FINANCIAL RISKS OF FOSSIL FUELS AND THE CLEAN DEVELOPMENT MECHANISMS: PERSPECTIVE FROM EAST AFRICA

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ABSTRACT

Continued use and investment into fossil fuels pose significant global financial risks to fossil fuel companies and the global economy. With commitment by the international community to the unequivocal target of stopping the earth's atmosphere from warming by more than 2°C, these investments in costly ventures will clash with international climate goals and may never be viable. As the world increasingly limits carbon emissions and moves to alternative energy sources, investments in fossil fuels may take a huge hit. Despite the growth in the fossil financial market in recent decades, energy undertakings could lose value on stock exchanges, when investors realise that a large part of fossil fuel reserves cannot be burned, leading to a carbon bubble. A divestment movement in fossil fuels, concerned with effects of fossils in the global climate system, is taking shape to discourage investments in fossil fuel companies. East African countries of Tanzania, Kenya and Uganda are amenable to these risks, having discovered substantial and commercially viable quantities of oil, gas and coal.

Key words: climate change, stranded assets, carbon emissions, carbon bubble, financial risk

INTRODUCTION

Mounting scientific evidence has shown that climate change, involving changes in the global weather patterns, is becoming severe and must be addressed to reduce its impact in the world economy (Doran & Zimmerman, 2013; Oreskes, 2004; Sommerville, 2012). Scientists, through the Intergovernmental Panel on Climate Change (IPCC), have reached a consensus that the warming of the climate system is attributable to human actions (IPCC, 2007). Anthropogenic greenhouse gases (GHGs), the main catalysts of global warming, have been shown to be a result of human activities, mainly the combustion of fossil fuels and land use (Pachauri *et al.*, 2014). Though there are skeptics as to the existence and causes of climate change (Lindzen, 2012; Pielke, 2010), there is a general agreement that to combat global warming and hence climate change, urgent action needs to be taken to reduce or scale down the emission of greenhouse gases (Wara & Victor, 2008; Margulis *et al*., 2010).

Studies suggest that energy use, especially the burning of fossil fuels for industrial and home energy use, is a major cause of the increase in GHGs (Collins, 1991). The burning of fossil fuels releases carbon dioxide (CO_2) into the atmosphere, which thickens the layer of greenhouse gases surrounding the atmosphere, making the earth warmer (Anderegg *et al*., 2010). The global warming in effect, contributes to changes in global weather patterns leading to climate change (Le Treut *et al.*, 2007). IPCC (2007) reported that CO_2 is the major contributor to global warming with 77% of total GHGs while other gases, like methane and nitrous oxide contribute 14% and 8% respectively. Given the effects of fossil fuels on climate change and the fact that they are expected to be depleted over time, governments, scientists and investors have a common interest in identifying the most efficient and reliable energy sources to sustain future growth (Trainer, 2013; Linares *et al.*, 2006).

The threat of irreversible and dangerous climate change presents a significant challenge for governments, businesses and communities across the world. Researchers estimate that unabated climate change is estimated to cost as much as 20% of global GDP (Stern, 2008; IPCC, 2015). Stern (2008) estimates that without urgent intervention, the overall costs and risks of climate change would be equivalent to losing at least 5% of global

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GDP each year, now and forever. Therefore, scientists, economists and policy makers have advocated for prompt action to avoid the worst impacts of global warming (Gore, 2006).

A variety of responses have been suggested to help reverse the trend of global warming including education and awareness raising, improvements in energy efficiency and measures to stimulate the deployment of low-carbon technologies (Labatt & White, 2011; Stern, 2008; IPCC, 2007). But, a key policy requirement is carbon pricing – assigning a cost to emissions of greenhouse gases – through taxation, regulation, and/or emissions trading (Cleetus, 2008). It would make it untenable to keep on emitting and pay, which is in turn expected to reduce the use of fossil fuels. The development and deployment of renewable energy across the world is therefore expected to play a major role in resolving the climate problem.

Through the Paris Climate Agreement of 2015, the international community has committed itself to an unequivocal target of preventing the Earth's atmosphere from warming by not more than 2^0C by the end of the century (IPCC, 2016; Jacobs, 2016). Major carbon emitters such as the USA and China, who had not initially ratified the Kyoto Protocol, were part of the agreement though the US has now confirmed its decision to opt out of the agreement (EPA, 2017). The 2^0C target refers to the rise in temperature relative to pre-industrial levels. To achieve this target, more finances have to be availed to position the world into a clean development mechanism (Rogelj *et al*., 2016).

Economists estimate that global additional investment and financial flows of over USD 200 billion will be required annually up to 2030 to return global greenhouse gas (GHG) emissions to current levels (Buchner *et al*., 2011). An additional USD 100 billion per year will be needed to de-carbonise developing countries and set them on a clean path to development (Bastianin *et al.*, 2010). The International Energy Agency estimates that the power sector alone would need an estimated USD 30 billion per year between now and 2030 to transition to a low carbon pathway, in form of investments in renewable or low carbon energy, coupled with significant reduction in fossil fuel use (IEA, 2015).

QUANTIFYING THE RISKS OF FOSSIL FUEL INVESTMENTS: THE CARBON BUBBLE

Studies show that positioning the world to a low carbon path way would require significant reductions in the use of fossil fuels (Mulugetta & Urban, 2010). However, investing in energy companies, especially those dealing with oil and gas, has been good business for investors in recent years (Weber & Perrels, 2000). Moreover, everything people do requires energy and because of increase in world population, energy demand is expected to grow (Asif & Muneer, 2007). Henderson (2000) also reports that investing in energy gives one opportunities to shape the future while earning income. The demand for energy can also be attested by the fact that even with decline in global oil prices, shares of energy companies, especially multinationals such as BP and Shell, have continued to do well (Olah *et al*., 2011).

Research shows that continued investment in fossil fuels to power industrial and domestic use possesses a number of risks to investors (Schmidt, 2014). Asif and Muneer (2007) report that fossil fuel reserves are finite, and are expected to be depleted over time. EIA (2015) provides the global total fossil fuel reserves at 892 billion tonnes of coal, 186 trillion cubic meters of natural gas, and 1,688 billion barrels of crude oil. Although these numbers seem large, at today's level of extraction, it is estimated that proven reserves of coal would be exhausted in 113 years, the last cubic metre of natural gas in 2069, and the entirety of crude oil reserves by 2067 (Fossil Free, 2013). The depletion of these resources would render most of the assets, including shares in oil and gas companies, completely worthless.

The implementation of the Paris Climate Agreement, which calls for reduction in carbon emissions even from developing countries, is likely to strand most of the fossil fuel reserves (Caldecott & McDaniels, 2014). Stranded assets are those that lose value or turn into liabilities before the end of their expected economic life (Lee & Ellis, 2013). The primary concern for investors is that increased regulation of carbon emissions and related market forces will effectively render a large portion of known fossil fuel reserves unburnable (Carbon Tracker Initiative, 2013). Stranded fossil fuel investments would place a significant amount of shareholder value at risk, as the valuations of major energy companies are based in large part on the quantity of fossil fuel reserves in their possession (Carbon Trust, 2015). According to EIA (2015), there are estimated USD 20 trillion worth of proven reserves of coal, oil and gas in the world, which would significantly affect the world economy if they were to be stranded. PricewaterhouseCoopers (2014) estimates that the principal energy companies could lose between 40% and 60% of their stock exchange value if the 2^0C target is enforced.

Researchers also project that fossil fuel companies could be exposed to an economic stranding of their assets, a situation where they run the financial risk of losing value through oil price fluctuations (Caldecott *et al*., 2014). Data on oil and gas prices from Organisation of Petroleum Exporting Countries (OPEC) oil prices have been falling since 2014, widening the economic debate on economic viability of depending on oil and gas. For example, certain oil types, such as oil sands and shale oil break even at USD 80 per barrel or higher and of late, these assets have become loss-making (Reboredo *et al.*, 2014). Fossil Free (2016) also points out that fossil fuel investments are a risk for investors because of underperformance against benchmarks, which would involve quantification of risk factors to ring-fencing fossil fuel investment from equity portfolios.

Studies also have found that, globally, the market value of oil and gas companies has dropped by over USD 580 billion since 2014 (Fossil Free, 2016). Economic projections point out that in future, the risks of fossil fuel asset stranding could come from energy efficiency and advancements in renewables, battery storage and enhanced oil recovery (Ansar *et al*., 2013). Thomas (2008) also finds that enhanced oil recovery could increase the amount of crude oil that can be extracted from an oil field through the implementation of certain techniques. Although these drivers would impact demand for some fossil fuels, the timing of such structural events is difficult to predict. Begos and Loviglio (2013) find that the challenge facing investors is to devise a strategy around the stranded assets theme that captures both climate commitment and fiduciary duty.

Economists and policy makers are concerned with the global financial risks posed by fossil fuel companies investing in costly ventures that clash with international climate goals. For example, the Group of Twenty forum for governments and central bank governors from 20 major economies (G20) is concerned that a $6 trillion wave of investment into the nexus of oil, gas, and coal since 2007 is based on false assumptions, leaving companies with an overhang of debt and stranded assets that cannot easily be burned under CO_2 emission limits (G20 Communiqué, 2012).

Analysts from leading banks in the world, including the World Bank, Bank of England, HSBC and Citigroup have also warned that the vast majority of fossil fuel reserves are unburnable if climate change is to be limited to 2^0C, as pledged by world governments. Banks and economic researchers have specifically warned that insurance companies could suffer huge portfolio risks if their investments in fossil fuel companies are rendered worthless by action on climate change, leaving them with stranded assets (World Bank, 2014; Carbon Tracker Initiative, 2013). The World Bank (2015) has also stressed to financial regulators the need to address the systemic risk associated with carbon-intensive activities in their economies as soon as possible.

Researchers argue that the adoption of ambitious climate policies would likely lead to investors pulling their investments out of fossil fuel companies stocks, potentially bursting the bubble (Ritchie & Dowlatabadi, 2015). The carbon bubble is the financial risk exposure to fossil fuel companies that they would experience in impairment of assets stranded by policy, economics or innovation (Weyzig *et al.*, 2014). The carbon bubble describes a possible bubble on financial markets when investors pump their money into fossil energy companies because they believe that it will remain possible to sell their fossil fuel reserves in future (Griffin, *et al*., 2015). This drives up share prices, which encourages yet more investors to invest in these companies (Jakob & Hilaire, 2015). When they realise that not all of the reserves can be burned because of global climate targets, a sudden panic may break out on the markets. This would make investors withdraw their money and the bubble would burst (Leaton, 2012; Victor *et al.*, 1998). Studies show that investors are overly concerned that continued investment in exploration for, and processing of, oil, gas and coal could make them lose billions of dollars of stranded assets (Jakob & Hilaire, 2015). The question therefore is: "How much more of the earth's fossil fuels can we extract and burn in the short- to medium-term future and still avoid severe global warming?" (Eastin *et al.*, 2011).

Studies find that as the world comes to a consensus on the impact of carbon emissions on global climate change, better and cleaner energy sources are gaining more focus (Burian & Arens, 2014). The realisation of the financial and environmental implications of carbon emissions has driven a lot of enthusiasm on the requirement of a clean development mechanism (Röttgers & Grote, 2014). Burian and Arens (2014) reports that a clean development mechanism would provide low- and middle-income countries, such as those in East Africa, with an alternative means to development without endangering the environment. Solar energy, wind power and moving water, ocean tide, geothermal power are all traditional sources of alternative energy that are making progress in delivering clean and sustainable energy. Renewable energy enthusiasts believe that the world can fully run on this clean energy by year 2050 (Trainer, 2013). However, it remains to be seen how such a mechanism can help

this countries achieve faster growth, without depending on fossil fuels, as did many of the industrialised countries.

REGULATORY INTERVENTION ON CARBON EMISSIONS

Scientific evidence adduced by IPCC (2015) shows that global warming is unequivocally caused by human activities. Van der Linden *et al.* (2015) also warn that the planet is already on track to experience more severe consequences from global warming than previously projected. Studies on global warming therefore suggest that regulatory interventions have to come sooner, rather than later and in a more dramatic way, if we are to save the planet. The scientific community also enumerates the impacts and future risks of global warming and recommends options for mitigation and adaptation (IPCC, 2015). One of the clear recommendations is that the world has the means to limit climate change and build a more prosperous, sustainable future, if only human activities that increase carbon emissions could be regulated (IPCC, 2015).

Regulation of carbon emissions from burning of fossil fuels has been in place since the enactment of the Kyoto Protocol in 1997, and its eventual coming into force in 2005 (UNFCCC, 1997). The protocol was a legally binding agreement under which industrialised nations agreed to cut their collective emissions of greenhouse gases by 5.2% compared to the year 1990 levels (UNFCCC, 2007). Of the three flexibility mechanisms created by the protocol to enable Annex I Parties meet their emission limitation commitments, the clean development mechanism was meant to help developing countries transition to clean sources of energy through sale of carbon credits from emissions reduced by their projects. The other two, the International Emissions Trading (IET) and the Joint Implementation (JI) allow Annex I Parties to trade their emissions and implement projects jointly with any other country (UNFCCC, 1997).

The Kyoto Protocol, which initially targeted the period from 2008 to 2012, was extended to 2020 at Doha, Qatar and has seen the launch of many emission trading systems to regulate greenhouse gases (Lohmann & Sexton, 2010). It has since been replaced by the Paris Climate Agreement of 2015, which was ratified by almost 200 countries (Clémençon, 2016). The agreement recognises the use of carbon markets by countries using internationally transferred mitigation outcomes to implement their Intended Nationally Determined Contributions (INDCs) and establishes a new mechanism to succeed the Kyoto Protocol's Clean Development Mechanism, which generates tradable emission offsets (UNFCCC, 2015). It also promises to ramp up climate financing by USD 100 billion by 2020 for developing countries, in line with the 2012 Cancun commitment. However, in a move that is significant for Africa, the agreement also altered the provisions of the protocol to developing and developed countries, allowing developing countries to contribute to climate mitigation efforts as well (Rogelj, 2014).

Through the clean development mechanism, emission trading has been institutionalised through carbon markets (Burian & Arens, 2014). The carbon markets have been rapidly adopted as policy solutions to climate change, since the ratification of the Kyoto Protocol. However, even countries that were not initially signatories to the protocol have now launched emission trading. Cap and trade markets are now functional in over 40 countries, including the US and China. The European Union (EU) which has by far the largest and most robust emission trading system, is currently reforming its Emissions Trading System (ETS) and additional reforms are expected to be forthcoming (Linares, *et al.*, 2014).

The prospects of carbon markets for Africa have long been heralded by the World Bank, among others, but little of the money arrives on the ground. Evidence shows that Africa, and indeed East Africa, has not used the carbon markets like other developing countries in Asia and Latin America. For example, out of the total 8,814 projects registered by CDM 2014, only 261 are from Africa, a mere 3.0% compared to Latin America and Asia pacific that hold 95%. Moreover, to date, no country in Sub-Saharan Africa has put in place a price on carbon. Although many African countries have put in place national regulations on emission of carbon dioxide and other greenhouse gases, the CDM has not been beneficial to Africa (World Bank, 2011; Mulugeta, 2012).

Studies show that through the implementation of a CDM envisaged under the two climate agreements, governments can affect the fortunes of fossil fuel companies (Linnenluecke *et al*., 2015). The governments can do this in many ways for example, carbon pricing, limiting carbon emissions through direct taxation or regulation, and restricting horizontal drilling and hydraulic fracturing (Bullard, 2014). This would make it extremely expensive to develop some of their proven reserves.

Due to concerns over climate change, the development of oilfields located in sensitive environments is also likely to be more tightly regulated going forward, especially after major environmental disasters by oil companies such as British Petroleum and Shell (Brown, 2015). Because of increased costs of production, it would potentially force companies to abandon some assets (Aldy & Stavins, 2012). Moreover, across the world, market regulators are increasing disclosure requirements as concerns about the environment mount (Wangombe, 2016). Publicly traded companies, including those trading in stock markets in East Africa, are being called upon to publish information on how climate change could affect their performance. The expected dramatic and stricter regulations of emissions are likely to increase the risk factors facing investors in fuel companies (SEC, 2010; World Bank, 2011).

INVESTORS CONCERN ON CLIMATE CHANGE

Economists agree that oil, gas and coal companies form one of the world's largest asset classes, worth nearly USD 5 trillion at current stock market values (Bullard, 2014). Researchers have shown that over a long time, fossil fuels have been investor favourites because they offer scale, liquidity, growth, and yields more than other types of assets (De Cian *et al*., 2016). The world's largest investors and many governments are the key shareholders in fossil fuel companies. For example, BlackRock, the largest investor in oil and gas equities, controls USD 140 billion via just its largest 25 holdings (Bloomberg Finance, 2014). Governments in many countries, including China, Russia, and also in the East African countries of Tanzania, Kenya and Uganda, are strategic investors in public companies as well (World Bank, 2015). However, in the past two years, dozens of public and private institutions have announced plans to divest fossil fuels from their portfolios, increasingly over concerns that these types of investments have the potential to affect global climate patterns (Stephens, 2014).

Concerns over climate change have forced some individuals, corporations, activists and well as pressure groups to start creating awareness of the effects of carbon emissions and the impact they have on the global climate system (Fossil Free, 2016; Ritchie & Dowlatabadi, 2015). They have joined together into a kind of movement to divest from companies that emit carbon, primarily fossil fuels (Ayling & Gunningham, 2017). The potential rationale for the fossil fuel divestment reflects various societal or practical considerations including environmental concerns, moral and ethical stances, concerns about asset stranding, and portfolio diversification (Caldecott & McDaniels, 2014). Fossil fuel divestment (FFD) covers a range of approaches to companies either exclusively active in hydrocarbons (such as oil, gas, and coal firms) or with high 'carbon reserves' in their portfolios, such as miners (Bloomberg Finance, 2014). The young, rapid and fast evolving movement calls on investors to remove stocks, bonds and other instruments from their portfolios with an obvious need to reinvest elsewhere.

Current research shows that the fossil fuel divestment is gaining momentum, with big banks, activists, students, celebrities and high-profile groups such as the US catholic group joining in (Goldenberg, 2014; Grady-Benson & Sarathy, 2016; Ayling & Gunningham, 2017). Banks, such as HSBC, have been informing people of the risks of continued investment in fossil fuel companies, whose value will be reduced by climate change action and the shift to clean energy. Although Africa has not been active in the movement, high profile individuals such as South Africa's Desmond Tutu have joined in. The new movement to divest from fossil fuels has now over 2,000 individuals and 400 institutions all now committed to pulling their money from fossil fuel companies, together representing a remarkable USD 2.6 trillion worth of investments (Linnenluecke *et al*., 2015; van der Ploeg, 2016).

For the fossil fuel divestment to expand, the movement requires more financial commitment. Whereas it is easy for an individual to move assets out of one index fund and into another, it is much harder for an institution to move billions of dollars, where they have enjoyed growth and yield, out of one company and into another (Fabian, 2015). Studies have found that fossil fuel divestment is a major challenge for those institutional investors that aim to pursue it, just as it is a challenge to many of the investment vehicles in clean energy that could receive new capital (Bloomberg New Energy Finance, 2014; Bullard, 2014). Researchers opine that though fossil fuel divestment represents an opportunity to create new investments, it is hard to convince holders of trillions of dollars of capital that alternatives to fossil fuels are equally worthy investments (van der Ploeg, 2016; Ansar *et al.*, 2013).

The fossil fuel divestment movement is aimed primarily at stripping legitimacy from fossil fuel companies (Epstein & Roy, 2001). Studies show that a growing number of investors are more inclined to deal with the uncertainties associated with divestment or active ownership rather than remaining exposed to the inherent risks of owning stock in companies that ascribe to an unsustainable business model (Wachira *et al*., 2016). Alongside

the divestment from fossil fuel companies, many corporate shareholders are today passing resolutions addressing environmental risks, calling on corporations to be environmentally accountable and sustainable (Stanny & Ely, 2008). Sustainability accounting, to help companies account for their environmental activities, is gaining grounds especially with changes in the global climate system (Wangombe, 2016; Lamberton, 2005).

Clean energy investments such as clean energy equities and green bonds have been touted as alternatives to fossil fuel investments (Aliyu *et al.*, 2015). Bloomberg New Energy Finance (2017) already forecasts that USD 5.5 trillion worth of investment in renewable energy power generation will be made from today through to 2030. There is also concerted effort by environmental activists to prove to the world that 100% renewable energy for all is achievable by 2050, and is the only way to ensure the world does not descend into catastrophic climate change (Linnenluecke *et al*., 2015). Researchers argue that it is possible to transform the world energy supply by switching to renewables, which would mean a stabilisation of global CO_2 emissions by 2020, and bringing down emissions towards near zero emissions in 2050 (Fabian, 2015; Brown, 2015). The Energy Revolution proposes a phase-out of fossil fuels starting with lignite (the most carbon-intensive) by 2035, followed by coal (2045), then oil and then finally gas (2050) (Greenpeace, 2015).

OIL AND GAS IN EAST AFRICA: IS IT TIME TO HOLD ONTO THE DREAM?

According to the World Bank (2016) the East Africa region has enjoyed robust economic growth averaging 4.5% over the last decade. Rodrik (2016) and Seyoum *et al.* (2015) attribute this growth to diversity of economic drivers, driven by sectors as agriculture, tourism, trade, manufacturing and services. However, the World Bank (2016) points out that East Africa still remains one of the world's poorest, least developed regions. Many of its inhabitants live on less than a dollar a day and it continues to be ravaged by diseases such as AIDS, malaria and tuberculosis (Ahmed *et al.*, 2016). Low levels of development in the region are also reflected in an inadequate and poorly maintained infrastructure. The discovery of significant and commercially viable amounts of oil and gas reserves could therefore not have come at a better time. The development of this oil and gas reserves is expected to provide a major stimulus to the local economies, and improve the standards of living for its people.

Until the last few years, the East African region has been a sleepy backwater for the upstream industry (EAC, 2012). The discovery of significant quantities of oil and gas in Uganda, Tanzania and Kenya is expected to usher in a boom in oil revenues, which has the potential of transforming the economic landscape (World Bank, 2016). Tanzania, in the year 2000, discovered an additional 2.17 trillion cubic feet of possible natural gas deposits, raising the East African nation's total estimated recoverable natural gas reserves to more than 57.5 trillion cubic feet. According to Tanzania Petroleum Development Corporation (TPDC), of all the natural gas reserves, 47.08 trillion cubic feet is offshore and 10.17 is onshore.

According to Uganda Petroleum Authority (2006), Uganda discovered 3.5 billion barrels of oil along the Albertine Graben area in 2006, which was eventually revised upwards to 6.5 billion barrels in 2014, an appraisal that also showed commercial deposits of natural gas. Onshore oil discoveries in Uganda have been followed by discoveries in Kenya. Analysis by the prospecting companies – Tullow Oil – has discovered around one billion barrels of crude oil in the Lokichar Basin of Turkana County. Bloomberg Energy (2016) also reports that the 450 kilometre long Rift Valley Basin could hold as much as 10 billion barrels of crude oil. Because of these discoveries, every potential hydrocarbon basin across East Africa has become a subject of intensive interest. The Ministry of Energy and Petroleum (2014) also confirms that Kenya has discovered 1 billion metric tonnes of recoverable coal along the Mui Basin in Kitui County. Moreover, abundant domestic supplies would eliminate the need for oil imports, thus producing considerable savings for businesses as well as generating ample tax revenues for governments, besides ecological gains.

Research shows that the discoveries of oil and gas in East Africa, just like in other regions, will bring significant benefits to the East Africans (Kebede *et al.*, 2010). Ariweriokuma (2008) confirms that oil and gas revenues help the countries reduce their dependency on donors for budgetary support. Already, Tanzania and Uganda have passed the 50% mark in own budgetary financing, with Kenya having reduced its donor dependency on budget support to a paltry 6% (IMF, 2017). Prudent management of oil resources will also help in the reduction of trade deficits and balance of payments, which had been worsened by rapid rise in crude oil prices (Dunning, 2008). Sagar (2005) also advises that oil and gas will help local currencies gain against foreign currencies such as the dollar, because of increased accumulation of oil and gas exports. Other studies also show that oil and gas production will spawn investment downstream, mid-stream and upstream infrastructure, buoying the economies of Kenya, Uganda and Tanzania (IMF, 2017; Taylor, 2006).

DEVELOPING COUNTRIES AND THE CARBON BUBBLE: IS EAST AFRICA AT RISK?

Researchers show that low- and middle-income countries, including those in Africa, are more vulnerable to climate change due to lack of adequate infrastructure and support mechanisms to adapt efficiently. However, the historical responsibility for global climate change lies squarely with the industrialised countries, a fact recognised in the Kyoto Protocol, and its successor, the Paris Climate Agreement (IPCC, 2007; Le Treut *et al*., 2007). The Paris Climate Agreement of 2015 requires developing countries to also declare their Intended Nationally Determined Contributions (INDCs) in reduction of greenhouse gas emissions (UNFCCC, 2016). Since developing countries bear little responsibility for the woes of global climate change that the world faces today, due to their level of industrialisation, this requirement places a heavy burden on their development (World Bank, 2012).

For developing countries to get to the level of industrialisation attained by their western counterparts, they have to consume loads of cheap energy for both industrial as well as domestic needs (Henderson, 2000). Fossil fuels provide the best form of energy as they are cheaper and have extensive uses. Moreover, it is a known fact that it is not easy to develop without fossil fuels. In many respects, many developing countries, especially in Africa, are much like the UK, or Germany, or France at the dawn of the industrial revolution, when European nations built their economies on King Coal (Edenhofer, 2015). Research has also proven that developing cleaner sources of energy, such as renewable energy projects, requires advanced technology and huge capital investments (Yadoo & Cruickshank, 2012). Many low- and middle-income countries, such as those in Africa, do not have the required technology or the capital that is needed to produce significant amounts of power from these resources.

Having discovered substantial amounts of fossil fuels, the East African countries of Uganda, Tanzania and Kenya are ready for an economic take off, after years of subdued economic growth. With an estimated combined GDP of USD 140 billion in 2017, these economies will substantially gain from development and production of their total combined oil and gas reserves of over 7.5 billion barrels and 57.5 trillion cubic feet respectively (EIA, 2017). To stop such poor countries as those in East Africa from exploiting their oil and gas reserves because of climate change concerns, they have to be provided with an alternative source of cheaper energy to develop (Deichmann *et al.*, 2011). Another African example would be a country like Botswana, which sits atop Africa's largest coal resource of 200 billion tones and yet imports 80% of its electricity from neighbouring South Africa. It is not possible to stop such a country from exploiting such reserves (Ramanathan, 2005).

The International Energy Agency (2015) reports that most of the world's oil, gas and coal deposits are found in developing countries. Li, and Qiao (2012) warn that the risks of holding fossil fuel stocks are not unique to the developed world. With the differentiated responsibilities envisaged under the Paris Climate Agreement, developing countries, especially the low and middle income like those in East Africa, are likely to face most of the risks. If their oil and gas reserves were to be stranded due to climate regulation, it would deal a big blow to their fragile economies (Kebede *et al.*, 2010). However, as the world moves towards lesser and lesser fossils due to risk of increased global warming, the effect of the carbon bubble is going to be strongly felt in developing countries as well (Arabella Advisors, 2015). The UN stresses that developed countries must find a way of recognising the economic cost of developing countries leaving their fossil fuels in the ground (UN, 2015). Moreover, the rich world must support poorest countries to transition from fossil fuels much more quickly than the rich world has managed (Mertz *et al*., 2009).

The Paris Climate Agreement provides for commitment of USD 100 billion per year up to 2020 by developed countries to developing countries for climate mitigation (UNFCCC, 2015). The agreement also allows countries to trade their emission offsets, through a mechanism to be developed. For the East African countries that have been ravaged by the woes of climate change, this is welcome news. However, the promises must be taken with caution. Ervine (2014) reports that many of the promises made by the global north to the global south in the past have not materialised. Africa's participation in the CDM remains low, compared to other regions. East Africa, for example, has less than 30 CDM projects. Moreover, the region's participation in the voluntary carbon markets has also been subdued (Mulugeta & Urban, 2010).

The carbon market has also been fraught with a lot of impediments, including prohibitive cost of starting, sustaining and registering CDM projects, the relative availability and cost of low-cost emission reduction potentials, high investment risks in some African countries and the overall policy framework in potential host countries (Muzee, 2011; Carbon Africa, 2012). The UN (2014) established the Green Climate Fund, currently

capitalised at USD 10 billion to encourage developing countries to turn from fossil fuels. The fund, however, does not compensate countries for economic loss or for the loss of opportunity that results from leaving fossil fuels in the ground. As to whether the East African countries should abandon their oil, gas and coal resources, merely standing on the promises of carbon financing that is yet to come, remains to be seen.

CONCLUSION

Increase in emissions of greenhouse gases, both natural and anthropogenic, has been shown to be the main catalyst for global warming, which causes changes in global weather patterns. Burning of fossil fuels for both industrial and domestic use has been identified as the major cause for this increase in carbon emissions. To reduce the carbon emissions, the world must transition to a low carbon pathway, through the implementation of a clean development mechanism. The mechanism has already been envisaged in the two international climate agreements, the Kyoto Protocol and its predecessor, the Paris Climate Agreement.

This article argues that the implementation of the clean development mechanism, through the two agreements will render many fossil fuel investments not to be exploited or unburnable. Already, a fossil fuels divestment movement, spearheaded by banks, activists and high-profile groups is gaining momentum. With the discovery of substantial and economically viable quantities of oil, gas and coal in the three East African countries of Tanzania, Kenya and Uganda, the stranding of fossil fuel investments will deal a blow to the long and awaited development in these countries. Although these countries are more vulnerable to effects of climate change because of lack of ability, the option of not developing their oil, gas and coal reserves does not arise.

For developing countries such as Tanzania, Kenya and Uganda to develop without exploiting their oil and gas deposits, they require a lot of financial and technological support from rich countries to develop in a more sustainable way. However, rich countries have been criticised for failing to take adequate action to reduce their carbon emissions, and failing to provide promised resources to poor countries. Failure by the rich countries to meet their obligations on carbon finance commitments has eroded trust and quashed ambitions among developing countries. As signatories to the Paris Climate Agreement, East Africa is likely also to be affected by the carbon bubble, if climate legislation and other financial risks were to strand these assets. These countries, like the rest of the world, may have to ignore the use of the clean development mechanism in their quest to grow.

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