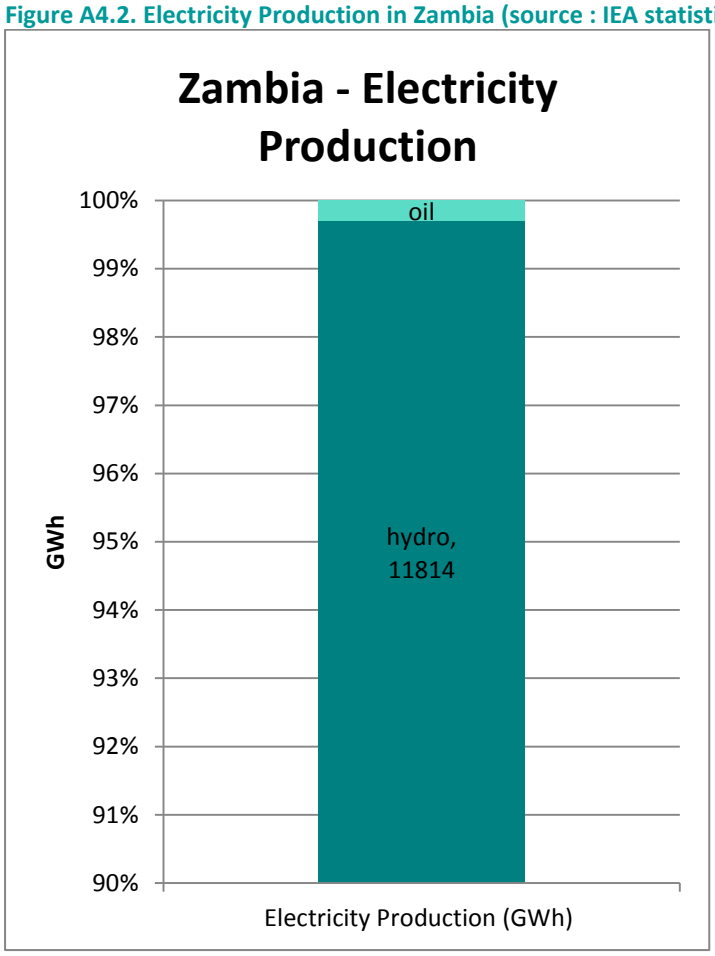


Over 90% of produced electricity comes from hydro sources. The energy market structure and consumption shows that traditional wood fuels (biomass), such as firewood and charcoal sourced from natural woodlands and agricultural lands, dominate the energy market. Currently, more than 70% of Zambians use biomass sources such as charcoal (firewood). This has increased the levels of

[17] **(Source: IEA www.iea.org/statistics)**

deforestation in the country because it is a cheaper energy source.

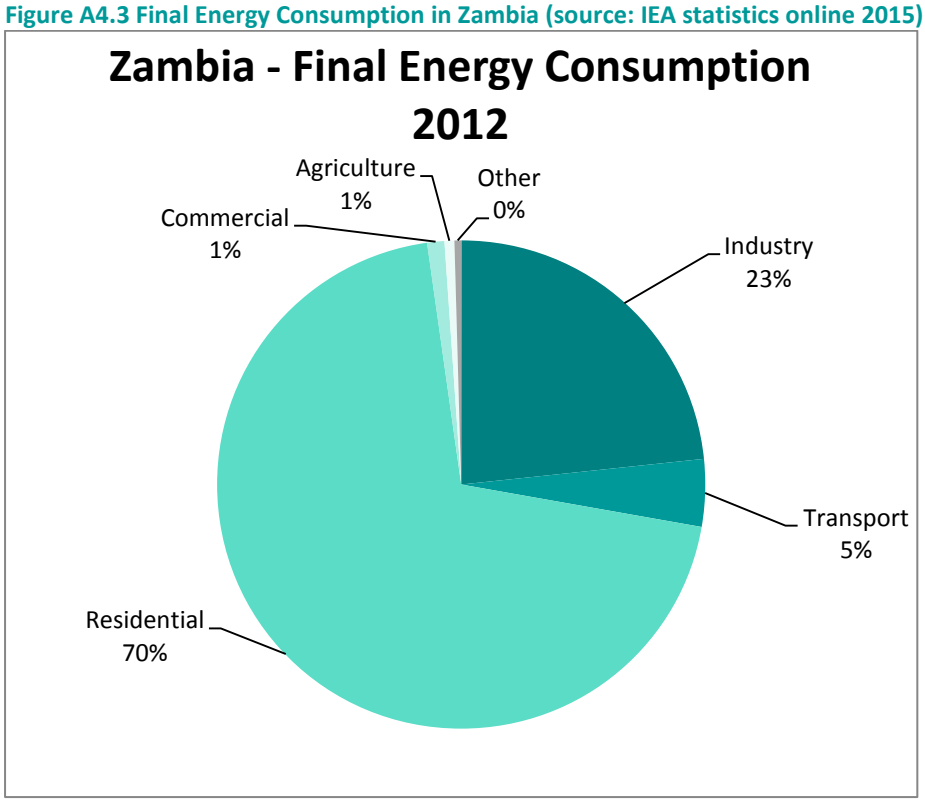
Figure A4.2. Electricity Production in Zambia (source : IEA statistics online 2015)



Demand for energy has been rising due to economic activity in the country, particularly in the mining, manufacturing and agricultural sectors. According to the Ministry of Finance, Zambia's economy has been growing at an average of 5% per annum over the past ten years. Strategic utilization and development of Zambia's energy sources can increase industry competitiveness, improve rural service delivery and reduce rural poverty. The Policy Monitoring and Research Centre (PMRC) report of October 2013 states that by December 2012, total energy demand had exceeded internal generating capacity. This was due to expansions in the mining sector and manufacturing sector, the overall expansion of the economy and increases in population. The current power deficit has resulted in prolonged load-shedding and power cuts, which have occasionally affected trade and production.

PMRC statistics show that the mining sector and domestic consumers combined account for 82% of total electricity consumption. Zambia is also faced with the challenge of satisfying the energy requirements of more than 80% of its population with renewable forms of energy.

Figure A4.3 Final Energy Consumption in Zambia (source: IEA statistics online 2015)



The 2013 PMRC report further states that electricity access rates in Zambia were at 22%–25% nationally: 49.3% in urban areas, but only 3.2% in rural areas for a population of 13 million people. Through its Vision 2030 programme, the government has set a target of increasing electrification rates to 66% of households by 2030, of which 90% would be for urban areas and 51% for rural areas.

The government also has recognized that energy efficiency and conservation programmes are required to free up available energy for redistribution to increase access rates. In the sixth National Development Plan (2011 -2015), the government has declared the need to develop and implement an energy efficiency strategy.

Energy Efficiency Programmes in Zambia

Zambia has yet to develop energy efficiency strategy. Opportunities abound to save energy in the Zambian economy. Several players are currently making commendable efforts to save energy. The Ministry of Mines, Energy and Water Development – Department of Energy has been spearheading policy and promotional forums regarding energy efficiency. The local power utility, ZESCO, is running a Demand Side Management programme (DSM), through which several interventions, including solar water heaters and switching incandescent bulbs to CFL, are being rolled out.

Energy efficiency programmes by international partners and manufacturing associations in selected SMEs are also evident. Suffice it to mention that the national energy efficiency strategy will be key in addressing huge nation-wide opportunities to save and conserve energy. The Vision in the sixth National Development Plan, 2011-2015, states that Zambia will seek to have “universal access to clean, reliable and affordable energy at the lowest total economic, financial, social and environmental cost consistent with national development goals by 2030”.

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Zambia are listed in the Table below.

Table A4.1 Energy Efficiency Initiatives in Zambia

Initiative/Activity/Programme/and Sponsors	Brief outline and planned dates (whether past/present/or future)
Implementation of energy audits in energy-intensive industries in Lusaka, Copperbelt and N/Western Provinces	Yet to be undertaken upon procurement of energy audit kit
Promotion of the Use of Liquefied Petroleum Gas (LPG)	Encourage private-sector participation in the near future (2015) through: • Introduction of tax incentives on importation of LPG cylinders; • Addressing high prices of LPG by holding stakeholder meetings.
	Conduct awareness campaigns in 2015 on LPG utilisation by: • Organising TV discussion programmes once every quarter; • Holding radio discussion programmes once every quarter; • Printing posters and fliers on LPG use; • Organising community roadshows once every quarter.
Promotion of Energy Efficiency	Coordinate the commemoration of the Annual Energy Week in 2015 across the country through: • Writing to Provincial Permanent Secretaries to help coordinate the event at provincial level by end of February 2015; • Holding preparatory meetings which start by the 1st Week of March; • Organise 3 TV & radio discussion programmes between March and July 2015; • Holding the Energy Week meetings in all the provincial centers; • Develop electronic & print media advertisements just before commemoration; • Commemoration of the Annual Energy Week by the 3rd Week of July 2015. Implement programme to phase out incandescent (ordinary) bulbs in line with the resolution of May 2013 of the SADC Council of Energy Ministers in 2015 through: • Holding the workshop by 1st quarter to develop necessary Legislation, i.e. S.I; • Pass legislation by 2nd quarter.

The barriers identified in these initiatives that need to be addressed are shown in Table A4.2 below:

Table A4.2 Barriers to EE initiatives identified in Zambia

(b) Barriers identified in past and present studies/initiatives that need to be addressed (both at regional and country levels)	
Initiatives/projects/programmes	**Barriers (at both regional and country levels)**
• The Government of the Republic of Zambia introduced the Statutory Instruments Number 32 and 33 in 2008 which removed duty on the importation of energy saving equipment	Despite the removal of duty on the importation of energy saving equipment, some energy-saving products (e.g. energy saving lamps) are still expensive
• Lack of Legislation on Energy Conservation and Management	This has resulted in energy ***'wastage'*** in all sectors of the economy especially in industry and mining. These sectors are not accountable or responsible in the way they consume energy because of lack of legislation; they can use energy anyhow, as long as they can afford it.
• Low electricity tariff	This hinders private-sector investment in the power sector

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table A4.3 below.

Table A4.3 Co-benefits of EE initiatives in Zambia

Initiatives/projects/programmes	Co-benefits to Energy Access
Introduction of pre-paid electricity metres in all sectors of the economy by the national utility, ZESCO Limited	This has resulted in energy savings through cost savings by customers. e.g. at household level most consumers realise that leaving the bulbs on when not required will result in them incurring large energy bills therefore, they are compelled to switch off when the lights are not required
The blending of bio-diesel and ethanol with diesel and petrol respectively	This will reduce dependence on fossil fuels as well as the associated costs
Installation of solar water heaters (SWHS) in place of electric geysers in public buildings	Demand Side Management (DSM) measures necessary for mitigation of excessive power demand
Installation of solar technology for lighting in public buildings and households	The installation of solar technology is being undertaken as a strategy to promote renewable energy technologies available in Zambia and provision of modern energy services in remote areas which are not yet connected to the national grid

Additional energy efficiency potential across various sectors in Zambia is as follows.

Table A4.4 Identified Energy Efficiency Potential across Sectors in Zambia

Sector	Energy Efficiency Potential
Mining and	Power factor correction and energy efficient equipment (machinery)
Commercial Buildings	Installation of pre-paid meters and replacement of ordinary bulbs with energy saving lamps, solar water heaters
Homes	Installation of pre-paid meters and replacement of ordinary bulbs with energy saving lamps and electric geysers with solar water heaters
Transport	The blending of bio-diesel and ethanol with diesel and petrol respectively

Energy Efficiency Strategy for Zambia

Following the release of the sixth National Development Plan (NDP) (2011-2015), in 2012 the Ministry of Mines, Energy and Water Development (MMEWD) advertised for a consultancy to develop an Energy Efficiency (EE) Strategy for Zambia. This never materialized due to budgetary constraints. Stakeholders hope that this important task will be revisited. The NDP plan on the energy policy section on Energy Efficiency & Management states the scope as follows:

Objective: *To ensure that major industrial sectors, public institutions and households bring their energy intensities in line with internationally acceptable standards and best practices.*

Strategy: *Develop and implement an Energy Efficiency Strategy.*

Programmes: *Energy Efficiency and Conservation*

ZESCO: Demand Side Management: Energy Efficiency Initiatives

The Demand Side Management (DSM) Programme being undertaken by ZESCO is an initiative of the Ministry of Energy and Water Development and the World Bank ESMAP programme in collaboration with ZESCO Limited. The Programme was implemented in 1994 with the creation of a special department at ZESCO.

Demand Side Management (DSM) strategies ensure that electricity is utilized efficiently and that the energy thus saved becomes available for new developments which have the potential to create jobs. DSM also reduces the evening peak, avoids load shedding and thus defers the building of new power plants, which in effect is a saving, as the immediate sourcing of funds for new power plants falls off. In its business strategy, ZESCO plans to expand its customer base without having to compromise the quality of supply through power deficits leading to load shedding.

Therefore, while it ensures the growth of its customer base, resulting in increased demand, the ZESCO business strategy also provides for demand-side management strategies that unlock energy from existing customers through the efficient use of electricity and makes it available for new developments.

ZESCO's demand-side strategy utilizes worldwide, proven methods which include prepayment metering, compact fluorescent lamps, solar geysers and the provision of technical advisory services to customers on the efficient use of electricity.

ZESCO, in addition to the pre-payment metering scheme, has embarked on the following Demand Side Management initiatives:

Compact Fluorescent Lamps (CFLs)

ZESCO, with the aid of funding from the World Bank, is implementing a project called Increased Access to Electricity Services. Under the project, 1,000,000 CFLs have been procured and have been distributed free of cost to customers.

It is estimated that about 50MW of power will be saved from this initiative alone. In addition, through its joint venture company in Ndola, ZESCO also will make available 2,000,000 CFLs for distribution at minimal cost to customers. This initiative will free an additional 100MW of power, bringing the total power expected to be saved to 150MW.

Installation of Solar Geysers

The introduction of solar geysers by ZESCO is one of the initiatives aimed at saving energy and protecting the environment. Under this initiative, ZESCO will install a total of 350,000 solar geysers over a period of three years free of cost to customers. In the initial phase, which is currently in progress, ZESCO will install 100,000 geysers. It is expected that, from the installation of these geysers, ZESCO will save a further 150 MW. It is expected that these savings will significantly contribute to the elimination of load shedding, which is currently costing ZESCO a staggering US$6.1million per year.

With energy savings estimated at 150MW per year, it is envisaged that about 1.2M tonnes of carbon emission reductions (CERs) will be achieved.

Other Energy-Saving Initiative Projects Under Consideration

ZESCO is also encouraging other stakeholders to introduce additional sustainable use of solar energy to cover street lighting, traffic lights, lanterns and any other energy-efficient technologies and initiatives to save energy and the environment[18].

The successes and challenges are outlined in the Ministry of Mines, Energy and Water Development Record referred to in Section 3.1 above.

Energy Regulation Board (ERB)

The need to establish a regulator in the energy sector mainly arose from the liberalization policy, which allowed many players to come into the sector, which in turn required an agency to ensure that there was coordination and a level playing field in the sector. The Energy Regulation Board

18 Press Release extracted from Zesco website under customer information http://www.zesco.co.zm/)

(ERB) was thus established in 1997 following the enactment of the Energy Regulation Act, Cap 436 of the Laws of Zambia. ERB has a mandate to promote energy efficiency.

Energy Efficiency Initiatives

In conjunction with the Ministry of Mines, Energy and Water Development, each year ERB holds an Energy Conservation Week, the main objective of which is to raise awareness of energy conservation and its benefits to individuals and the country as a whole. The Energy Week concept seeks to inform energy users of the available alternative and renewable sources of energy and of the efficient use of energy. Advice is given regarding energy-efficient solutions in lighting, heating and ventilation, cooking and baking, geysers, ironing, refrigeration and fridges, etc.

The successes and challenges are outlined in the Ministry of Mines, Energy and Water Development Record referred to in Section 3.1 above.

Efficiency Energy Management Programme (EEMP) in Southern Africa (2011-2014)

A consortium led by the Danish Technological Institute has been appointed by the European Union's Centre for the Development of Enterprise (CDE) to implement the Efficiency Energy Management Programme (EEMP) in Southern Africa (Botswana, Lesotho, Malawi, Mozambique, Namibia, Swaziland and Zambia) during the period from 2011 to 2014. In Zambia, as in the other countries, the programme aimed at introducing efficient energy management in selected SMEs in the food processing, building materials and hospitality sectors.

The objective of the EEMP was to create awareness of the value of energy management among selected enterprises with a view to improving their energy consumption and competitiveness. The enterprises will be assisted in achieving energy efficiency by implementing appropriate energy-saving measures through the adoption of best practices in energy management. The EEMP scope of work included conducting energy audits, advice on the implementation of energy efficiency (EE) measures, the monitoring and optimization of energy consumption, and the training of client employees.

Successes

Seven enterprises were selected in Zambia. Energy audits were conducted, audit reports issued and feedback meetings held. All the firms appreciated the work of the EEMP. Clear areas of opportunities to save energy were highlighted. More efficient options or alternative cheaper energy sources were highlighted for each firm. Awareness of energy efficiency was imparted in the firms' management teams. Business proposals were drafted on behalf of the firms for the more costly and more detailed recommendations. These business plans were meant to help the firm approach the financial institution if it wished to borrow money to finance energy efficiency projects. The EEMP did not include donor financing for implementation of the energy efficiency measures.

Challenges

There was evidently little knowledge in the industry about energy efficiency and its benefits. Nearly all firms needed financial investment to implement most of the recommendations, but internal resources did not allow a budget for the relatively new concept of energy management. Furthermore financial institutions would need education and awareness in order for them to be assured of client investment returns so that they could provide financing for energy management. Awareness training of employees by the EEMP has not yet taken place due to delayed approval of this next phase.

ZAM Energy Efficiency Initiative: implementation of the private sector initiative to improve energy efficiency and management in the manufacturing sector

This initiative was launched in June 2013, and the pilot programme was planned to run for about a year. A local consulting firm won the bid to implement the Energy Management for Sustainable Production in the Steel & Metal Fabrication and Wood Sectors Project, which is funded by the Finnish Fund for Local Cooperation. The Project aims to support manufacturers to use energy efficiently and reduce their expenditure on it.

During the implementation of this grant project, the beneficiary companies will be supported in understanding their energy efficiency and management situations by means of an energy audit to determine areas for improvement. The companies will then be supported in managing their various energy resources efficiently through training and other technical support. The other partners in the implementation of this project are ZESCO and the Ministry of Mines, Energy and Water Development. The fifty targeted beneficiary companies enrolled into this pilot project are drawn from the metal engineering and wood processing subsectors.

Successes

Audits have been conducted in Lusaka, and about twenty firms have been audited. Copperbelt province is next.

Challenges

The client has yet to receive reports to evaluate project performance across firms based in Lusaka Province.

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Acknowledgement

Special thanks to staff in the Department of Energy – Ministry of Mines, Energy and Water Resources, Energy Management Section , for supplying the report information in Part 3.1 (a),(b), (c),(d) and (e) through a question sent out to them.

Other information has been sourced from the ZESCO website, ZESCO DSM reports, Ministry of Mines, Energy and Water Resources reports; Energy Regulation Board (ERB) website reports,. the Zambia Association of Manufacturers (ZAM), the Energy Efficiency Management Programme (EEMP) office in Zambia, the Policy Monitoring and Research Centre PMRC) reports, and the Kafue Gorge Regional Training Centre (KGRTC) energy reports and records.

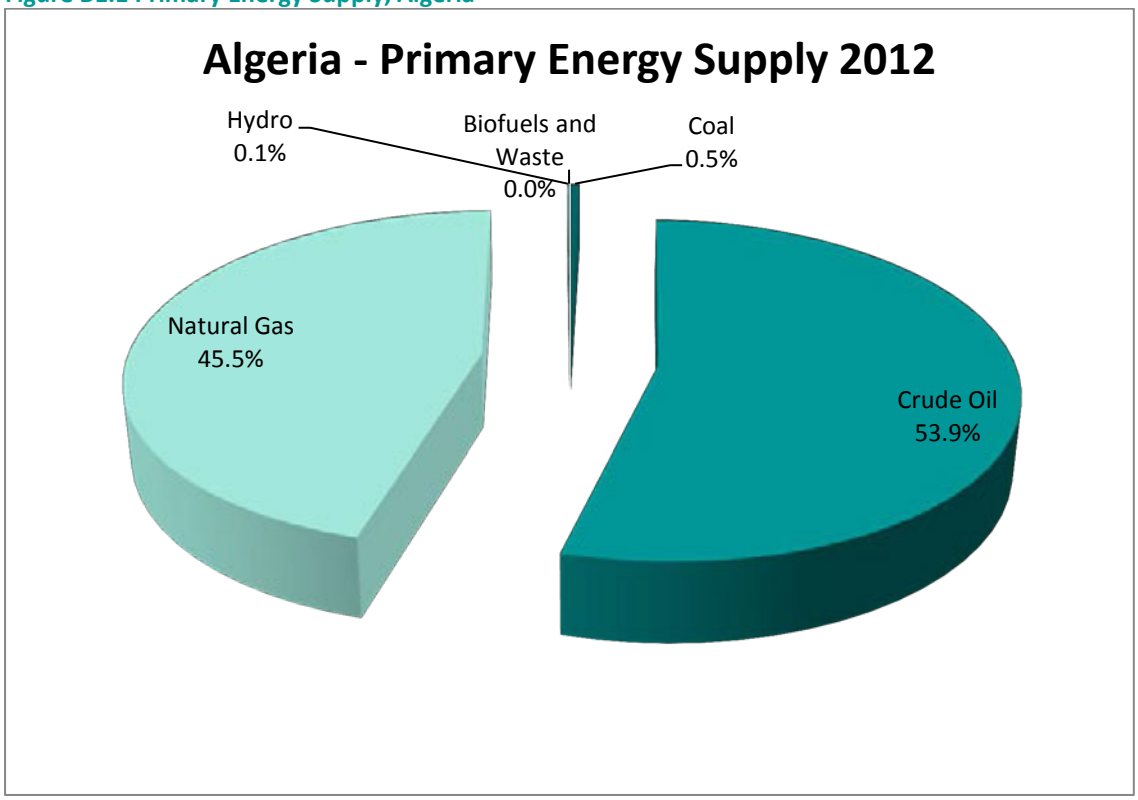
ANNEX B. Country Reports: Other Surveyed Countries

B1. Algeria

Overview of the Algerian Energy Sector

Primary energy supplied in Algeria is predominantly crude oil and natural gas. Less than 1% is made up of hydro, biofuels and coal combined.

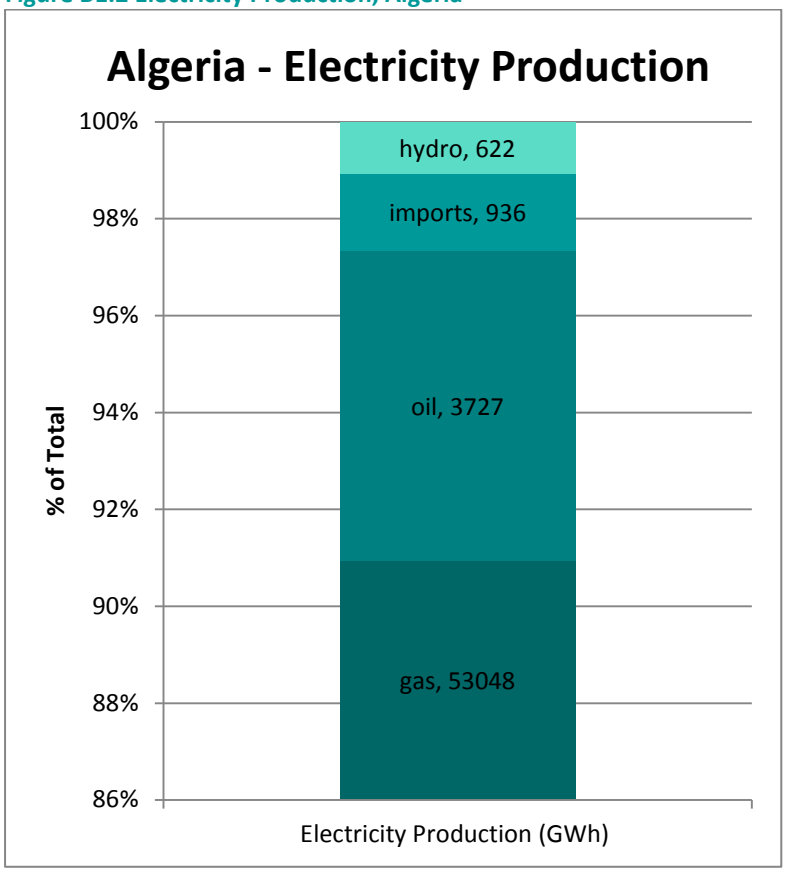
Figure B1.1 Primary Energy Supply, Algeria[19]



Energy needs are met by Sonelgaz, a state-owned utility in charge of natural gas and electricity distributions within the country. Currently, it produces electricity predominantly from natural gas (90%), with oil producing 5% and hydro and imported electricity making up the balance. Figure B1.2 shows a breakdown of electricity generation.

[19] **(source: IEA statistics online 2015)**

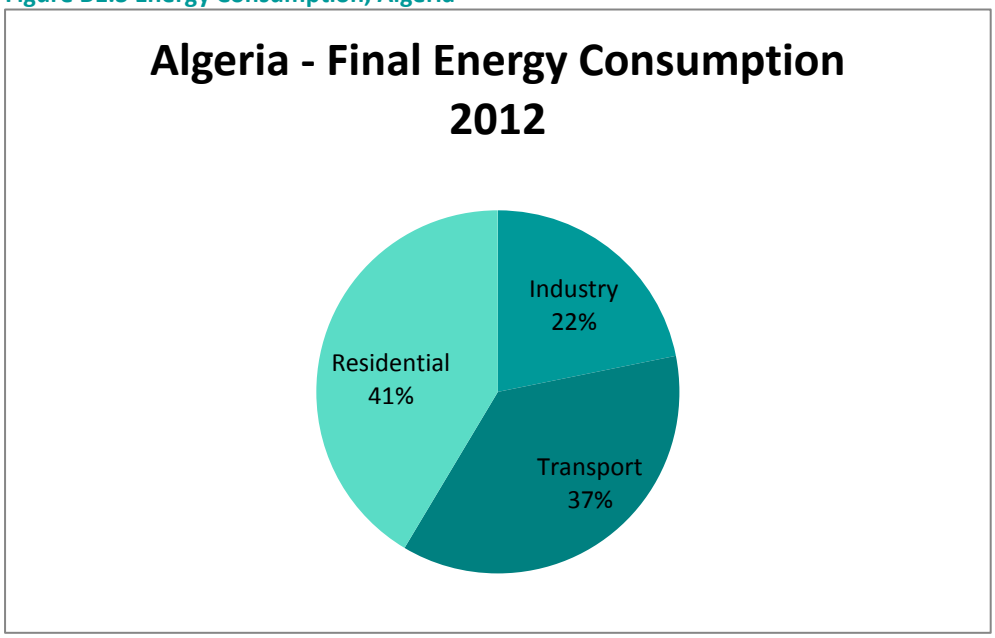
Figure B1.2 Electricity Production, Algeria [20]



The graph below gives the total energy consumption per sector in Algeria for 2012.

[20] (source: IEA statistics online 2015)

Figure B1.3 Energy Consumption, Algeria [21]



From Figure B1.3 it can be seen that the major consumer of energy in Algeria is the domestic sector, followed by the transport and industrial sectors.

[21] (source: IEA statistics online 2015)

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Algeria are listed in the table below.

Table B1.1 Energy Efficiency Initiatives in Algeria

Initiative/Activity/Programme/ and Sponsors	Brief outline and planned dates (whether past/present/or future)
Renewable Energy Programme **Sponsors:** ➢ National Funds of Research (FNRS) 2001, ➢ National Fund for Energy Development (FNME) 2005, ➢ Fund for National Research Projects, ➢ Special Fund for Renewable Energy Programme : 2011, ➢ National Fund for Energy Efficiency (NFEE), ➢ Renewable Energy National Fund provided by 0.5% of oil tax ➢ Global Fund of more than 120 Billion Dollars.	Date: 2009-2011 **Objectives:** ➢ To identifying the possible energy generation alternatives that can be tapped into to meet the increasing demand for electricity. ➢ To use solar and wind energy as the two main types of renewable energies to meet the increasing demand for energy. ➢ Installation of a total power capacity of 110 MW by 2013. ➢ Installed power capacity to reach 650 MW by 2015. ➢ Installed power capacity to reach about 2600 MW by 2020 and a possible energy of export of 2000 MW. ➢ To generate an additional capacity of 12000MW by 2030 and a possible export of about 10 000 MW. ➢ To achieve an estimated solar photovoltaic capacity of 800MW by 2020. ➢ To achieve an additional 200MW in the period between 2012 and 2030. ➢ To generate 3000MW of energy from Solar Thermal Energy (CSP) between 2011- 2013. ➢ 1200MW of energy to be installed from 2016 to 2020. ➢ Installation of a total capacity of about 600MW per year from 2021 to 2030. ➢ 1 TWh of energy to be generated along the coast from wind energy, 4.5 TWh in the highlands, and 31.5 TWh in the Sahara.
Energy efficiency programme	Date: started 2010 and still in force **Objectives:** ➢ Improve heat insulation of buildings; reduce energy

	consumption related to heating and cooling by about 40%. ➢ Developing solar water heating by replacement of conventional system with a more energy-efficient system. ➢ To spread the use of low energy consumption lamps by gradually prohibiting the marketing of incandescent lamps on the domestic market to reach a total ban by 2020. ➢ Promoting LPG and NG fuels by increasing about 20% the market share of LPG / F by 2020 and giving direct financial assistance to individuals wishing to convert their vehicles to LPG / F. ➢ Promoting energy efficiency in the industrial sector by co-financing energy audits and feasibility studies that will enable companies to precisely define technical and economical solutions best suited for reducing energy consumption. ➢ Development of solar cooling systems.

The barriers identified in these initiatives that need to be addressed are shown in Table B1.2 below:

Table B1.2 Barriers to EE initiatives identified in Algeria

Initiatives/projects/programmes	Barriers (at both regional and country levels)
Technical Barriers Political Barriers	➢ Plant inefficiency ➢ Intermittency of solar or wind resources, which leads to variations in the amount of harnessed energy. ➢ Vulnerability of electrical systems like inverters and power electronics being used together in the “balance of system” with power variations at the grid interface to ensure that intermittent connections are managed properly. ➢ State domination of the energy sector ➢ Bureaucracy ➢ Lack of know-how and qualified professionals in the field of renewable energy. ➢ Private sector awareness of the renewable energy and energy efficiency programme in Algeria. ➢ Education and training in the renewable energy and energy efficiency programme is very limited. ➢ Weak Ccordination and exchange of experiences (national, African and European)

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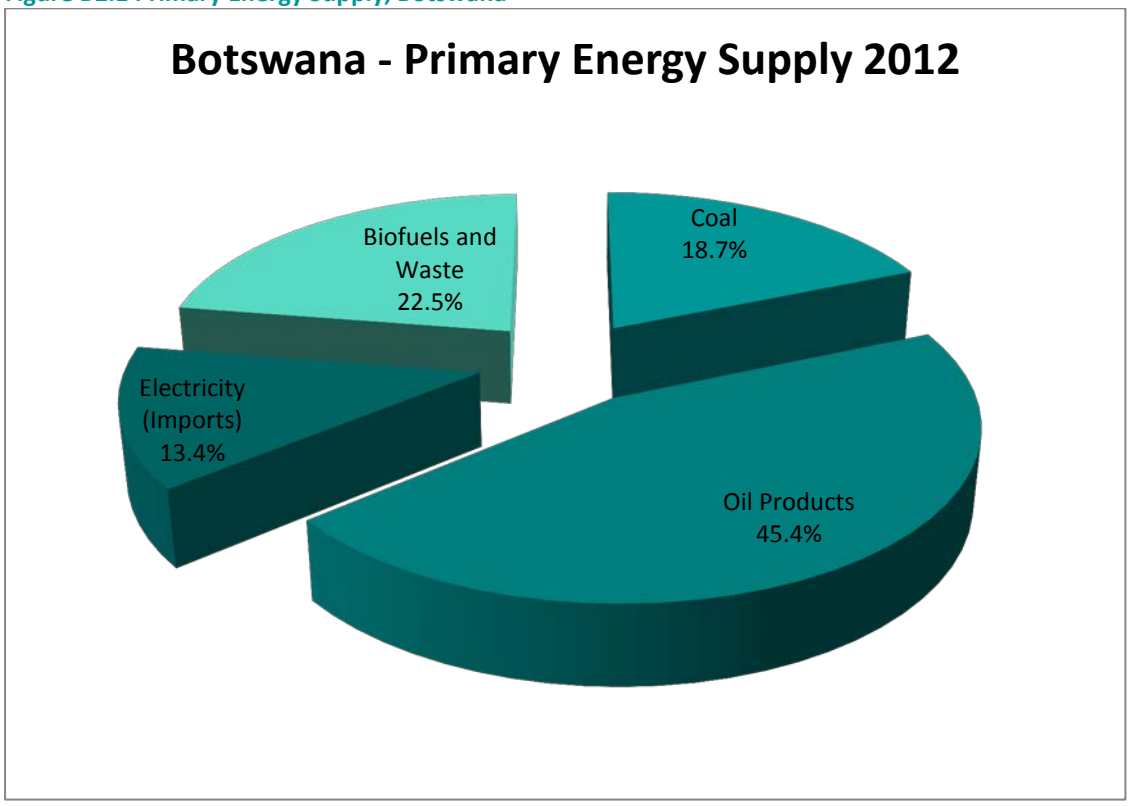
B2. Botswana

Overview of Botswana's Energy Sector

Botswana depends mainly on coal, oil and their derivatives for its primary energy supply. Biofuels represents 22.5% of the total share of primary energy supply, while electricity imports account for just over 13%. The following illustration shows the primary energy supply in Botswana in 2012.

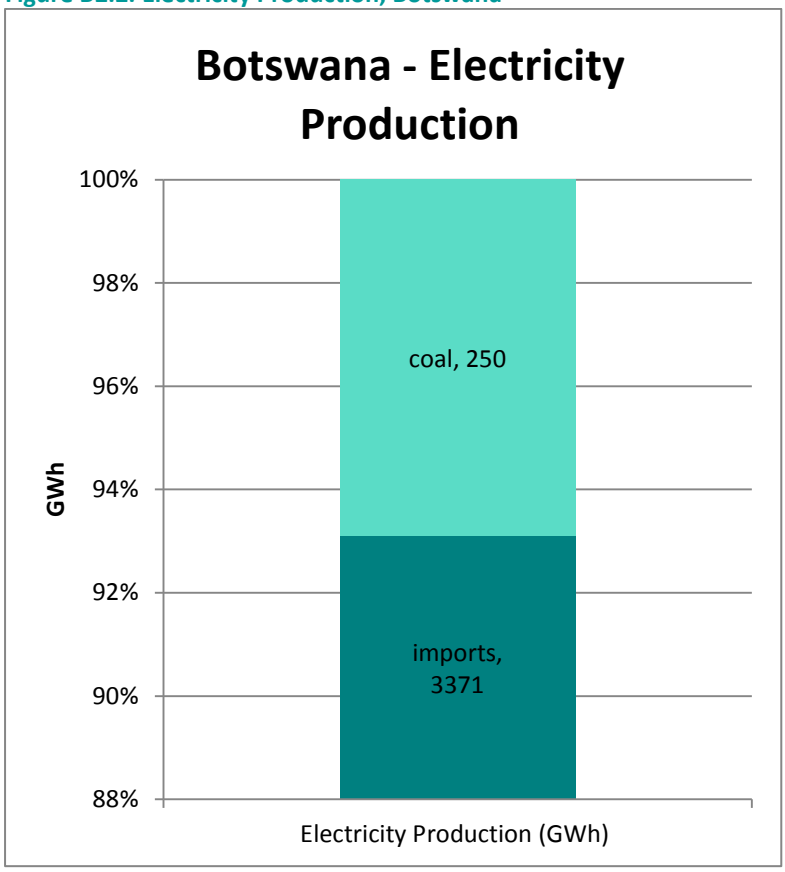
Figure B2.1 Primary Energy Supply, Botswana[22]



[22] **(source: IEA statistics online 2015)**

Botswana generates less than 8% of its own electricity needs, with the bulk being reliant on imports. Figure B2.2 shows this breakdown.

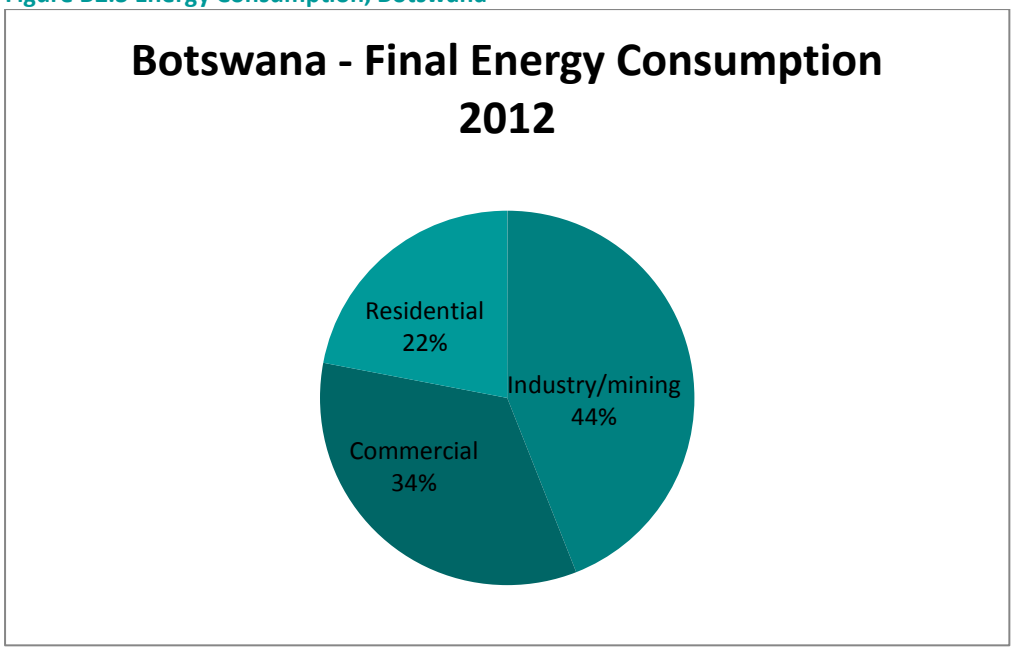
Figure B2.2. Electricity Production, Botswana[23]



[23] **(source: IEA statistics online 2015)**

Final energy consumption for Botswana is shown in Figure B2.3 below. The industrial and mining sectors are the highest users of energy, followed by the commercial sector. The residential sector consumes 22% of final energy, most likely biofuel (wood) for cooking and heating.

Figure B2.3 Energy Consumption, Botswana[24]



Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Botswana are listed in the table below.

Table B2.1 Energy Efficiency Initiatives in Botswana

Initiative/Activity/Programme/and Sponsors	Brief outline and planned dates (whether past/present/or future)
Botswana Energy Master Plan	Date: introduced since 1996 and reviewed in 2003. **Objectives:** ▪ Promotion of solar energy by the Botswana Government. ▪ Integration of grid and non-grid technologies. ▪ Encouragement of research and development with regard to renewable energy sources. ▪ Identification of an appropriate institutional framework for rural

[24] **(source: IEA statistics online 2015)**

	electricity using renewable energy. ▪ Development of strategies for removing barriers to the widespread use of renewable energies. ▪ Promotion of women and children's welfare through the provision of PV power generation (lighting). Components 1, 4 and 5 are being implemented.
National Photovoltaic Rural Electrification Programme	Date: introduced since 1997. Rural communities in Botswana can utilise a financing scheme to purchase photovoltaic systems repayable over four years with interest. This programme involves economic instruments, direct investments, infrastructure investments, fiscal/financial incentives, loans.
PV System Pilot Projects [Government of Botswana in collaboration with Japanese International Cooperation Agency (JICA)]	Date: introduced in 2002, but no longer in force. **Objectives:** ▪ The project aimed at providing lighting for rural dwellers using a PV solar home system (SHS) ranging from 50 to 250 Wp in three villages (Kudumatse, Lorolwana and Motlhabaneng).
9th National Development Plan 2003-2009 (NDP9)	Date: introduced in 2003, but no longer in force. The energy mix must be environmentally friendly and sustainable, as well as being affordable and optimally balanced. **Objective:** ▪ The focus is on public education and developing institutional frameworks. Rural electrification is a continued priority, with solar PV playing an explicit role.
10th National Development Plan 2009-2016 (NDP10)	Date: in force since 2009. NDP10 builds on NDP9, of which it is a continuation. **Objectives:** ▪ Main focus on increasing the use of renewable energy as a way of augmenting existing energy sources and improving security of supply for other fuels. ▪ To encourage private-sector involvement in renewable energy and its enforcement in governmental institutions. ▪ To develop regulations for solar and biofuels to guide the production and use of renewables.

The barriers identified in these initiatives that need to be addressed are shown in Table B2.2 below:

Table B2.2 Barriers to EE Initiatives Identified in Botswana

Barriers (at both regional and country levels)	Benefits of overcoming barriers
Lack of legal and regulatory framework	▪ Using legislation can make RETs competitive with conventional fuels.
Lack of resources	▪ Institutions spearheading grid and non-grid rural electrification are already in place, but their activities are limited by a lack of resources.
Weak dissemination strategies	▪ Improved information dissemination strategies can enable consumers to make informed energy choices.
Lack of expertise (There is a general lack of expertise in RETs in the SADC region, and this is recognized as a major weakness within this sub-region)	▪ Most RET projects are donor-driven and lack a component for skills transfers, human resources or technology diffusion. ▪ Lack of management skills and organizational performance leads to project failure when expatriates leave, hence the need to link aid-funded projects with the training of local staff.

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table B2.3 below.

Table B2.3 Co-benefits of EE Initiatives in Botswana

Initiatives/projects/programmes	Co-benefits to Energy Access
PV System Pilot Projects	▪ The fee-for-service model looks affordable to large sections of the rural population, and hence might have greater potential for developing a large market for rural solar PV applications. ▪ The affordability level of solar home systems in the country's rural communities stands at 63.2%.

9th National Development Plan 2003-2009 (NDP9)	Increase in electricity access in rural areas.

Additional energy efficiency potential across various sectors in Botswana is as follows.

Table B2.4 Identified Energy Efficiency Potential across Sectors in Botswana

Sector	Energy Efficiency Potential
Transport (highest consumer of petroleum products in Botswana)	▪ Use of non-motorised transport. ▪ Scaling-up of the public transport system as an alternative to using private cars.
Lighting	▪ The use of more efficient fluorescent tubes and light fittings, and the elimination of incandescent lighting.
Building	▪ High standards of building insulation, including double glazing in all new construction.
Industrial	▪ More efficient boiler plants, including many modular boiler installations. ▪ Experimental installations of solar collectors and heat pumps. ▪ The recovery of the rejected heat of refrigeration to provide hot water throughout the year and air heating in the winter. ▪ Introduce use of microprocessor energy management systems.

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B3. Burkina Faso

Overview of the Energy Sector in BURKINA FASO

There is no clear information available on energy efficiency initiatives for Burkina Faso. The installed electricity generating capacity of Burkina Faso in 2013 was 252,000kW (Macro-economy Meter 2013).

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Burkina Faso are listed in the table below.

Table B3.1 Energy Efficiency Initiatives in Burkina Faso

Initiative/Activity/Programme/and Sponsors	Brief outline and planned dates (whether past/present/or future)
$12million initiative by UNIDO	Date: the initiative has been concluded since 2012. **Objectives:** ➢ Focus on the agro-allied sector ➢ Promoting energy efficiency ➢ Poverty reduction ➢ Encouragement of entrepreneurship ➢ Alleviation of youth unemployment.

World Bank Board of Executive Directors / International Development Association (IDA)	The initiative was issued in 2013 and still on-going. **Objectives:** ➢ To use a $US50 million credit approved by the International Development Association (IDA) to support Burkina Faso's efforts to improve the reliability of electricity supply. ➢ To increase access to electricity generally. ➢ To increase and also spread the use of renewable energy sources in the rural areas of Burkino Faso (World Bank 2014).

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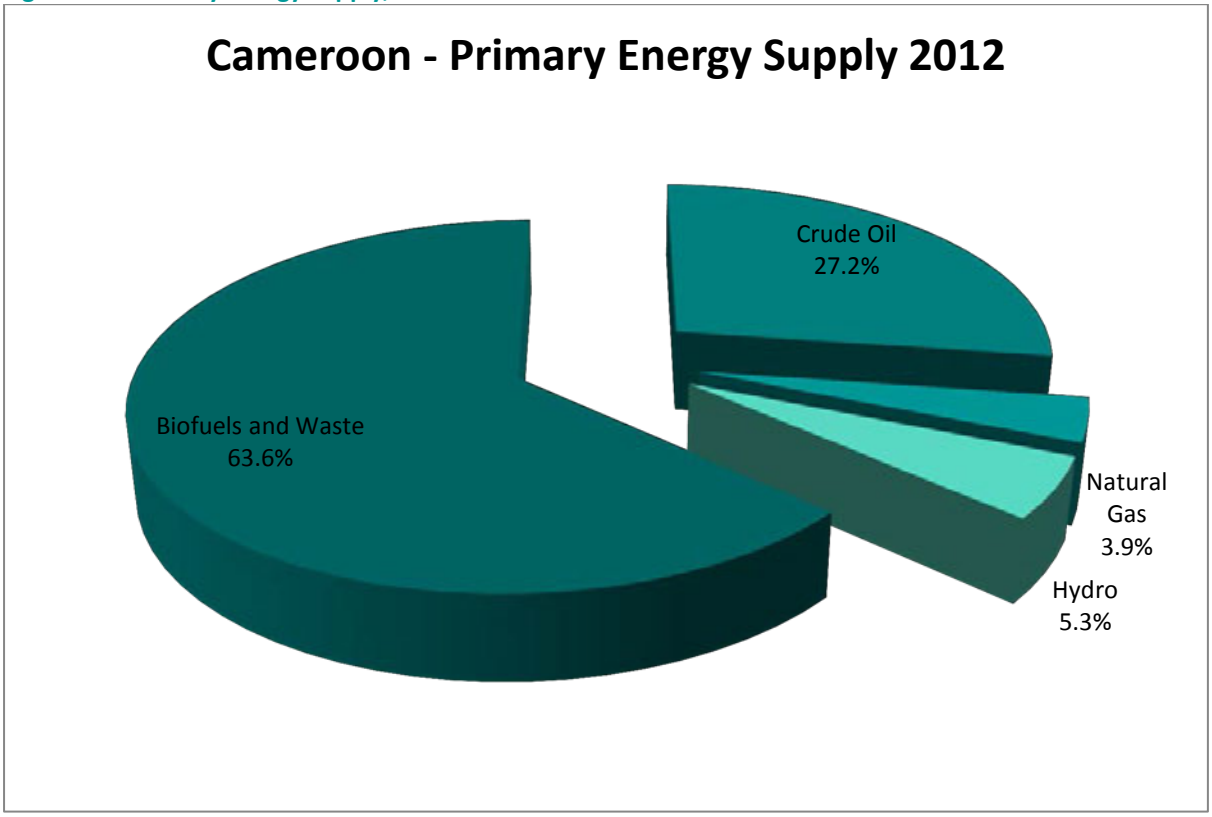
World Bank 2014. *Burkina Faso: World Bank to Help Bring Electricity to Urban and Rural Areas 2013.* http://www.worldbank.org/en/news/press-release/2013/07/30/burkina-faso-world-bank-to-help-bring-electricity-to-urban-and-rural-areas

B4. Cameroon

Overview of the Energy Sector in Cameroon

The primary energy supply in Cameroon comes from biomass, oil, hydro and natural gas, as illustrated in the following diagram.

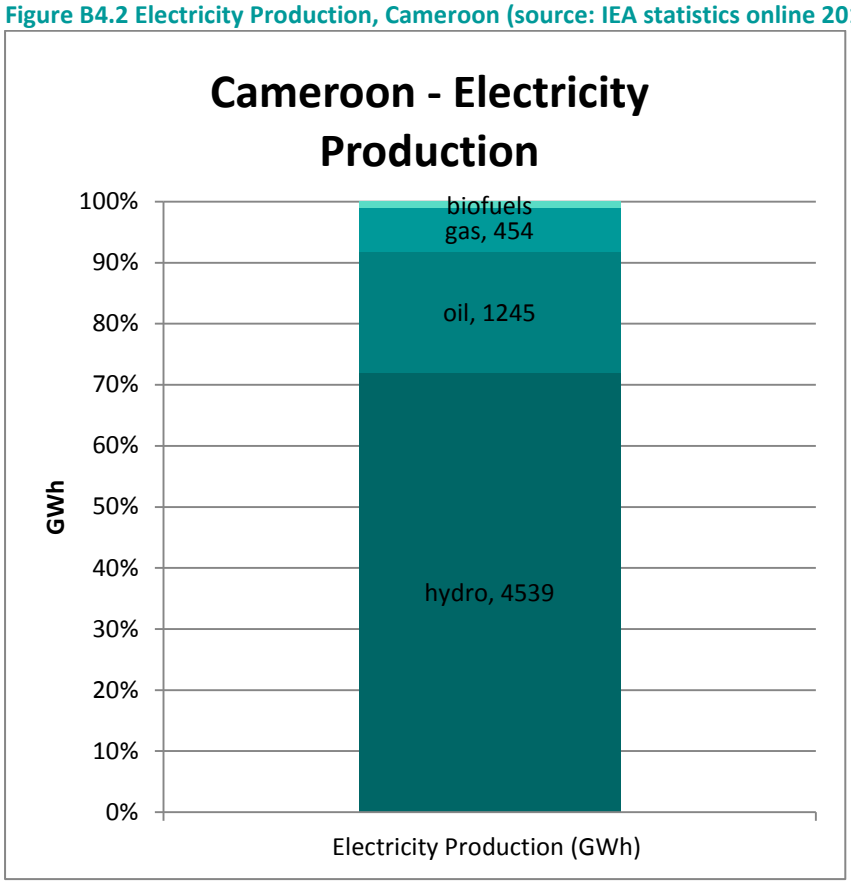
Figure B4.1 Primary Energy Supply, Cameroon [25]



[25] **(source: IEA statistics online 2015)**

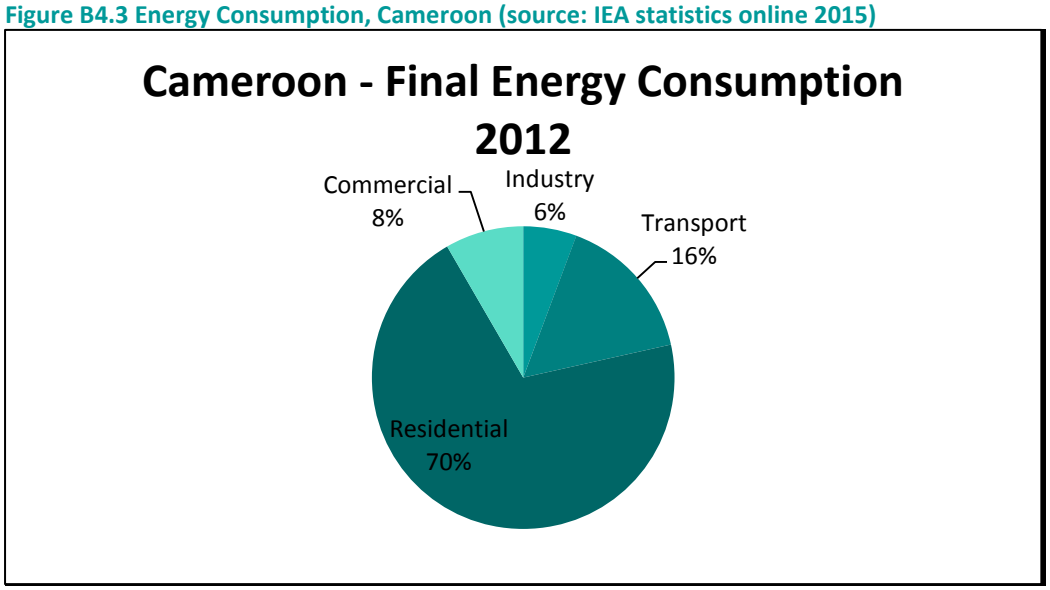
Over 70% of electricity in Cameroon is generated by hydro. The remainder is generated from oil and gas, with a small amount of biofuels making up the balance. The breakdown of electricity generation is shown in Figure B4.2 below.

Figure B4.2 Electricity Production, Cameroon (source: IEA statistics online 2015)



Final energy consumption for Cameroon is show in Figure B4.3. Energy is predominantly used in the residential sector, accounting for 70% of energy used.

Figure B4.3 Energy Consumption, Cameroon (source: IEA statistics online 2015)



Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Cameroon are listed in the table below.

Table B4.1 Energy Efficiency Initiatives in Cameroon

Initiative/Activity/Programme/ and Sponsors	Brief outline and planned dates (whether past/present/or future)
Development of a National Energy Efficiency Policy and Plan Supported by: European Union Energy Initiative Partnership Dialogue Facility (EUEI PDF)	Date: December 2012-December 2013. **Objectives:** ➢ To contribute to the improvement of efficiency in use of electricity in Cameroon. ➢ The proposed National Energy Efficiency Plan sets targets for energy efficiency (EE) to be pursued by the industrial, public buildings' and household sectors, and to define the institutional and regulatory framework necessary to incentivise the targeted implementation.
Energy Efficiency and Energy Conservation for Indigenous Women in the Mayo Tsanaga and Diamaré Departments of the Extreme Northern Province of Cameroon Sponsor: GEF Small Grants Programme	Date: 2009-2011 **Objectives:** ➢ This project involves indigenous women in the local production of cheap, environmentally friendly stoves and cookers in northern Cameroon. ➢ To reduce fuel wood use in an area that is at risk of turning into a desert due to climate change.
National Energy Efficiency Policy, Strategy and Action Plan in the electricity sector in Cameroon	Date: March 2014 **Objective:** ➢ The main goal of the project is to rapidly put in place an action plan aimed to significantly increase the efficiency of electricity use in Cameroon in order to reduce the pressure on demand and the imbalance between electricity supply and demand in the country in the short and medium term. ➢ The creation of an institutional and regulatory framework for the promotion of energy efficiency and energy-saving measures in the electricity sector.

The barriers identified in these initiatives that need to be addressed are shown in Table B4.2 below:

Table B4.2 Barriers to EE Initiatives Identified in Cameroon

Initiatives/projects/programmes	Barriers (at both regional and country levels)
General barriers	Lack of finance Lack of knowledge and skills to maintain renewable energy systems Lack of awareness Lack of adequate energy policies

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table B4.3 below.

Table B4.3 Co-benefits of EE Initiatives in Cameroon

Initiatives/projects/programme	Co-benefits to Energy Access
Energy Efficiency and Energy Conservation for Indigenous Women in the Mayo Tsanaga and Diamaré Departments of the Extreme-Northern Province of Cameroon National Energy Efficiency Policy, Strategy and Action Plan in the electricity sector in Cameroon	➢ 6,500 households use energy-efficient cooking stoves daily ➢ 50,000 households have reduced firewood consumption by 50 percent ➢ 5,000 tons of firewood saved annually ➢ This project also uses peer education to build ownership of and engagement in the improved cooking technologies, while an outreach campaign also educates communities about simple measures that further increase fuel efficiency. More specifically, once implemented, the anticipated results of a national energy efficiency policy are as follows: ➢ Reduced energy bills in public buildings, ➢ Increased energy efficiency in the industrial sector, ➢ Increased energy efficiency in the household sector, particularly with regard to the management of peak periods

Project to strengthen and extend the electricity transmission and distribution networks	➢ Implementation of this project will enhance the technical performance of the existing network and extend electricity supply to 423 new localities so far not connected to the grid. ➢ The extension of the HV line, as well as the rehabilitation and extension of the MV/LV network, will make it possible to increase the supply capacity in order to ensure better countrywide coverage by the national grid. ➢ The new connections and public lighting will contribute to achieving the objectives of increasing access rates as defined in the country's new sector strategy and improving the conditions for urban and rural security.
Rural Electrification Master Plan	➢ Electrification of about 660 localities through the extension of the interconnected grids, the rehabilitation and construction of isolated diesel power plants and mini-hydro plants, and the development of a regional grid. ➢ By 2020, the government aims to achieve a 48% countrywide electrification rate, a 75% electricity access rate and a 20% rural electrification rate.

Additional energy efficiency potential across various sectors in Cameroon is as follows.

Table B4.4 Identified Energy Efficiency Potential across Sectors in Cameroon

Sector	Energy Efficiency Potential
Industrial	Co-generation from biomass The promotion of co-generation projects would lead to: ➢ the recovery of waste from the industrial process that could replace fossil fuels ➢ reduced grid demand on the part of industry Technical energy efficiency measures The key objective is to reduce the losses attributable to an inefficient use of electricity due to the lack of a fully-fledged internal energy management system in most industries.
Tertiary building (public administration buildings, commercial buildings, restaurants and hotels, education and health buildings, office buildings such as telecommunications, real estate and finance)	The potential savings for existing buildings are divided between: ➢ short-term actions covering organisation (e.g. energy management), awareness raising and the reinforcement of maintenance programmes ➢ medium-term actions aimed to improve lighting and air-conditioning performance For all new buildings, a pressing need is the development of a building energy quality code, with the aim of improving construction quality by imposing realistic specifications based on the state of the art and on experience in construction in Cameroon.
Residential	➢ Improvement of household equipment today (lighting, television sets, fridges) and in goods that will be acquired in the future (housing, air conditioners, household equipment). ➢ The construction of housing in particular has a strong potential for savings, especially by reducing the need for air conditioning through specific EE measures focused on building regulations (insulation, sunscreens) and on the performance of air-conditioning units (energy performance standards).
Energy supply (generation, transmission and distribution)	The electricity system on the supply side in Cameroon is characterized by heavy losses. As far as generation is concerned, EE actions could essentially take place at the level of the thermal plants and could lead to savings of 160Mwh/year and around 1,000 tons of fuel. Transport electricity losses are estimated at 6.3% on average, distribution losses are at the 12% level, which is twice the level of losses of an optimized network. The electricity savings potential is therefore quite important

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B5. Chad

Overview of Chad's energy sector

Chad's primary energy sources are biomass, oil and oil products. Biomass accounts for more than 90% of the total primary energy supply, while oil accounts for only a small proportion of the total supply (Irena).

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Chad are listed in the table below.

Table B5.1 Energy Efficiency Initiatives in Chad

Initiative/Activity/Programme/and Sponsors	Brief outline and planned dates (whether past/present/or future)
National Development Plan 2013-2015	**Dates: 2013-2015** **Objective:** ➢ To develop a system for the production, transmission and distribution for electrical energy that is more economical and more reliable. ➢ To promote clean alternative sources of energy with a view to protecting the environment.
Energy Master Plan	To promote the Energy Sector in Chad *(Document not available online; limited information).*

The barriers identified in these initiatives that need to be addressed are shown in Table B5.2 below:

Table B5.2 Barriers to EE Initiatives Identified in Chad

Initiatives/projects/programmes	Barriers (at both regional and country levels)
General barriers (renewable energy)	➢ There is no regulatory framework for the development and implementation of renewable energy systems in the country.

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table B5.3.

Table B5.3 Co-benefits of EE Initiatives in Chad

Initiatives/projects/programmes	Co-benefits to Energy Access
Construction of Djermaya-Centrale N'Djamena 66kV power line and of the 90 kV N'Djamena electric loop and distribution network Rural mini-solar power plant project (to bring electricity to five villages) Solar power project (to bring electricity to 33 towns and villages) Establishing power supply to the city of Léré from Fianga The Plan Stratégique d'Amélioration de la Gestion et de la Gouvernance de l'Énergie ("Strategic Electricity Management and Governance Improvement Plan") Solar street lighting project in Am Djarass	Facilitating access to electricity to a large section of the population
Support project to the Agence de développement des énergies renouvelables (ADER –Renewable Energy Development Agency)	➢ More professional and effective management of the National Electricity Company, improving operating results. ➢ Make power available throughout the country. ➢ Ensure that the population has access to high-quality, low-cost energy services. ➢ Achieve an increase in the use of renewable energy.
Promoting Renewable Energy-Based Mini-Grids for Rural Areas Electrification and Productive Uses	➢ Reduce policy barriers to the creation of grid-connected renewable energy systems with the creation of a market-oriented institutional, financial, policy and regulatory framework. ➢ Develop a package of investment incentives, standardised PPAs, tariffs, pricing mechanisms, risk management instruments and business models to support the scaling up of RE mini-grids. ➢ Implement two PV solar-based mini-grids on selected sites, with a total of 0.2MW capacity. ➢ Establish around 250 electricity connections per site by 2013, powering approximately 1250 households and local businesses and a total of approximately 6250 persons *(latest information not available online)* ➢ Train a team of local authority officers and interested private-sector service providers-to-be in the operation, maintenance and management of RE-based mini-grid systems.

Additional energy efficiency potential across various sectors in Chad is as follows.

Table B5.4 Identified Energy Efficiency Potential across Sectors in Chad

Sector	Energy Efficiency Potential
General	Enormous potential in renewable energy sector (solar, wind, biomass)

References

International Energy Agency (IEA) Statistics online. http://www.iea.org/statistics Accessed July 2015

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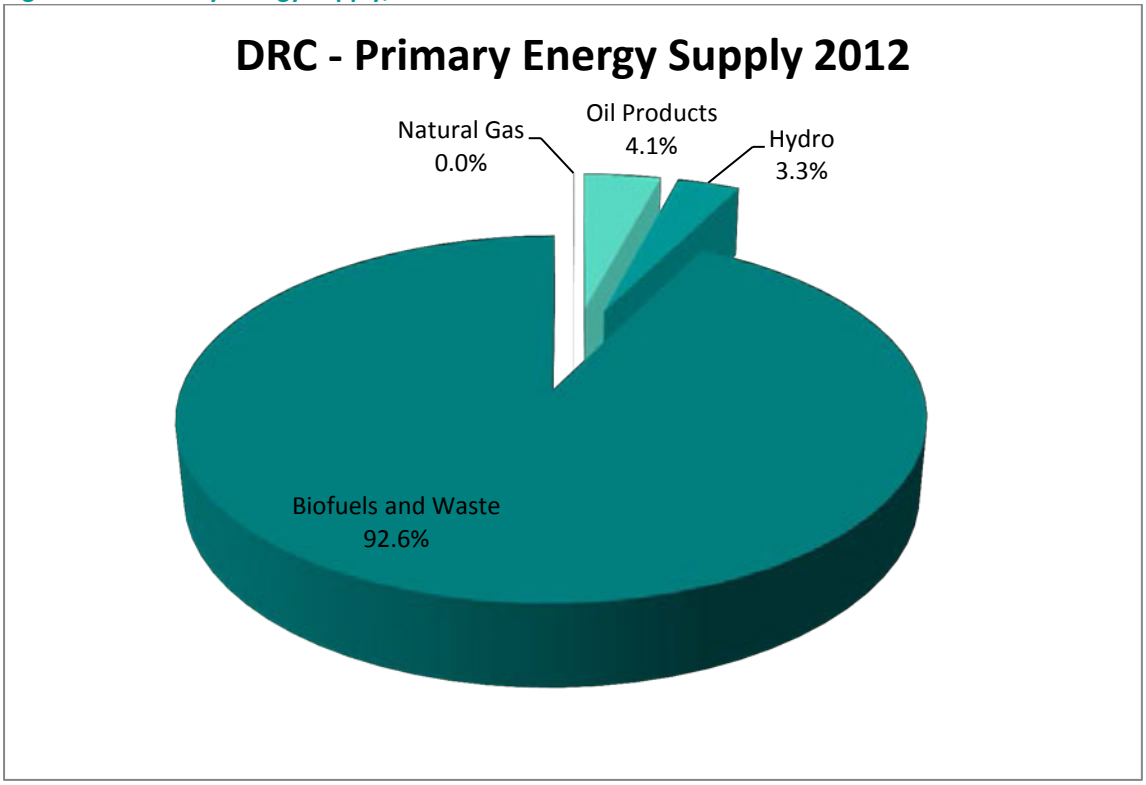
B6. Democratic Republic of Congo (DRC)

Overview of the Energy Sector in the Democratic Republic of Congo

The figure below shows the primary energy supply in the Democratic Republic of Congo. The major primary energy source is biomass, representing more than 90% of total supply, with oil, hydro and gas accounting for the remainder.

Figure B6.1 Primary Energy Supply, DRC [26]



[26] **(source: IEA statistics online 2015)**

Figure B6.2 Electricity Production, DRC [27]

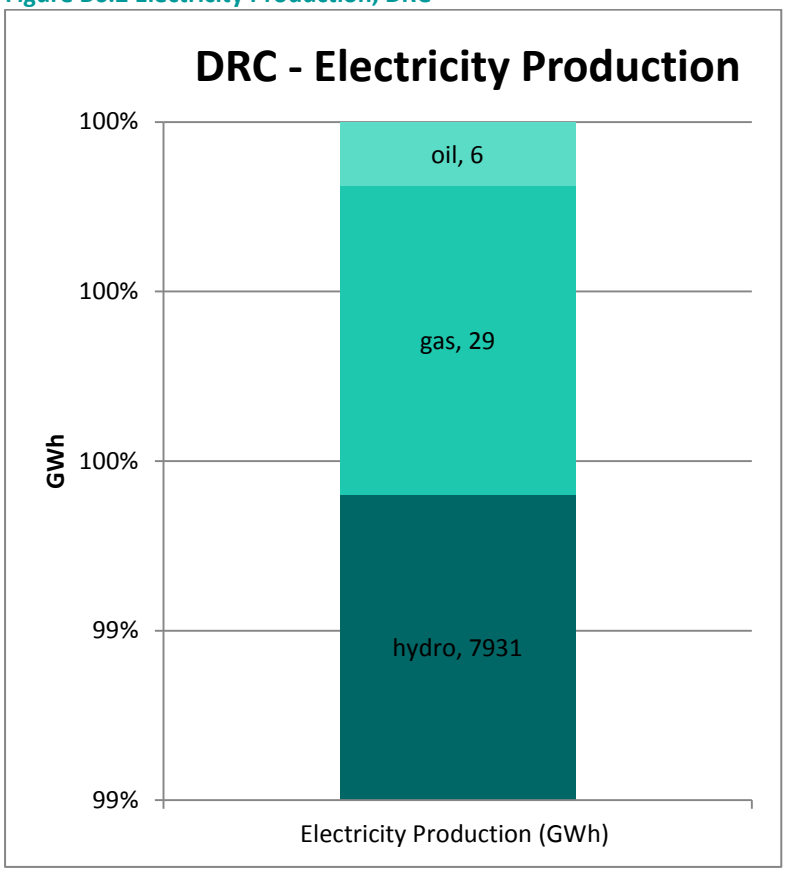
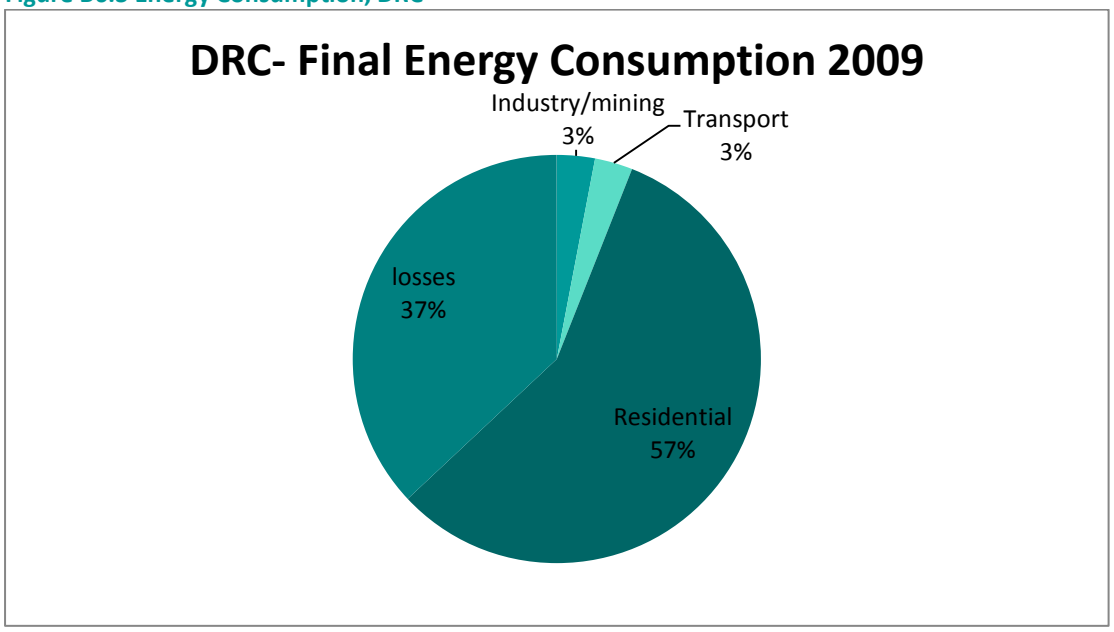


Figure B6.3 Energy Consumption, DRC [28]



[27] (source: IEA statistics online 2015)

[28] (source: IEA statistics online 2015)

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in the DRC are listed in the table below.

Table B6.1 Energy Efficiency Initiatives in the Democratic Republic of Congo

Initiative/Activity/Programme/and Sponsors	Brief outline and planned dates (whether past/present/or future)
Diversification of energy enterprises to increase resilience to climate change	Date: currently in force. The Ministry of Environment is struggling to diversify energy production sources to increase national resilience to the adverse effects of climate change. Policy type: regulatory instruments, auditing Policy target: multiple RE sources

The barriers identified in these initiatives that need to be addressed are shown in Table B6.2 below:

Table B6.2 Barriers to EE Initiatives Identified in the Democratic Republic of Congo

Initiatives/projects/programmes	Barriers (at both regional and country levels)
General barriers concerning energy efficiency	➢ Lack of institutional capacity ➢ Current absence of a large sustainable energy market due to the high-risk environment for private investors in the country ➢ Lack of an independent regulatory body for the energy sector

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table B6.3 below.

Table B6.3 Co-benefits of EE Initiatives in the Democratic Republic of Congo

Initiatives/projects/programmes	Co-benefits to Energy Access
Sustainable Energy for All (SE4ALL): Inga Hydropower project in DRC	➢ To provide electricity to rural areas and to transform villages and lifestyles by providing access to sources of renewable energy
Semi-Urban and Rural Electrification Project	Grant approved by the African Development Bank Group in 2010. The project will finance the construction of electricity infrastructure and the rehabilitation of distribution networks in the areas below: ➢ Electrification of five areas in Kinshasa

	➢ Discharge Programme for sixteen municipal councils in Kinshasa ➢ Rehabilitation and extension of the Ngombe Matadi network in Bas-Congo ➢ Rehabilitation and extension of the Dima and Bendela network in Bandundu ➢ Rehabilitation and extension of the Kabare network in South Kivu ➢ Rehabilitation and extension of the Yakusu in the East Province.

Additional energy efficiency potential across various sectors in the DRC is as follows.

Table B6.4 Identified Energy Efficiency Potential across Sectors in the Democratic Republic of Congo

Sector	Energy Efficiency Potential
Residential	➢ Use of domestic biogas digesters in rural households. Biogas digesters can produce biogas for cooking and/or lighting using animal manure and other agricultural wastes, as well as wastes from food. ➢ The use of efficient cooking stoves. (Currently, most fuelwood is burned on inefficient, traditional, three-stone cooking fires). ➢ Solar lamps can replace kerosene. A national solar lighting programme could also be implemented. ➢ CFL distribution programme.
Public Services	➢ Efficient street lighting, LED-based traffic lights. ➢ Efficient pumps (water pumping is another highly energy-consuming service in water supply and wastewater treatment. The most efficient pumps are four to five times more efficient than ordinary pumps). Solar water pumping is also a possibility using off-grid systems.
Electricity distribution	➢ In the existing electricity grids, measures can be taken to reduce technical energy losses. Options include upgrading the voltage of a transmission and distribution system, and replacing existing transformers with more efficient ones. ➢ Currently, 20% of generated power is lost in the transmission and distribution processes, enough to meet the current power deficit.

Transport	Converting from diesel to biodiesel based on jatropha or other oilseeds.

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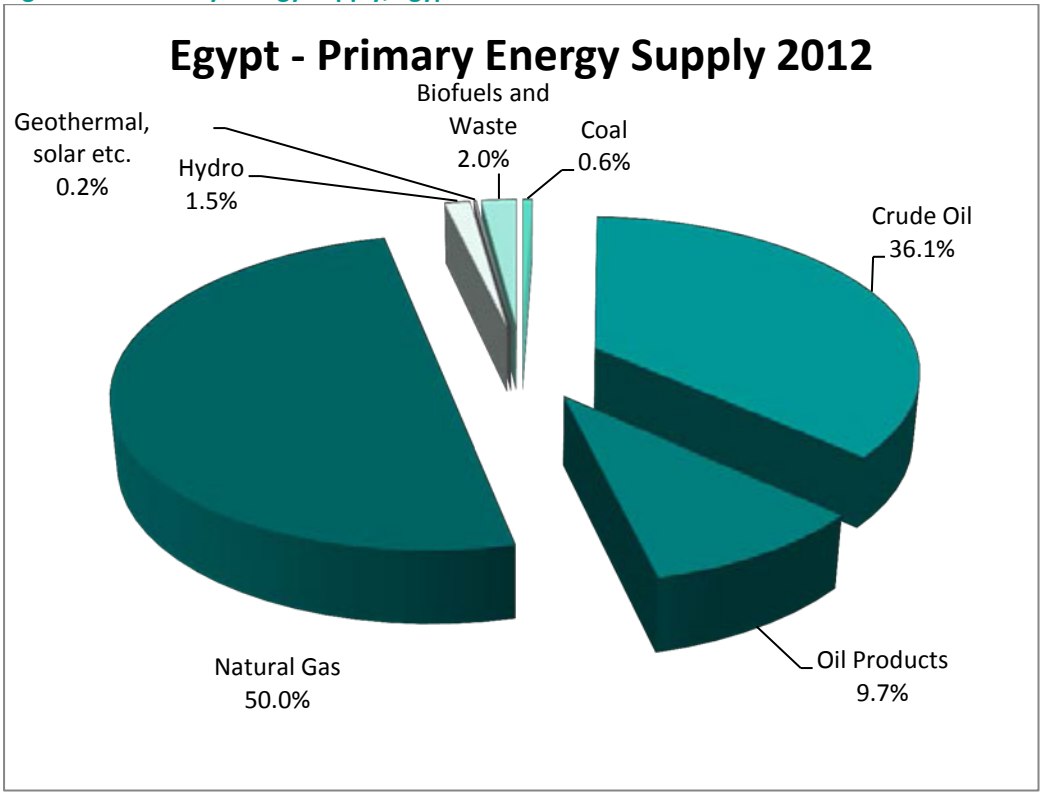
B7. Egypt

Overview of Egypt's Energy Sector

Natural gas makes up half of Egypt's primary energy, followed by crude oil at 36%. The proportional split of primary energy is shown below.

Figure B7.1 Primary Energy Supply, Egypt [29]

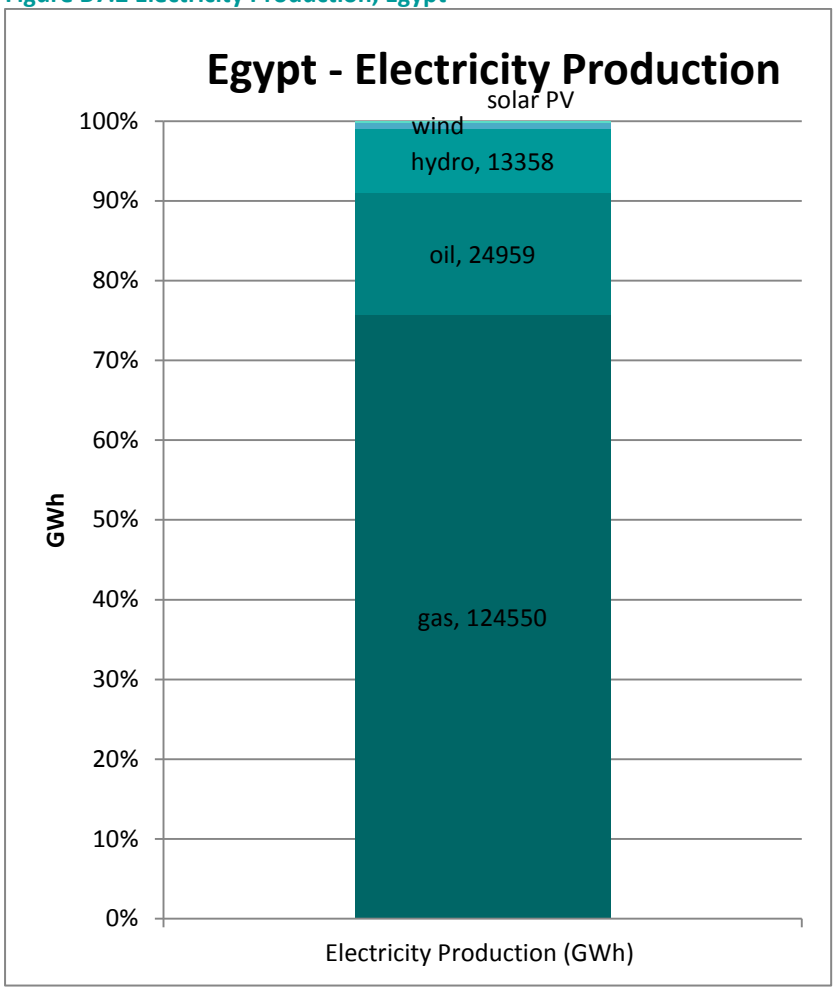


Egypt's power sector is controlled by two ministries: the Ministry of Petroleum, which oversees the upstream and downstream oil and gas sector; and the Ministry of Electricity and Energy, which is in-charge of electricity generation, transmission and distribution. Egypt had an installed electricity capacity of 25,000MW at the end of 2010 (ADP 2012).

[29] **(source: IEA statistics online 2015)**

Over 70% of Egypt's electricity is generated from natural gas, with the remainder coming from oil, hydro and very small contributions from wind and solar PV. This is shown in Figure B7.2 below.

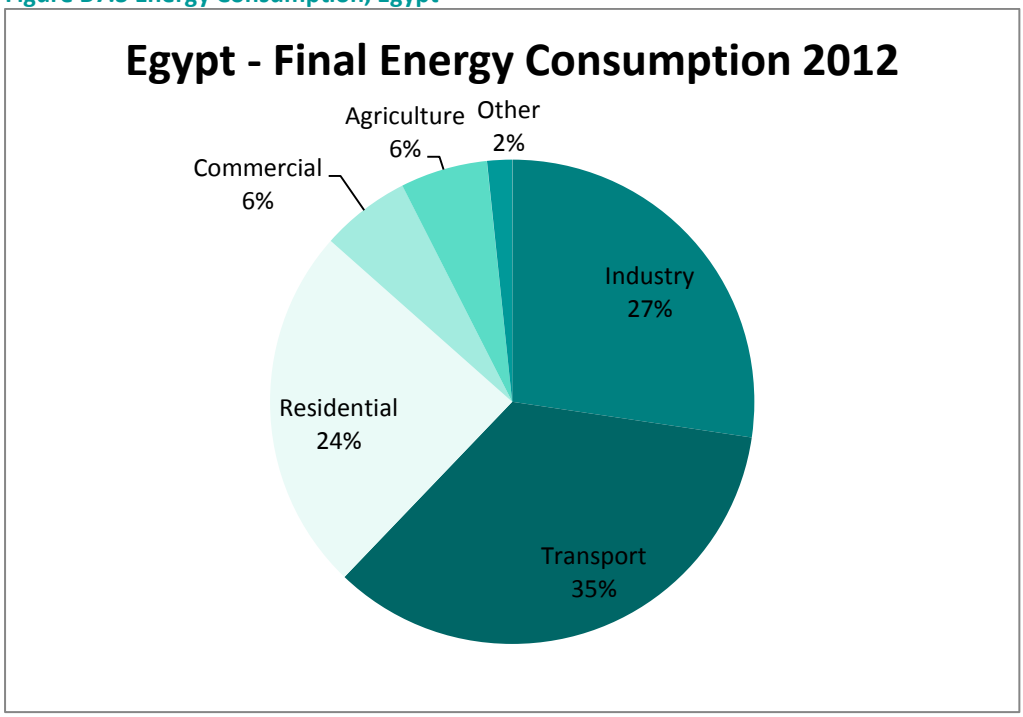
Figure B7.2 Electricity Production, Egypt [30]



[30] **(source: IEA statistics online 2015)**

Final energy consumption in Egypt is shown in Figure B7.3 below. Transport is the largest user, followed by the residential and industrial sectors.

Figure B7.3 Energy Consumption, Egypt [31]



[31] **(source: IEA statistics online 2015)**

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in the Egypt are listed in the table below.

Table B7.1 Energy Efficiency Initiatives in Egypt

Initiative/Activity/Programme/and Sponsors	Brief outline and planned dates (whether past/present/or future)
The funding of EE standards for four domestic appliances and efficiency codes for new buildings, with voluntary compliance without any enforcement procedure (ADP 2012)	Date: launched in 2005 and on-going This programme is known to have achieved some success, but its effectiveness and sustainability has not yet been assessed (ADP 2010). The programme promotes the use of CFLs to replace incandescent lamps. **Objectives:** • 20% savings in improved technology are envisaged. • 10-40% savings in the industrial sector • 20-80% savings in energy efficiency in buildings and appliances through insulation and improved standards. • 15% savings in the transport sector, relying on existing modes and technologies of transportation.

The barriers identified in these initiatives that need to be addressed are shown in Table B7.2 below:

Table B7.2 Barriers to EE Initiatives Identified in Egypt

Barriers (at both regional and country levels)	Benefits of overcoming barriers
BARRIERS TO EE IN EGYPT • **Institutional and legal constraints:** absence of laws, regulations, policies, comprehensive and clear policies and programmes to promote EE (ADP 2012). • **Lack of adequate data and information:** there is little reliable data or information on energy use by subsectors, key industries, equipment and appliances. There are no mandatory fuel efficiency standards for transport, no mandatory energy-efficiency building codes, no benchmarking for	Not known

industries, and only a few energy-efficiency standards for appliances (ADP 2012). • **Financial constraints:** there are no dedicated funds or other financial mechanisms and incentives to support energy efficiency activities. Energy prices are well below costs and do not encourage energy savings (ADP 2012). • **Capacity Constraints:** there is insufficient capacity to develop energy-efficiency programmes and projects.	

References

ADP 2012. (Razavi, H. et al. 2012). *Clean energy development in Egypt 2012.*

International Energy Agency (IEA) Statistics online. http://www.iea.org/statistics Accessed July 2015

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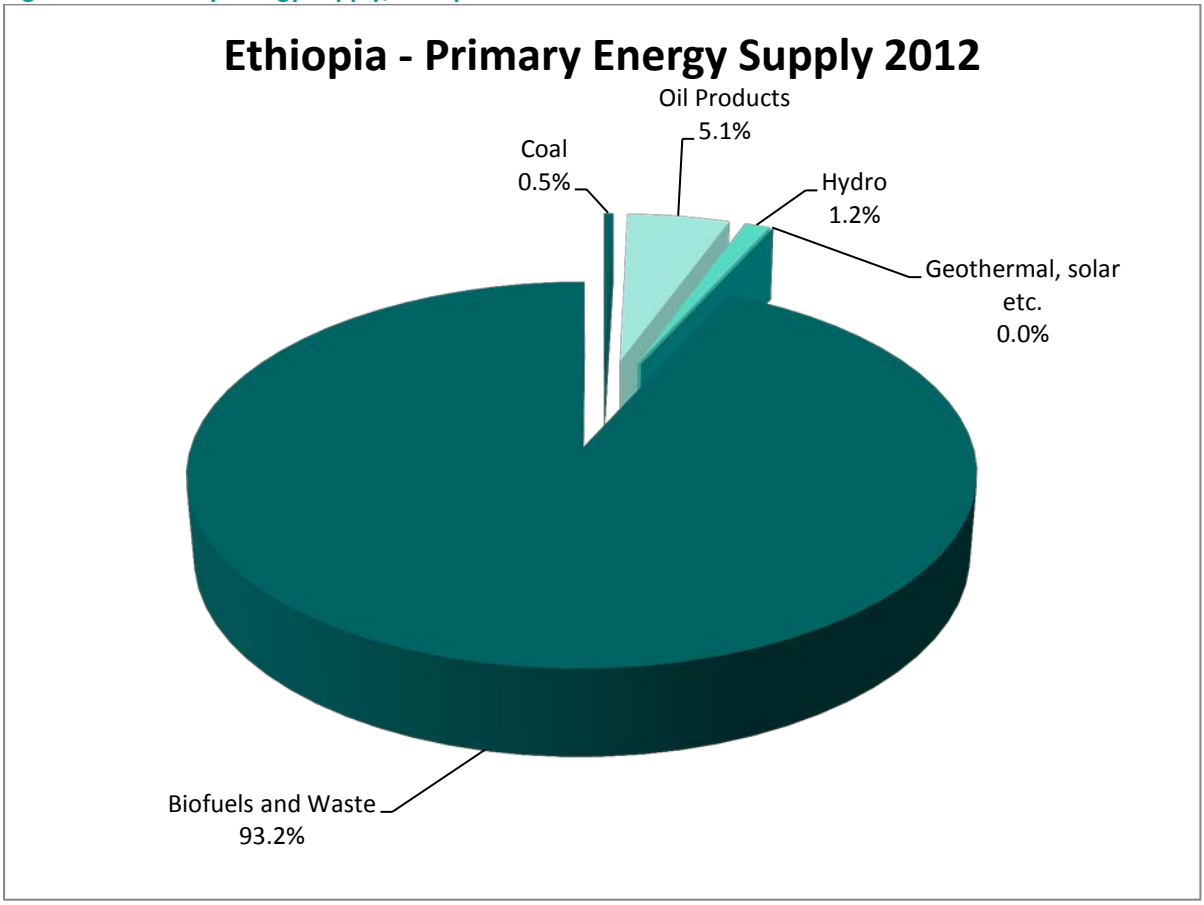
B8. Ethiopia

Overview of the Energy Sector in Ethiopia

The primary energy supply in Ethiopia comes from biomass, geothermal, oil and hydro. Biomass represents the largest share of total primary energy supply, while geothermal represents the lowest share, as observed in Figure B8.1 below.

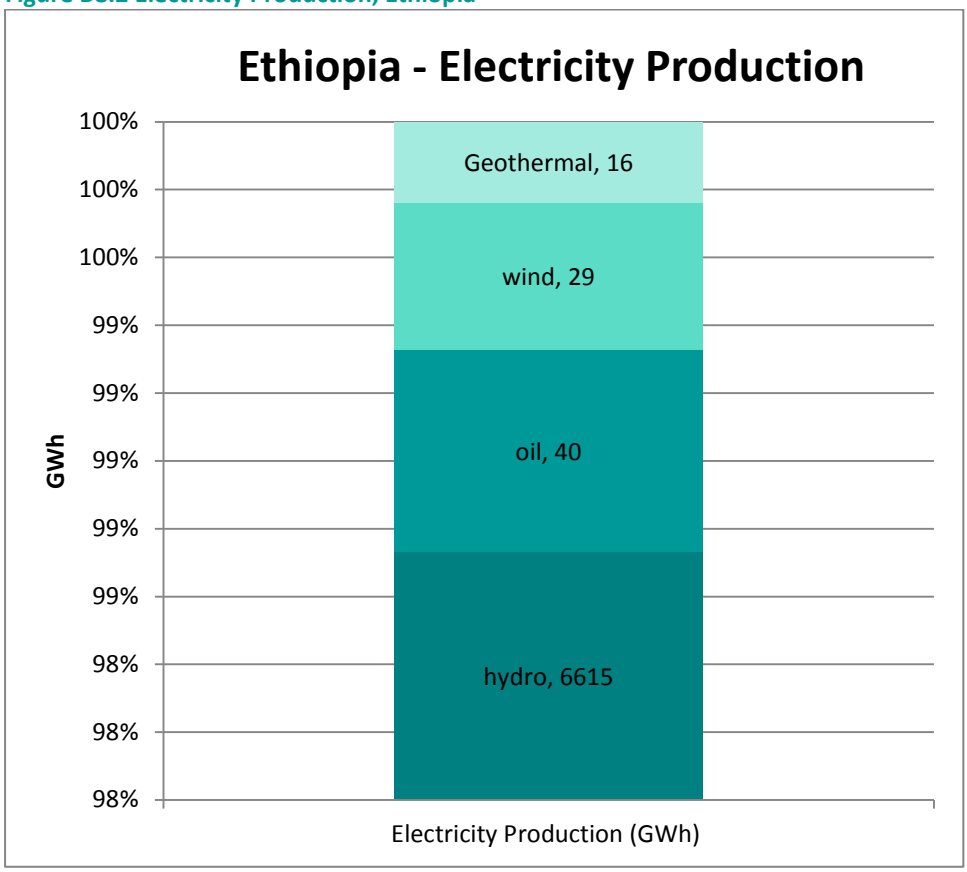
Figure B8.1 Primary Energy Supply, Ethiopia [32]



Almost all of Ethiopia's electricity is generated from hydro (99%), as is shown in Figure B8.2 below. Very small proportions of oil, wind and geothermal generation are used.

[32] **(source: IEA statistics online 2015)**

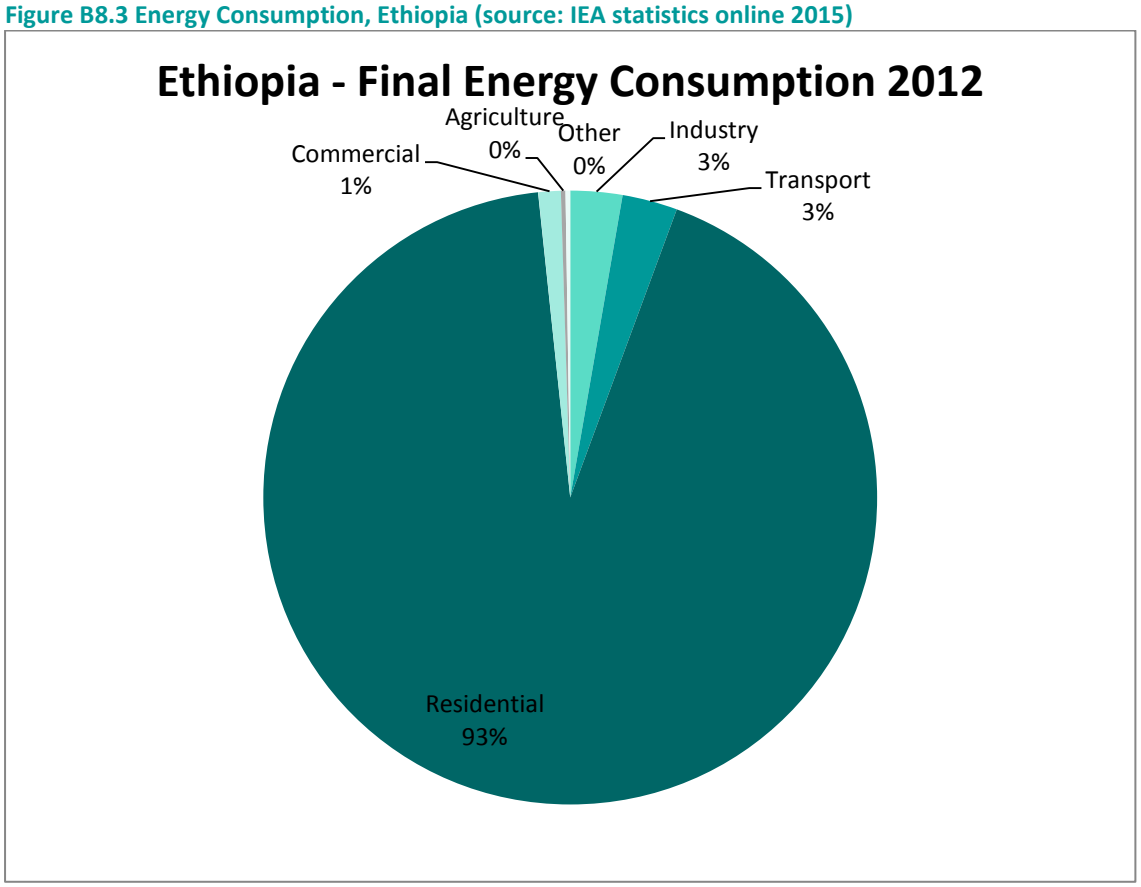
Figure B8.2 Electricity Production, Ethiopia [33]



Final energy consumption is shown below in Figure B8.3. The majority of energy is consumed in the residential sector, which will account for the biofuels consumed, i.e. cooking and heating with wood.

[33] **(source: IEA statistics online 2015)**

Figure B8.3 Energy Consumption, Ethiopia (source: IEA statistics online 2015)



Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Ethiopia are listed in the table below.

Table B8.1 Energy Efficiency Initiatives in Ethiopia

Initiative/Activity/Programme/and Sponsors	Brief outline and planned dates (whether past/present/or future)
National Energy Policy	Issued in March 1994 and still in force Objectives: ➢ To ensure a reliable supply of energy at the right time and at affordable prices, particularly to support the country's agricultural and industrial development strategies adopted by the Government of Ethiopia. ➢ To ensure and encourage a gradual shift from traditional energy sources to modern energy sources.

	➢ ➢ To streamline and remove bottlenecks encountered in the development and utilization of energy resources and to give a priority to the development of indigenous energy resources with the goal of attaining self-sufficiency. ➢ To set general guidelines and strategies for the development and supply of energy resources. ➢ To increase energy utilization efficiency and reduce energy wastage. ➢ To ensure that the development and utilization of energy is benign to the environment.
Growth and Transformation Plan (GTP)	Date: 2010/11-2014/15 Objectives: ➢ development of renewable energy ➢ expansion of energy infrastructure ➢ creation of an institutional capacity that can effectively and efficiently manage such energy sources and infrastructure
Climate Resilient Green Economy Initiative (CRGE)	In general, four initiatives for fast-track implementation have been selected under the CRGE: (i) exploiting Ethiopia's vast hydropower potential; (ii) large-scale promotion of advanced rural cooking technologies; (iii) efficiency improvements to the livestock value chain; and (iv) reducing emissions from deforestation and forest degradation (REDD).
The National Regulatory System to Ensure Conservation of Electricity and Energy Efficiency	➢ Implementation strategies will seek to meet the increasing demand for energy by encouraging private investors and the state-owned utility engaged in the sector. ➢ Actions taken to support this strategy include licensing applicants and granting certificates of competence to potential energy producers. ➢ A further approach is to ensure that reasonable and affordable tariff structures are applied. Energy audit activities will involve the establishment of energy efficiency management sections for selected consumers, particularly high energy consuming organizations. ➢ Energy conservation and mitigation of energy losses will be pursued for each economic sector. The measures to be taken will identify the most efficient energy consumption technologies, establish performance standards, implement and conduct regular inspection

	activities on electric utilities, prepare reports and take the corrective measures necessary.
The Rural Electrification Fund	➢ To support rural socio-economic development through improving access to electricity for the purpose of productive economic uses and improving rural livelihoods, including health, education, irrigation, agro-processing, clean water supply and security; ➢ Finance rural electrification projects to be carried out primarily by the private sector, including cooperatives, local government bodies and local communities; ➢ Promote, facilitate and provide technical, operational and business development and management support services for rural electrification projects; ➢ Prepare an off-grid rural electrification master plan (with annually updated plans) and conduct feasibility studies to identify suitable RE projects to be implemented by the private sector (including NGOs, CBOs, co-operatives, municipalities/local governments and other entities)
Alternative Energy Development and Promotion	➢ To develop the country's abundant renewable energy resources and technologies through the adoption or innovation of new technologies ➢ To produce prototypes and test the efficiency of energy sources and technologies based on consumer demand. ➢ Awareness within communities will be created and promoted. ➢ Demand for alternative energy technologies will be improved and loans arranged for manufacturers and consumers to install alternative technologies.

The barriers identified in these initiatives that need to be addressed are shown in Table B8.2 below:

Table B8.2 Barriers to EE Initiatives Identified in Ethiopia

Initiatives/projects/programmes	Barriers (at both regional and country levels)
Scaling Up Renewable Energy Programme	➢ Lack of locally developed and adapted technologies that fit local conditions ➢ Human resources constraints ➢ Lack of on-job training experiences ➢ Lack of technology transfer ➢ Lack of proven track record in new renewable energy technologies ➢ Lack of detailed road maps for development models ➢ Lack of available finance

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table B8.3 below.

Table B8.3 Co-benefits of EE Initiatives in Ethiopia

Initiatives/projects/programmes	Co-benefits to Energy Access
Growth and Transformation Plan (GTP)	➢ During the GTP period, the gap between the demand for and supply of electricity will be minimized. ➢ The per capita consumption of electricity by households is expected to increase during the GTP period. ➢ The government will ensure a cost-effective, high-quality supply of energy, as well as energy efficiency and conservation. The regulatory framework will be effectively enforced. ➢ The GTP sets as its target during the plan period an additional 8,000 MW energy generated from renewable energy sources. ➢ The plan further envisages increasing the customer base of the power utility from the current level of 2 million to 4 million and the general access rate from 41% to 75%.

	➢ Regarding bio-fuel usage and production, the plan aims to increase bio-ethanol production and usage to 194.9 million litres and biodiesel usage to 1.6 billion litres. The number of ethanol to benzene blending facilities is also targeted to reach eight and that of biodiesel 72. ➢ The plan further aims to increase the dissemination of alternative energy technologies in order to reduce the deforestation rate effectively and alleviate the burden of widely dispersed rural settlers.
Climate Resilient Green Economy Initiative (CRGE)	➢ The CRGE envisages developing up to 25,000 MW of Ethiopia's generating potential by 2030. Of this, hydro accounts for 22,000 MW, geothermal 1,000MW, and wind 2,000MW. ➢ In the formulation of the CRGE, since rural energy usage will remain dependent on traditional fuels, especially for cooking purposes, a large abatement of emissions is expected from improving fuel efficiency and shifting fuels (from fuel wood to biogas etc.) for cooking stoves. ➢ A programme is anticipated under the CRGE, aiming at scaling up the dissemination to 9 million stoves by 2015 and to 34 million stoves by 2030. The programme, in addition to the emissions reductions, is expected to increase rural household incomes by up to 10%, reduce deforestation and create an industry for the manufacture of cooking stoves.

Additional energy efficiency potential across various sectors in Ethiopia is as follows in Table B8.4 on the next page.

Table B8.4 Identified Energy Efficiency Potential across Sectors in Ethiopia

Sector	Energy Efficiency Potential
Residential	Improved cooking stove technologies
Transport	➢ Use of liquid biofuels (biodiesel and bioethanol). The government has drawn up a clear plan to increase biofuel production. The plan is to increase ethanol production from its level of 7.1 million litres in 2010 to 181.6 million litres by the end of 2015. ➢ Introduce stricter fuel efficiency standards for passenger and cargo transportation and promote the purchase of hybrid and electric vehicles to counter the low efficiency of the existing vehicle fleet. ➢ Construct an electric rail network powered by renewable energy to replace road freight transport. ➢ Improve urban transport in Addis Ababa by introducing urban electric rail, enabling fast and efficient transportation.
Buildings	Accelerated transition to high-efficiency light bulbs.
Industrial	Cement: fastest growing sector, high emissions. ➢ Improved energy efficiency of the process by converting the technology used from dry to pre-calciner kilns and from rotary to grate coolers, as well as by introducing computerized energy management and control systems, which can decrease energy demand and hence the cost of emissions from cement production. ➢ Replace clinker by increasing the pumice content, leading to a decrease in both variable production costs and emissions. ➢ Increased share of biomass in the mix of energy for production in cement factories, potentially decreasing costs and emissions.

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B9. Lesotho

Overview of the energy sector in Lesotho

The primary energy sources in Lesotho consist of biomass, oil and its derivatives, and hydro. Biomass accounts for more than 80% of the total primary energy supply.

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Lesotho are listed in the table below.

Table B9.1 Energy Efficiency Initiatives in Lesotho

Initiative/Activity/Programme/ and Sponsors	Brief outline and planned dates (whether past/present/or future)
The Draft Energy Policy for the Kingdom of Lesotho	Date: drafted in 2003. **Objectives:** ➢ To contribute towards the improvement of livelihoods ➢ To contribute towards economic growth and investment ➢ To ensure security of supply ➢ To contribute towards the protection of the environment
National Strategic Development Plan	Dates: 2012/13-2016/17 **Objectives:** ➢ To give priority to clean energy and green technologies with investment in hydro, wind and solar to meet Lesotho's energy demand. ➢ To give recognition to energy as an important driver of growth. ➢ To increase energy production capacity to attain self-sufficiency and export clean energy by expanding electricity access to industry, commercial centres and households. ➢ To promote the conservation and efficient use of energy, as well as the distribution of alternative sources.

The SADC Renewable Energy Strategy and Action Plan (RESAP)	Date: 2011 **Objective:** ➢ The focus of the RESAP will be on bioenergy, solar energy, wind, hydro-power and energy efficiency development in the region.
Lesotho Renewable Energy Based Rural Electrification Project (LREBRE). Sponsors: UNDP/GEF, Government of Lesotho	Dates: 2007-2012 **Objectives**: ➢ Development of renewable energy market in Lesotho. ➢ Improvement of people's livelihoods by promoting the utilisation of renewable energy, particularly solar, to provide basic electricity services. ➢ Reduction of carbon dioxide emissions by encouraging the use of renewable energy technologies, particularly solar photovoltaic.
The Lesotho Renewable Energy Policy	The policy document was expected to be adopted in 2012. **Objectives:** This policy will pave way for the development of renewable energy resources in Lesotho, with an emphasis on affordability and sustainability.

The barriers identified in these initiatives that need to be addressed are shown in Table B9.2 below:

Table B9.2 Barriers to EE Initiatives Identified in Lesotho

Initiatives/projects/programmes	Barriers (at both regional and country levels)
Small hydropower development	➢ Difficulty of access to some sites ➢ Lack of availability of spare parts in the local market
Lesotho Renewable Energy Based Rural Electrification Project (LREBRE)	<u>Institutional barriers:</u> ➢ Lack of effective infrastructure for delivering renewable energy-based services on a sustainable basis. ➢ Fragmented institutional responsibilities and lack of integrated planning and implementation by various stakeholders. <u>Economic, Financial and Market barriers:</u> ➢ Limited private-sector capacity for supplying, distributing, installing and maintaining renewable energy systems.

	➢ Limited business skills: the required business skills to start energy enterprises are lacking. ➢ Lack of or limited in-country experience of renewable energy systems. ➢ Lack of adequate financing arrangements for renewable energy companies and end users. Technical barriers: ➢ Poor workmanship in the installation, operation and maintenance of renewable energy systems. Barriers pertaining to information, education and training: ➢ Lack of access to necessary information. ➢ Lack of public awareness of the technologies. ➢ Lack of trained manpower at all levels, and particularly insufficient qualified staff to maintain renewable energy systems.

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table B9.3 below.

Table B9.3 Co-benefits of EE initiatives in Lesotho

Initiatives/projects/programmes	Co-benefits to Energy Access
Lesotho Renewable Energy Based Rural Electrification Project (LREBRE)	➢ Increase in electricity access due to increase in solar PV installations, with 1537 systems installed within the project districts and 5254 countrywide after 2008. ➢ The Lesotho Solar Energy Society was also re-activated due to this project, achieving an increase from 20 registered solar dealers in 2008 to 70 in 2010.
Lesotho Highlands Water Project	➢ Generation of electricity

Additional energy efficiency potential across various sectors in Lesotho is as follows.

Table B9.4 Identified Energy Efficiency Potential across sectors in Lesotho

Sector	Energy Efficiency Potential
Residential	➢ Firewood is used for cooking in 56% of households in Lesotho, and most of the fuel is burned in inefficient, traditional three-stone cooking fires. ➢ Efficient cooking stoves, if used in Lesotho, have an emissions reduction potential of 200,000 tCO_2e per year.
Residential/Farming/Building	➢ Solar PV systems can be used to generate electricity for rural households, tobacco farms and rural buildings.
Transport	➢ Biodiesel can be used for transportation in Lesotho. It is estimated that this strategy has an emissions reduction potential of 22 500 tCO_2e per year.
Mining	Possible strategies that can be used: ➢ Installing timers on boilers ➢ Shutting off pressurised fans over weekends ➢ introducing battery-powered vehicles ➢ using solar panels for electricity generation

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B10. Madagascar

Overview of the Energy Sector in Madagascar

Madagascar relies mainly on biomass (90%) and oil (9%) for its primary energy supply (IRENA 2009).

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Madagascar are listed in the table below.

Table B10.1 Energy Efficiency Initiatives in Madagascar

Initiative/Activity/Programme/ and Sponsors	Brief outline and planned dates (whether past/present/or future)
Reform of Electricity Sector in Madagascar Sponsors: Government, WB, EU	In force since 1999. **Outline:** This law authorises the participation of private operators in the power sector in Madagascar through the award of concessions or permits. They are awarded through a bidding process based on a Development Master Plan.
Decentralised Rural Electrification Programme Sponsors: Government, WB, GIZ, UE, BAD	Started in 2008 and still in force. **Objective:** To improve the rate of access to electricity in rural areas by prioritizing the deployment of renewable resources in order to achieve the Millennium Development Goals and the "Sustainable Energy for All" Programme. **Policy type**: Policy Support, Strategic Planning, Voluntary Approaches, Negotiated Agreements (Public-Private Sector), Voluntary Approaches, Public Voluntary Schemes, Economic Instruments, Market-based Instruments, GHG Emissions Trading, Green Certificates, White Certificates **Policy target**: Hydropower, Bioenergy, Biomass for Power, Solar, Solar Photovoltaic, Wind, Onshore

The barriers identified in these initiatives that need to be addressed are shown in Table B10.2 below:

Table B10.2 Barriers to EE initiatives identified in Madagascar

Initiatives/projects/programmes	Barriers (at both regional and country levels)
Renewable energy policy for the development of clean sources of energy	➢ Lack of funding for private investments and lack of a transparent model for commercialization.
Hydropower Development Programme	➢ No feed-in tariff incentive (only two operators of small hydropower plants have managed to conclude individual feed-in contracts with JIRAMA on the basis of a ten-year tenure and a rather low FIT of approximately €0.04 per kWh). **Barriers to the development of small hydropower in rural areas are:** ➢ the long distances between consumption points and potential sites; ➢ low population density and low electricity demand; ➢ low utilization factor; ➢ prohibitively high capital costs; ➢ lack of capital and liquidity by entrepreneurs

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table 10.3 below.

Table B10.3 Co-benefits of EE Initiatives in Madagascar

Initiatives/projects/programmes	Co-benefits to Energy Access
Planning software and feasibility studies	This has enabled the Agency for Promoting Rural Electrification to improve its planning processes.
Rural electrification through renewable energy	➢ Promoting rural electrification through renewable energies. ➢ Three micro-hydropower plants co-financed by GIZ will give 17,000 people access to electricity in Madagascar.
Bioenergelec (biomass energy for poverty reduction through decentralized rural electrification)	This project aims at contributing to the: ➢ reduction of rural poverty and improvement of living conditions of people dependent on biomass energy ➢ sustainable development of both planted and natural forest ecosystems in four regions of Madagascar to provide biomass energy to supply equipment for decentralized rural electrification (DRE) ➢ The generalization of DRE produced from biomass-energy in poor and isolated rural areas in Madagascar.

Additional energy efficiency potential across various sectors in Madagascar is as follows.

Table B10.4 Identified Energy Efficiency Potential across Sectors in Madagascar

Sector	Energy Efficiency Potential
Residential	➢ Programmes are in place to utilise solar cookers in the country in an effort to reduce dependency on biomass. ➢ Charcoal is a major source of fuel, and its production is often inefficient. ➢ Energy diversification to LPG to reduce dependency on wood energy.
Transport	➢ Use of biofuels for transport. ➢ Biodiesel can be produced from Jatropha in

	Madagascar.

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B11. Malawi

Overview of the Energy Sector in Malawi

The population of Malawi was about 17, 377,468 in 2014 (Index Mundi 2014). According to Peng, W. et al. (2012), Malawi is one of the poorest countries in the world, with a gross domestic product per capita of about USD 900 in 2010. It is a landlocked country located in southern Africa, between latitudes 9˚22'S and 17˚3'S and longitudes 33˚40'E and 35˚55'E. The country is about 900 km long and 80 to 161 km wide, with a total area of 118,484 km^2 (11.8 million ha), of which 80% is land. The rest of its area is covered by water, mainly consisting of Lake Malawi, which is about 586 km long and 16 to 80 km wide, Lake Chilwa, Lake Malombe and Lake Chiuta. GDP composition by sector is 35.5% agriculture, 19.9% industry and 44.6% services (Peng, W. et al. 2012). Malawi is solely dependent on biomass fuels for its energy needs: firewood, charcoal, crop residues and animal dung (GoM 2009).

Energy Policies in Malawi

- National Forestry Policy 1996
- Biomass Energy Strategy 2009
- National Energy Policy 2013
- Malawi Energy Regulatory Authority (MERA)
- Rural Electrification Fund
- Development of liberalised electricity and liquid fuels sectors (GoM 2009).

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Malawi are listed in the table below.

Table B11.1 Energy Efficiency Initiatives in Malawi

Initiative/Activity/Programme/and Sponsors	Brief outline and planned dates (whether past/present/or future)
Malawi's National Energy Policy 2013.	Date: since 2003 and still in force. **Objectives:** ➢ To transform the country's economy from high dependency on biomass energy towards greater reliance on other energy sources, particularly for the electricity sector. ➢ Improving the efficiency and effectiveness of commercial energy supply industries ➢ Improving the security and reliability of energy supply systems; ➢ Increasing access to affordable and modern energy services; ➢ Stimulation of economic development and rural transformation for poverty reduction purposes; ➢ Improvement of energy sector governance; ➢ Mitigation of environmental, safety and health impacts of energy production and utilization; ➢ Making the energy sector robust and efficient to support government's agenda of poverty reduction and sustainable economic development, consequently enhancing labour productivity; ➢ Catalysing the establishment of a more liberalized, private sector-driven energy supply industry and ➢ Transforming the country's energy economy from one that is over-dependent on biomass to one with a high modern energy mix.

High-Efficiency Appliances and Energy Efficiency Labelling	**Objective:** ➢ To encourage switching from conventional charcoal cooking stoves to improved charcoal stoves with obvious energy-savings consequences for urban households (GoM 2009).
The European Union Energy Initiative Partnership Dialogue Facility (EUEI-PDF). Testing of the programme is expected to be carried out through standard setting by the Malawi Bureau of Standards (MBS). These standards may also be verified through public campaigns and capacity-building for producers and importers of approved energy-efficient devices (GoM 2009).	Date: 2007 The GoM requested assistance from the European Union Energy Initiative Partnership Dialogue Facility (EUEI-PDF) for the design of a national Biomass Energy Strategy (BEST) (GoM 2009). **Objectives:** ➢ The development of a rational and implementable approach to the management of Malawi's biomass energy sector through a combination of measures designed to improve the sustainability of biomass energy supply. ➢ To scale up end-user efficiencies and the promotion of appropriate alternatives (GoM 2009).

Additional energy efficiency potential across various sectors in Malawi is as follows.

Table B11.2 Identified Energy Efficiency Potential across Sectors in Malawi

Initiatives/projects/programmes	Barriers (at both regional and country levels)
General Barriers	**Anticipated Barrier and Challenges** ➢ Customers could purchase new in order to exchange the approved maximum number of incandescent bulbs allowed under the programme. ➢ Customers may not install all the CFLs collected. ➢ Customers may keep the CFLs to replace the low quality CFLs that they are currently using. This is possible since changing a CFL for another CFL does not reduce demand. ➢ Customers may be tempted to sell the acquired CFLs, which could be subsequently smuggled to neighbouring countries (Gooneratne, F., and Visser, A. 2010).

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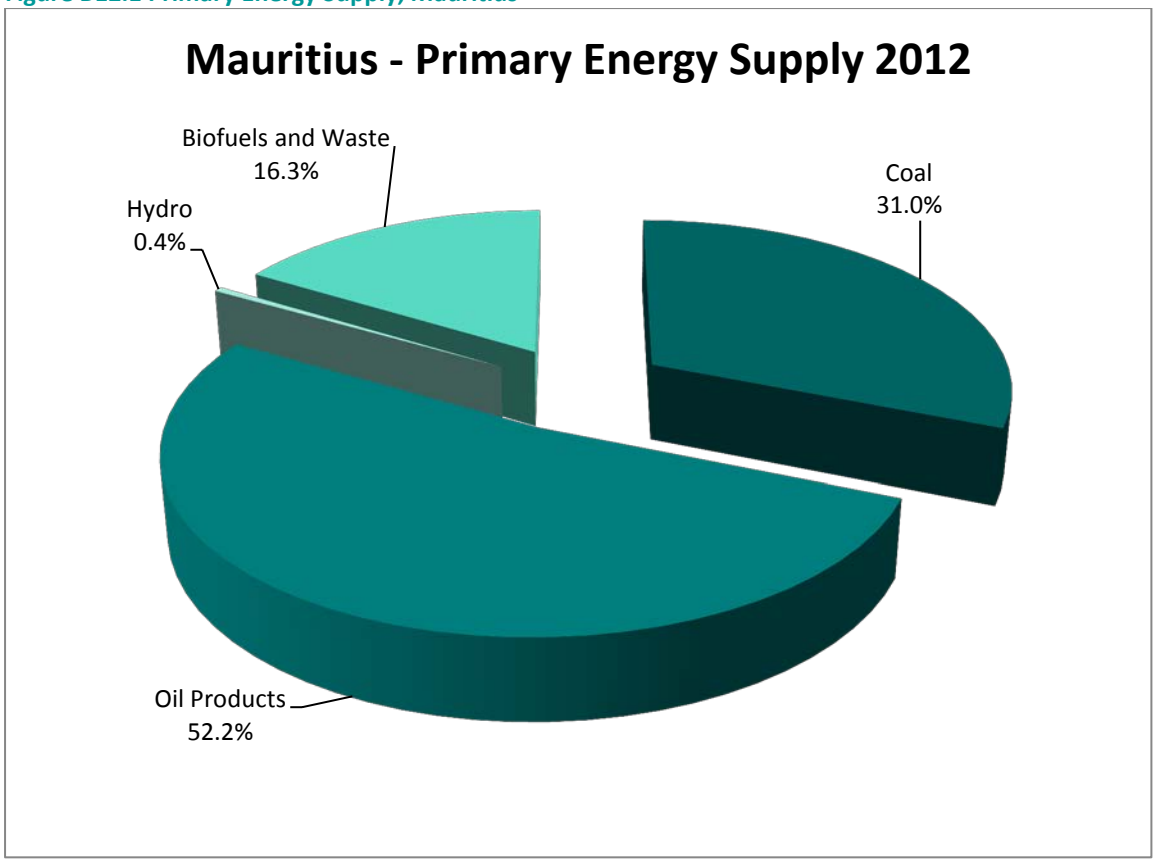
B12. Mauritius

Overview of the energy sector in Mauritius

It can be observed from Figure B12.1 below that Mauritius depends on oil, biomass, coal and hydro for its primary energy supply. The biomass that is used is typically bagasse, the cellulosic residue left after sugar has been extracted from sugarcane.

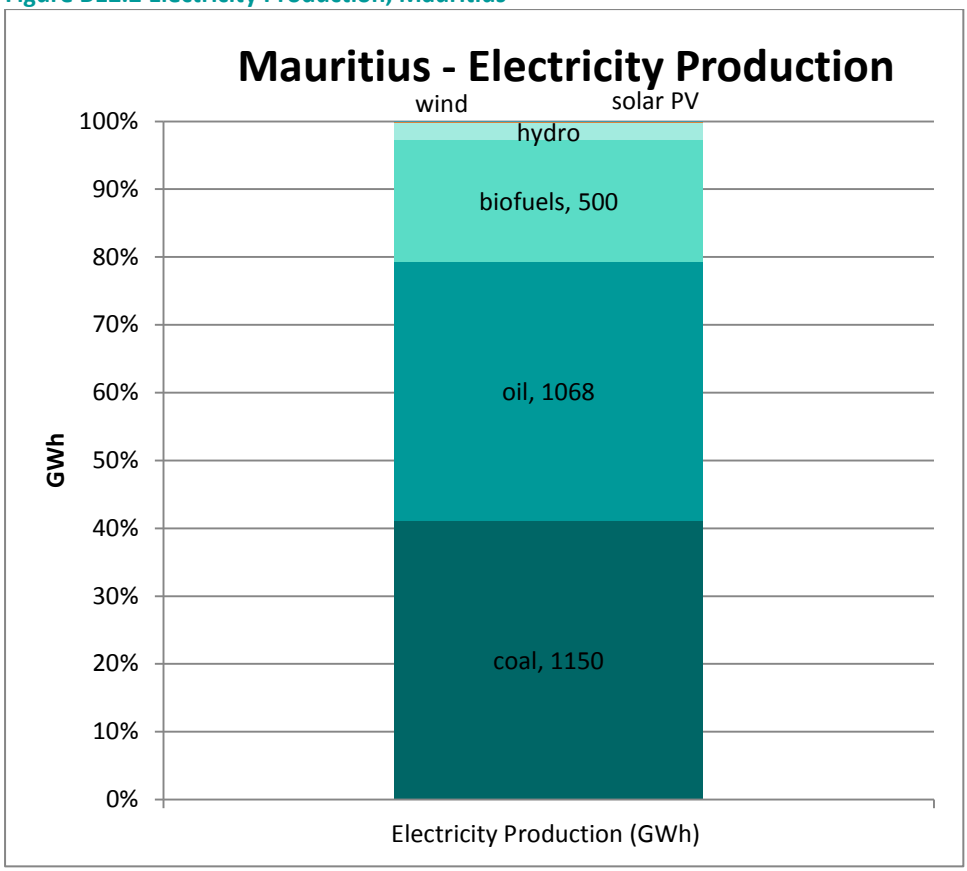
Figure B12.1 Primary Energy Supply, Mauritius [34]



[34] **(source: IEA statistics online 2015)**

Electricity production in Mauritius is made up of approximately 40% coal and 40% oil, with the balance coming from biofuels, hydro, solar and wind. Figure 12.2 below gives a proportional breakdown of the electricity production.

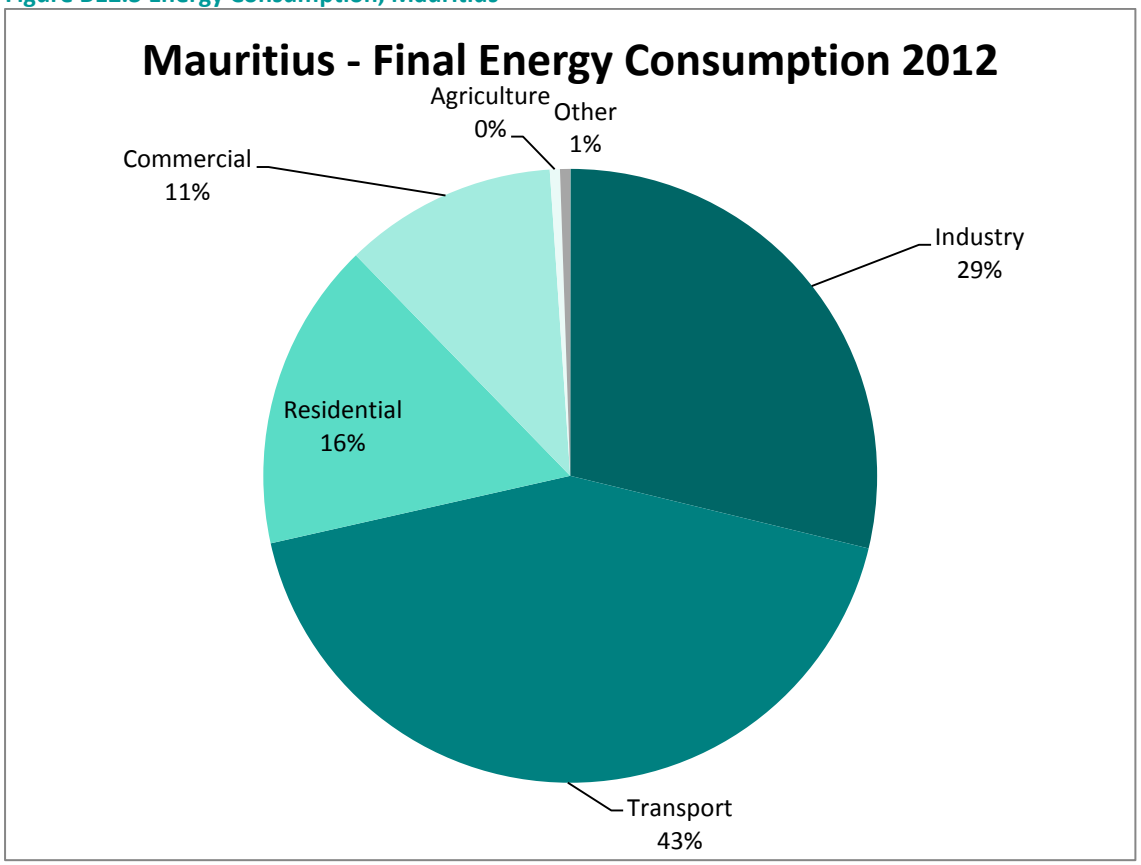
Figure B12.2 Electricity Production, Mauritius [35]



[35] **(source: IEA statistics online 2015)**

The transport sector is the largest end user of energy, with 43%, followed by industry with 29% and residential and commercial with 16% and 11% respectively. This is shown below in Figure B12.3.

Figure B12.3 Energy Consumption, Mauritius[36]



Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Mauritius are listed in the table below.

Table B12.1 Energy Efficiency Initiatives in Mauritius

Initiative/Activity/Programme/and Sponsors	Brief outline and planned dates (whether past/present/or future)
Maurice Ile Durable (MID) **Sponsors:** Finances raised from carbon tax on fossil fuels and MID fund.	Announced 2008, effective date 2009, updated 2013 **Objectives:** ➢ To respond to the global energy crisis of 2007. ➢ To make Mauritius a world model of sustainable development by lowering its dependency on fossil fuels through increased utilization

[36] **(source: IEA statistics online 2015)**

	of renewable energies and energy efficiency measures by 2028.
Grid Code for Small Scale Distributed Generation (SSDG)	In force since 2010 **Objective:** ➢ To communicate clearly to the public the procedures for application, the requirements of the Grid Code, the feed-in tariff scheme and other related issues regarding Small Scale Distributed Generation (SSDG) and the deployment of renewable energies on the island.
Small Scale Distributed Generation (SSDG) (Feed-in tariff/met metering scheme)	In force since 2010 **Objective:** ➢ To support deployment of small-scale renewable energy installations adding 2MW of new electricity generation.
Energy Efficiency Act 2011	Date 2011. **Objectives:** ➢ To decrease energy use and costs ➢ To protect the environment ➢ To enhance productivity and contribute to climate change mitigation.
Energy Efficiency Management Office	Energy Act 2011 **Objectives:** ➢ promote awareness on the efficient use of energy ➢ implement strategies pertaining to this matter
Sugar Industry Efficiency Act	Introduced in 1988 as part of the government's initiative **Objective:** ➢ To encourage sugar factories to use bagasse to produce electricity efficiently and export it to the grid.
Subsidy on CFLs	Implemented in 2008 **Objective:** To reduce evening peak demand in Mauritius
Daylight Saving Time project (DST)	Implemented from October 2008 to March 2009 **Objective:** Aimed at making efficient use of daylight and reducing the demand for electric lighting by shifting human activity patterns.
Product labelling and efficiency standards	**Objective:** Energy labelling standards have been set for some electrical appliances in an attempt to help consumers select energy-efficient products.
Setting up of a framework for energy efficiency and energy	Implemented from November 2012 to July 2013. **Objectives:** ➢ To adopt energy efficiency measures in the industrial sector in

conservation in industries in Mauritius	Mauritius, in line with the government's vision to make sustainable development a priority, and also in agreement with the MID concept. ➢ To set up good codes of practice in industrial energy management ➢ To develop an Energy Audit Software Tool for industrial energy systems ➢ To train people to conduct energy audits of industrial energy processes ➢ An energy audit was carried out in five industries in Mauritius
Green Building Council of Mauritius	Established in 2009 **Objective:** ➢ To achieve sustainability in the built environment sector in Mauritius
Removal of Barriers to Energy Efficiency and Energy Conservation in Buildings Sponsors: UNDP-GEF	Implementation began in 2008 **Objectives:** ➢ to make recommendations in order to overcome barriers to energy efficiency in both existing and new buildings in Mauritius ➢ to investigate market barriers in all areas of energy use in buildings, namely in terms of the physical structure of the building, the equipment used and people's behaviour
Draft Energy Efficiency Building Regulations	**Objective:** ➢ Make available technical information for compliance with the minimum energy efficiency requirements in buildings, and to outline a mechanism for both compliance and inspection.

The barriers identified in these initiatives that need to be addressed are shown in Table B12.2 below:

Table B12.2 Barriers to EE Initiatives Identified in Mauritius

Initiatives/projects/programmes	Barriers (at both regional and country levels)
Daylight Saving Time project (DST)	➢ The project had to be discontinued since there were public protests associated with the consequent social and cultural disruption. ➢ Changes in behaviour are contributing factors for some energy efficiency policies to become successful.

	➢ Lack of sensitisation campaigns for the general public.
Sustainability and expansion of renewable energy generation	➢ Lack of financial incentives in small markets.

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table B12.3 below.

Table B12.3 Co-benefits of EE Initiatives in Mauritius

Initiatives/projects/programme	Co-benefits to Energy Access
CFL project	➢ Success of CFL project, with an energy saving of 14 MW having been achieved during the evening peak.
Sugar Industry Efficiency Act	➢ The percentage of power produced in industrial cogeneration has tripled since the Act was implemented in 1988. ➢ The prospects for producing electricity from bagasse, coupled with the opportunity to export excess power to the grid, have led to a significant increase in the energy efficiency of sugar mills in Mauritius.
Setting up a framework for energy efficiency and energy conservation in industries in Mauritius	➢ RT Knits Ltd is one of five companies in Mauritius where an energy audit was carried out under this project. ➢ The use of renewable energy technologies such as solar and wind energy and the implementation of energy efficiency measures such as natural ventilation, LED and CFL tubes have resulted in a decrease of 30% in the companies's overall energy consumption.

Additional energy efficiency potential across various sectors in Mauritius is as follows.

Table B12.4 Identified Energy Efficiency Potential across sectors in Mauritius

Sector	Energy Efficiency Potential
Transport	Use of biofuels (Lignocellulosic Waste To Bio-Ethanol)

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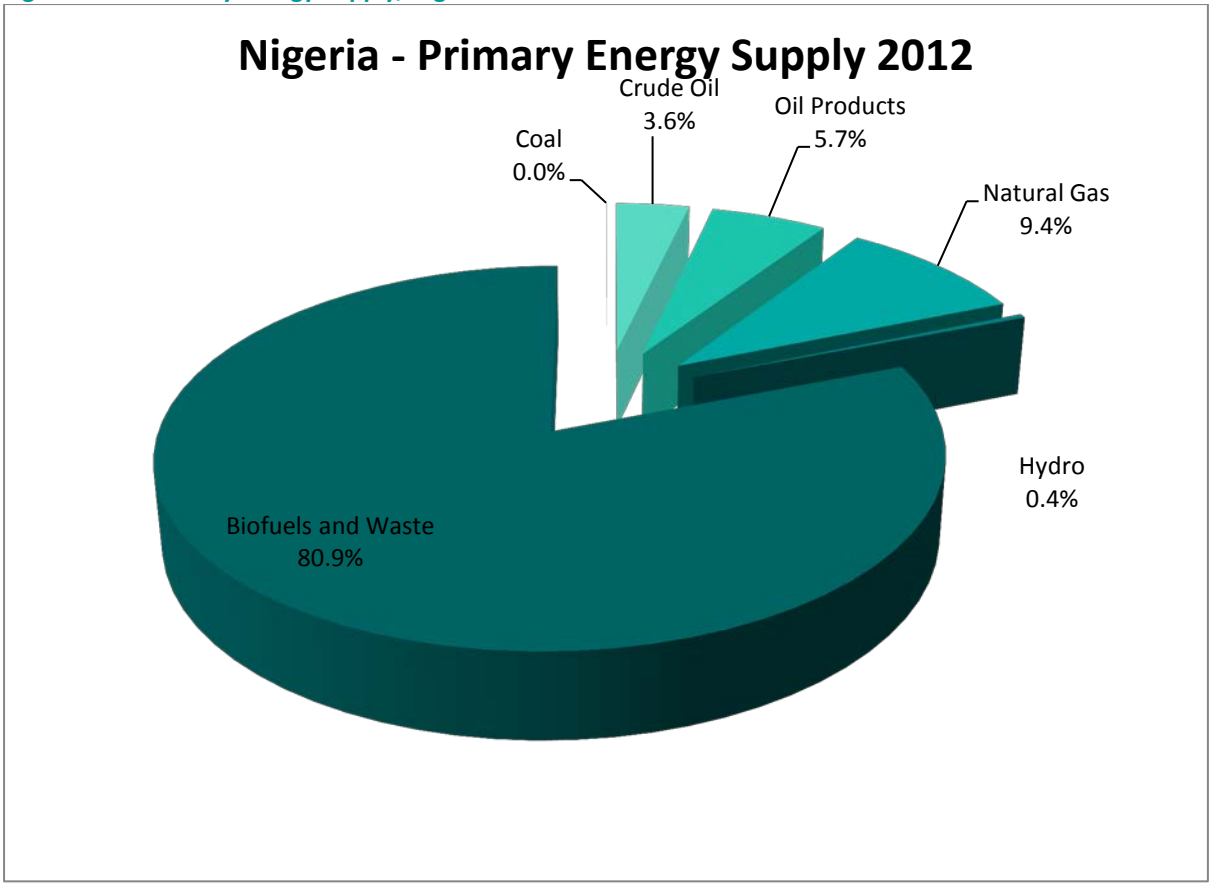
B13. Nigeria

Overview of the Energy Sector in Nigeria

Over 80% of primary energy in Nigeria is sourced from biofuels and waste. The balance is made up of natural gas, crude oil and oil products. This is shown below in Figure B13.1.

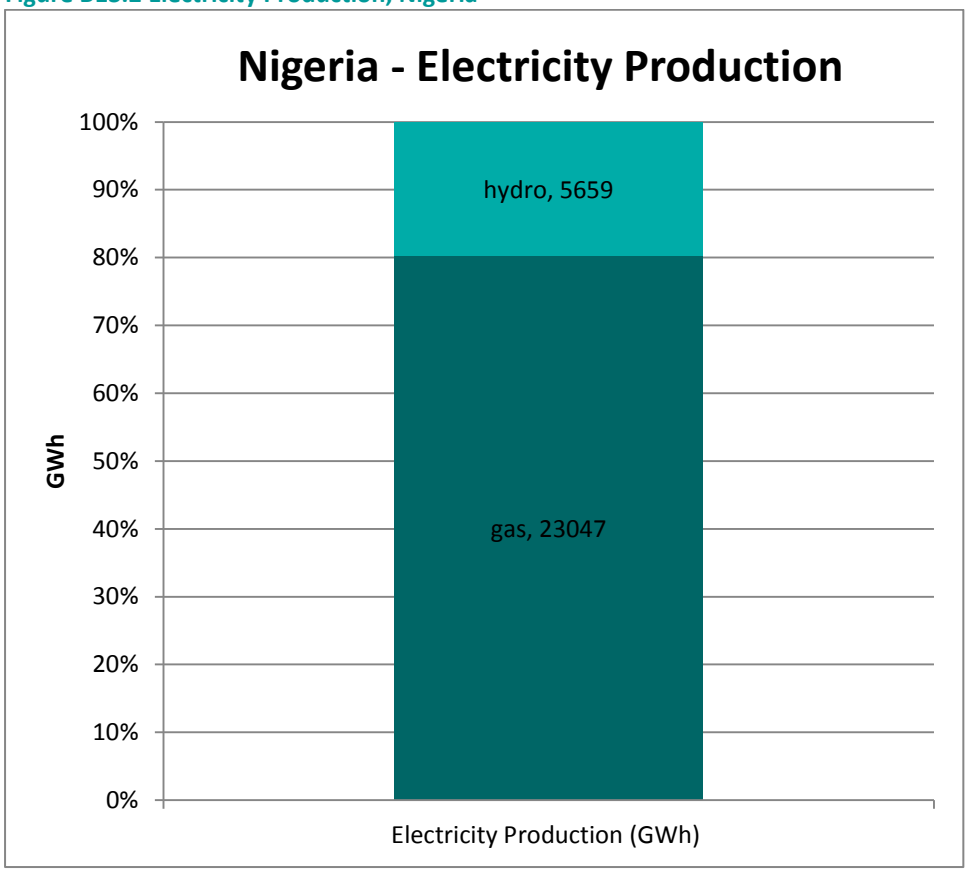
Figure B13.1 Primary Energy Supply, Nigeria [37]



[37] **(source: IEA statistics online 2015)**

The bulk of electricity is generated using gas (80%), and the balance is from hydropower. Figure B13.2 shows the division.

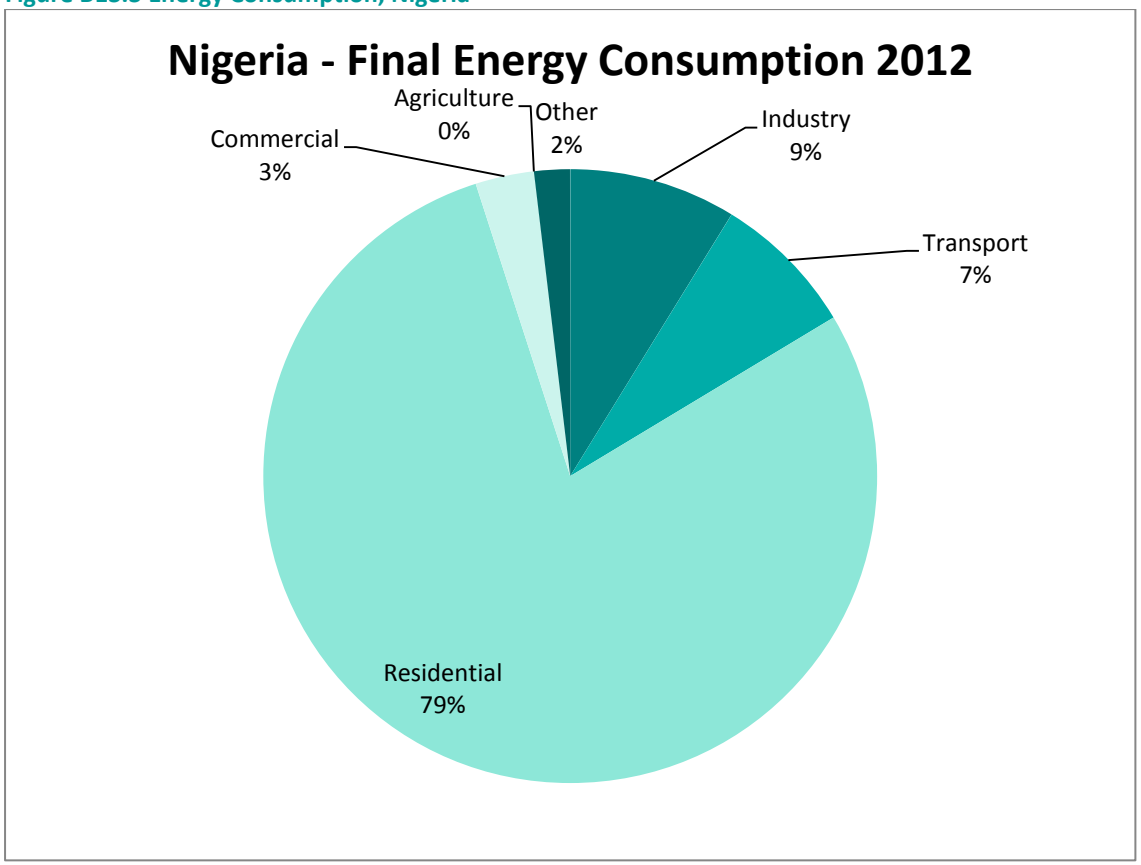
Figure B13.2 Electricity Production, Nigeria [38]



[38] **(source: IEA statistics online 2015)**

Final end-use energy consumption is predominantly in the residential sector at 79%. This is mainly wood fuel for cooking and heating. The industrial and transport sectors follow at 9% and 7% respectively. The proportional split is shown below in Figure B13.3.

Figure B13.3 Energy Consumption, Nigeria[39]



[39] **(source: IEA statistics online 2015)**

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Nigeria are listed in the table below.

Table B13.1 Energy Efficiency Initiatives in Nigeria

Initiative/Activity/Programme/ and Sponsors	Brief outline and planned dates (whether past/present/or future)
Gef Strategic Programme On Energy in West Africa UNDP Energy Project (FRN (n.d)). ➢ Standards and labels (S&L) and demand-side management ➢ Energy Labels and Minimum Energy Performance Standards (MEPS) for new equipment. **Sponsors/Stakeholders/Executors:** ➢ Energy Commission of Nigeria ➢ The Federal Ministry of Environment (FRN n.d.).	**Timeframe of the Project** CEO endorsement/Approval: February 2011 Implementation Starts: September 2011 Mid-term evaluation: March 2011 Project closing date: September 2015 **Project Budget** ➢ GEF – US$ 3 million (including PPG and agency fees) ➢ Co-financing – US$ 7.1 million (FRN n.d.) **Objectives:** ➢ To improve the energy efficiency of selected end-use appliances in the residential and public sectors. Examples: refrigeration and air conditioners, lighting appliances, electric motors etc. ➢ To reduce energy-related CO_2 emissions by reducing the demand for energy in the country's residential and public sectors (FRN n.d.). ➢ Improving the capacity of all relevant stakeholders at the national level with regard to the concept, nature, and potential of energy efficiency in the residential and public sector. ➢ Development of new energy efficiency legal requirements for selected end-use equipment in Nigeria. ➢ Training of professional stakeholders and public outreach activities, and enforcement of new energy efficiency legislation. Support and encourage schemes that will increase the penetration of energy efficiency appliances. ➢ Transformation of the lighting market: promotion of energy saving lamps (FRN n.d.). ➢ Assess and validate the energy and GHG savings potential for the residential and public sectors. ➢ Develop, formalize and implement a monitoring and

	data-collection system for end-use, sales, energy demand and energy consumption. ➢ Assist the government in drafting and implementing required new energy efficiency policy and regulations. ➢ Launch a pilot programme to test and finalize appropriate energy efficiency schemes such as energy labels. ➢ Design, test, validate and adopt national labelling content and format standards. ➢ Train appliance professionals and conduct a national outreach campaign to educate buyers, consumers and businesses on new energy efficiency requirements and benefits (FRN n.d.). ➢ Launch a large-scale pilot campaign for energy efficiency lamps, including the distribution of at least one million CFLs to households, businesses and public services. ➢ Design financial incentives for local importers and traders to sell EE lighting products (FRN n.d.). **PROGRESS OF EE INITIATIVE** ➢ A National Energy Efficiency Policy that will draw up a road map for integrating energy efficiency into national programmes, a project being developed with implementing partners (FRN n.d.). ➢ An awareness campaign has been launched, and the capacity of the relevant stakeholders is being enhanced to meet the objectives of the project.

The barriers identified in these initiatives that need to be addressed are shown in Table B13.2 below:

Table B13.2 Barriers to EE Initiatives Identified in Nigeria

Initiatives/projects/programmes	Barriers (at both regional and country levels)
General barriers	➢ Lack of knowledge and skills to maintain renewable energy systems ➢ Lack of awareness

	➢ Lack of adequate energy policies

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table B13.3 below.

Table B13.3 Co-benefits of EE Initiatives in Nigeria

Initiatives/projects/programme	Co-benefits to Energy Access
➢ Standards and labels (S&L) and demand-side management ➢ Energy Labels and Minimum Energy Performance Standards (MEPS) for new equipment.	➢ A total of one million compact fluorescent lamps were distributed in residential and public buildings across Nigeria by the Energy Commission of Nigeria, leading to peak reductions of 38 MW of electricity. (FRN n.d.)

Additional energy efficiency potential across various sectors in Nigeria is as follows.

Table B13.4 Identified Energy Efficiency Potential across Sectors in Nigeria

Sector	Energy Efficiency Potential
Industrial	**Co-generation from biomass:** The promotion of co-generation project development would lead to: ➢ the recovery of waste from industrial processes, which could replace fossil fuels ➢ reduced grid demand on the part of industry **Technical energy efficiency measures:** ➢ To reduce the losses imputable to an inefficient use of electricity due to the lack of a fully-fledged internal energy management system in most industries.
Tertiary building (public administration buildings, commercial buildings, restaurants and hotels, education and health buildings, office buildings such as	The potential savings for existing buildings are divided between: ➢ short-term actions covering organisation (e.g. energy management), awareness raising and the reinforcement of maintenance programmes ➢ medium-term actions aimed to improve lighting and air-

telecommunications, real estate and finance)	conditioning performance For all new buildings, the development of a building energy quality code, with the aim of improving construction quality by imposing realistic specifications based on the state of the art and on experience in construction in Nigeria.

References

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http://www.euei-pdf.org/country-studies/development-of-a-national-energy-efficiency-policy-and-plan

https://unfccc.int/secretariat/momentum_for_change/items/8293.php

https://sgp.undp.org/index.php?option=com_sgpprojects&view=projectdetail&id=15151&Itemid=205

http://www.euei-pdf.org/sites/default/files/files/field_pblctn_file/EUEI_PDF_Final_report_EN_version_MARCH2014.pdf

http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/-%20Cameroon%20-%20AR%20Electricity%20Project%20-%5B1%5D.pdf

http://www.energyrecipes.org/reports/reports/061127%20Recipes%20-%20Cameroon%20RE%20potential%20report.pdf

B14. Rwanda

Overview of the Energy Sector in Rwanda

Rwanda electricity installed capacity was approximately 110MW in 2012.

Electricity access rate: 16% by 2012 (POA 2013).

Biomass contributes **about** 86% of primary energy consumed, of which;

Wood contributes **about** 57%

Charcoal **about** 23%, and

Crop residues and peat (about 6%) (POA 2013).

Non-biomass sources contribute about 14%, of which;

Petroleum products: about 11%

Electricity: approximately 3% (POA 2013).

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Rwanda are listed in the table below.

Table B14.1 Energy Efficiency Initiatives in Rwanda

Initiative/Activity/Programme/ and Sponsors	Brief outline and planned dates (whether past/present/or future)
The World Bank electricity access scale-up project. **Sponsors:** ➢ World Bank ➢ Clean Development Mechanism (World Bank's community development carbon fund).	**Brief outline:** The most significant use of electrical energy in Rwanda by households is in the lighting sector (Ministry of Infrastructure 2009). Over 200,000 Rwandan households have received compact fluorescent light bulbs (CFLs) and carbon credits.
Rwanda Electrogaz Compact Fluorescent Lamp (CFL) Distribution project,	The Rwanda Energy Group – the national public electricity utility, formerly called Electrogaz – conducted an ambitious countrywide distribution of 800,000 high-quality compact fluorescent lamps (CFLs).

RE Efficiency Strategies	➢ **Off-grid solar PVs.** These are promoted to connect remote areas with limited access to grid electricity. **300** rural schools are targeted to have access to off-grid solar. **PROJECT SUCCESS:** 45% success (POA 2013). ➢ **Solar water heaters**. Through EWSA, the government promotes the use of solar water heaters and plans to instruct new buildings to have solar water heating devices installed during construction (POA 2013). **PROJECT SUCCESS**: the plan is underway (POA 2013). ➢ **Energy efficient lamps**: over 400,000 CFLs had been distributed by 2012(POA 2013). ➢ **Electricity scale-up project:** installation of 800,000 CFLs purchased, distributed and installed, sponsored by the World Bank (Ministry of Infrastructure 2009). Households buy the CFLs at a very low cost and in return have to have incandescent bulbs to hand in; households are limited to five CFLs at the subsidised rate (Ministry of Infrastructure 2009;(World Bank 2014). ➢ **Improved cooking stoves**: the target is to have at least 50% of households with access to improved cooking stoves by 2017 (POA 2013).

The barriers identified in these initiatives that need to be addressed are shown in Table B14.2 below:

Table B14.2 Barriers to EE Initiatives Identified in Rwanda

Initiatives/projects/programmes	Barriers (at both regional and country levels)
General barriers	➢ Lack of finance ➢ Lack of knowledge and skills to maintain renewable energy systems ➢ Lack of awareness ➢ Lack of adequate energy policies

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table B14.3 below.

Table B14.3 Co-benefits of EE Initiatives in Rwanda

Initiatives/projects/programme	Co-benefits to Energy Access
Rwanda Electrogaz Compact Fluorescent Lamp (CFL) Distribution Project.	➢ The high adoption rate and new energy-saving behaviour by customers earned an annual savings of 64 GWh per year, valued at $14.5 million, and a reduction in the demand for power of approximately 30MW (World Bank 2014). ➢ The project is also helping the climate, and is the first in Rwanda to earn carbon credits through certified emission reductions from the Clean Development Mechanism. ➢ It is expected to reduce approximately 24,000 tonnes of CO_2 per year, equivalent to taking 5,000 cars off the road (World Bank 2014). ➢ Savings of 30 MW per annum by 2012 (Ministry of Infrastructure 2009). ➢ Future carbon credits purchased by the Community Development Carbon Fund (CDCF). An application for carbon credits for the CFL project is well advanced (World Bank 2014, Ministry of Infrastructure 2009).

References

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Ministry of infrastructure 2009. National Energy Policy and National Energy Strategy 2008-2012. Http://www. Euei-pdf.org/sites/ default/files/files/fieild_pblctn_file/EUEI%20PDF_Rwanda_Energy%20Policy%202008-2013_final_jan%202009_EN.pdf [26 November 2014].

POA 2013. Initiatives to promote renewable Energy in Rwanda: RE Energy Programme of Activities (PoA) Workshop).

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B15. Sierra Leone

Overview of the Energy Sector in Sierra Leone

According to NEPSL (2012), Sierra Leone, which is situated in West Africa, has a total land area of approximately 72,325 sq. km, an estimated population of about 6 million in 2011, and a growth rate of 3.3%. GDP per capita of Sierra Leone was estimated to be around US$ 482 in 2011.

Energy consumption in Sierra Leone is dominated by biomass, which accounts for over 80% of energy used. The largest source of biomass energy is wood fuel, followed by charcoal. Imported petroleum products account for approximately 13%. Grid-generated electricity accounts for the remainder of the power supplied to the country's citizens. Wood fuel is the traditional form of energy and is used almost exclusively by households for cooking and craft activities. Access to electricity is 10%. Efficiency and access are constrained by high technical losses on the T&D network, which are further compounded by low voltage quality due to the overburdening of infrastructure from illegal use.

The stock of energy efficient appliances and equipment so far is low. Also, the development and use of renewable energy from hydro, solar, biomass and other facilities is still progressing only slowly (NEPSL 2012).

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Sierra Leone are listed in the table below.

Table B15.1 Energy Efficiency Initiatives in Sierra Leone

Initiative/Activity/Programme/ and Sponsors	Brief outline and planned dates (whether past/present/or future)
Sierra Leone National Energy Strategic Plan **2009. (**MEWR 2009**)**	Dated 2009 **Objectives:** ➢ Reduce energy losses through the upgrading of power transmission and distribution systems and also to reduce human theft. ➢ Promote the use of energy efficient equipment and technologies; ➢ Encourage the use of equipment for power factor correction in industries and homes; ➢ Promote the development and introduction of improved fuel-saving kerosene, charcoal and wood stoves; ➢ Launch an awareness campaign to sensitise consumers to the importance of energy efficiency and its relationship to productive use and economy of scale of investment ➢ Promote capacity building in energy auditing and efficiency analysis. ➢ Introduce an **Energy Efficiency and Conservation Act** to set out mandatory energy management practices, building codes, requirements for the energy efficiency levels of energy-consuming equipment, and energy audit regimes for formal industries and commercial entities (MEWR 2009).

The barriers identified in these initiatives that need to be addressed are shown in Table B15.2 below:

Table B15.2 Barriers to EE Initiatives Identified in Sierra Leone

Initiatives/projects/programmes	Barriers (at both regional and country levels)
General barriers	➢ Inadequate funding ➢ Capacity building issues ➢ Lack of awareness ➢ Improper co-ordination ➢ Lack of knowledge and skills to maintain renewable energy systems ➢ Lack of adequate energy policies

Additional energy efficiency potential across various sectors in Sierra Leone is as follows.

Table B15.3 Identified Energy Efficiency Potential across Sectors in Sierra Leone

Sector	Energy Efficiency Potential
Household sector Commercial sub-sector	Sierra Leone has great potential for energy efficiency (NEPSL 2012). For the household sector, the government has placed an emphasis on the promotion of LPG as a cooking fuel, as well as on the wider dissemination of fuel-saving stoves and the adoption of renewable technologies. In the commercial sub-sector, the focus is on more efficient energy devices for communal cooking and heating and for lighting. A review of the energy sector in Sierra Leone reveals that poor efficiency plagues almost every energy sub-sector. For instance, over 45% of the electricity generated in the Western area remains unaccounted for, while traditional methods using firewood and charcoal have efficiencies of below 30% (NEPSL 2012).

References

NEPSL 2012. *National Energy Profile of Sierra Leone 2012.* http://www.undp.org/content/dam/sierraleone/docs/focusareadocs/undp_sle_energyprofile.pdf [28 November 2012]

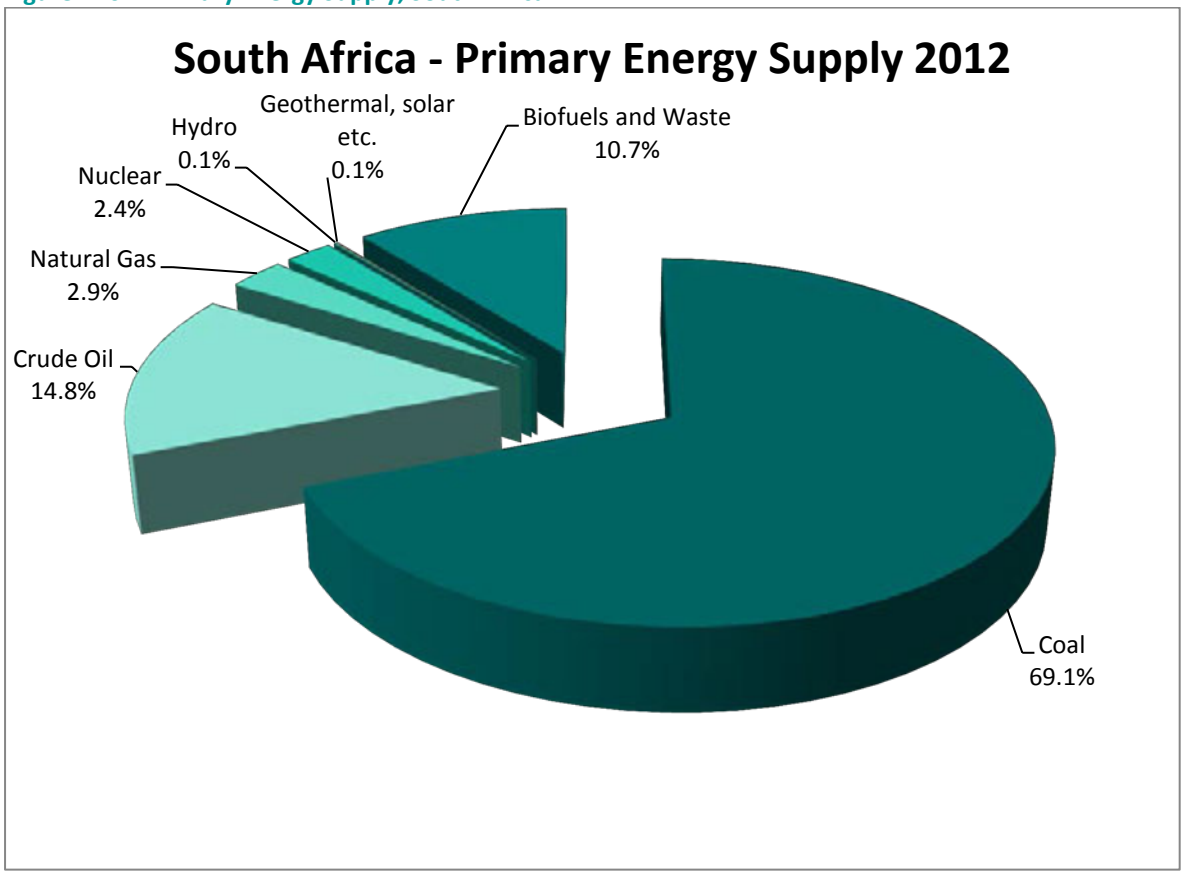
MEWR 2009. *Ministry of Energy and Water Resources (2009) Sierra Leone national energy strategic plan. Available:* http://www.ecowrex. org/system/files/repository/2009_energy_strategic_plan_-_min_ener.pdf

B16. South Africa

Overview of South Africa's Energy Sector

South Africa's energy supply is dominated by coal, with 69% of the primary energy supply, followed by crude oil with 15%, biofuels and wastes with 10.7 %, and gas, nuclear and hydro accounting for the remainder, as shown for 2012 in Figure B16.1.

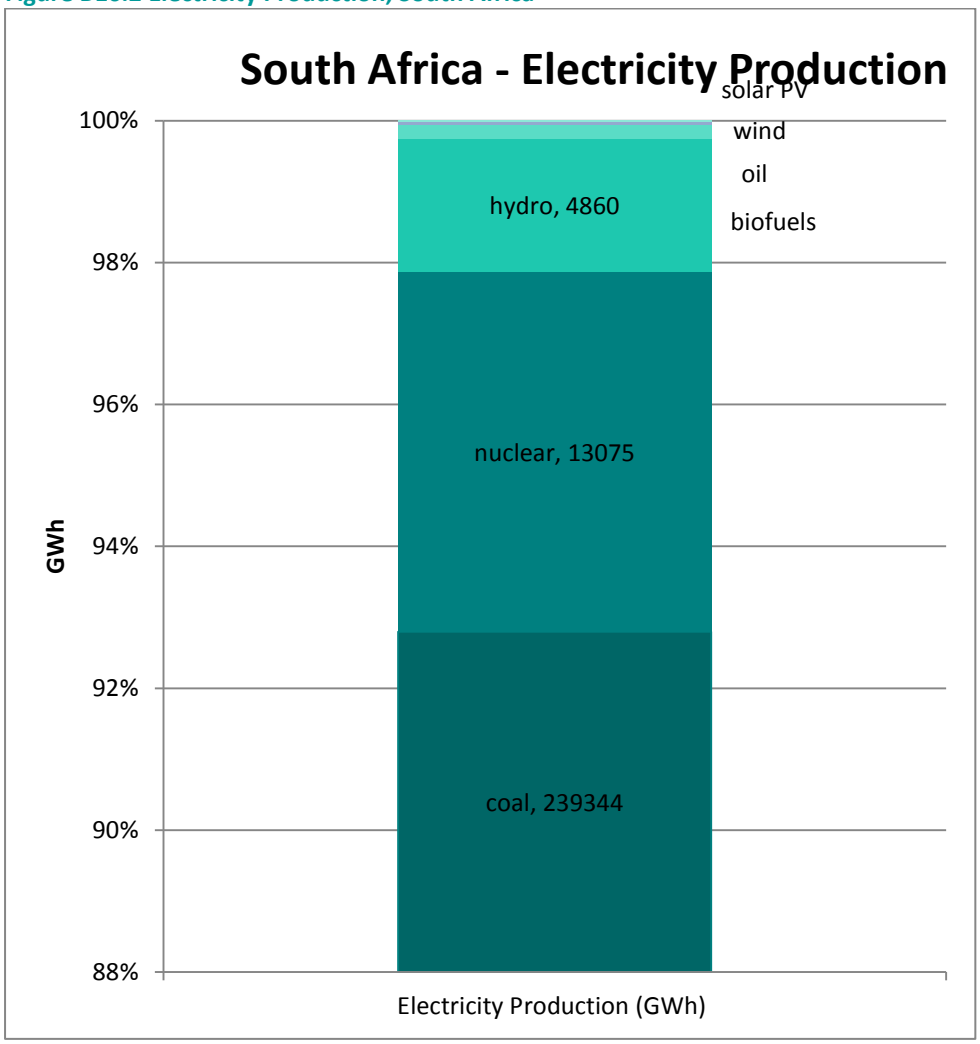
Figure B16.1 Primary Energy Supply, South Africa [40]



[40] **(source: IEA statistics online 2015)**

South Africa is the only African country that generates electricity from nuclear power, although only 5% of total electrical production is from this source. Coal is still the predominant fuel used to generate electricity, at 93% of production. A small amount, less than 2%, of electricity is generated by renewables such as hydro, solar and wind. Figure B16.2 below shows a breakdown of electricity production.

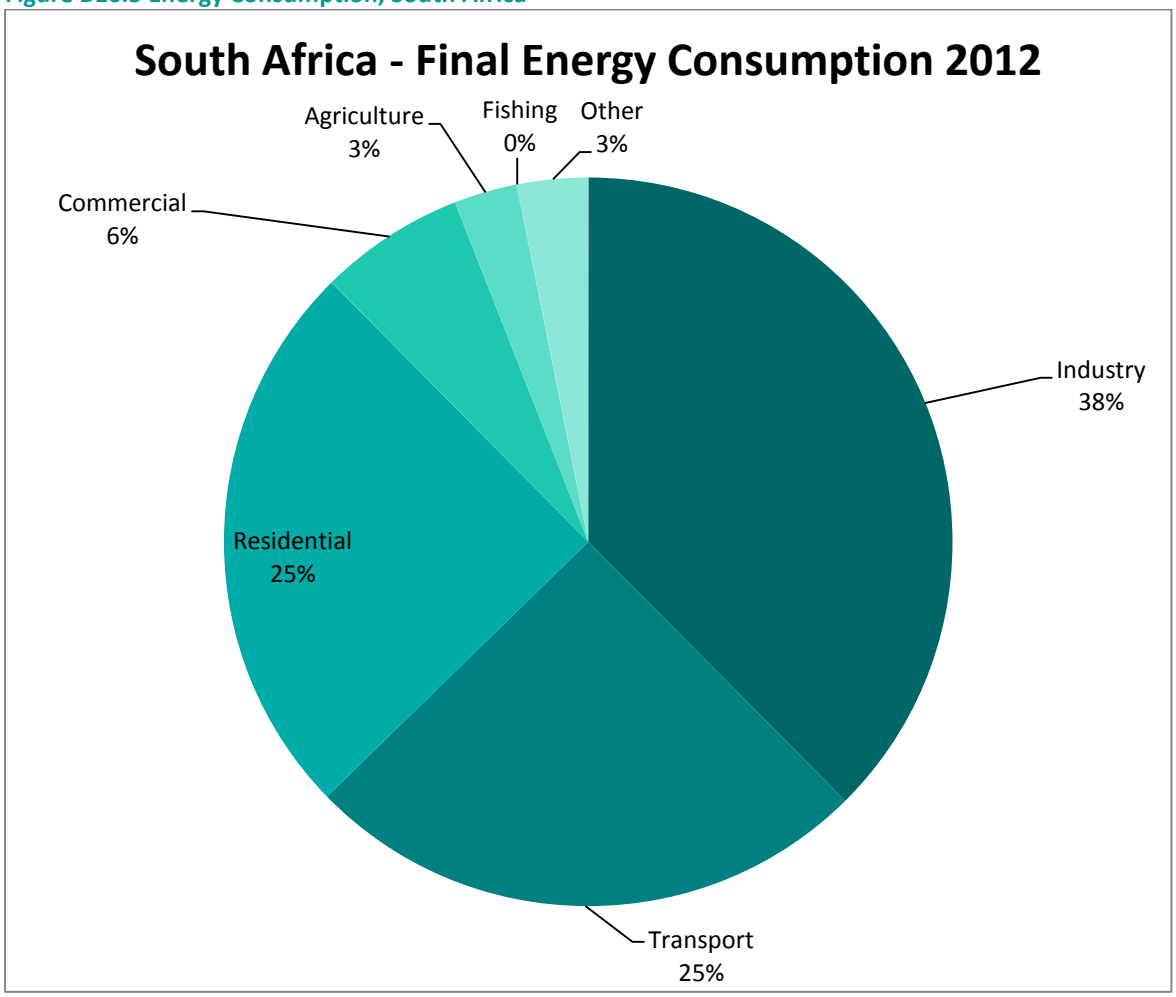
Figure B16.2 Electricity Production, South Africa [41]



[41] **(source: IEA statistics online 2015)**

Energy use per sector is shown in Figure B16.3 below. South Africa has a high level of industrial use at 38%, followed by residential and transport at 25% Each. Commercial use is at 6%.

Figure B16.3 Energy Consumption, South Africa [42]



[42] (source: IEA statistics online 2015)

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in South Africa are listed in the table below.

Table B16.1 Energy Efficiency Initiatives in South Africa

Initiative/Activity/Programme/and Sponsors	Brief outline and planned dates (whether past/present/or future)
Energy Efficiency Strategy	Drafted in 2005. Revised in 2008; second revision underway since 2012, but not finalised at the time of writing.
Integrated Resource Plan (IRP)	Promulgated in 2010
Eskom Demand Side Management Programme	Established in 2005 and funded through the electricity tariff structure administered by the Electricity Regulator (NERSA).
Solar Water Heater Mass Rollout (Eskom / DoE)	The SWH programme was launched in 2010 with a target of installing 1 million SWHs by 2014 in order to save 650MW of demand.
National Industrial Energy Efficiency Project. NCPC in association with UNIDO	The UNIDO / NCPC project was started in 2010 to provide support for capacity building in EE through subsidised training programmes and energy audits. The programme has currently saved an estimated 571 GWh of energy.
Private Sector Energy Efficiency Project (PSEE). NBI / DoE funded by DFID	Launched in December 2013, and funded by DFID until December 2015. Aims to improve industrial and commercial EE through subsidised energy surveys.
Publication of Energy Efficiency Standards. SANS50001, SANS50010, SANS10400XA	Standards have been published, but currently adherence to them is voluntary. Building codes are being changed to ensure adherence to SANS10400XA (new buildings only).

The barriers identified in these initiatives that need to be addressed are shown in Table B16.2 below:

Table B16.2 Barriers to EE Initiatives Identified in South Africa

Barriers (at both regional and country levels)	Benefits of overcoming barriers
Lack of penetration into residential market	Improved uptake of EE across other domestic technologies
Lack of long-term strategies	Instead of focussing on short and medium term EE to manage the supply crisis, longer term planning would see more sustainable solutions
Reduction is DSM budget by NERSA	Increased funding of DSM and EE from energy revenue would provide more institutional support
Paradox of EE being primarily driven by the generating utility	EE should be driven independently of the utility to avoid a conflict of interest when the supply situation stabilises

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table B16.3 below.

Table B16.3 Co-benefits of EE Initiatives in South Africa

Initiatives/projects/programmes	Co-benefits to Energy Access
SWH roll out to low-cost housing	This benefits poor households who may not have had any water heating facilities prior to the roll out

Additional energy efficiency potential across various sectors in South Africa is as follows.

Table B16.4 Identified Energy Efficiency Potential across Sectors in South Africa

Sector	Energy Efficiency Potential
Transport	Use of non-motorised transport. Scaling up the public transport system as an alternative to using private cars.
Lighting	The further roll out of CFLs, as well as LED lighting.
Building	Regulation on new building standards published.
Industrial	Ongoing support for the UNIDO and PSEE programmes once the current funding comes to an end.

References

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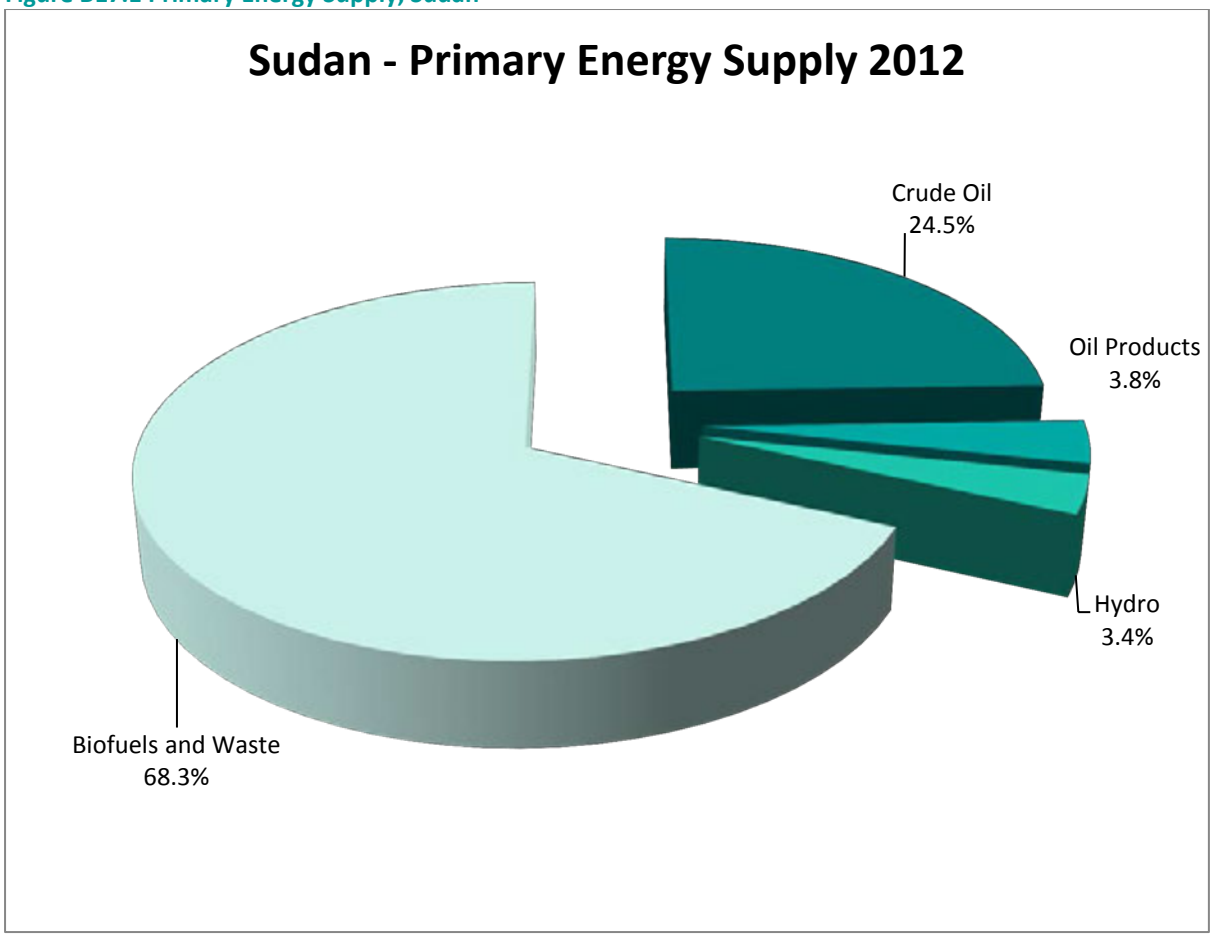
B17. Sudan

Overview of the Energy Sector in Sudan

Biofuel comprises more than 68% of primary energy in Sudan. Crude oil, oil products and hydro make up the balance, as shown in Figure B17.1 below.

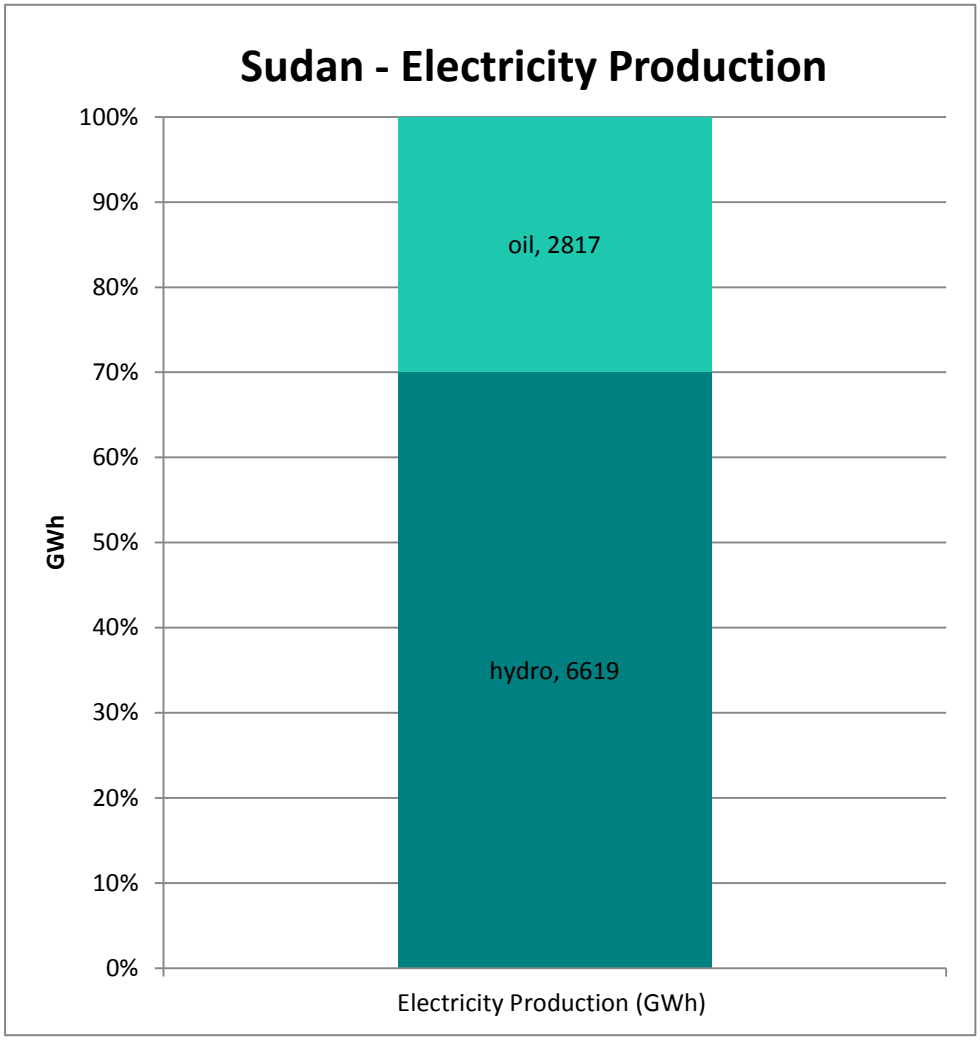
Figure B17.1 Primary Energy Supply, Sudan [43]



[43] **(source: IEA statistics online 2015)**

Sudan's electricity generation mix consists of hydropower and energy generated from oil sources. The following figure illustrates electricity generation from both sources in 2012.

Figure B17.2 Electricity Production, Sudan[44]

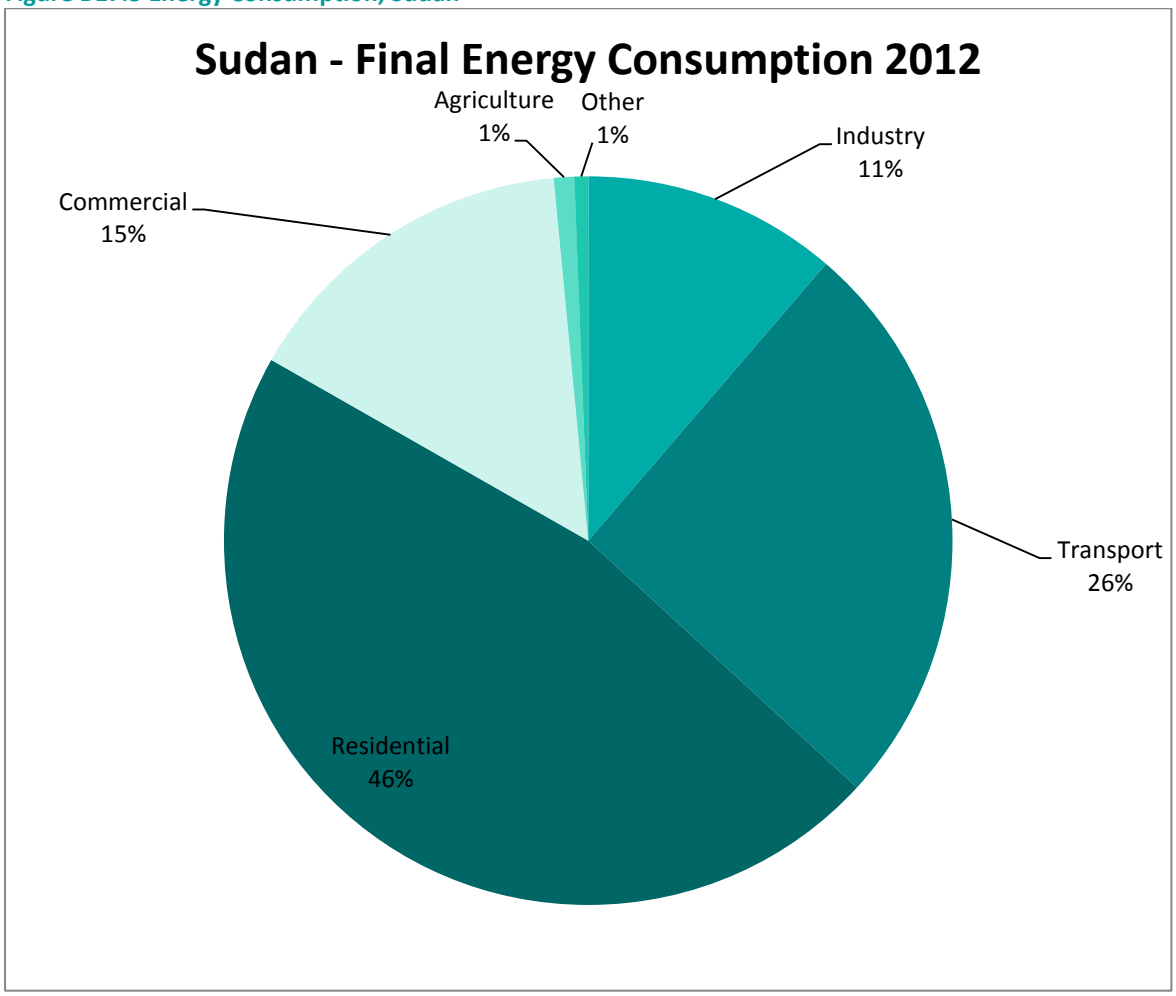


From the above it is evident that hydropower produces most of the electricity (70%) used in the country, followed by oil at 30%.

[44] **(source: IEA statistics online 2015)**

About 70% of the electricity is consumed in the Khartoum area, rural areas being without access to electricity. End-use energy consumption shows that residential use accounts for approximately 46% of energy, followed by the transport and commercial sectors. In the figure below, a proportional breakdown of final energy consumption is shown.

Figure B17.3 Energy Consumption, Sudan[45]



[45] **(source: IEA statistics online 2015)**

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Sudan are listed in the table below.

Table B17.1 Energy Efficiency Initiatives in Sudan

Initiative/Activity/Programme/and Sponsors	Brief outline and planned dates (whether past/present/or future)
Energy Efficiency Programmes in Sudan	Start date: 2005 Expected date of completion: 2007 The Sudan Renewable Energy Master Plan (drafted in 2005) promoted the use of renewable energy sources. Projects such as photovoltaic (PV) installations and biomass co-generation were deemed a priority as means to escape technological dependence on an oil-based market in the sector's development. **Objectives:** ➢ To review the current status of renewable energy development in Sudan. ➢ To assess the prospects and to propose a master plan for policy development and the systematic implementation of programmes for the promotion and commercialization of renewable energy applications, including appropriate institutional structures and linkages. ➢ To facilitate a progressively increasing contribution from renewable sources of energy as part of the national energy balance, thus helping to improve energy services, especially in rural areas. ➢ To reduce dependence on conventional energy and switch to environmentally sound and sustainable development. ➢ To generate electrical power to improve economic and social development in the country. ➢ To provide relatively cheap electrical power for the improvement of irrigation in the country's agriculture. ➢ To use electricity to pump up ground water for use in the agricultural sector. ➢ To implement industrial projects, food industry projects and mining projects that are reliant upon

	electrical power.
A Global Environmental Facility (GEF) project **Sponsor:** UNDP ➢ The Solar Power Traffic Light Project **Project Executors:** Beijing Sundan Solar Technology Company	Start-up Date: 2011 Expected Date of completion: 2014. **Brief Outline:** As part of the economic and technical cooperation agreement signed by China and South Sudan on 22 November 2011, ***the solar traffic light project*** was initiated. Under the project, 63 solar-powered traffic lights will be installed at junctions and roundabouts at fifteen main roads in Juba, stretching from the airport to Juba Teaching Hospital and Juba Town, and from Gudelle junction to Juba University and Konyokonyo. **Objectives:** ➢ To reduce energy consumption and the increasing road accidents in the South Sudanese capital, Juba.

➢ Solar Sister	**Brief outline:** Solar Sister is an African women-led grassroots green energy revolution and a partnership of non-governmental organisations, women's organisations and solar-lighting producers. They run a direct sales network of women entrepreneurs, selling solar-powered lanterns as a clean and non-hazardous light source for rural households. Solar Sister empowers African women by providing them with clean energy and economic opportunities. The plan in the coming years is to scale up the initiative, which is currently operating in Uganda, Rwanda and South Sudan, to cover five more sub-Saharan countries. **Objectives:** ➢ The initiative aims to spread solar power across Africa with the help of a direct sales network by providing access to electricity in rural areas, especially for women. ➢ To close the gender technology gap. Women are trained to become entrepreneurs, thus providing them with a "business in a bag". This consists of an initial stock of portable solar products, plus training and marketing materials. The female entrepreneurs then sell the products in rural areas, earning a commission on each sale. Solar Sister works in partnership with grassroots women's groups. ➢ To ensure that the provision of clean energy forms part of development programmes.
The IndiGo pay-as-you-go personal solar electricity system**.**	Date started : September 2011 **Brief outline:** Eight19 launched its IndiGo pay-as-you-go personal solar electricity system for off-grid communities in Kenya in September 2011. The expansion of this project has begun deploying its IndiGo system in South Sudan. Eight19 and World Venture (an international charitable organisation) aim to deploy these systems in rural villages in the region of Nimule in South Sudan. Eight19 predicted introduction of 1000 units in the region in the first half of 2012. Sudan is the fourth country in which this project has been launched since it began in Kenya. **Objective:** ➢ To stimulate social and economic development and

	provide the energy to power lighting, Internet connections and electronic devices.
Wind Energy	➢ Average wind speeds are estimated at 3-6 m/s, with the highest speeds recorded along the Red Sea coast. Wind energy in Sudan is currently used for pumping water from deep and shallow wells to provide drinking water and irrigation through the use of wind pumps. ➢ Wind has not yet been significantly exploited for power generation in Sudan. Experience in wind energy in Sudan started in the 1950s, when 250 wind pumps from the Australian government were installed as part of the El Gezira Agricultural Scheme (Southern Cross Wind Pumps).The pumps gradually disappeared as a result of a lack of spare parts and maintenance skills, combined with competition from relatively cheap diesel pumps. ➢ In the last fifteen years the Energy Research Institute (ERI) has installed fifteen Consultancy Services Wind Energy Developing Countries (CWD 5000 mm diameter) wind pumps around the Khartoum area, in Northern State and in Eastern State. Now the ERI, with the cooperation of the Sudanese Agricultural Bank (SAB), has introduced sixty wind pumps to be used for water pumping in agricultural schemes. Only five of the pumps have been manufactured and installed; the other 55 are in the process of being manufactured locally. ➢
Biomass	➢ Sugar plants in Sudan produce about 55.5 MW of energy, mainly for their own operations. There are plans to expand cogeneration in sugar production further using more advanced plant equipment. In addition, plans are currently being developed to use an agricultural pest, the Mesquite shrub, for household energy production.
Geothermal energy	➢ The geothermal energy potential is estimated at 400

	MW. Potential sites have been identified near the Jabel Marra volcano, the Tagbo and Meidob Hills, the Bayud volcanic field and the Red Sea coast. The country is currently seeking assistance from the Kenyan Geothermal Development Company (GDC) to undertake an assessment of the geothermal resource (https://www.climateinvestmentfunds.org, n.d.).
Hydropower energy	➢ Sudan has a hydropower potential estimated at 4,920 MW, but only 10% of that potential is currently being utilised. More than 200 suitable sites have been identified along the Blue Nile and the main Nile, where in-stream turbines can be used to generate electricity. The total potential of mini-hydropower plants is assessed at 67 GWh/year for the southern region of the country. ➢ The country's main hydroelectricity generating facility produces about 280 MW at the Roseires dam located on the Blue Nile river basin. The facility has frequently been attacked by rebel groups, and low water levels often cause its capacity to fall to 100 MW as a result of these attacks.

The barriers identified in these initiatives that need to be addressed are shown in Table B17.2 below:

Table B17.2 Barriers to EE initiatives identified in Sudan

Initiatives/projects/programmes	Barriers (at both regional and country levels)
General Barriers	➢ Lack of finance ➢ Lack of knowledge and skills to maintain renewable energy systems ➢ Lack of awareness ➢ Lack of adequate energy policies

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table B17.3 below.

Table B17.3 Co-benefits of EE Initiatives in Sudan

Initiatives/projects/programme	Co-benefits to Energy Access
Solar Sister	➢ Built a network of over 400 female clean energy entrepreneurs across Uganda. ➢ Distributed life-changing technologies to over 58 underserved communities throughout Uganda benefitting over 60,000 people. ➢ Expanded into Tanzania and Nigeria with a programme of clean energy access through women's enterprise. ➢ Expanded its product offerings to include a broad array of life-giving clean-energy technologies, including portable solar lights and mobile-phone chargers, small solar home systems, larger solar systems for schools, clinics or shops, and clean cooking stoves for home or institutional use. **Future plans:** ➢ Train another 200 Solar Sister entrepreneurs ➢ Establish twenty teams with local staff providing a high level of support and accountability ➢ Provide 75,000 people with clean solar lighting

	➢ Replace kerosene lamps with solar lamps, thus reducing the amount of kerosene used by over eight million litres

Additional energy efficiency potential across various sectors in Sudan is as follows.

Table B17.4 Identified Energy Efficiency Potential across Sectors in Sudan

Sector	Energy Efficiency Potential
Industrial	**Co-generation from biomass** The promotion of co-generation project development would lead to: ➢ the recovery of waste from industrial processes, which could replace fossil fuels ➢ reduced grid demand on the part of industry **Technical energy efficiency measures** The key objective is to reduce the losses attributable to the inefficient use of electricity due to the lack of a fully-fledged internal energy system management in most industries.

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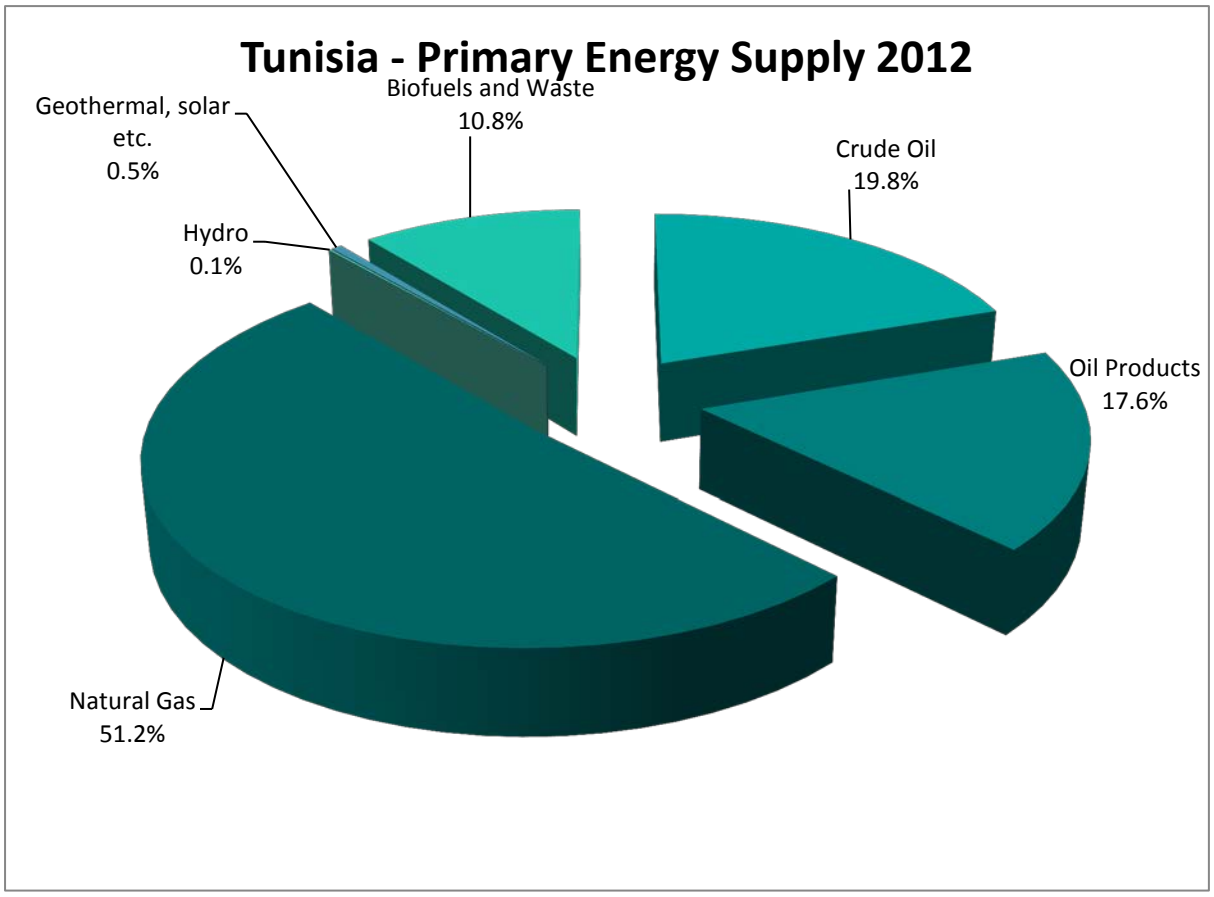
B18. Tunisia

Overview of the Energy Sector in Tunisia

Natural gas provides most of Tunisia's primary energy requirements at 51%. Oil products, crude oil and biofuels make up the bulk of the remaining fuel supply. There are also small amounts of geothermal and hydro components. This is shown below in Figure B18.1.

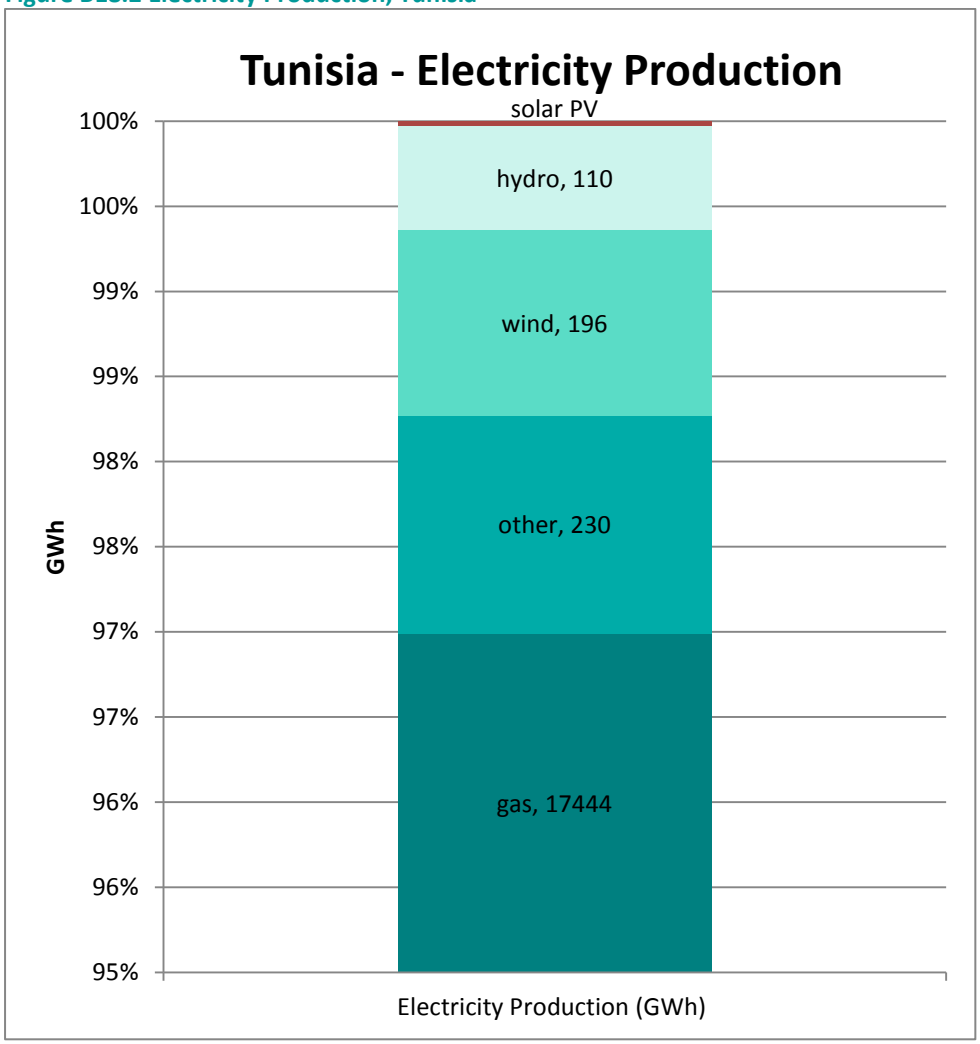
Figure B18.1 Primary Energy Supply, Tunisia [46]



[46] **(source: IEA statistics online 2015)**

Electricity production in Tunisia is primarily from natural gas (97%). Wind, hydro and other sources make up the balance. This is shown below.

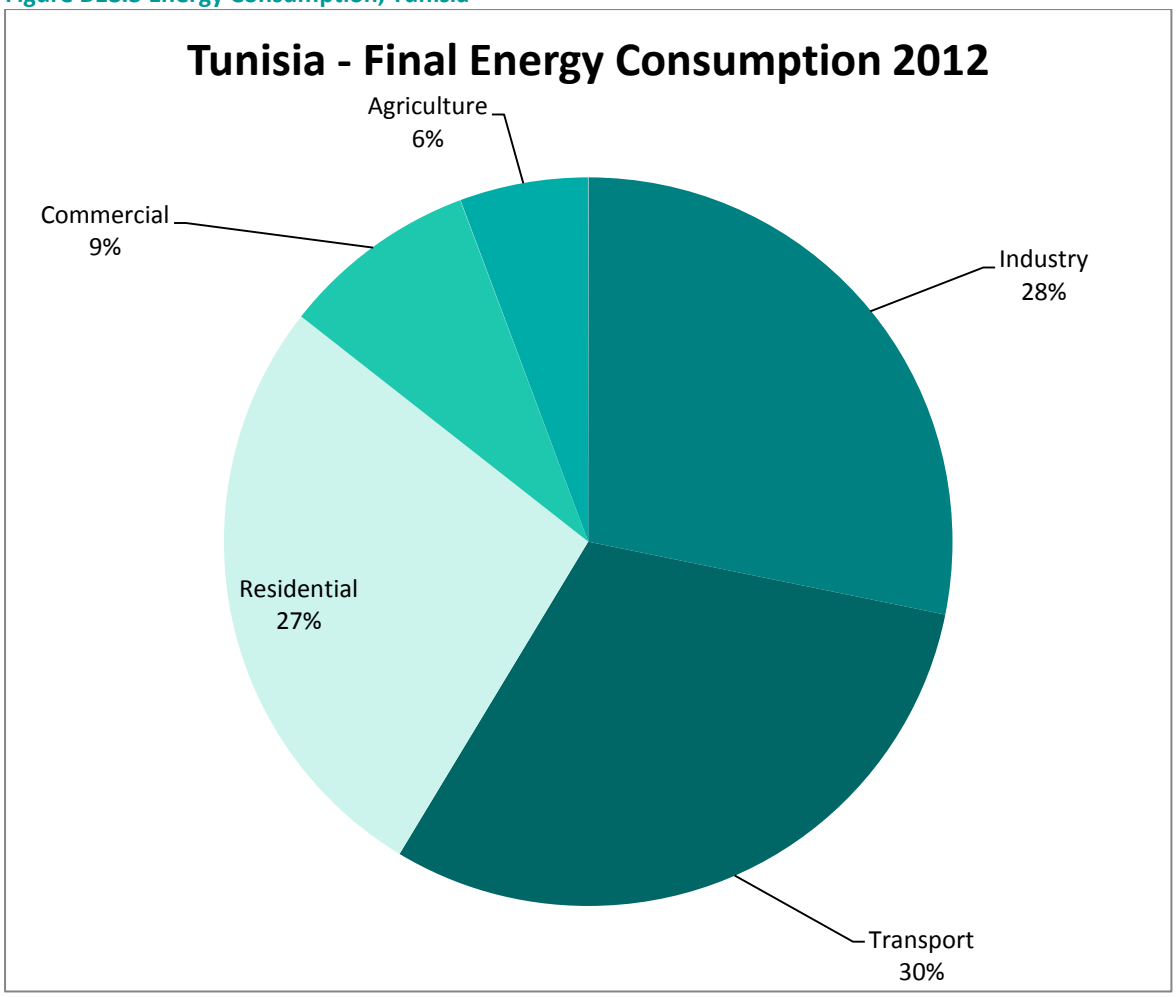
Figure B18.2 Electricity Production, Tunisia [47]



[47] **(source: IEA statistics online 2015)**

Final energy consumption is evenly split between the residential, transport and industrial sectors at approximately 30% each. The commercial sector and agriculture make up the balance, as shown in Figure B18.3 below.

Figure B18.3 Energy Consumption, Tunisia[48]



Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Tunisia are listed in the table below.

[48] **(source: IEA statistics online 2015)**

Table B18.1 Energy Efficiency Initiatives in Tunisia

Initiative/Activity/Programme/ and Sponsors	Brief outline and planned dates (whether past/present/or future)
Promotion of Renewable Energy and Energy Sponsors: ➢ Federal Ministry for Economic Cooperation and Development ➢ The Tunisian National Agency for Energy Efficiency (ANME), (EnergyPedia 2014). Implementers: ➢ Deutsche Gesellschaft für Internationale Zusammenarbeit (EnergyPedia 2014)	Dated 2003 In November 2003, a project for the Promotion of Renewable Energy and Energy Efficiency (ER2E) was initiated in the context of Tunisian–German cooperation Objective: ➢ To assist the ANME in developing appropriate approaches for energy management in Tunisia.
Solar water heaters Sponsors: ➢ United Nations Environment Programme (UNEP) ➢ World Bank	Start-up date: 2005 Modified date: 2008 Upgraded: 2012 Brief outline: Successfully installed more than forty square metres per 1,000 inhabitants (EnergyPedia 2014). The programme aimed at the installation of 60,000 m^2 of collector surface in the tertiary sector between 2008 and 2011, including 80 hotels. As of the end of 2012, a total of 490.000 m2 had been installed since the introduction of the PROSOL programme in the residential sector for domestic hot water purposes. These SWHs are thermosiphon systems with mainly flat-plate and some evacuated tube collectors. The number of SWH companies eligible within Prosol had reached 47 by the end of 2010. At the same point, 1,042 installers were active in the market (EnergyPedia 2014).
Energy Audit	Budget: TND 239 million (EnergyPedia 2014). During the 2005-2010 period, over 420 energy audits were carried out in various industrial, tertiary and transportation sectors, over 50% more than the number of audits conducted during the 1987-2003 period. Between 2005 and 2010, 651 Programme contracts were established, representing a total investment of TND 239 million (EnergyPedia 2014).
The GEF Partial guarantee (ESCOs), (World Bank 2014).	Budget: US$200,000 (World Bank 2014). Objective:

	➢ To promote the use of energy service companies

The barriers identified in these initiatives that need to be addressed are shown in Table B18.2 below:

Table B18.2 Barriers to EE Initiatives Identified in Tunisia

Initiatives/projects/programmes	Barriers (at both regional and country levels)
General Barriers	➢ Lack of finance ➢ Lack of knowledge and skills to maintain renewable energy systems ➢ Lack of awareness ➢ Lack of adequate energy policies

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table B18.3 below.

Table B18.3 Co-benefits of EE Initiatives in Tunisia

Initiatives/projects/programmes	Co-benefits to Energy Access
Energy efficiency programme in the industrial sector 2004 (World Bank 2014).	➢ All Tunisians enjoyed a healthier life (World Bank 2014). ➢ Industries benefitted from lower production costs, with 713,333 tons of CO_2 avoided. ➢ Investment assistance encouraged energy efficiency actions by medium-sized and large enterprises through ESCOs. ➢ The sub-projects' actions in respect of this component resulted in 710,333 tons of CO_2 emissions avoided over the duration of the project, from 2004-2011, and 101,476 tons of CO_2 emissions avoided annually. ➢ The target was 636,422 tons for the entire project and 127,284 tons of CO_2 annually, while the sub-projects also contributed to the actual energy savings of at least 31 ktoe per year. They are expected to generate 51 ktoe per year of energy savings going forward, compared to the target of actual energy savings of at least 10 ktoe per year, and expected future savings of 33 ktoe per

	year (World Bank 2014). ➢ From 2004 to 2011, 101,476 tons of CO_2 emissions avoided annually, savings being 710,333 tons of CO_2 under the GEF project, (World Bank 2014). BENEFICIARIES ➢ Industrial companies ➢ Engineering consultants ➢ Financial institutions (banks, leasing companies) (World Bank 2014).
	PROGRAMMES TO SUSTAIN THE EE INITIATIVES The programme made provision for critical resources for • raising awareness • enhancing technical skills • empowering market operators like ESCOs and industrial companies to invest in EE projects

Additional energy efficiency potential across various sectors in Tunisia is as follows.

Table B18.4 Identified Energy Efficiency Potential across Sectors in Tunisia

Sector	Energy Efficiency Potential
Industrial	Cogeneration: The cogeneration potential in Tunisia is estimated at around 606 MW (522 MW in the industrial sector and 84 MW in the tertiary sector). At the end of 2010, installed capacity had reached 32.6 MW, in other words, less than 8% of the industrial sector's potential. Although the Tunisian cogeneration market is not strong enough to establish a local industry, development of this sector requires the supply of accessories and related services, such as engineering, installation and maintenance.

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B19. Uganda

Overview of the Energy Sector in Uganda

The energy sector is one of the key economic sectors in Uganda. The country had a total energy consumption of approximately 11 million TOE (tonnes of oil equivalent) in 2010. Biomass is the most important source of energy for about 97% of the population. It provides about 90% of total primary energy consumption in the form of firewood, charcoal or crop residues. Electricity contributes only 1.1% to the national energy balance (121,000 TOE), while oil products, which are mainly used for vehicles and thermal power plants, account for the remaining 8.9%.

In 2004, Uganda reformed its energy sector to include a new legal and regulatory framework whereby the Uganda Electricity Board was abolished, making way for public and private partnerships. The government has enabled private-sector investments in electricity generation and distribution, while transmission above 33kV remains a public function provided through the Uganda Electricity Transmission Company Limited (UETCL). The Electricity Regulatory Authority (ERA) was established to licence and regulate the operations of all electricity operators, while the Rural Electrification Agency (REA) was put in place to ensure that the rural electrification project met its targets.

The Uganda Electricity Generation Company Limited (UEGCL) is a state-owned utility whose primary purpose is to generate electric power for use in Uganda and for sale to willing neighbouring countries. Most of the electricity is generated through hydropower.

Uganda has an installed electricity-generating capacity of 595 MW. The electrification rate in Uganda is very low, with 12% nationally and only 5% - 6% in rural areas. Uganda currently has one of the lowest rates of per capita electricity consumption in the world, at just 70 kWh per year (Africa's average: 578 kWh per capita, world average: 2,572 kWh per capita). 72% of total electricity supplied by the main grid is consumed by 12% of the domestic population concentrated in the Kampala metropolitan area and the nearby towns of Entebbe and Jinja. Approximately 1% of rural households use off-grid electrification technologies, which are usually diesel generators or solar photovoltaic systems, about 30MW of the generated electricity being exported to Kenya.

Electricity demand has grown at an average of 10% per annum as a result of the significant GDP growth of over 6% during the past two decades. This increase in demand has led to heavy load-shedding in past years.

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Uganda are listed in the table below.

Table B19.1 Energy Efficiency Initiatives in Uganda

Initiative/Activity/Programme/ and Sponsors	Brief outline and planned dates (whether past/present/or future)
Promotion of Renewable Energy and Energy Efficiency Programme – PREEEP **Sponsors:** German government **Implementors:** ➢ Ugandan Ministry of Energy and Mineral Development (MEMD) ➢ Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	**Date** **Objectives:** ➢ The Promotion of Renewable Energy and Energy Efficiency Programme (PREEEP) ➢ To provide Ugandans with access to modern energy services ➢ To make existing energy use more sustainable and efficient. ➢ To provide technical and skills development support to the Ugandan energy sector through the German government ➢ To promote rural electrification. ➢ To promote energy efficiency. ➢ To promote and improve biomass technologies. ➢ To support energy policy.
The Energy for Rural Transformation programme (ERT) **Sponsors:** IDA/GEF	Start date: 2002 Effective completion date: 2012 **Brief outline:** The Energy for Rural Transformation programme (ERT) is a private sector-led ten-year programme (2002-2012) developed by the Government of Uganda with support from IDA/GEF. The features of the programme include: ➢ Extension of the existing electricity grid where feasible; ➢ The development of renewable energy resources to supply decentralised grid systems; ➢ Use of solar PVs to supply consumers located in remote areas, including households, schools, health centres and community centres; ➢ An information communication technology component, to expand telecommunication services; and ➢ Water, agriculture, health and education components, to maximize the benefits of the availability of energy services in those sectors. **Objectives:**

	➢ The overall goal of this programme is to increase electricity access in rural areas from 1% to 10% by 2012. The programme aims to stimulate rapid growth in rural areas by helping them access modern and efficient energy. The programme aims to: ➢ Improve farmers' incomes, as rural energy is used in enterprises that add value to agricultural products; ➢ Reduce poverty levels through the provision of employment in rural areas; ➢ Bringing foreign currency into the economy through enterprises such as fish-processing and coffee factories; ➢ Improving people's lives through the provision of energy for social services (health, education and water).
Solar power ➢ Rural Electrification Strategy and Plan (RESP) ➢ Energy for Rural Transformation (ERT) programme **Sponsors:** ➢ Dutch organization, Humanist Institute for Development Cooperation (HIVOS). ➢ Habitat for Humanity and Solar Electric Light Fund ➢ US Department of Energy ➢ World Bank ➢ Ministries of Health ➢ Ministry of Education ➢ Ministry of Water ➢ The Uganda Communication Commission	Date started: 1980 Modified in 2001 **Objectives:** ➢ To provide power supply for lighting and vaccine refrigeration in health centres. ➢ To increase use of solar PV in rural areas. ➢ To increase PV sales. ➢ To install 80,000 PV systems by 2012. ➢ To install 45,000 solar water heaters by 2012.

The barriers identified in these initiatives that need to be addressed are shown in Table B19.2 below:

Table B19.2 Barriers to EE Initiatives Identified in Uganda

Initiatives/projects/programmes	Barriers (at both regional and country levels)
The Energy for Rural Transformation programme (ERT)	➢ Lack of sufficient information and data on the various renewable energy sources; ➢ High cost of investment in renewable energy technologies (RETs); ➢ Lack of adequate contribution from the rural electrification fund; ➢ Low incomes of the poor, especially in rural areas; ➢ High upfront costs of connection to the grid or alternative systems; ➢ Implementing reforms in the energy sector that may benefit the rich and not the poor; ➢ Inadequate technical and business development capacity in RETs; ➢ Poor infrastructure for the distribution of modern energy; ➢ Inadequate financing mechanisms to encourage private-sector investments and provide credit facilities; ➢ Inadequate financing for government to develop projects as public or IPPS; ➢ Inappropriate policies to encourage the flow of funds into the sector ➢ Environmental lobby against resources like hydropower; ➢ Poor infrastructure, which inhibits fuel substitution: the use of LPG is one of the steps that might improve rural energy supply.
Solar energy	➢ Low levels of affordability in rural areas, especially due to the high upfront costs associated with cash purchases. Credit facilities are limited, and hire-purchase arrangements are not well developed. ➢ Lack of rural distribution of after-sales services centres with appropriate capacity increases transaction costs and leads to frequent system malfunction which gives solar PV a bad

	reputation. ➢ ➢ Limited capacity of the private sector to procure solar PV systems in large quantities, with consequent inability to take advantage of economies of scale to bring down the costs of solar systems. ➢ Lack of public knowledge regarding the benefit and limitations of solar PV and where to source the equipment to enable them make an informed decision to purchase solar PV systems.
Wind energy	➢ The lack of a comprehensive wind map for the county. The available wind data is insufficient to determine the potential of wind for energy production. Continuous wind data is not collected regarding the daily, seasonal or annual variation of wind speed and direction. ➢ Limited government investment in assessing wind resources. ➢ Inadequate policy to support small-scale wind energy projects. There are no preferential feed-in tariffs to the national grid for wind-generated electricity.
The Energy for Rural Transformation programme (ERT)	The programme is supposed to be private sector-led. However, a number of challenges for local private entrepreneurs exist, one of which is their unwillingness to commit money to long term projects where the capital investment is heavy.
Geo-Thermal Energy **Sponsors:** ➢ African Development Bank (AfDB ➢ IAEA (International Atomic Energy Agency) ➢ Iceland and BGR (German Federal Institute for	Date 1993 **Brief Outline:** Geothermal energy resources in Uganda are estimated at 450 MW. Exploration for geothermal energy has been in progress since 1993 with support from the African Development Bank (AfDB), IAEA (International Atomic Energy Agency), Iceland and BGR (German Federal Institute for Geosciences and Natural Resources). Iceland has financed two pre-feasibility studies, BGR one. So far three potential areas, all situated in western Uganda in the western branch of the East African Rift Valley, have been identified for detailed exploration. The three potential areas are Katwe-Kikorongo, Buranga and Kibiro. These sites have also been included in the National Development Plan with the aim of constructing three geothermal plants with a combined capacity of 100 MW by 2014/15. MEMD is planning to develop a Geothermal Policy and subsequently, a

Geosciences and Natural Resources	Geothermal Act. The three sites have been licenced to private developers (three-year exploration licence based on the Mining Act of 2003). Study results indicate that the temperature level varies between

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table B19.3 below.

Table B19.3 Co-benefits of EE initiatives in Uganda

Initiatives/projects/programmes	Co-benefits to Energy Access
Promotion of Renewable Energy and Energy Efficiency Programme – PREEEP	The PREEEP supports social institutions to access solar photovoltaic electricity and improved cooking stoves by providing technical and financial assistance. Through the programme, 120 institutions have access to solar photovoltaic electricity, and more than 250 institutions have installed improved cooking stoves. The programme offers to cover 80% of the overall costs for solar PV systems if the benefitting institutions meet the following selection criteria: ➢ The institution should be located more than five kilometres away from the nearest electricity grid and should not be earmarked for grid extension within the next ten years. If the grid is nearby and the costs of grid connection are low, PREEEP may consider supporting the institution to connect to the electricity grid. ➢ The institution should commit itself to contributing 20% of the overall costs and to cater for the operation and maintenance of the proposed system. ➢ For the installation of the improved cooking stoves, PREEEP offers to cover up to 50% of project costs, provided that the institution runs a cooking programme, has a permanent kitchen and is willing and able to cover the remaining costs for the stoves.
The rocket mud stove **Sponsors:** ➢ The European Union for institutions in Northern Uganda ➢ The Dutch German Energy Partnership	The PREEEP also promotes the rocket mud stove in rural areas. These new stoves provide the following benefits: ➢ The stoves have been tested and proven to be economical in firewood consumption, saving more than 50% compared to the traditional (open) three-stone fireplace. Thus it cooks faster since it generates a hot fire and ensures better heat transfer. ➢ Cooking with these stoves greatly reduces kitchen

	smoke due to better burning. Moreover, the 2-pot stove has a chimney that eliminates any trace of smoke. ➢ Once lit, the stove fire does not stop unless firewood feed into the stove is stopped. There is no need to strain one's lungs to blow air into the stove to fan the flame as is the case with the traditional (open) three-stone fire. This is done by the air chamber below the feeding shelf. ➢ The stoves are safe to use domestic appliances. The fire is shielded out of reach and therefore less likely to cause burns to children and the user. ➢ The stoves use less firewood, leading to a reduction in the rate of deforestation. The stoves are less polluting because of their nearly smokeless operation.
The energy for rural transformation programme (ERT)	➢ Projects under the programme benefit from subsidies to buy down capital costs. ➢ In total the project cost was US $10M, and the company will employ about 6000 people. ➢ Access to electricity in rural areas has increased from 1% to 4% in the past three years.

Additional energy efficiency potential across various sectors in Uganda is as follows.

Table B19.4 Identified Energy Efficiency Potential across sectors in Uganda

Sector	Energy Efficiency Potential
Industrial	**Co-generation from biomass:** The promotion of co-generation project development would lead to: ➢ the recovery of waste from industrial processes, which could replace fossil fuels ➢ reduced grid demand on the part of industry **Technical energy efficiency measures:** The key objective is to reduce the losses attributable to an inefficient use of electricity due to the lack of a fully-fledged internal energy management system in most industries.
Tertiary building (public administration buildings, commercial buildings, restaurants and hotels, education and health buildings, office buildings such as telecommunications, real estate and finance)	The potential savings for existing buildings are divided between: ➢ short-term actions covering organisation (e.g. energy management), awareness raising and the reinforcement of maintenance programmes ➢ medium-term actions aiming to improve lighting and air-conditioning performance ➢ For all new buildings, the development of a building energy quality code with the aim of improving construction quality by imposing realistic specifications based on the state of the art and on experience in construction in Uganda.
Residential	➢ Improvement of household equipment today (lighting, television sets, fridges) and in goods that will be acquired in the future (housing, air conditioners, household equipment). ➢ The construction of housing in particular has a strong potential for savings, especially by reducing the need for air conditioning through specific EE measures focused on building rules (insulation, sunscreens) and on the performance of air-conditioning units (energy performance standards).
Energy supply (generation, transmission	➢ Checking and abating losses from transmission and distribution.

and distribution)	

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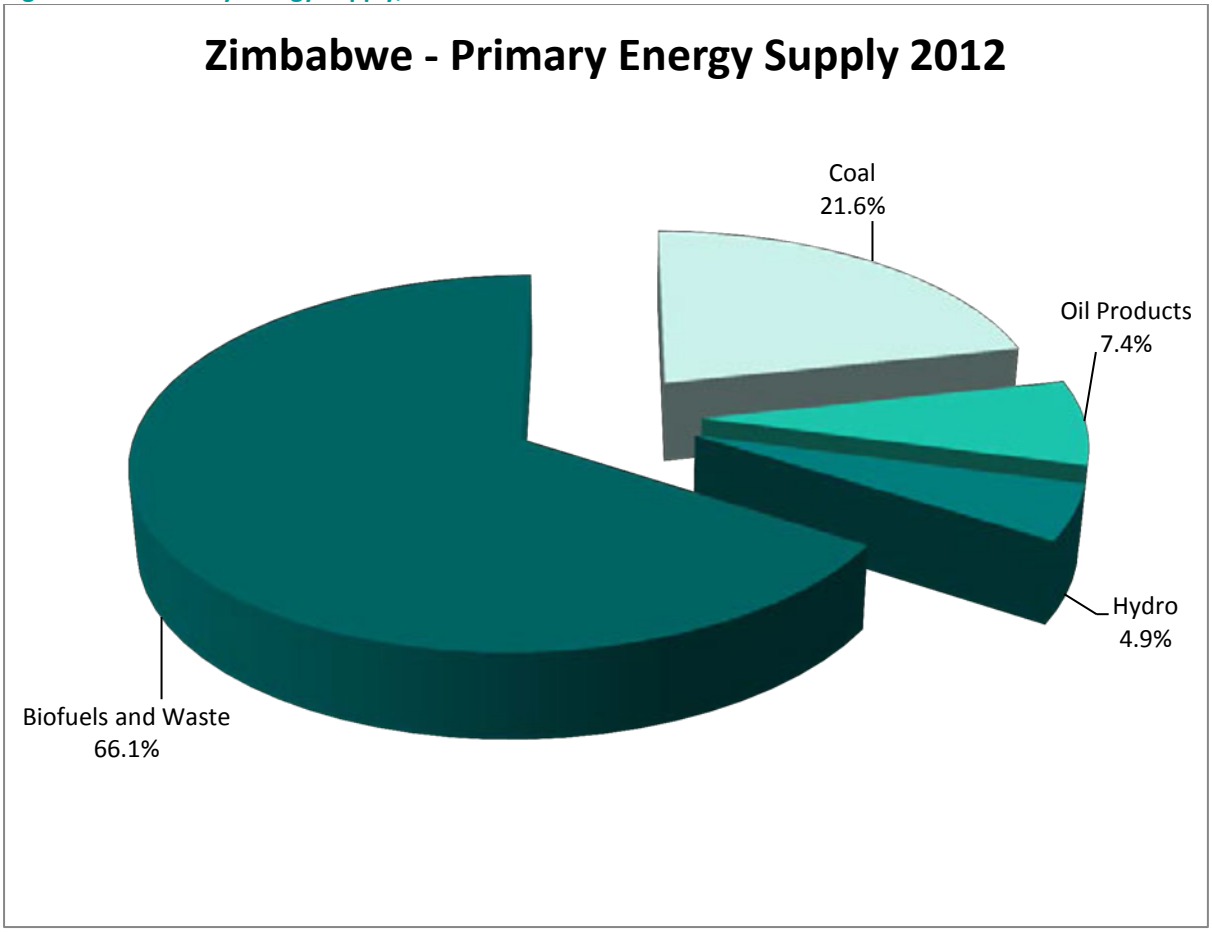
B20. Zimbabwe

Overview of Zimbabwe's energy sector

The primary energy sources in Zimbabwe include biomass, coal and oil, plus their derivatives and hydro. Biomass and coal represent the largest share of total primary energy supply in the country, as depicted in the following figure.

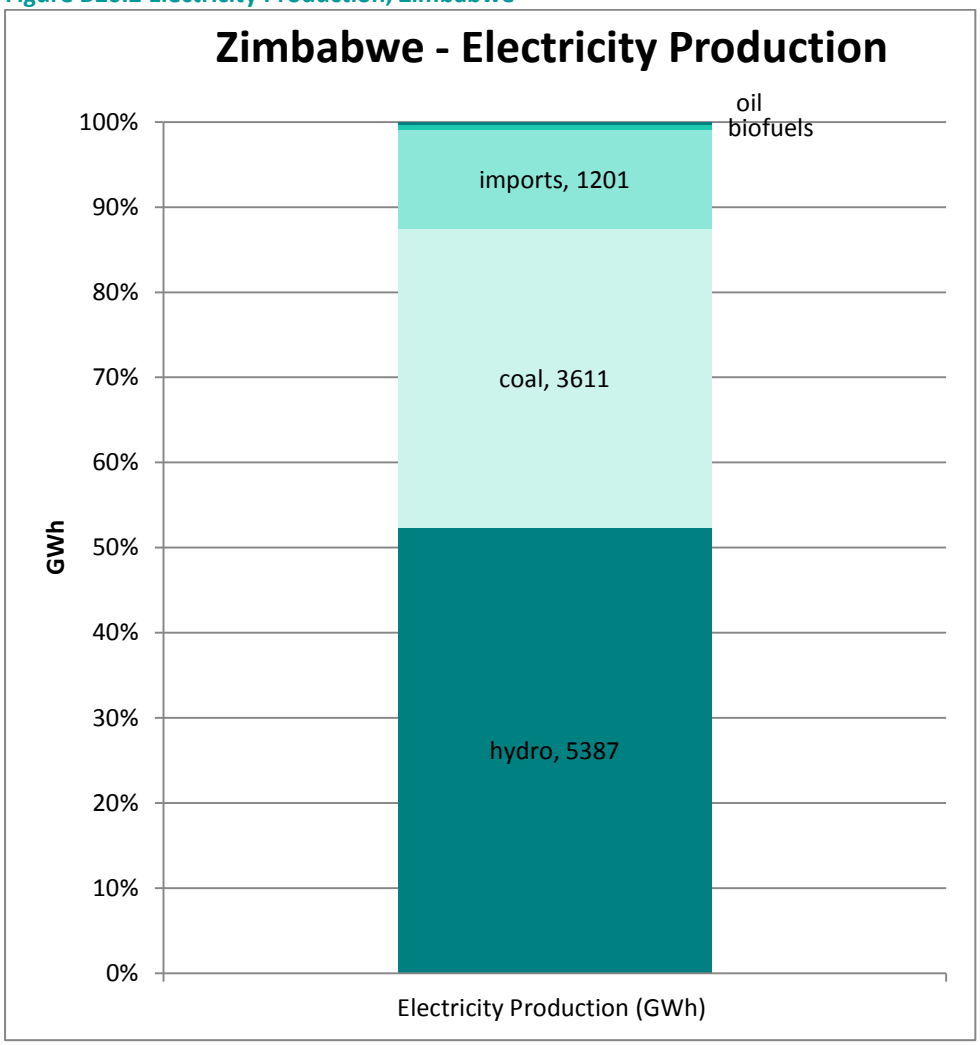
Figure B20.1 Primary Energy Supply, Zimbabwe [49]



[49] **(source: IEA statistics online 2015)**

Electricity production in Zimbabwe consists of approximately 50% hydro power, 40% coal generation, and the balance mostly supplied from imported electricity. Figure B20.2 below shows the breakdown.

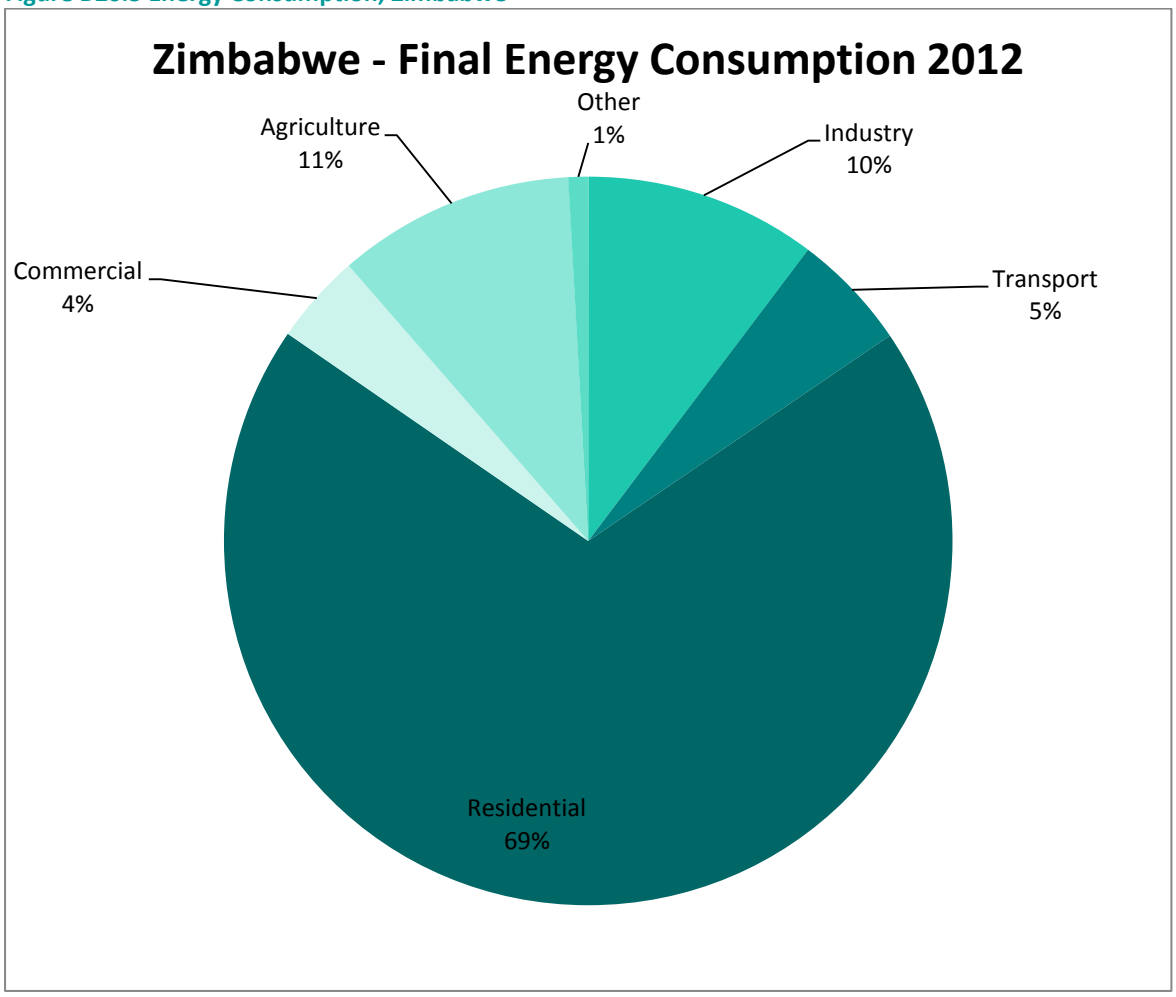
Figure B20.2 Electricity Production, Zimbabwe [50]



[50] **(source: IEA statistics online 2015)**

Final energy consumption, shown below in Figure B20.3, is mostly in the residential sector (69%). Agriculture and industry follow with 11% and 10% respectively.

Figure B20.3 Energy Consumption, Zimbabwe [51]



[51] **(source: IEA statistics online 2015)**

Energy Efficiency Initiatives

Past successful energy efficiency initiatives and activities in Zimbabwe are listed in the table below.

Table B20.1 Energy Efficiency Initiatives in Zimbabwe

Initiative/Activity/Programme/and Sponsors	Brief outline and planned dates (whether past/present/or future)
National Electricity Act	➢ In force since 2002. ➢ The Electricity Act provided for the establishment of the Zimbabwe Electricity Regulatory Commission (ZERC). ➢ ZERC was responsible for licencing operators in the electricity sector, the setting of electricity tariffs and general regulation of the electricity sector to promote fair competition in the electricity industry. Since the establishment of the Zimbabwe Energy Regulatory Authority (ZERA) in January 2012, all ZERC's duties have been transferred to ZERA, and ZERC has been abolished.
Rural Electrification Fund Act	➢ In force since 2002. ➢ This Act allowed for the establishment of the Rural Electrification Fund Board responsible for the holding and distribution of Rural Electrification Funds for all rural electrification projects countrywide. ➢ Allows for the expansion of the national electricity grid to rural government institutions, business centres and chief's homesteads with a 100% subsidy, and a 60% subsidy on other connections. Also provides for decentralised electrification using renewable energy.
Energy Regulatory Act	➢ In force since 2011. ➢ The ZERA board issues and withdraws licences from all players in the electricity, petroleum and renewable energy sectors. It is also responsible for creating a legal framework for fair competition in both sectors.

The barriers identified in these initiatives that need to be addressed are shown in Table B20.2 below:

Table B20.2 Barriers to EE initiatives identified in Zimbabwe

Initiatives/projects/programmes	Barriers (at both regional and country levels)
Energy efficiency, renewable energy technologies and conservation initiatives	➢ Inadequate funding to finance these programmes. ➢ Low public awareness and uptake of the efficacy and potential of renewable energy technologies. ➢ Poor development of competitive alternative energy sources, a lack of incentives, including financing mechanisms, for their development, and insufficient incentives to introduce fuel/technology substitutes. ➢ Poor policy on renewable energy technologies, poor institutional framework and poor infrastructure
Rural Electrification Programme (REP)	The first REP was initiated in the 1980s, but it had to be abandoned in 1990 due to cash-flow problems and the lack of a comprehensive policy on rural electrification.
UNDP-GEF Solar Project for rural household and community use in Zimbabwe	Lack of sustainable energy policy at that time (1993).

In addition to energy savings, there are benefits from these initiatives in terms of reduced environmental impacts, improved access to energy or improved quality of life as a result of the initiative. Some of these co-benefits are listed in Table B20.3 below.

Table B20.3 Co-benefits of EE initiatives in Zimbabwe

Initiatives/projects/programmes	Co-benefits to Energy Access
UNDP-GEF Solar Project for rural household and community use in Zimbabwe	PV lighting was provided to about 10,000 households and service centres in Zimbabwe.
Household Energy Plan	To address issues related to shortages, the inefficient use of biomass, and the affordability of modern energy services.
Compact Fluorescent Light Bulbs	➢ Government will supply and introduce 4.5 million compact fluorescent light bulbs, as well as a prepaid metering system so as to reduce peak demand. ➢ From a preliminary survey, it was established that a minimum of 203 MW could be saved in Zimbabwe during evening peak periods.
Improved cooking technology	To reduce wood-fuel consumption
National awareness-raising programmes	To improve energy savings and conservation, education and information dissemination about energy technology options, costs and technical know-how
“Time-use” electricity tariffs	To encourage energy efficiency
Public–private sector partnerships	To optimise the application of technology in energy-use management

Additional energy efficiency potential across various sectors in Zimbabwe is as follows.

Table B20.4 Identified Energy Efficiency Potential across sectors in Zimbabwe

Sector	Energy Efficiency Potential
Residential	Reduce dependence on unsustainable fuelwood resources by switching to electricity, petroleum products and biofuels, especially LPG in urban areas and biogas in rural areas, as cooking and heating fuels.
Mining and industry	Adoption of more efficient technologies, machinery and processes.
Transport	➢ Using environmentally friendly fossil fuels, e.g. unleaded gasoline, blended petrol, low-sulphur diesel – and the importation of more fuel-efficient vehicles. ➢ Using alternative fuels such as biodiesel and ethanol blending.
Agriculture	Using low-energy equipment.
Commerce	The adoption of energy-demand management and the implementation of energy-conservation measures in institutional buildings and government departments.

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