INTRODUCTION TO RENEWABLE ENERGIES IN AFRICA

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Abstract
Compared to the rest of the world, there is a general shortage of energy related information in Africa (on potential of energy resources, actual installed systems and current energy use). This lack of information is even more apparent for renewable energies. It is indeed difficult to compare the potentialities for the different energy options due to the scattered validated information. Nevertheless, available data sources are in agreement in describing a difficult situation as far as access to energy is concerned.
The high share of rural population, coupled with the low ability and willingness to pay, the low per capita energy consumption and the high rate of non-electrified rural areas, has traditionally pushed rural communities to make use of locally available energy sources, mostly biomass from agriculture residues and forest ad savannah wood for their daily cooking and heating needs.
Renewable energy resources are diffuse in the territory and mapping their physical availability can only be the first step in understanding their exploitation especially for people without modern forms of energy in Africa. A deep knowledge of the existing and feasible energy infrastructures is fundamental for moving towards the assessment of the economically utilizable renewable energy.
Indeed, according to IEA data, 99.6% of the African population without electricity access is concentrated in Sub-Saharan Africa (SSA) countries, reflecting the great disparities in the different African regions caused also by the still unbalanced development of the energy production and transport infrastructures in the continent.
In summary, if properly exploited, renewable energies are a big opportunity for improving the currently very poor access to energy for rural communities.
Keywords: Access to renewable energy, current state of energy, exploitation, infrastructure, availability

1. Introduction

Energy is crucial in the fight against poverty, as it is among the greatest drivers of development. Ancient and modern civilizations rose on the back of energy [1]. From captive humans to coal and oil, energy has played a central role in human progress, as it enables mass production of goods and services [1]. A paradigm shift in transitioning to a new form of energy defines human progress as well as its quality of civilization. However, a step in achieving this progression does not happen until a society fully recognizes the heavy economic, social and environmental costs arising from the energy form it is using. While oil and coal are far more efficient than rudimentary energy forms, they also come with bouts of economic, social, and environmental costs. When a society is not prepared for a change, that society can continue to stick with what it has and knows best. This is true of South Sudan, as it seems to stick to oil, a form of energy that is not able to meet its needs in an efficient and sustainable manner. The African countries must prepare as there is an opportunity for them to transition to an efficient and renewable energy, and this can happen when they fully recognize the costs associated with the exploitation of fossil fuel and embarks on a full transition to renewable energy.

2. Access to Energy in African Countries

Compared to the rest of the world, there is a general shortage of energy related information in Africa (on potential of energy resources, actual installed systems and current energy use). This lack of information is even more apparent for renewable energies [2]. It is indeed difficult to compare the potential for the different energy options due to the scattered validated information. Nevertheless, available data sources are in agreement in describing a difficult situation as far as access to energy is concerned.

Fig. 1 shows the energy (top) and electricity (bottom) consumption per capita, in 2006 [3], to be compared with an International Energy Agency definition of an individual in electricity poverty when not having access to at least 120 kWh of electricity per year for lighting and other basic households needs.

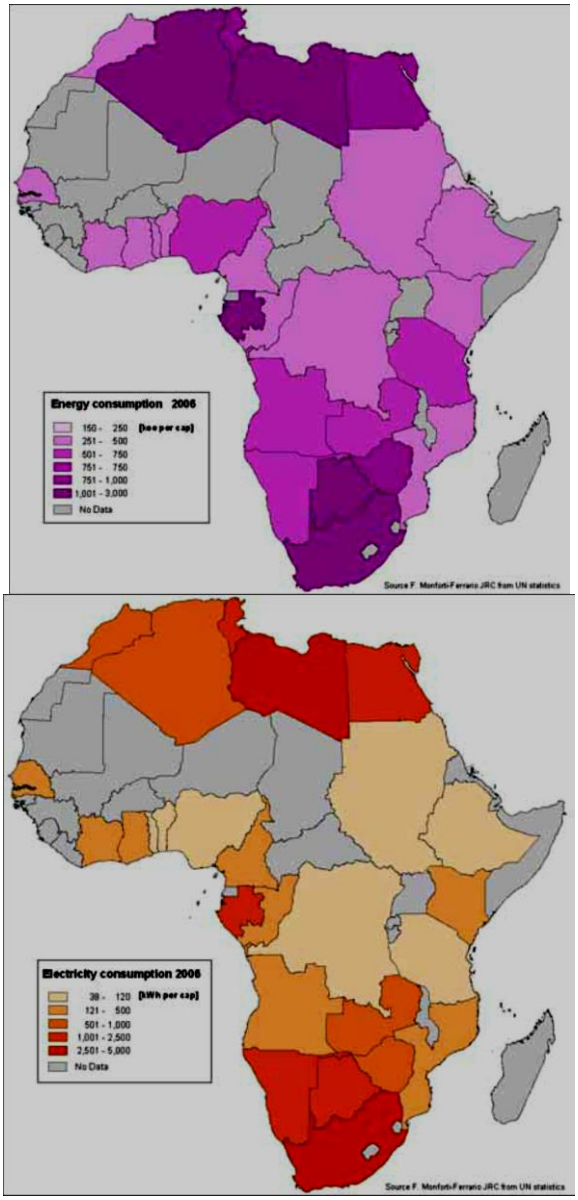

Fig. 1 Energy consumption (top – kgoe per capita) and electricity consumption (bottom – kWh per capita) in 2006 in several African countries

According to 2010 estimates, approximately 3 billion people worldwide rely on traditional biomass for cooking and heating, and about 20% of the world's population, 1.4 billion people, have no access to electricity [4] with 85% of those people living in rural areas. Up to a billion more have access only to unreliable electricity networks [5].

In the African continent, according to Alliance for Rural Electrification elaboration of IEA data [6], the overall amount of people without access to electricity has reached 589 million in 2008, with additional 9 millions of people with no access to electricity every year since 2002. Nevertheless, the electrification rate increased from 35.5% in 2002 to 40% in 2008. More in detail, the urban electrification rate has reached 66.8% in 2008 while the rural electrification rate was stuck to 22.7% in 2008 showing a very small increase from the 2002 figure of 19%. Considering that around 59.6% of people are estimated to live in sparsely populated rural areas [3], access to energy and especially electricity remains a major issue for most of the continent.

3. The current State of Renewable Energies in Africa

The high share of rural population, coupled with the low ability and willingness to pay (affordability), the low per capita energy consumption and the high rate of non-electrified rural areas, has traditionally pushed rural communities to make use of locally available energy sources, mostly biomass from agriculture residues and forest ad savannah wood for their daily cooking and heating needs.

Fig. 2 shows the share of total energy use coming from biomass and organic waste combustion (BOWC) in some African countries in 2006-2008 (top), and the longer 1990-2010 trend making more evident the deeply different use of mostly local biomass resources between Sub-Saharan Africa (SSA) (with the exception of South Africa) and northern Africa, with SSA using these energy sources for an average share of 57.6% of total energy needs in 2008 [7].

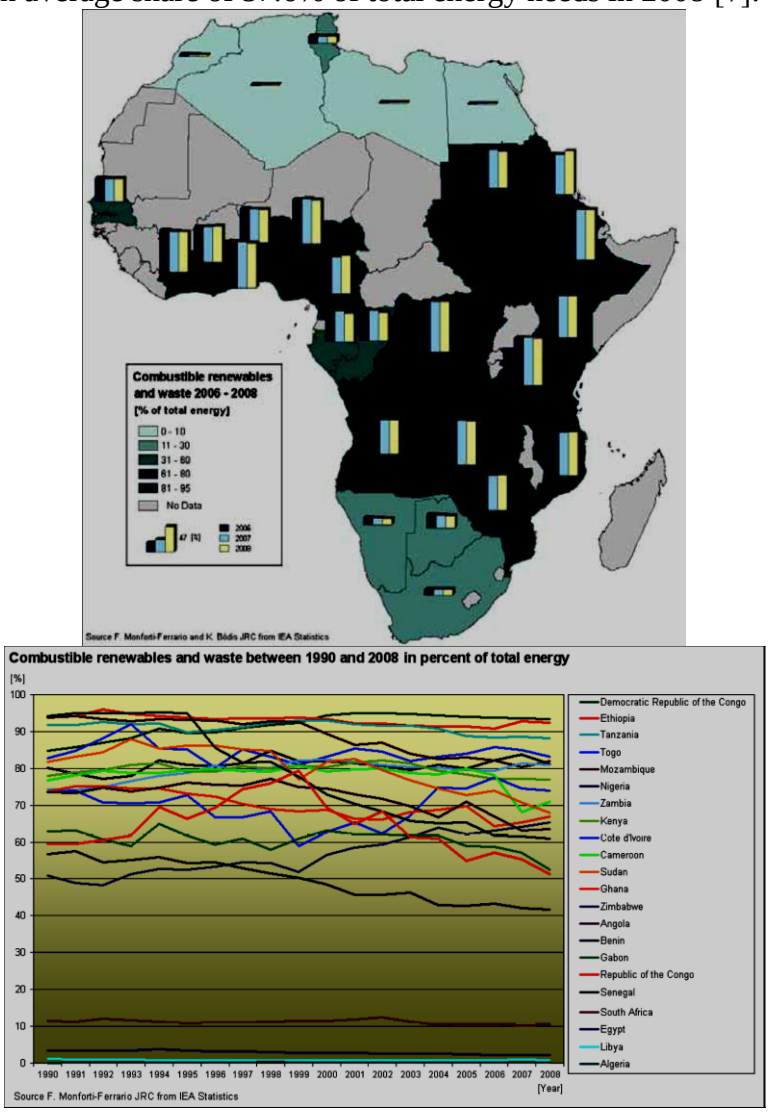

Fig. 2 Share of total energy use coming from biomass and organic waste combustion. 2006-2008 data (top) and 1990-2010 trends (bottom)

Table 1 below shows how in 2008 biomass and organic waste combustion in SSA are mainly used in residential sector and, conversely, how the residential sector is often almost totally dependent on these resources [7].

Table 1 Dependence of residential energy needs from BOWC in five SSA countries

Country	Share of BOWC used for residential needs - 2008	Share of residential energy needs covered by BOWC -2008
Dem. Rep. of the Congo	80%	99%
Ethiopia	100%	99%
Tanzania	85%	98%
Togo	90%	91%
Mozambique	90%	99%

Unfortunately local biomass and organic waste sources are often exploited in a non-sustainable way and burnt into non-appropriate stoves and oven, causing a diffuse problem of indoor air quality.
Fig. 3 shows the amount of renewable energy produced from solar, hydro, wind and geothermal sources in 2006-2008 and the similar 1990-2010 trends. It is worth noticing that among the six leading countries (Mozambique, Zambia, Namibia, Kenya, Ghana and Cameroon), five derive almost all their renewable energy from some large hydro plants while only one (Kenya) shows a relevant non-hydro renewable energy production coming from geothermal [7].

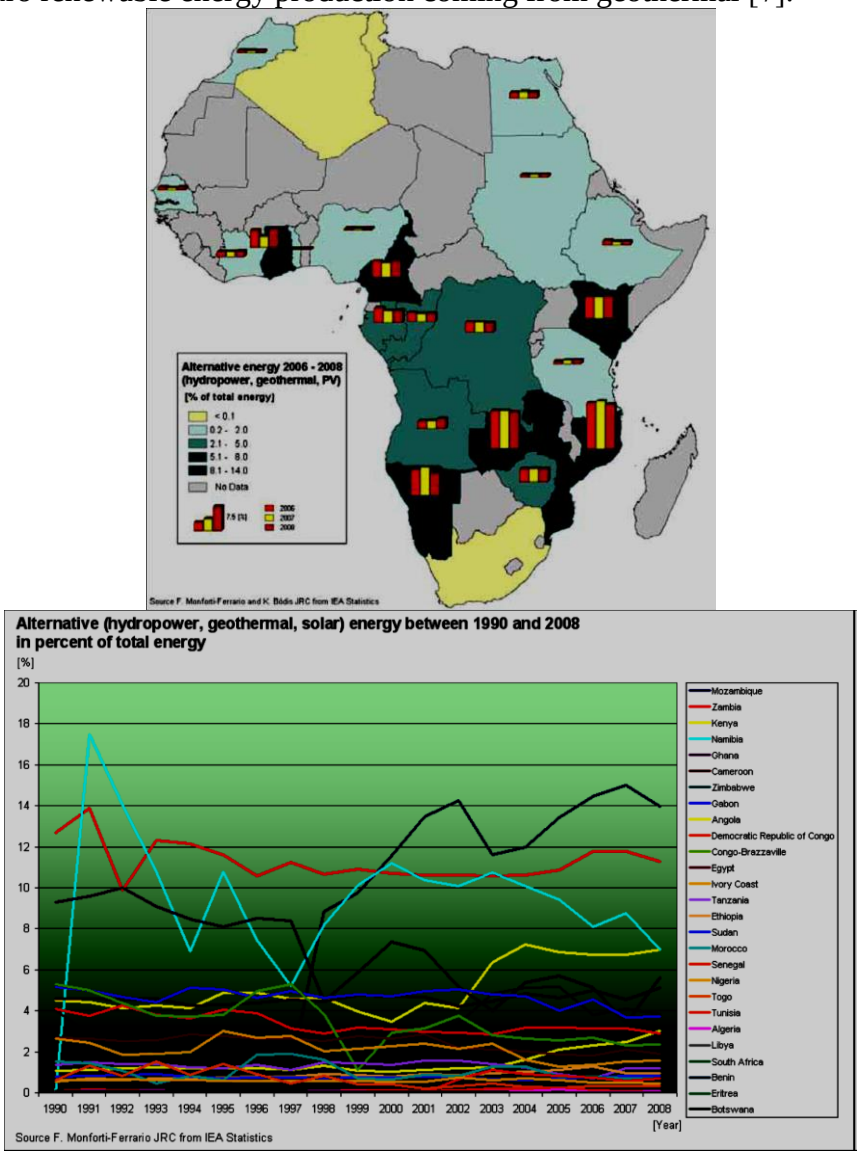

Fig. 3 Share of total energy use coming from wind, solar, hydro and geothermal sources. 2006-2008 data (top) and 1990-2010 trends (bottom)

4. Renewable Energy Exploitation and Infrastructure Availability in Africa

Renewable energy resources are diffuse in the territory and mapping their physical availability can only be the first step in understanding their exploitation especially for people without modern forms of energy in Africa. A deep knowledge of the existing and feasible energy infrastructures is fundamental for moving towards the assessment of the economically utilizable renewable energy.
Indeed, according to IEA data, 99.6% of the African population without electricity access is concentrated in Sub-Saharan Africa (SSA) countries, reflecting the great disparities in the different African regions caused also by the still unbalanced development of the energy production and transport infrastructures in the continent.
Fig. 4 shows the JRC elaboration of available data of the electricity grid in all African countries [8] and the location and type of the main power plants in Sub-Saharan Africa, as collected by JRC in the frame of the AFRETEP project (left) together with the population density of the African

continent [9]. The comparison of the two maps makes it evident how several areas of the continent are still well far away from relevant energy infrastructures even with non-negligible population density.

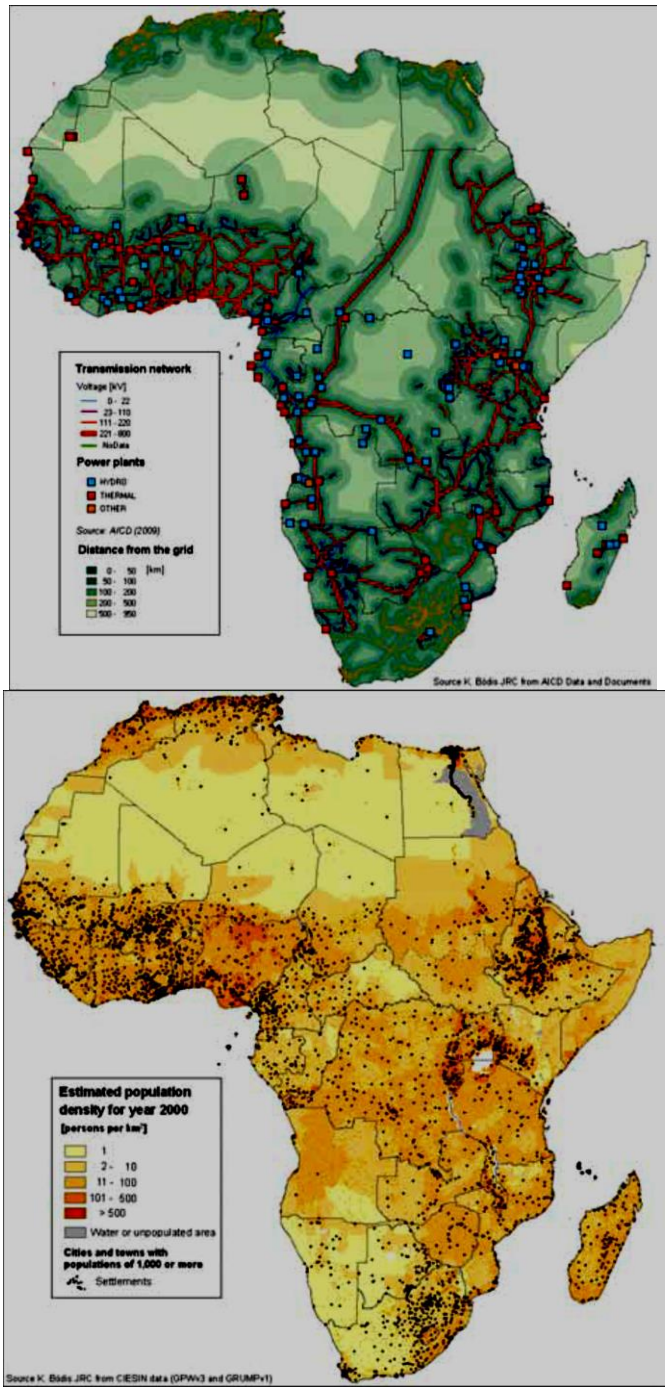

Figure 1.4 The geographical deployment and voltage capacity of electricity grid in African continent (yellow lines mean transmission/distribution grid existing but no data on capacity are available) and power plants in Sub-Saharan countries (top) and population density estimated in year 2000 in the African continent (bottom)

Moreover, one has also to notice that in Africa the population access to fossil energy sources too is not always easy. Fig. 5 [10] shows the accessibility map elaborated by JRC on the basis of available transport infrastructure data, showing the time needed to reach every area of the continent from the nearest town with more than 50,000 inhabitants. This map provides an overview of how long goods, including fossil fuels, need to travel from mid-size towns to reach dispersed rural areas: in case of fuels travelling by trucks the longer the travel time the higher the price of fuel and the smaller the total availability.

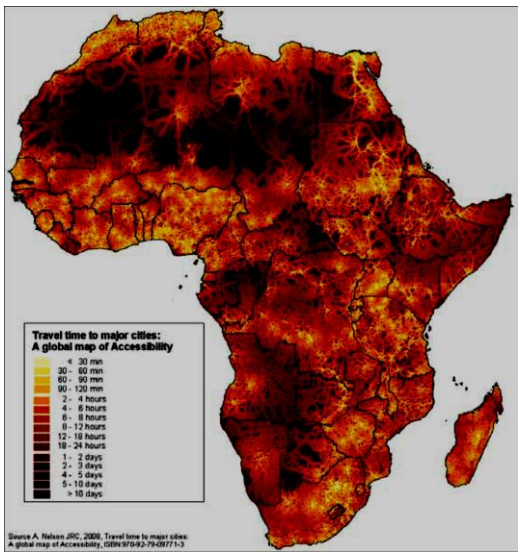

Fig. 5 Travel time from the nearest 50,000 towns in Africa

In summary, if properly exploited, renewable energies are a big opportunity for improving the currently very poor access to energy for rural communities.

5. Conclusions

It is recommend that in the short to medium terms, the government should establish an incentivized renewable energy micro-projects policy through a feed in tariff policy across the nation. Such a policy should culminate in a Micro-Projects Act that is able to : provide producers with certainty and legally guaranteed returns, set and specify safety and environmental standards for the producers, provide tax exemption and depreciation allowance on renewable energy equipment, and remove subsidies on diesel fuel and redirect them toward renewable sources.

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