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## How can we promote renewable energy and energy efficiency in Central Africa? A Cameroon case study

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## ABSTRACT

Central Africa possesses important renewable energy potential that continues to suffer from poor development. The primary cause of the poor use of renewable energy is the poor commitment and dedication among the region's governments who have not taken the necessary measures to support the sector. The primary purpose of this paper is to emphasize the renewable energy resources of Central Africa that they may be used optimally. The report also describes the availability of renewable energy resources and suggests actions to promote and sustain their development by improving access to sustainable, environmentally friendly, and affordable energy services, making significant improvements to energy infrastructure in Central Africa, and promoting renewable energy and energy efficiency. The work presents the potential for solar, biomass and hydropower, indicating where development is available. Next, the identified obstacles of clean energy promotion are targeted. Finally, suggestions are offered to help countries develop a vision aimed at developing good clean energy policy that increases the status of environmentally friendly energy. A Cameroon case study is examined as an illustration. Several documents are cited from institutions in the region and abroad.

### 1. Introduction

Central Africa possesses important renewable energy potential, namely, hydro, tidal, solar and biomass sources. This important potential continues to suffer from poor development and carbon energy remains the primary power source. There are many reasons for the poor commitment and dedication among governments to promote clean energy. The purpose of this paper is to address the issue of clean energy promotion in the Central African context with respect to ongoing energy policy. Because the region is experiencing power shortages from the electrical grid in remote areas and in cities, thermal plants are among the solutions that are planned or under construction. This solution is currently being implemented in Cameroon and other countries in the region, although is not environmentally friendly and hence is not a long-term solution.

### 2. Methodology

This report describes the availability of renewable energy resources and suggests actions to promote and sustain their development. Based on the knowledge of the Central African energy sector, this paper will

identify actions for improved access to sustainable, friendly, and affordable energy services to consumers as well as suggest significant improvements to energy infrastructure in Central Africa and the promotion of renewable energy and energy efficiency.

This work will first show the potential for three primary renewable energy sources, solar, biomass and hydro, indicating where development is available. Then, the identified obstacles for the promotion of clean energy will be targeted. The proposed solution is recommended given the purchasing power and socioeconomic environment of the region. Finally, suggestions will be made to help the countries develop a vision aimed at developing good clean energy policy to increase the status of the renewable energy sector and better contribute to confronting climate change. The Cameroon case study presented is very interesting because the country has a large variety of renewable energy potential and can develop and export energy to neighboring countries.

The state of development of Cameroon's energy sector is presented. Based on ongoing projects and strategic documents adopted by the country, the direction taken towards specific actions is suggested. Provided an overview and assessment of the institutional structural reform of Cameroon's power sector, based on the weaknesses of the

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institutions, specific suggestions are made for the enhancement of renewable energy resources to support energy access and security nationwide and in remote areas in particular, where the fight against poverty is more challenging.

We obtained data directly from particular stakeholders in each country in the region, and we also used several documents from institutions in the region and abroad, as well as available websites and maps. At the regional level, we obtained data from the International Commission of Congo-Oubangui-Sangha (CICOS), the Economic Community of Central African States (CEMAC), the Central African Power Pool (CAPP), Ministries and utilities when travelling in the region. We also collected data from the World Bank, World Wide Fund for Nature (WWF) and research institutes in Europe via the Internet. Based on the data collected and the experiences of countries with successful policies on renewable energy promotion (Europe, America, and Asia), we offer suggestions.

### 3. General information on Central Africa

Central Africa (Cameroon, the Central African Republic, Gabon, the Republic of the Congo, Chad, Equatorial Guinea, and the Democratic Republic of the Congo) is situated between latitude 13°S and 22°N and longitude 8°E and 22°E and has the data depicted in Table 1 below.

### 4. Renewable energy potential in Central Africa

#### 4.1. Hydro potential

The overall hydro potential in Central Africa is estimated to be 133 GW, and less than 3% is developed thus far. In the Republic of the Congo, more than 471 MW of thermal plants are installed at 61 sites, whereas 209 MW [1] of hydro capacity is installed at 3 sites (Imboulou, Moukoulou and Djoué). In Gabon, the 275 MW thermal plants located in Port Gentil and Owendo are under development compared to the 261 MW in hydro plants that under development (Grand Poubara, Fe II, and Chutes de l'Impératrices).

In Cameroon, 547 MW of thermal plants (some located in Kribi, Yassa, and Limbe) are operating or are under development compared to 242 MW [2] of hydro plants that are under construction (Memve'ele, Mekin and Lom Pangar).

Equatorial Guinea has just completed a 120 MW hydro plant at Djibloho and is constructing another 200 MW plant on the Wele River. The thermal installed capacity is approximately 40 MW. All thermal plants mentioned in Table 2 below are fossil-fuel plants (using gas, light or heavy fuel oil).

**Table 1**

Data on Central Africa.

Source: Wikipedia, January 2015

Name	Capital	Official languages	Area (km <sup>2</sup> )	Population
Angola	Luanda	Portuguese	1,246,700	20,609,294
Cameroon	Yaoundé	French, English	475,442	20,129,878
Central African Republic	Bangui	Sango, French	622,984	4,576,000
Chad	N'Djamena	French, Arabic	1,284,000	11,274,106
Democratic Republic of the Congo	Kinshasa	French	2,344,858	69,575,000
Republic of the Congo	Brazzaville	French	342,000	4,366,266
Equatorial Guinea	Malabo	Spanish, French	28,051	740,000
Gabon	Libreville	French	267,668	1,576,665
Total				132,847,209

**Table 2**

Installed hydro capacity and hydro potential of Central African countries

Source: [3–7]

Country	Installed hydro capacity (MW)	Potential (MW)	Installed thermal plants (MW)
Democratic republic of the CONGO	2 584	100 000	37
Cameroon	725	20 000	547
Gabon	311	6 000	176
Republic of the Congo	135	2 500	471
Central African Republic	19	2 800	24
Equatorial Guinea	121	2 400	38
CHAD	0	0	200

#### 4.2. Wind potential

According to the GEOS-1 satellite measurements from NASA (Fig. 1), from July 1983 to June 1993, the wind potential of the region is poor along the equator. Chad is the only country with an average wind speed above 5 m/s throughout the entire country, indicating the possibility for wind development.

#### 4.3. Geothermal potential

Some hot water sources are identified in the region, but a detailed study for the assessment of geothermal potential has not yet been conducted in Central Africa, although one important volcano (Mount Cameroon) is still active. The eastern part of the Democratic Republic of the Congo might have important geothermal potential because it is part of the Indian Ocean's ring of fire (Fig. 2).

#### 4.4. Solar potential

As depicted in Fig. 3, Africa is situated along the Equator, making the continent one of the sunniest in the world. Based on the data from the Solar Radiation project [10], the lowest daily mean radiation ranges from approximately 4 kWh/day/m<sup>2</sup> (wet forest) to above 8 kWh (dry desert in Chad). The modified map below from SolarGIS shows the average solar radiation of the entire continent in general and the region in particular. It appears that Central Africa has great solar potential.

#### 4.5. Biomass potential

Central Africa possesses nearly one-quarter of the world's tropical forests. This forest is the second largest tropical forest in the world after the Amazon forest. Its mosaic of ecosystems regulates local climate and the flow of water. The forest covers an important area, from the Albertine Rift (Rwanda, Burundi, and Uganda) to the Gulf of Guinea (Equatorial Guinea, Gabon, and Cameroon) and harbors a variety of forests. It is one of the few places where wild dense forests can still be found in the world, with an area of approximately 500 million acres, spanning the boundaries of Cameroon, the Central African Republic, the Democratic Republic of the Congo, Equatorial Guinea, Gabon and the Republic of the Congo (Fig. 4).

Inadequate and improper forest management practices are a threat to the long-term viability of these forests, significantly reducing their economic potential and resulting in negative social and environmental impacts. Over 50% ([13]) of the Congo Basin's forests are under commercial logging leases. Despite several sustainable forest management programs, Central African tropical forests are disappearing at an alarming rate ([14] [15] [16]).

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