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Renewable energy potentials in Cameroon: Prospects and challenges.

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Abstract: This paper aims at discussing the renewable energy potentials in delivering parts of the energy needs in Cameroon. The country has an enormous renewable energy potential. The lack of clear renewable energy policy in the mix is an issue that needs to be addressed urgently by the Cameroonian government policy makers. The absence of commitment and enthusiasm from the government is weakening the sector potentiality to be developed either by private sector investments and also foreign investors. Solar, wind and thermal energy plants are essential to meet the electrification of Cameroon.

Keywords: Energy; Renewable energy; Cameroon

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Cameroon is a country that lies within the Gulf of Guinea and bordered by six countries i.e. Nigeria, Chad, Central African Republic Congo, Gabon and the Equatorial Guinea, as shown in Fig 1. Cameroon is Africa in miniature and is characterized by diversity. It is the most populated country in the Economic Community of Central African States (CEMAC) region, with fast growing population. According to United Nations studies [1] the population of Cameroon is about 20 million, and is growing by approximately 2% every year [2]. About 20% of the population lives in two major cities - Douala and Yaoundé (Capital) [3]. Cameroon, as compared to other African countries, enjoys a relatively high social and political stability [2]. French Cameroon become independent in 1960 and merged with Southern British Cameroon in 1961 and the two entities are now known as the Republic of Cameroon [4].

[Insert Figure 1 here]

Cameroon as a country in Central Africa is endowed with abundance of renewable energy (RE) sources [5] but this energy has not been fully utilized or harnessed. The majority of the country's population uses conventional solid fuels such as charcoal for cooking and other household lightning needs [6]. The major energy sources in Cameroon are petroleum, coal and hydropower, biofuels and waste [5] and their percentage distribution shown in Fig 2. In terms of electricity, 75% of the Cameroon's electric power is obtained from hydropower schemes while the remaining from the other renewable energy sources. The hydro schemes estimated at 721MW hydro scheme, were obtained from an installed capacity

49 of approximately 1000MW [5]. In Cameroon, there are three major hydroelectric power
50 stations i.e. Song Loulou, Edea, and Lagdo. Cameroon is regarded as possessing the second
51 largest hydro stations apart from the Democratic republic of Congo [7].

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53 [Insert Figure 2 here]

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56 Despite the huge hydroelectric power schemes, electricity in Cameroon is not evenly
57 distributed, with only 20% of the population having access to the national grid [8]. The
58 majority of the population connected to the electrical grid is the urban dwellers while there is
59 little development regarding rural electrification schemes. Apart from hydo, fuel also
60 constitutes 11% of the electricity produced in Cameroon. There are good potentials for
61 biomass up to 20 million hectares of tropical forest [7]. The natural gas is estimated at
62 110,000 million m³ [7]. Despite all these potentials, little resources have been allocated to
63 develop them.

64 This paper looks at the energy trend and consumption in Cameroon. An evaluation of
65 the significant renewable energy (RE) policies would be carried out, together. This paper also
66 critically evaluates the present and future RE installations for Cameroon and comes up with
67 recommendation based on the strength and weaknesses of the RE schemes. Finally
68 conclusion would be made on the ways to accelerate the RE policies.

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96 **3.0 Status quo of renewable energy in Cameroon**

Energy remains an important aspect of any nation and Cameroon is not immune from this. The current high industrial and commercial growth depends largely on the availability of energy sources. The development of energy sector remains one of the major attractions for foreign investors and strengthening growth. The World Bank Investment Climate [10] has indicated that limited access to reliable electricity is among the major hindrance in conducting business in Cameroon and this is seriously damaging Cameroons growth domestic product growth (GDP) closer to 2% [5].

With the help of the United Nations development program and the World Bank, the government of Cameroon has adopted the national energy plan for reducing poverty (PANERP), the implementation of such projects aims to increase the access rate of energy in both the urban and rural areas [11]. The major energy potentials in Cameroon are as follows:

109 **3.1 Solar Energy**

There is good solar potential in Cameroon (see Fig. 5) but it is not well developed. The major cause of the poor state of solar energy development is the poor commitment and dedication of government in taking important steps to boost the sector. In most part of the country, the mean solar irradiance is approximately $5.8\text{kWh/m}^2/\text{day}$ [2].

114

115 [Insert Figure 5 here]

116

Solar power is currently used for powering cellular base transceiver stations and solar powering of street lights in parts of Yaounde (see Fig. 6). Only 50 PV installations currently exist [2].

[Insert Figure 6 here]

3.2 Wind Energy

Wind energy is fringe. In most part of the country the average wind speed is about 2-4m/s at 100meter height [2]. The northern part of Cameroon and coastal areas has some favourable sites having existing wind power stations. Presently, there are two rapid wind turbines installed at a hotel in Douala. The regions having warm springs are the Ngaoundere, the region of mount Cameroon and the Menengoumba zone with Moudou Lake.

3.3 Hydropower

Hydropower remains the major source of energy in Cameroon. At present, the overall potential for hydro is approximated at 23GW, with production potential of 103TWh per year [12], but it is not fully utilized. Three major hydroelectric facilities exist in the country namely Edea, Songloulou and Lagdo power stations and many hydropower generating dams under construction. There are mini/micro hydro potentials up to 1MW approximated at 1.115TWh [2] which were not been exploited.

3.4 Biomass Energy

Cameroon has a large and unutilized potential of biomass primarily from agriculture and forest. Back to 2006, 66 sites with transformation capabilities of 2.7million m³ were recognized [13]. Presently, biomass is used virtually in all sectors of the economy in Cameroon i.e. industrial and residential. 75% of residential energy consumption is basically the biomass while the biomass covers up to 90% energy requirement in the industries [13]. There is also huge utilization of palm oil for production of biodiesel mainly used for agricultural purposes. Furthermore, Abanda [14] argues that firewood in remote area is being depleted without being replenished and that had led to many challenges of energy affordability and environmental impact. Therefore, other renewable energy sources would have enormous environmental and energy potential.

3.5 Geothermal Energy

Cameroon has potentials for geothermal energy which has not been tapped. There are hot water regions but no feasibility studies have been carried out to identify their full potential. According to the Cameroon report [2], areas of interest identified include Ngaoundere region, Mt Cameroon region and Manengoumba area with Lake Moundou.

4.0 Energy policy in Cameroon

There is no explicit energy policy in Cameroon that is available to the public. Back in 1990 Cameroon had an energy policy to incorporate all the available energy sources but has not been implemented. In December 1998, another policy relating to energy focuses only on hydroelectric power. The Ministry of Energy and water in 2005 affirmed that a new Energy

plan would be developed by 2030[15]. There is also the Vision 2035 which has significant plan for investing relating to the renewable energy. The Vision 2035 objectives of the Cameroonian government emphasise on energy independence by increasing the production and delivery of electricity, oil and gas products to enhance the economic advancement [12]. There is also the rural electrification master plan to develop electricity in the rural areas. There would be an extension of the national grid, the renovation and reconstruction of diesel power plants and other small hydro plants. The future renewable energy policy of Cameroon currently being prepared focusses on mixing the renewable energy resources for power and heating production [12]. According to Tansi [16], there are no guidelines in Cameroon relating to renewable energy alone, but there are laws passed by the Cameroonian government dealing with energy of which renewable energy is incorporated.

5.0 Future Renewable Energy plans

Currently, 5% of the hydropower potential in Cameroon has been exploited [9]. The government of Cameroon has planned future investment in hydropower. Table 1 shows the future investments in the hydropower in Cameroon. The AEL-SONEL, the main electricity supplier in Cameroon is presently working with SIEMENS Company to develop water management modelling software to improve the productivity of the Sanaga river basin, which is the main hydroelectric power source in Cameroon [13].

[Insert Table 1 here]

As stated previously, there are great solar potentials in Cameroon but it has not been fully exploited. Solar energy is one of the rapidly growing businesses in the world and therefore Cameroon can get lot of benefits through investment in this sector. Investing in solar energy can provide tremendous benefit to the people of Cameroon and the environment. Currently, solar PV has been used for public lightning in Yaoundé region and some hotels [18]. To date, the Government of Cameroon do not have clear plan for solar energy.

The wind energy evaluation has been done by the Ecovalen (a Spanish firm) [19]. This firm is working in collaboration with the Cameroon government towards establishing wind turbines in the North West region, which is expected to supply electricity to this region for about 20 years [19].

The Government of Cameroon does not have defined policy on biomass but the process of creating these laws is being considered. Main consideration for the future is developing criteria for sustainable palm oil production.

6.0 Problems and prospect of developing RE potentials in Cameroon

6.1 Lack of RE policies and financial investments

In reviewing the renewable energy policy and potentials for Cameroon, there is evidence that renewable energy is not yet developed. In implementing the RE polices there are issues that may hinder or accelerate the process. The development of business activities in Cameroon in RE sector may be hindered by several factors, such as the institutional environment. There is absence of standard and quality control mechanism in the sector. Lack of initial financial investments into the sector can hinder the development of potential renewable energy projects. There is also lack of reliable infrastructure in the sector to kick

start its development potential. However, RE are found to be more expensive than the conventional electricity technologies and this has been found to be deter some private investors from venturing into this sector in developing countries [16].

6.2 Hydropower

Hydropower has been the most developed and concern of the government. However there issues that are slowing the hydropower development. There is lack of good governance in developing dams. Tariffs are not well defined to attract investors. There is lack of accountability from the government making it difficult to enforce certain rules and regulations. The quality of maintenance of hydropower dams is below average and the production plant operates with performance rate inferior to 55% [20].

In order to accelerate the hydropower production, the above issues needs to be addressed. Due to the complexity in hydropower projects, the Cameroonian government needs competent energy strategies to plan ahead in terms of technical, economic and environmental feasibilities. There is need for capacity building in this area to meet up the implementation targets. The government should establish hydropower research institute for man power training and development in the country.

6.3 Solar energy

The solar energy is at pilot stage now in Cameroon. There are several issues that are hindering the process. The Government has not taken necessary steps to enhance the sector.

This may be due to the high capital cost of solar technology. There is also lack of sensitization by the government toward the public on the benefit of the solar energy. There is also lack of solar energy infrastructure that can be integrated into the national grid. The pilot projects in Yaoundé area is yet to fully utilized due to many factors, for example poor maintenance and PV panels are covered by dust. Poor quality sensors were used on these panels and the batteries used for the project were not of high quality. In order to enhance solar energy in Cameroon, the government recently signed an agreement with China to carry out feasibility studies aiming at installation several light points in Yaoundé [5].

Recently, Cameroon obtained eKiss (energy-keep it simple and safe) mobile off-grid photovoltaic systems from PV technology from Antaris solar ESI-Africa [21]. This technology is capable of generating electricity on a standalone basis. It can supply from 350W to 2000W and suitable for powering remote areas in Cameroon which do not have reliable access to the national grid.

6.4 Biomass

Despite Cameroon having high biomass potentials, there are still problems hindering its development. This range from poor and inadequate mismanagement of the forest which is also a threat to the environment. The government should take adequate step to manage commercial and illegal logging in forest in Cameroon.

6.5 Geothermal

Geothermal energy sources are other areas that the Cameroon government can focus on to meet up the demand for electricity, specifically for the rural dwellers. An investigative study should be carried out to identify more hot water sources.

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257 **7.0 Conclusion and recommendation**

258 From this paper, it is obvious that Cameroon has huge energy potentials. There are
259 proven deposits of crude oil, large rivers, biomass and solar energy that have not been fully
260 utilized. Energy production from hydropower has been the main focus of the governments for
261 many years. There is no strong policy for other abundant renewable energy sources in the
262 future energy mix of the country.

263 From the analysis in this paper, it is clear that RE can play a role in reducing the
264 energy demand, especially in the rural areas, where only 10-14% of the populations have
265 access to electricity. This paper is promoting the utilization of renewable energy sources to
266 minimize the gap between energy demand and supply. Proper RE policies in Cameroon can
267 boost private and foreign investment in the sector for future development. The government
268 should take a leading role in sensitizing the public about the benefit of renewable energy.

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Figure description

Figure	Description	Proposed size (width)
1	Map of Cameroon [4].	90mm
2	Energy sources in Cameroon [6].	90mm
3	Energy supply scenario for Cameroon [2].	90mm
4	Energy consumption by sector in Cameroon [2].	90mm
5	The solar irradiation map of Cameroon [17].	140mm
6	Solar powering of street lights in Yaoundé area [5].	90mm

Table description

Table	Description	Proposed size (width)
1	Future hydropower investments in Cameroon [13].	140mm

Table 1: Future hydropower investments in Cameroon [13].

Name	Power generated	Investment (€m)
Edea/Song Loulou	30MW	76.22
Lom Pamgar	170MW	76.22
Nachtigal	280MW	228.67
Warak	75MW	114.33
Song Dong	280MW	266.78
Meve, Ele	200MW	304.9

Figure1
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Figure2
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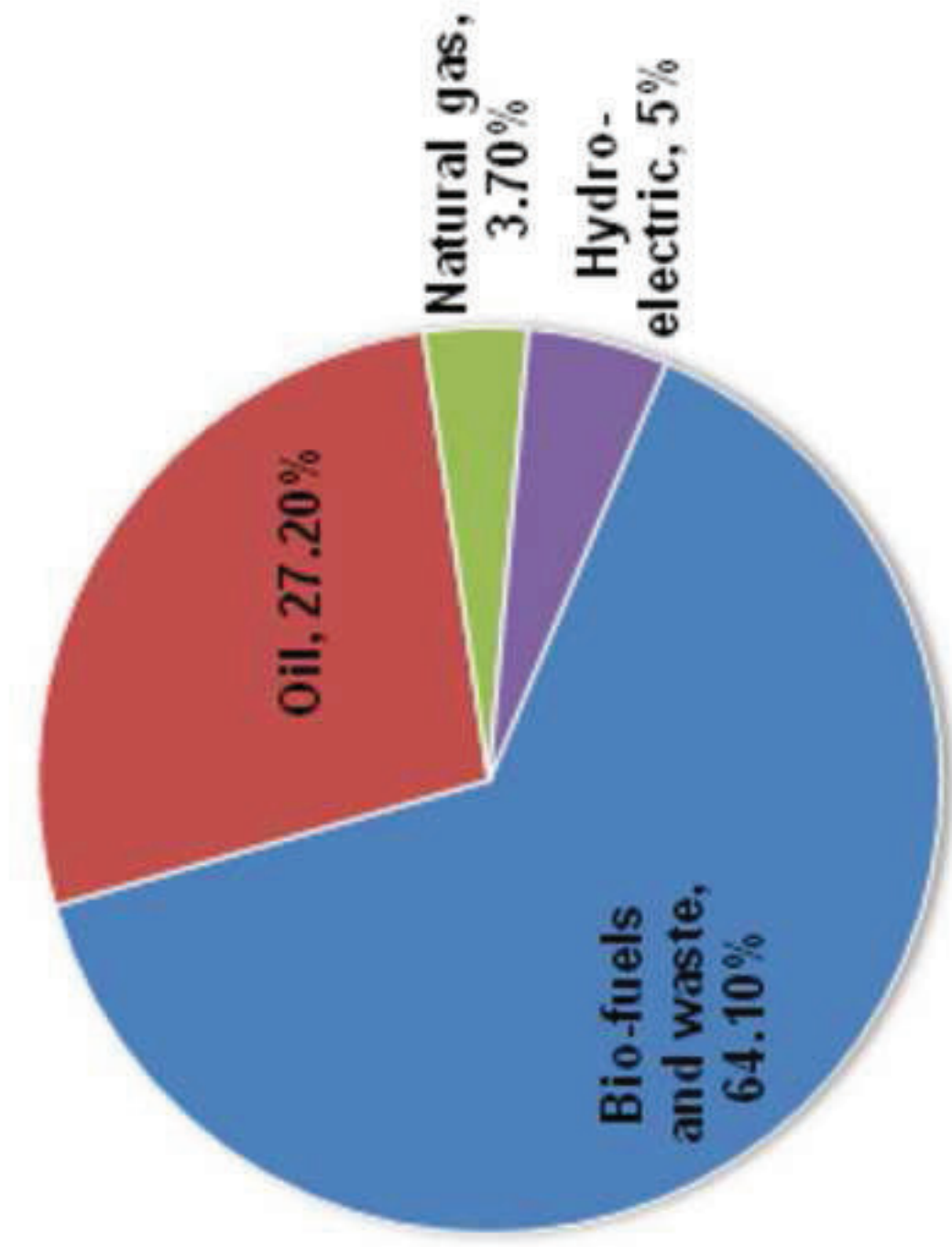


Figure3
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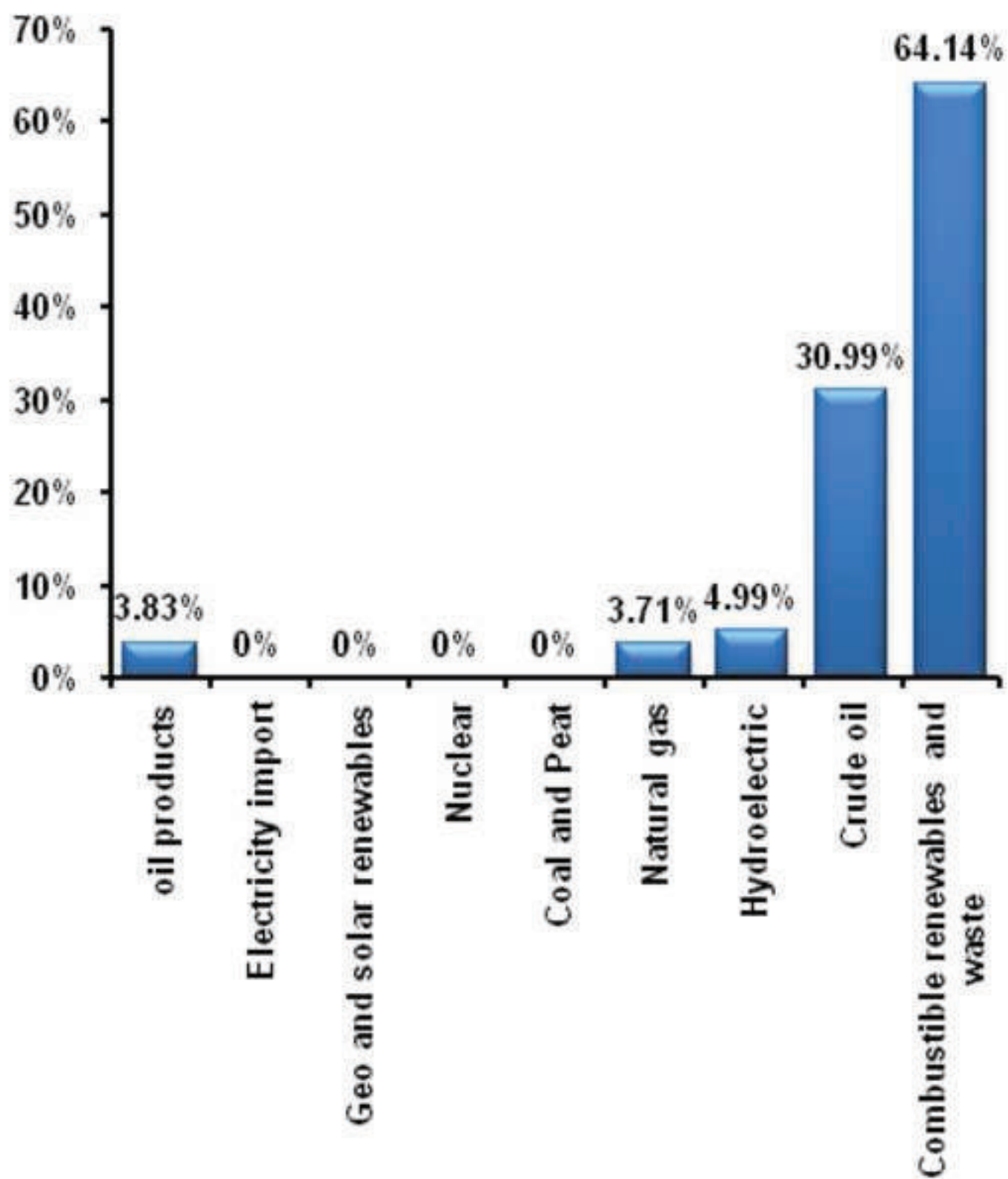


Figure4
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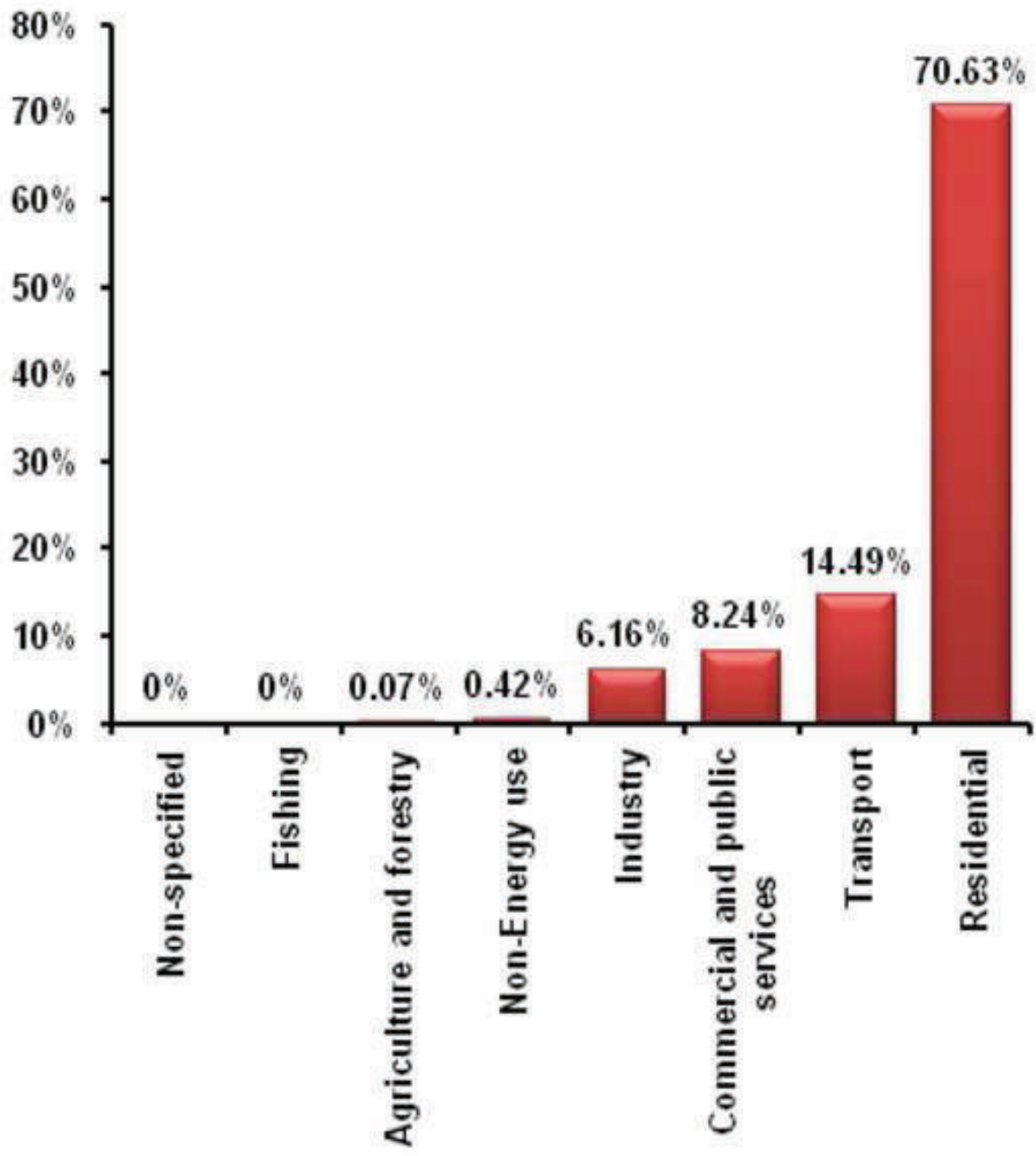


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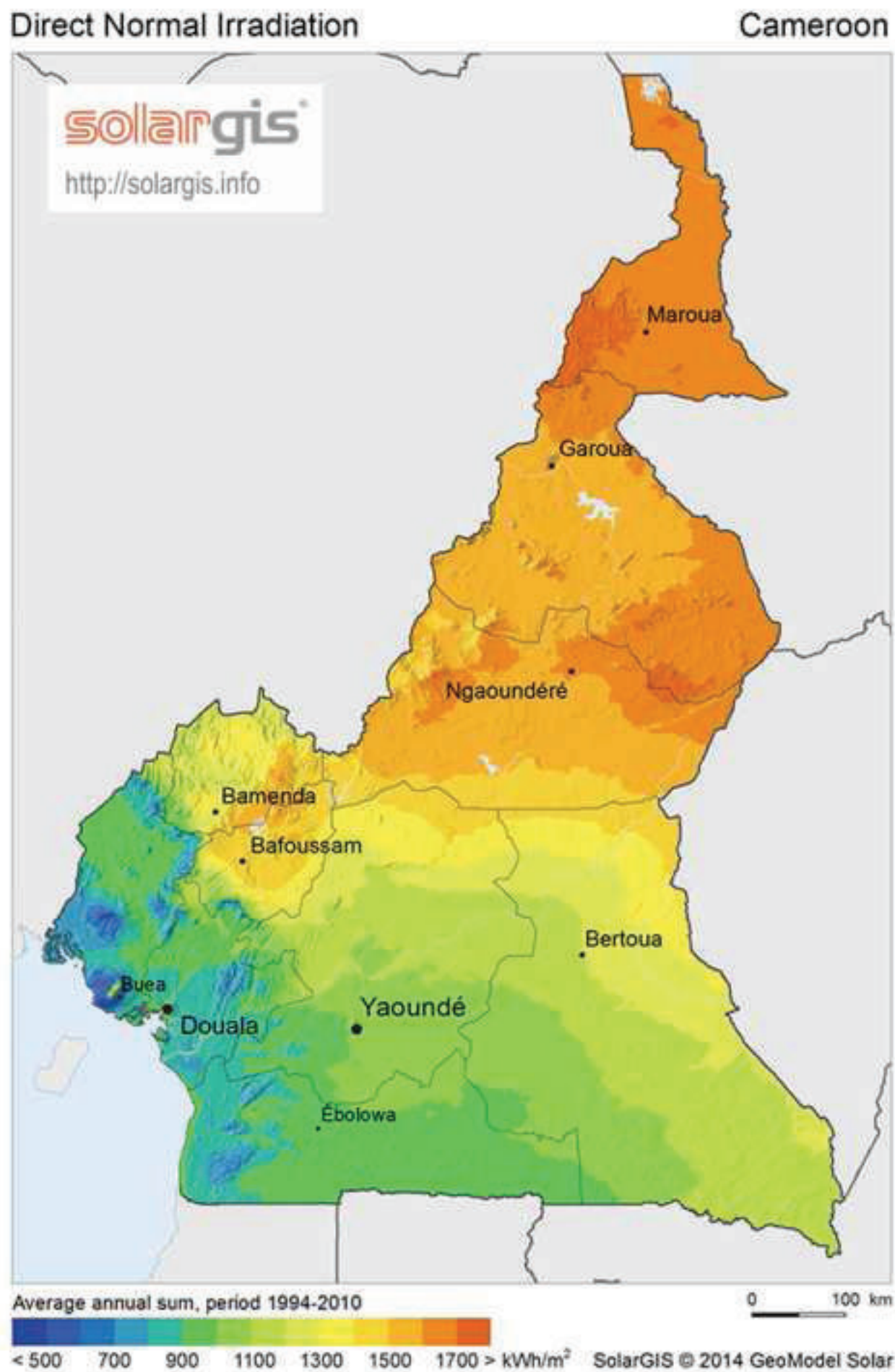


Figure6

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