



Business models and innovativeness of potential renewable energy projects in Africa



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ARTICLE INFO

Article history:

Received 5 September 2017

Received in revised form

8 January 2018

Accepted 7 February 2018

Available online 8 February 2018

Keywords:

Project

Renewable energy

Business model

Innovativeness

Africa

Investment opportunity

Local student perspective

ABSTRACT

This study provides an overview of potential renewable energy (RE) projects for Africa. Pan African University master students were asked by their lecturer to characterize African projects they had in minds in uniform tables. Items of the project investment plan include project synopsis, the sponsors, market analysis and strategy, project scope, regulation and environmental information, project costs, financial projections, business model, and project innovativeness. Students' RE projects are assessed with emphasis put on employed business models and project innovativeness. Criticalities for the implementation of these projects are discussed in African contexts providing outlook for future investment opportunities in the African continent. The work provides insights from the local students' perspective for the various stakeholders interested in RE project investments in Africa. Useful suggestions formulated directly by young Africans are presented which may contribute to improved risks management when these or other potential RE projects will be deployed. Inputs from local people on how they understand the process of implementing RE projects in Africa might be interesting for investors seeking information about suitable ways for RE project deployment. Students characterize local contexts and identify numerous barriers for deployment of RE systems in Africa. Overall, this study explains the potential lying in renewable energy harvesting in Africa, seeks to emphasize major barriers for implementation of RE projects as well as investigates investment opportunities to implement economically feasible RE projects for cleaner and climate friendly energy future of this continent.

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1. Introduction

Africa integrates three major opportunities that can make renewable energy (RE) projects economically viable: (1) very high

potential of renewable energy sources, (2) high energy prices in local energy markets and (3) growing demands due to accompanying population and economic growths in almost all countries. Besides, human capital is available in place for labor intensive RE

Abbreviations: AD, Anaerobic Digestion; CHP, Combined Heat and Power; CPV, Concentrated Photovoltaics; DNI, Direct Normal Irradiance; EIA, Environmental Impact Assessment; EKN, the Royal Netherlands Embassy; FiT, Feed-in Tariff; GDP, Gross Domestic Product; GHG, Greenhouse Gas; GIZ, Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH; IEA, International Energy Agency; IRENA, International Renewable Energy Agency; IRR, Internal Rate of Return; LCA, Life Cycle Assessment; MSW, Municipal Solid Waste; NPV, Net Present Value; O&M, Operation and Maintenance; PPA, Power Purchase Agreement; PV, Photovoltaics; R&D, Research and Development; RE, Renewable Energy; UV, Ultraviolet; IASS, Institute for Advanced Sustainability Studies; SREP, Scaling-up Renewable Energy Program; MEMD, Ministry of Energy and Mineral Development; NCE, New Climate Economy; REFiT, Renewable Energy Feed-in Tariff; GETFiT, Global Energy Transfer Feed-in Tariff.

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projects. The environment is still relatively clean, hence implementing clean energy sources will bring co-benefits such as eco-tourism, sustainable agriculture, cleaner water resources etc. [1]. The use of renewables can also reduce poverty and improve sanitation which are extreme problems in many African countries, especially in sub-Saharan. A major issue is very limited access to electricity for people in sub-Saharan African countries and this problem can be largely mitigated by developing RE systems. Moreover, there seems to be international political goodwill for supporting African continent development in a climate friendly way, e.g. by putting emphasis on increased low-carbon renewable energy penetration [2,3]. Other driving factors facilitating deployment of renewables in the African continent include: (1) domestic availability of resources, (2) potential to reduce import bills or increase revenues from export, (3) cost-competitiveness compared to newly-built fossil fuel power plants, (4) capability to displace expensive and polluting diesel-based micro-grids, (5) faster deployment of RE projects compared to nuclear and fossil fuel projects, (6) job creation and socio-economic development including poverty reduction especially in rural areas, and (7) low-carbon energy and environmental co-benefits, such as improved local air quality and water security [4].

In view of these drivers for economically viable development of RE projects in Africa the current RE penetration seems far from saturation meaning that there is a huge potential market. But the progress of development of RE systems in Africa is still slow. According to [5], over the period 2000–2012 sub-Saharan African per capita energy consumption was roughly constant even though per capita gross domestic product (GDP) growth in this time period was 3-fold. It means that per capita GDP growth did not trigger energy consumption growth in this period. Nevertheless, if funding is available and suitable policies are created RE deployment may accelerate on the long run. International Renewable Energy Agency (IRENA) expects that between 2013 and 2030 African modern renewable energy utilization will grow from 1.1 to 9 EJ/yr [6].

In this context, the current study has been undertaken in order to investigate and highlight business opportunities associated with RE projects in Africa. The research synthesizes project proposals suggested by Pan African University master of energy students. Some of these projects have attractive business models and are potentially innovative. It is important that most promising RE projects should be implemented first, because of good economic prospects and low associated risks. The implementation of the best energy projects might contribute to the economic development of Africa. Investments in these projects will contribute to infrastructure development [7] which can be shared for other uses. The more RE projects are deployed, the easier it is to deploy next projects. Consequently, development of many RE projects can trigger sustainable economic growth in Africa while enabling the continent to reduce greenhouse gas emissions as well as promoting climate change mitigation. In addition, the involvement of Pan Africa University students in this research initiative contributes to their training as future RE project developers, project skilled staff, supporters of policymakers and people influential in renewable energy matters. These young enthusiastic students also bring local knowledge from all parts of Africa thus enriching this RE projects overview with improved understanding of African contexts. All five economic regions of Africa have been represented by students with RE projects in Kenya, Rwanda and Uganda from the Eastern region of Africa, Cameroon from Central Africa, Ivory Coast, Nigeria and Senegal from the Western region, Egypt in the Northern region, and Zambia in the Southern region. The RE projects whose potential is analyzed include: solar, biomass, hydro and wind. Thus, the research highlights how various African RE projects can become economically viable options for investors and other stakeholders.

2. Research methods

During the academic course titled “Energy economics, finance and management” held at Pan African University, Institute of Water and Energy Sciences (including Climate Change), Tlemcen, Algeria [8], first year master students 2015/2016 (energy engineering track and policy track) obtained an assignment from their lecturer. The students were asked to describe one renewable energy (RE) project in an African country that may be considered as a business opportunity in the short and long runs and is potentially innovative. The students were asked to fill Table 1 describing items of the project investment plan and send it back to the lecturer.

Students participating in the course filled Table 1 and sent it back to the lecturer during the course. Some of these outcomes are utilized in this paper. Selected twenty students' RE projects are provided in Appendix 1.

In the next step the projects are assessed and outcomes are presented for each item of the project investment plan. Further, criticalities for the successful implementation of these and other similar RE projects are analyzed considering African contexts. Finally, the research is summarized by providing major concluding remarks and outlook for the future.

3. Assessment of Pan African university students' renewable energy projects for Africa

The students presented a large variety of RE projects, see Appendix 1 for detailed project descriptions. The suggested projects use different RE technologies and resources available across different African countries. The projects are of Solar, Bioenergy, Wind, and Hydro power. Most project ideas suggested by students are of Solar and Bioenergy. The total number of selected projects is 20. A total of 10 projects relate to Solar, 8 to Bioenergy, 1 to Wind, and 1 to Hydro. Solar projects present multiple investment opportunities and these projects can be quickly implemented and thus, if funding would be available, they could meet growing power demands in Africa. Bioenergy projects offer energy provision together with a productive solution to the increasing amount of waste in Africa mainly from agriculture, businesses such as mining and wastes generated by quickly increasing urbanization. Further, Africa has abundant solar and bioenergy resources, solar radiation are good for PV and CSP and bioenergy potential varies from industry to industry.

Many RE projects are intended to improve energy access for people living in both rural and urban areas and this will support economic development of the regions they are created for by using RE sources. Further, RE if utilized will support business development, improve productivity and promote green growth. Africa has vast market for RE projects and the projects presented here are the first of their kind in the regions they are suggested for, meaning they are potentially innovative. This comes with many benefits such as limited competition but also with challenges such as lacking sufficient infrastructure and policies.

Many African countries are truly open to foreign investments and have put in place policies to create a friendly environment for investors. Uganda for example has a Renewable Energy Investment Guide created by the Republic of Uganda's Ministry of Energy and Mineral Development in partnership with the Royal Netherlands Embassy (EKN, the Netherlands) and Deutsche Gesellschaft Für Internationale Zusammenarbeit GmbH (GIZ, Germany) [9]. This guide advises what every potential investor of Uganda must know and must have while planning their investment. It also gives a general overview of the country's geographic, political, economic and administrative environment outlining the status quo of the energy sector including the RE sector, the financial sector and the

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