EXAMINING POSSIBLE RELATIONSHIP BETWEEN CARBON FINANCE AVAILABILITY AND GROWTH OF WIND ENERGY

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Abstract

This paper evaluates the possible relationship between carbon fund availability and the growth of wind energy. This has become apposite considering global quest for renewable energies as a veritable option for carbon reduction and sustainable development. Whilst some extant literature blames delay in climate policy as an obstacle to green energy, others regard carbon finance availability as a booster to renewable energy. Raging argument is that similar to any other investment, renewable energy finance availability may mar or catalyse growth in renewable energy. Consequently, in this paper, a conceptual overview of carbon finance and renewable energy is undertaken and a test of the relationship between the World Bank carbon finance availability and wind energy growth is conducted. The result indicates a significant positive relationship between World Bank carbon financing and global growth in wind energy. The paper thus concludes that aside from policy options, renewable energy financing seems to be a contributory catalyst that may spur improvement in global renewable energy. The paper highlights that achieving green economic development in developing countries would depend, not only on climate policies alone, but also on sustainable financing. Hence government and private sources of funding is very desirable in achieving global green economic development, most importantly, for developing economies. The paper thus offers a research agenda on awareness creating for local and international sources of green energy for developing countries.

Keywords: Carbon Finance, Wind Energy, Renewable Energy, Sustainable Development, Green Economy

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1. Introduction

Wind energy generation has an important role to play in a country's and global future energy generation portfolios; similar to portfolio management, a proactive energy management should require that future exposure to unpredictable risks and volatility in fuel prices (which has already begun) may need diversification in a country's energy generation portfolio (Doherty et al, 2006; Blanco, 2009). According to the forecast of Global Wind Energy Council (GWEC, 2006), globally, wind energy is predicted to supply an amount of electricity – around 16% in 2020. For example, the rising electricity price in South Africa is partly because of a single energy generation portfolio which is heavily under pressure. Such rising prices invariably affect the sustainable livelihood of the poor which has a somewhat demeaning effect on sustainable economic development campaign. Wind energy is regarded as one of the cost-effective, scalable means of meeting the renewable energy standard (Nordman, 2009; Toke et al, 2008).

Despite the fact that Africa is behind other nations in wind energy investment (World Bank, 2013), there seems to be a global upward movement in wind energy production since the year 2000. Concurrently, within this period, there has also been a rise in the World Bank's carbon finance provision (World Bank, 2010). Intuitively, one may imagine that the rise in carbon finance availability may have some relationship with the global rise in wind energy. This paper attempts to explore this relationship with the hope of highlighting the importance of finance in wind energy generation in Africa.

The problem that warrants this article is that whilst some extant literatures blame delay in climate policy as the major obstacle to green energy, others regard carbon finance availability as a booster to renewable energy. Raging argument is that similar to any other investment, renewable energy finance availability may mar or catalyse growth in renewable energy. However, no known research has as yet looked at the relationship between the World Bank's carbon finance provision and growth of global wind energy, and the African wind energy imperative. Therefore this article wishes to look into this

apparently obscured relationship in the extant research literature and thus make a modest contribution to existing literature in renewable energy and financing.

In light of the above problem, this article hopes to answer the question about the *possible relationship between the World Bank's carbon finance provision and global wind energy growth*. Accordingly the aim of this paper is to examine the possible relationship between the World Bank's carbon finance facility and growth in global wind energy, and to highlight the implication for Africa wind energy and sustainable economic development.

This article is organised as follows: the next section presents a brief review of related literature; this is followed by method, analysis and contribution section. The final section is the conclusion.

2. Related Literature

Extant literature has looked into the factors that affect wind energy investment; these factors includes amongst others, market drivers such as government incentives, demand for green tariffs, mandatory renewable energy obligations, and low costs social factors such as land lease, public and local acceptance of wind energy (Wüstenhagen, et al. 2007; Jobert, et al, 2007; Gross, 2007; Nadaï, 2007).

Some other strand of literatures which have examined the financial aspects of wind energy inclined toward the cost and tariff implications (Awerbuch, 2006; Couture & Gagnon 2010; Wiser, 1997; Blanco, 2009); and on sources of funding; but little literature has sought to address the relationship between carbon finance and wind energy investment. Couture & Gagnon (2010) evaluated the effect of feed-in tariff structure (FIT) on wind energy investment, and find that FIT is one of the most effective ways of enhancing renewable energy development at a reduced cost of investment(Hiroux and Saguan, 2010)[1].

In other research, Wiser (1997) adopts the conventional cash flow method to evaluate the effect of types of financing structures on the cost of wind energy. Wiser (1997) highlight that utility ownership of wind power plants reduces the cost of wind energy – cheaper than purchasing from private suppliers. Also, according to Awerbuch (2006) using the portfolio theory, indicate that effective mix of energy portfolio that incorporates a balance of wind energy and other renewables would ensure reduced energy cost and energy security. In his economics of renewable energy, Blanco (2009) stress that reduction in renewable energy production cost would largely depend on renewable energy policy in existence.

(Corsatea et al, 2014) examined the effect of private and public funding on the effectiveness of selected wind turbine manufacturing companies. They find that public support enhances credit access for wind energy companies, and that corporate bonds are an important source of finance for wind technology research and investment. They thus stress that corporate bond is very essential in sustaining the operation of wind energy companies. Debt is said to be a more common source of financing wind energy with the argument that debt servicing costs are cheaper than equity (Corsatea et al, 2014; Pollio, 1998; Harper et al, 2007). However private funding is seen to be limited by market uncertainties associated wind energy, and this accounts for the reason why private funding is lower in the early stages of wind energy projects (Corsatea et al, 2014). Also according to Corsatea et al, (2014), the risk of wind energy technology seems to scare financiers like the banks in supporting wind energy projects during the early stages of wind energy. This makes it imperative for public or government financial support to be strong and available during the early stages of the wind energy life cycle (Murphy and Edwards, 2003).

In their five case study review of renewable energy policies, Wiser and Pickle (1998) finds that one of the reasons why renewable energy policies are less effective and efficient is that renewable energy project financing process is often overlooked in the early stages of renewable energy policies. Hence Wiser and Pickle (1998) highlight that renewable energy policies that show weak durability attract more financing costs. It is very vital therefore to integrate viable financial planning from the early stages of renewable energy policies since according to Lewis (2010) carbon finance is crucial towards decarbonising investment in energy infrastructures.

Lewis (2010) admits that the use of wind energy is crucial towards emission reduction, but the disagreement over the role of developed nations in financing this scheme and the nature and/or structure of financing is still posing a set-back to effective wind energy growth and development in developing nations. Development of wind energy is seen to support sustainable economic development of countries as it assists, amongst others, in boosting local job creation, zero carbon emission of energy generation, lease payment to landowners – yielding direct economic benefit to rural dwellers, and the provision of electricity to rural dwellers (see e.g. Vidal-Legaz et al. 2013; Mulvaney et al. 2013).

Given huge sustainable economic development imperative of wind energy Dincer (2000), Lund (2007), Bugaje (2006), renewable energy has been receiving greater attention and funding from the World Bank (Martinot, 2001; Lewis, 2010). The following section presents the World Bank's data on renewable energy support – with particular emphasis on wind energy and concomitant development in wind energy.

3. Methodology

The approach is a combination of qualitative and quantitative design using archival data from the

World Bank (WB) Carbon Finance Unit and the Global Wind Energy Council (GWEC). The quantitative analysis makes use of simple regression to examine possible relationship between WB carbon finance provision and growth in global wind energy; the qualitative analysis is made up of a description of trends in carbon finance and growth of wind energy.

Figure 1 below shows the priority accorded to renewable energy at the World Bank; out of 100% available carbon finance projects at the World; renewable energy has a greater share of 31%. This large share has been made possible by the growth of carbon funds at the World Bank (see Table 1).

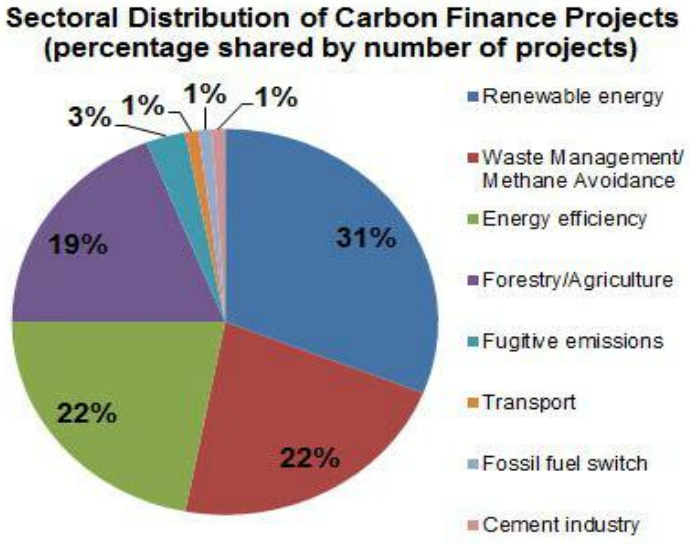

Figure 1. World Bank Sectorial Distribution of Carbon Finance Projects

Source: from: The World Bank (2013, P. 2) Climate Finance: Sectorial distribution of carbon finance projects, available at: http://www.worldbank.org/en/topic/climatefinance (accessed 30 Dec 2013)

Table 1. Growth of Carbon Funds at the World Bank

Year	US$ Mill
2000	145
2001	145
2002	180
2003	217
2004	315
2005	643
2006	1621
2007	1867
2008	2245
2009	2358
2010	2388

Source: Compiled from: World Bank (2010, p.11) Carbon finance at the World Bank: carbon finance for sustainable development - 2010 annual report, available at: http://siteresources.worldbank.org/INTCARBONFINANCE/Resources/64897_World_Bank_web_lower_Res..pdf (accessed 30 Dec 2013)

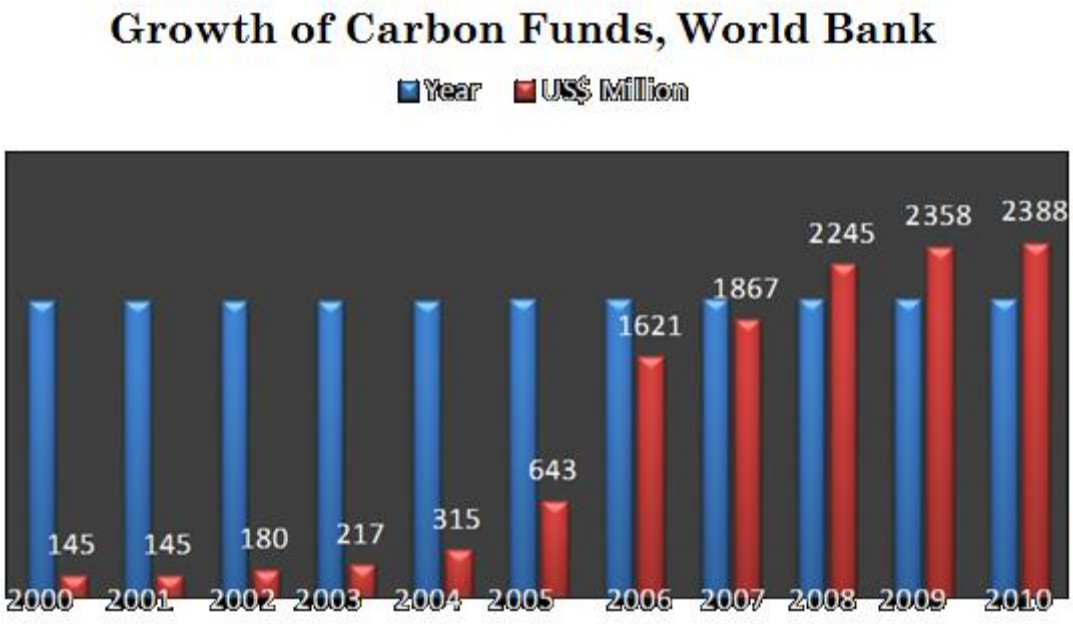

Figure 2. Growths of Carbon Funds at the World Bank

Source: Author's graph from data in Table 1

Regression Analysis of the Possible Relationship between World Bank's Carbon Finance and Growth of Wind Energy

The simple model for the relationship sought: $Y_i = a + bX_i + e$

H0: there is no relationship between carbon finance and growth of wind energy
H1: there is a relationship between carbon finance and growth of wind energy

Hypothesis:

Table 2. Growth of Carbon Finance and Wind Energy (2000 – 2010)

Year	US$ Mill	Wind Energy MW
2000	145	17400
2001	145	23900
2002	180	31100
2003	217	39431
2004	315	47620
2005	643	59091
2006	1621	74006
2007	1867	93639
2008	2245	120267
2009	2358	158864
2010	2388	197686

Source: Adapted from:
Global Wind Energy Council –GWEC (2012, p. 3) global wind statistics 2012, available at: http://www.gwec.net/wp-content/uploads/2013/02/GWEC-PRstats-2012_english.pdf (accessed Dec 30 2013). And World Bank (2010, p.11) Carbon finance at the World Bank: carbon finance for sustainable development - 2010 annual report, available at: http://siteresources.worldbank.org/INTCARBONFINANCE/Resources/64897_World_Bank_web_lower_Res..pdf (accessed 30 Dec 2013).

Table 3. Regression Output of the Relationship between World Bank Carbon Finance and Growth of Global Wind Energy

Relationship between World Bank Carbon Finance and Growth of Gobal Wind Energy (in MW)								
Regression Statistics								
R	0.923009632							
R Square	0.85194678							
Adjusted R Square	0.835496423							
Standard Error	23814.51995							
Observations	11							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	29371138571	2.94E+10	51.78895159	0.000051027			
Residual	9	5104182244	5.67E+08					
Total	10	34475320815						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	17765.9781	11075.90974	1.60402	0.14317295	-7289.47044	42821.427	-7289.470443	42821.42665
US$ Mill	55.06254049	7.65134325	7.196454	0.00005102	37.75399955	72.371081	37.75399955	72.37108142

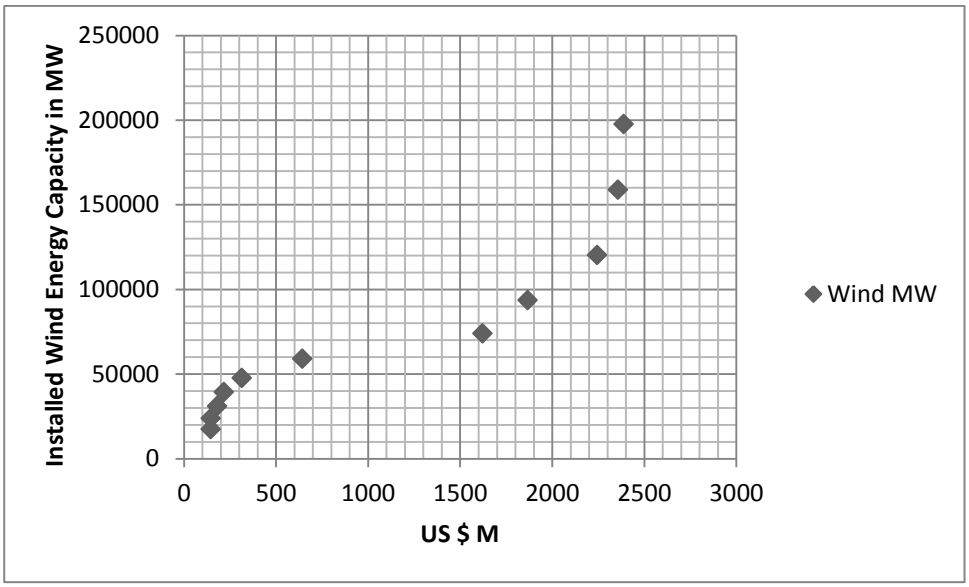

Figure 3. Scatter Plot of the Relationship between World Bank Carbon Finance and Growth of Global Wind Energy

Tested at 5% significance level, the F statistics indicates there is a significant positive relationship of less than 1% (whilst holding the random variables constant at 0). The scatter line on Figure 3 also indicates that a relationship exists between carbon finance provision and growth of wind energy.

The implication therefore is that availability of carbon finance may likely spur growth in wind energy; this thus seems to be a possible indicator (amongst others) of why Africa lags behind other nations in wind energy. On the other hand, it can also be seen from the scatter plot that the scatter points does not all fall on a straight line, indicating the effect of other random variables. Accordingly this article suggests an agenda for further study to employ a multiple paradigm (that considers the random variables) to look for other variables aside carbon finance availability that may also spur growth in wind energy.

Implication for Africa's Wind Energy Development

It can be seen from the foregoing that there is some degree of relationship between carbon finance availability and growth of wind energy. Data from the Global Wind Energy Council (GWEC, 2012) indicates that Africa is behind the rest of the world in wind energy installation. The financial implication of wind energy may likely be the reason why Africa has the least share of the global wind energy statistics (see table 4 below, compiled from the Global Wind Energy Council [GWEC], 2012):

Table 4. Installed Global Wind Energy as at End of 2012

REGION	INSTALLED WIND POWER CAPACITY (MW) end of 2012
Africa & Middle East	1 135
Asia	97 810
Europe	109 237
Latin America and Caribbean	3 505
North America	67 576
Pacific Region	282 482

Source: compiled from Global Wind Statistics – Global Wind Energy Council (2012, P.2)
Available at: http://www.gwec.net/wp-content/uploads/2013/02/GWEC-PRstats-2012_english.pdf

The low capacity of installed wind energy in Africa may not be surprising as renewable energy involves a high cost of capital (Foster-Pedley & Hertzog, 2006) and thus creates a limitation to Africa wind energy investment. Hence meeting the needed financial requirement is admitted to be part of the obstacles facing wind energy development in Africa (Suberu et al. 2013; Karekezi et al. 2003).

And this problem is made worse by very little regional financial support for wind energy, thus (Ackermann & Söder, 2002; 2000) suggest that weak financial support for wind energy contributes to the slowness in Africa's wind energy development. The low financial input to Africa wind energy is made clear from the 2013 publication of *Global Trends in Renewable Energy Investment* by the Frankfurt School-UNEP Centre/BNEF (2013) – see Table 5 below.

Table 5. Global Trends in Renewable Energy Investment 2012 Data Table, $Bn

Region	2012 Renewable Energy Investment $Bn
America	50.9
Europe	79.9
Africa & Middle East	11.5
Asia	102.1
Total as at 2012	244.4

Source: compiled from: Frankfurt School-UNEP Centre/BNEF (2013, p. 16) Global Trends in Renewable Energy Investment 2013, available at: http://www.unep.org/pdf/GTR-UNEP-FS-BNEF2.pdf (accessed Dec 24 2013).

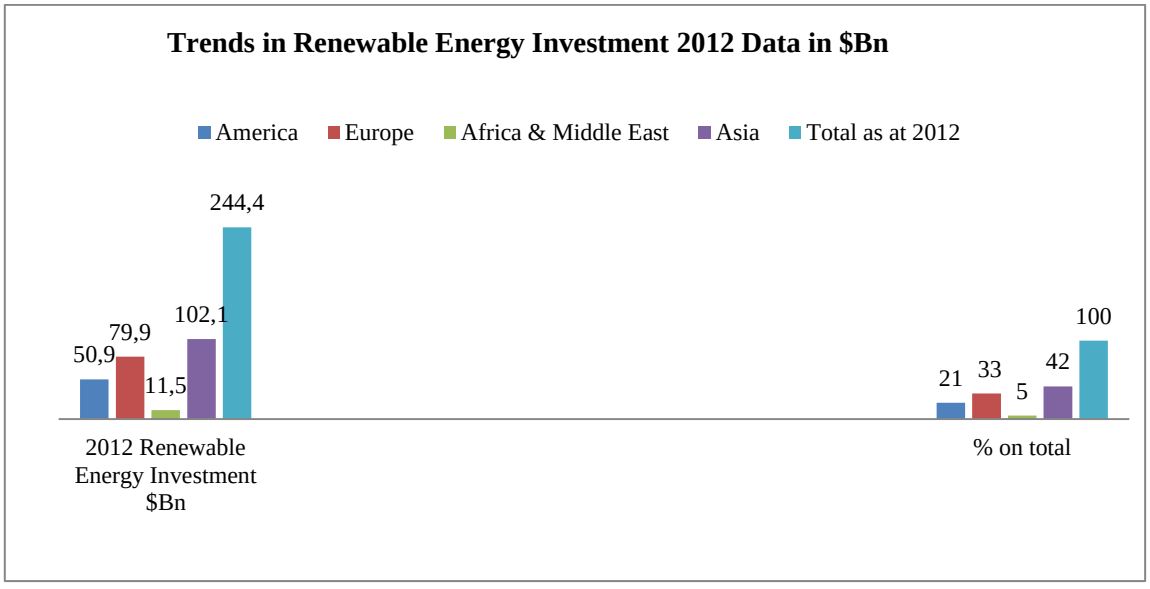

Figure 4. Bar Graph of Trends in Renewable Energy Investment 2012 Data in $Bn

Source: Author's chart with data derived from Table 4

Overall the foregoing data indicate that Africa is indeed behind other nations in financial investment in renewable energy. This may apparently arise due to weak financial support which could be either because

there is insufficient renewable energy finance for Africa or because Africa is not taking advantage of the international and regional renewable energy finance options (NEPAD-OECD Africa Investment Initiative, 2009). This paper thus makes a contribution by offering an agenda for further research to investigate aside from finance, other possible courses of delay in Africa's wind energy development and in general, Africa's renewable energy development.

Conclusion

This paper examined the possible relationship between the World Bank carbon finance facility and the global development in wind energy. The paper adopted a combination of literature review and as well, made use of and analysed quantitative data from the database of the World Bank carbon finance and the Global Wind Energy Council. The literature confirms that carbon finance availability is an important factor that may boost the development and growth of wind energy. Again the simple regression analysis of the relationship between the World Bank carbon finance and growth of wind energy indicates a significant positive relationship.

Furthermore, a descriptive analysis of data from the Global Wind Energy Council on the Installed Global Wind Energy as at End of 2012, and from the Frankfurt School-UNEP Centre on the Global Trends (in billion Dollars) of Renewable Energy Investment indicate that Africa is indeed behind other nations in wind energy investment and production. The implication is that renewable energy policies in Africa should be made to incorporate veritable financing structures. It is found that public funding is very essential during the early stages of the life cycle of wind energy; hence the governments may assist wind energy companies during the initial stages of wind energy technology and/or investment. Accordingly achieving green economic development in developing countries would depend, not only on climate policies alone, but also on sustainable financing. Hence government and private sources of funding is very desirable in achieving global green economic development, most importantly, for developing economies like Africa. The paper offers a research agenda on awareness creating for local and international sources of wind energy finance for Africa; it also recommends further research to look closely at other factors aside from finance that may spur wind energy development in Africa, this is important to assist in strengthening wind energy policies in Africa

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