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Addressing the renewable energy financing gap in Africa to promote universal energy access: Integrated renewable energy financing in Malawi

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ABSTRACT

The Sustainable Energy for All Initiative is a global initiative launched by the United Nations Secretary-General in 2012 with a goal of providing universal access to modern energy services by 2030. To achieve this goal, substantial financial and technological investments will be required at a rate far exceeding historical levels. Sub-Saharan Africa has a 30.5% electrification rate and policy reform issues to improve electrification have been poorly implemented thereby sprinkling doubt as to whether the region would be able to achieve 100% access to electricity for all by the year 2030. Sub-Saharan Africa faces a tough challenge in-order to achieve universal access to modern energy services since the region fails to attract energy sector investments. There is also a general perception that the region contributes very little to global greenhouse gas emissions hence offers few opportunities to reduce these emissions consequently missing out on attracting climate finance projects.

A guarantee of power purchase has been shown to attract energy sector investments. However, guarantees of power purchases such as Feed-in Tariffs, are experiencing slow market growth in developing countries because of a range of technical, regulatory and financial barriers. Using Malawi as a case study of a developing country, this review provides a perspective from a Sub-Saharan Africa Least Developed Country as to the various electrification, renewable energy deployment and climate change management challenges that still require urgent attention. This study shows that despite the perceived regulatory and financial challenges, Malawi can integrate and use a combination of (adapted) price guarantee schemes, cross subsidies and environmental taxes in-order to support initiatives aimed at supporting the country's development of renewable energy sources and hence indirectly support the Sustainable Energy for All Initiative.

Contents

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1. Introduction

Even though the provision of affordable modern energy and energy services are highly regarded as catalysts for economic development, improving peoples' livelihoods, and promoting sustainable development, it has been noted that access to modern energy and energy services is lacking in many developing countries. An estimated 1.3 billion people, approximately a fifth of the world's population, lack access to electricity at home and the vast majority of these people live in rural areas of Sub-Saharan Africa (SSA) and South Asia [1] (Fig. 1). In SSA, 81% of the region's population relies on traditional biomass fuels for cooking and heating [2]. This is in spite of the traditional use of biomass having several disadvantages such as being associated with significant amount of time spent, mainly by women and children, on fuelwood collection; indoor air pollution; and deforestation and soil degradation [2]. Arguably, these disadvantages will likely be exacerbated as some projections show that the number of people relying on traditional biomass will increase by 10%, from 585 million in 2009 to 645 million in 2030 under a business-as-usual scenario, as the rate of electricity connections will not be able to keep pace with population growth [3].

In what can be considered as a response to the deficient energy provisions noted in developing countries Ban Ki-Moon, Secretary-General of the United Nations launched the Sustainable Energy for All Initiative in 2012 as a multi-stakeholder partnership between governments, the private sector, and civil society. The initiative's three interlinked objectives to be achieved by 2030 are:

1. Ensure universal access to modern energy services;
2. Double the global rate of improvement in energy efficiency; and
3. Double the share of renewable energy in the global energy mix.

Energy sector initiatives, programmes and reforms aimed at improving people's access to modern energy and energy services are not a new phenomenon. However, the success of these initiatives, programmes and reforms has not always been positive and encouraging. Issues such as incomplete policy reforms, limited capital investment, lack of technological knowledge, constricted power generation planning and low rates of electrification [5,6], continue to undermine the development of the energy sectors. Moreover, policy reform issues to improve electrification have been poorly implemented and this sprinkles doubt as to whether some regions would be able to achieve 100% access to electricity for all by the year 2030 and beyond [7]. With an estimated 68% of current total anthropogenic greenhouse gas (GHG) emissions emanating from energy related-activities [7], there is also a great threat that increases in energy access and demand can potentially lead to rises in anthropogenic emission of GHGs which result in climate change [8]. This re-enforces the notion that improved access to modern energy can be beneficial to society but only if undertaken in a sustainable way. Consequently, renewable energy sources such as solar power, biomass power, wind power, hydropower and geothermal energy should be utilised to their full potential to avert further accumulation of GHGs, promote sustainable development, secure energy supply, support efforts to attain the Millennium Development Goals (MDGs), and contribute to social and economic development [9,10].

On a regional scale, different countries have different per capita incomes, energy endowments, economic structures, population sizes and distribution, technologies, and institutions [11] as such require different types of interventions to enable them to develop sustainable energy sectors and to ensure that the goals of the Sustainable Energy for All Initiative are achieved. Africa faces a huge challenge in-order to reach the universal energy access by 2030 goal because electricity generation capacity needs to grow at an annual rate of 13% – a significant increase in annual growth in generation capacity of less than 2% over the past two decades [12]. Every country in Africa has surplus energy resources, but financing difficulties have prevented the vast majority of countries from being able to fully exploit their energy potential. Consequently, some studies assume that universal electrification can be achieved by 2050 by countries with at least 60% current electrification and that countries below this level can achieve at least 80% electrification [13]. With these observations in mind, it can be seen that many countries in Africa (Table 1) are not going to be able to attain universal access by 2030 hence the need to explore and assess what other frameworks and instruments can be utilised in-order to complement the Sustainable Energy for All Initiative lest it fails. Arguably, the energy access challenge is more critical in SSA Least Developed Countries (LDCs). SSA is noted as the most physically and economically backward developing and poverty-stricken region in the world because it has experienced slower rates of development due to the low access to modern energy use in the region [7]. This review is therefore aimed at evaluating energy sector challenges in SSA in-order to improve stakeholder's

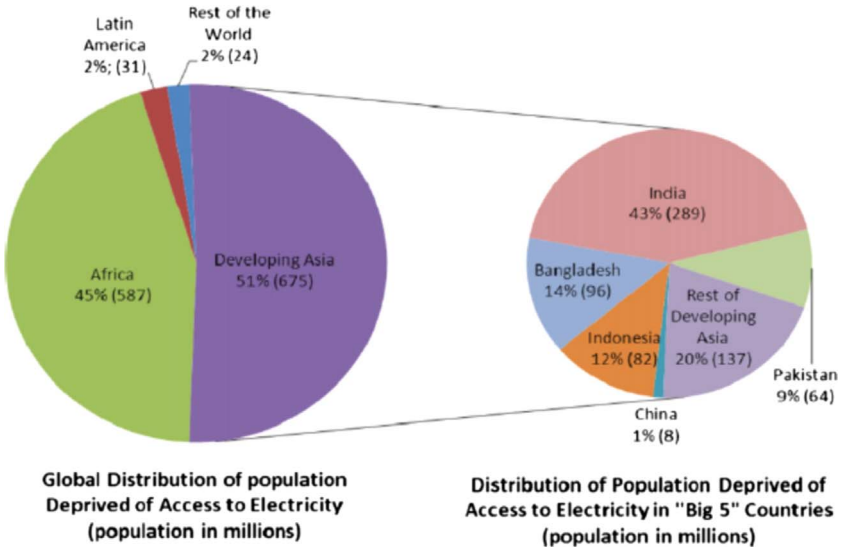

Fig. 1. Population without electricity.
Source: Rehman et al., 2012 [4].

Table 1
Country electrification rates.
Source: Hailu, 2012 [14].

Country	Electrification rate (%)	Population without electricity (millions)	Country	Electrification rate (%)	Population without electricity (millions)
Malawi	9	12.7	Eritrea	32	3.4
Uganda	9	28.1	Namibia	34	1.4
DR Congo	11.1	58.7	Sudan	35.9	27.1
Mozambique	11.7	20.2	Gabon	36.7	0.9
Tanzania	13.9	37.7	Congo	37.1	2.3
Burkina Faso	14.6	12.6	Zimbabwe	41.5	7.3
Lesotho	16	1.7	Senegal	42.2	7.3
Kenya	16.1	33.4	Botswana	45.4	1.1
Ethiopia	17.1	68.7	Cote d'Ivore	47.3	11.1
Zambia	18.8	10.5	Cameroon	48.7	10
Madagascar	19	15.9	Nigeria	50.6	76.4
Togo	20	5.3	Ghana	60.5	9.4
Benin	24.8	6.7	Mauritius	99.4	0
			Sub-Saharan Africa	**30.5**	**585.2**

understanding of effective policies and strategies that can assist in increasing the utilisation of renewable energy sources and contribute to efforts related to supporting the Sustainable Energy for All Initiative. The review begins with an evaluation of the benefits of up-scaling renewable energy deployment in SSA, followed in Section 3 by an analysis of the challenges related to attracting renewable energy investments in SSA. Section 4 covers the challenges of using some climate finance modalities for renewable energy deployment. In Section 5 Malawi is presented as a case study of how different funding mechanisms and existing financial instruments can be adapted in-order to finance renewable energy initiatives in the country (and other similar countries).

2. A case for up-scaling renewable energy deployment in Sub-Saharan Africa

Various energy sector stakeholders and policy makers in SSA acknowledge the vital role to which energy plays in relation to development. Whilst there is no definitive conclusion on the inter-temporal causal relationship between energy consumption and economic growth (i.e. whether economic growth causes energy consumption increases or if is the consumption of energy that causes economic growth) [15], what is universally acknowledged is that improved access to energy can promote industrial development, sustainable growth, job creation, poverty alleviation, and facilitate the achievement of the MDGs [16–18]. Various authors have however noted that making energy supply secure and curbing energy sector contributions to climate change are the two over-riding challenges faced by the energy sector on the road to a sustainable future [7,19,20]. A significant amount of anthropogenic GHG emissions are noted to be linked to energy related-activities. This follows that some projections to 2030 estimate that energy consumption will increase by over half (53%), energy-related carbon dioxide emissions will increase by over half (55%), and large populations of the world's poor will continue to lack access to electricity (about 1.5 billion) and modern cooking and heating services (about 2.5 billion) [21].

Africa has a vast untapped renewable energy potential, which could be used in an environmental-friendly way to meet Africa's energy demands several times over [22]. For example, the technically exploitable capability of hydropower in Africa is currently estimated to be about 19-fold of the present use [23]. It has therefore been suggested that the continent's low levels of energy access are a manifestation of the dynamic relationship between cost, income levels, relative price of fuels, initial cost of technology, subsidy programmes, grid connectivity and energy policy [14,24]. Arguably, African countries and particularly those in SSA have the potential to drastically improve their energy access rates from the current 30.5% by improving the implementation of initiatives addressing these issues.

The desire to make energy services not only accessible to most communities but also affordable complicates the energy policy and planning process as the majority of the potential customers can be classified as poor. In general, increasing affordability (e.g. by providing electricity subsidies to keep energy prices low) can make energy affordable even to poorer households but can in-fact reduce availability, as energy providers may find it unprofitable to extend coverage to areas where the poor reside [25]. In the absence of strategic interventions and instruments such as taxes, market based instruments, subsidies, tax exemptions, and loans for renewable energy development, the deployment of renewable energy is noted to be constrained [26,27]. Consequently, countries that have numerous renewable energy resources such as Malawi [28,29], Botswana [30], and South Africa [31] resort to exploiting their fossil energy sources thereby increasing their per capita carbon dioxide emissions (with negative consequences on climate change mitigation policies and goals). In most cases, the technologies and resources available for renewable energy generation are deemed sufficient to enable wide-scale deployment of renewable energy sources but it is the weaknesses in institutions, business models, and legal and regulatory frameworks that hinder deployment [32]. These factors therefore reduce the impact and contribution of renewable energy sources to enhancing access and affordability of modern energy. This therefore calls for the need to focus on innovative ways to raise funds that can assist in improving renewable energy deployment and technology transfers. With adequate and sustainable funding available, it would also be feasible to initiate capacity building initiatives aimed at enhancing institutions and legal and regulatory frameworks related to renewable energy.

3. Energy investments in Sub-Saharan Africa

Energy planning and policy encompasses plans, goals, strategies and regulatory frameworks that can help achieve the necessary economic, social and institutional conditions in the energy sector to improve access to reliable, affordable, economically viable, socially acceptable and environmentally sound energy services for sustainable development and poverty reduction [33]. Social and economic issues such as poverty, lack of political will and wrong approaches in addressing the energy problem affect the development of the energy sector [34] and as such some

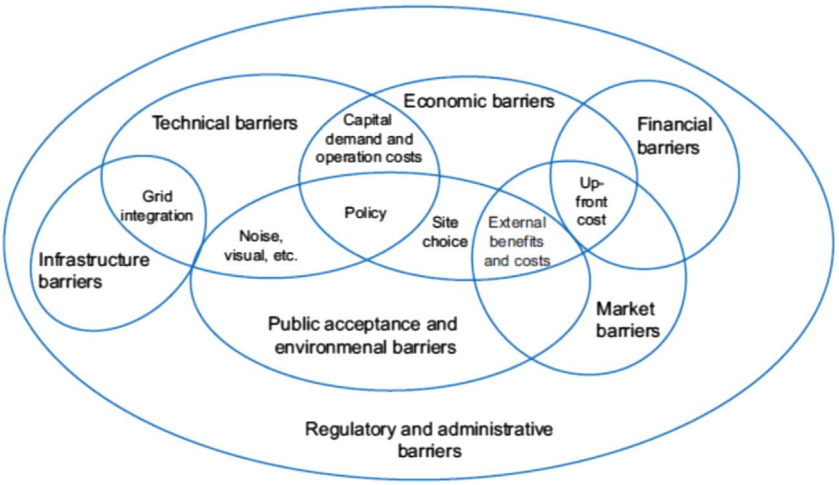

Fig. 2. Interlinked relationships between barriers.
Source: Müller et al., 2011 [41].

Table 2
Africa and world electricity access aggregates (2009).
Source: Javadi et al., 2013 [55].

	Population without electricity (millions)	Electrification rate (%)	Urban electrification rate (%)	Rural electrification rate (%)
Africa	587	41.8	68.8	25.0
North Africa	2	99.0	99.6	98.4
Sub-Saharan Africa	585	30.5	59.9	14.2
Developing Asia	675	81.0	94.0	73.2
China and East Asia	182	90.8	96.4	86.4
South Asia	493	68.5	89.5	59.9
Latin America	31	93.2	98.8	73.6
Middle East	21	89.0	98.5	71.8
Developing Countries	1314	74.7	90.6	63.2
World[a]	1317	80.5	93.7	68.0

[a] World includes OECD and Eastern Europe/Eurasia.

commentators consider a more active role of the private sector as the solution to enhancing energy sector developments [35,36]. Greater private sector participation within a clear regulatory environment can enhance the energy sector due to the private sector's access to additional finances, and better management and technical capacity [37]. Additionally, with more private sector participation in the energy sectors, national governments can devote more resources to other vital sectors such as agriculture, health, and education. Whilst the issues that hinder private sector participation in most SSA countries are widely known, the success to which different countries have had in reducing these barriers and promoting such energy investments varies, possibly because of the interlinked relationships of the barriers (Fig. 2). This follows that addressing one or more issues could have positive or negative consequences on the other issues (i.e. new strategies to address a barrier/barriers may complement or undermine the effectiveness of other strategies) or could lead to policy congestion where solutions produce new issues in the shape of policy overlaps, jurisdictional conflicts and unplanned results [38–40].

Demographic statistics for SSA indicate that the region has a total population of 910.4 million people, 37% of which live in urban areas [42]. As shown on Table 2, the region also shows a level of inequality as the urban electrification rate is 59.9% as opposed to 14.2% for rural areas (which also have the most population). Rural populations are therefore at a disadvantage in relation to access to social services and jobs [43]. Africa is also experiencing "jobless growth" and a growing predominantly youth population which can potentially lead to social problems when the provision of jobs and other social facilities is not sufficient [44,45]. The energy sector therefore has a vital role to promote equitable development as access to energy in rural areas has been shown to create employment and social services by increasing the scope and number of enterprises in rural areas [46]. Encouraging the private sector to intervene in electrification plans and programmes is particularly challenging as the private sector is motivated by profit maximisation, not the need for the service [47,48].

Regardless of the aforementioned challenges, there are some encouraging cases which demonstrate the successes of the private sector in promoting the deployment of renewable energy sources through their engagement with various stakeholders in various countries. For example, in Sierra Leone, South Africa and Uganda various private sector interventions are noted to have improved access to energy in the respective countries. In Sierra Leone, Addax Bioenergy Ltd invested over €258 million in the Makeni Power Project. The Makeni Power Project consists of a sugarcane plantation and bio-ethanol facility with a capacity to distil 385,000 l of ethanol per day and can generate up to 32 MW of electricity through its co-generation plant [49–51]. Addax Bioenergy Ltd was able to implement the project as the project could generate additional revenue through the sale of carbon credits through the Clean Development Mechanism (CDM) and obtained a Government backed Power Purchase Agreement with the National Power Authority to buy electricity that the project produced [49]. In South Africa, the Dundee Biogas Power Project is a Waste-to-Energy project that generates biogas and renewable energy. The project's success can be partly attributed to the cooperation between different farms to amalgamate their wastes so as to generate sufficient feedstock to generate sufficient methane from

anaerobic digestion [52]. In Uganda, the Bujagali Hydropower Project became Uganda's single largest private investment pre-2004 with a total investment of US$798,580,000.00 outnumbering the country's annual foreign direct investment (2004 value) by almost 400%. The project, which was developed by Bujagali Energy Limited produces 250 MW equating to 49% of the country's electricity generating capacity (2004 value) [53,54]. Some of the factors that contributed to the success of the project included the development of a Power Purchase Agreement that obliged Uganda Electricity Transmission Company Limited (UETCL) to purchase all the power produced by the Bujagali Project and the Government of Uganda to be a sovereign guarantor for the performance of UETCL [53]. These cases do not only demonstrate that large scale private sector led investments are feasible in Africa's energy sector, but arguably also show that government programmes and policies are essential in supporting the private sector to develop viable renewable energy projects for both urban and rural development.

4. Enhancing climate finance

Africa requires about US$100 billion a year in investments in-order to cope with its projected climate change impacts [56]. A failure to provide climate finance at the stipulated levels could increase the vulnerability of communities to climate change and result in an additional 100 million people living in extreme poverty by 2030 [56]. Consequently, climate funds created by multilateral and bilateral donors have been created to act as specialised financial mechanisms to channel their financial supports for climate change activities. Climate finance is expected to grow to US $100 billion per year by 2020 to complement development finance for energy access and support climate change mitigation and adaptation activities in developing countries [3]. Arguably, it therefore makes sense for policymakers in Africa to ensure that more climate funding activities and projects can be focused on activities in SSA so as to correct the current trend which shows other regions to be more favourable than SSA at attracting some climate finance projects as shown in Fig. 3.

Various climate finance modalities have the potential to complement the goals of the Sustainable Energy for All Initiative in a variety of ways. The Sustainable Energy for All Initiative encompasses a framework to mobilise financing to deliver universal access to modern energy services, up-scaling renewable energy deployment and scaling up energy efficiency. Similarly, various climate finance modalities and instruments (e.g. Climate Investment Funds, Adaptation Funds, etc.) encompass various frameworks to mobilise funds that can be used to support the deployment of renewable energy projects and promote energy efficiency

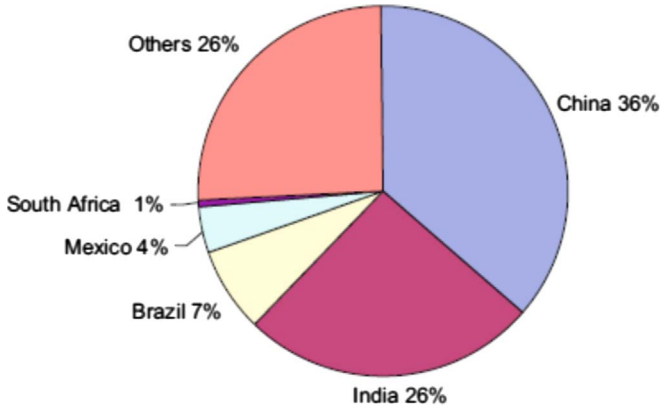

Fig. 3. Unequal distribution of CDM projects.
Source: Pegels, 2010 [57].

in domestic and commercial sectors. It can then be concluded that climate finance modalities and instruments are independent of the Sustainable Energy for All Initiative but are vital in also promoting the deployment of renewable energy technologies and promoting energy efficiency hence ensuring that energy access is enhanced in a sustainable way as well as complementing the Sustainable Energy for All Initiative.

Examples of climate finance modalities that have a bearing on improving the deployment of renewable energy particularly in Africa include the Scaling-Up Renewable Energy Program in Low Income Countries (SREP) and the Clean Technology Fund (CTF). The SREP was designed to demonstrate the economic, social and environmental viability of low carbon development pathways in the energy sector in low-income countries. Some projects implemented through the SREP include the Menengai Geothermal Development Project (Kenya) and the Geothermal Sector Development Project (Ethiopia) [58]. The CTF promotes scaled-up financing for demonstration, deployment and transfer of low-carbon technologies with significant potential for long-term GHG emissions savings. Some projects implemented through the CTF include the Eskom Renewable Energy Support Programme (South Africa) and the Quarzazte Concentrated Power Project (Morocco) [59]. In addition to this, globally some renewable energy initiatives encompass objectives focusing on improving the environment for renewable energy entrepreneurship, policy, regulation and finance as a means to complement climate change mitigation. These initiatives include the Millennium Villages Project Infrastructure Program, the Renewable Energy and Energy Efficiency Partnership (REEEP), the Lesotho Renewable Energy-Based Rural Electrification (LREBRE) Project, the National Domestic Biogas Programme (NDBP), etc. The Millennium Villages Project Infrastructure Program aimed to both accelerate the adoption of improved lighting technologies as well as to develop the local institutions for a sustainable market-based approach for renewable energy deployment [60]. The Renewable Energy and Energy Efficiency Partnership (REEEP) (2004–2009) supported 129 projects (in 56 countries) under its programmes, targeting low-carbon energy interventions in renewable energy and energy efficiency. The €10.8 million of REEEP financial support to projects also leveraged €26.7 million through co-financing from implementing partners, as well as other development and market transformation agencies [61]. The Global Environment Fund (GEF) has also been instrumental in supporting the deployment of renewable energy in Africa. For example, the Lesotho Renewable Energy-Based Rural Electrification (LREBRE) Project (2007–2012) was jointly funded by the GEF (through the United Nations Development Program) (US$2.5 million) and the Government of Lesotho (US$4.2 million). The project considered the deployment of renewable energy technologies/installing lighting systems in rural homes and public institutions as a means to facilitate Millennium Development Goal 7 (ensuring environmental sustainability) and Millennium Development Goal 1 (poverty reduction) [62]. In Rwanda, the Rwandan government, in partnership with the Netherlands Development Organization (SNV) and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), launched the National Domestic Biogas Programme (NDBP). The Programme had an initial budget of US$14.1 million and was aimed at developing a commercially viable Rwandan biogas sector and building 15,000 family sized biogas plants from 2007 to 2011 [63]. Various lessons have been learnt from the outcomes of these various programmes and financing instruments. A notable conclusion is that in-order to enhance the scalability of projects and predictability of funds for renewable energy projects that have a bearing on enhancing climate change mitigation, African countries will have to engage various stakeholders in both the energy sector and non-energy sectors (academia, business, non-governmental organisations, etc.). This will

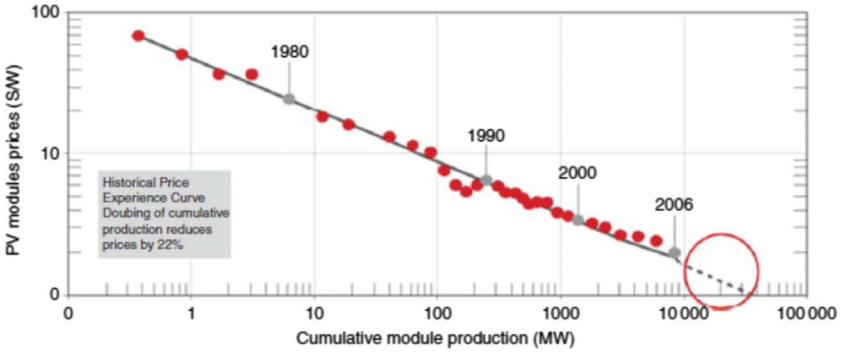

Fig. 4. Decreasing photovoltaic module prices.
Source: Jacobs and Sovacool, 2012 [68].

enable the countries to diversify financial instruments away from grants to loans and private capital to finance medium- and large-scale projects [64].

Most analysts and researchers agree that policy support is imperative in-order to make renewable energy more competitive and promote the large scale deployment of renewable energy technologies [65–67]. Many renewable energy technologies are not cost competitive in most market conditions but the price of most renewable energy technologies has been shown to be decreasing over time. For example, the doubling of the cumulative installed photovoltaic capacity leads to a 22% price reduction for modules hence with more deployment and maturisation of the technologies, further significant price reductions can be expected in the future [68] (Fig. 4). Furthermore, a faster rate of deployment of renewable energy technologies can speed up the maturisation and price reductions of renewable energy technologies. Arguably, renewable energy climate finance projects and the Sustainable Energy for All Initiative programmes when viewed in a complementary manner can increase the deployment of renewable energy technologies hence contribute to making modern energy more affordable to the majority of poor people quicker as price reductions will be attained quicker. In-order to realise this, there are a number of issues that specific countries have to overcome so as to attract many climate finance projects. Factors that attract investments towards climate finance projects or makes host countries attractive include the presence of political and macro-economic stability, sound regulatory frameworks (and efficient supporting institutions enforcing the relevant laws and regulations), and good physical and social infrastructure (including roads, communication systems and skilled labour) [47,48,69]. One of the greatest challenges for some climate finance modalities is not necessarily mobilising the funds but actually ensuring equitable representation and distribution of climate finance projects across the different regions more especially attracting renewable energy investments to LDCs [70]. This further highlights the problem that in the absence of the right interventions, climate finance modalities will continue to be concentrated in certain countries and that there is a need to find other innovative ways to fund renewable energy projects in LDCs.

5. Climate finance and renewable energy in Malawi

Malawi is a land locked LDC in Southern Africa. Malawi is bordered by Zambia to the northwest, Tanzania to the northeast, and Mozambique on the east, south and west. Malawi has an estimated growth rate of 2.8% and an estimated population of 15 million of which 85% are rural [71]. Poverty remains one of the most important social challenges in Malawi with gender inequalities, environmental degradation, food insecurity, and climate change contributing to and exacerbating poverty in the country [72]. The economy of Malawi is based on agriculture which contributes 34% of Gross Domestic Product (GDP) and employs about 80% of the county's population [73]. Power sector inadequacies (i.e. frequent power cuts, low generation capacity, etc.) [74,75] are regarded as impediments to the development of the country as the energy sector is failing to support the development of the mining, manufacturing and tourism sectors [29] which are considered key sectors to aid Malawi in diversifying its economy and reducing poverty. The economic cost of power outages in Malawi is estimated at 6.5% of GDP as compared to 5.5% of GDP in Uganda and 4% of GDP in Tanzania [1]. Developing a viable and sustainable energy sector is therefore a key requirement to assist with the country's development.

In what can be considered as a paradox, developing nations with little industrial activities and low electrification rates are considered as bad investment destinations for some climate finance mechanisms because they produce low GHG emissions [76]. Most developing countries in Africa arguably contribute very little to global GHG concentrations and subsequently offer few incentives and opportunities to reduce these emissions. As a consequence, these developing countries are missing out on attracting climate finance projects notably through the CDM [77]. Countries with higher potentials for emitting significant GHG emissions due to their levels of development and populations are more likely to attract CDM investments and programmes [47,48,78]. This is the case even though it is the low emitting countries that require the most support in-order to pursue low-carbon economies and development paths which are climate compatible [79]. Not surprisingly, Malawi has no registered CDM project highlighting the problems to which the country faces in providing an opportune environment for the implementation of CDM projects and other climate finance projects which can facilitate the wide-scale deployment of renewable energy.

A lack of funding and finance are often considered as significant factors for the slow development of the renewable energy sector in Malawi [71,80]. Financing and funding constraints arguably limit the extent to which renewable energy related research and development and capacity building activities can be undertaken in the country. However, the presence of barriers is not a consistent cause of project or programme failure as some projects still manage to achieve success regardless of the existence of the barriers [81]. It can therefore be argued that the presence of barriers need not be a disincentive to pursue renewable energy projects nor justification not to pursue renewable energy projects. Provided below are four cases highlighting different methods to which funds to finance renewable energy projects can be mobilised to ease funding constraints. The illustrations highlight how various funding mechanisms can be integrated and adapted in-

order to promote the deployment of renewable energy in the Malawi context.

5.1. Case 1 – Malawi Rural Electrification Programme

The Malawi Rural Electrification Programme (MAREP) is the Government of Malawi's effort to improve access to electricity in rural and peri-urban areas of Malawi. In 2003, the Government of Malawi implemented the National Energy Policy to address the multi-sectoral issues of poverty reduction through promoting opportunities (i.e. creating jobs); facilitating empowerment (i.e. laying political and legal basis for inclusive development and promoting gender equity); and enhancing security of energy supply [82]. The Malawi National Energy Policy also suggested the enactment of the Energy Regulation Act, Electricity Act, Renewable Energy Supply Act[1] and Rural Electrification Act as instruments to assist with the implementation of the Energy Policy. In 2004 the Rural Electrification Act was enacted to make provision for the promotion, funding, management and regulation of rural electrification; and for matters connected therewith and incidental thereto [83]. The key provisions of the Act include the establishment of the Malawi Rural Electrification Fund comprising of such sums as shall be appropriated by Parliament for the purposes of the Fund and rural electrification levies on energy sales. The funds collected through the Rural Electrification Act have greatly contributed to the development and sustainability of MAREP which is currently in phase seven having started in 2003.

In addition to annual allocations from the national budget, the price of petrol and diesel in Malawi incorporates the rural electrification levy in its price build up as such there is a consistent flow of funds available for rural electrification that are protected by national legislation. In a similar manner, it is conceivable for Malawi to develop a similar piece of legislation that can stipulate national budget allocations and levies from fossil fuels to be directed towards a fund for solely financing renewable energy initiatives.

5.2. Case 2 – The Lake Turkana Wind Power Project (LTWP) (Kenya)

Located in the Marsabit District of Kenya, The Lake Turkana Wind Power Project (LTWP) is a 300 MW wind farm (i.e. equivalent to 20% of the country's current total installed generation capacity). The LTWP provides various points that can be emulated in-order to promote renewable energy deployment. The €459 million project was developed without drawing any public funding which is a challenging task since the mobilisation of private enterprises to support renewable energy projects is challenging as investors are reluctant to allocate resources to technologies that guarantee uncertain returns [84]. The project is expected to reduce carbon emissions by 16 million tons during its 20-year lifespan as such it was registered under the CDM so as to generate additional finances through the sale of carbon credits [85].

In-order to improve the project's financial viability, reduce financial risks, and attract investors, the project developers came to an agreement with the national utility whereby a higher tariff and guaranteed price was agreed to on the condition that some funds from the sale of carbon credits from the project would be paid to the utility. This arrangement is rather unique as usually many projects base their financial viability and projections on the revenue from the sale of carbon credits whose value changes with market forces. This new arrangement can be seen to have significantly improved the sustainability of the project as the carbon price (Fig. 5) has been seen to be falling with no significant detriment to the revenues and credentials of the project.

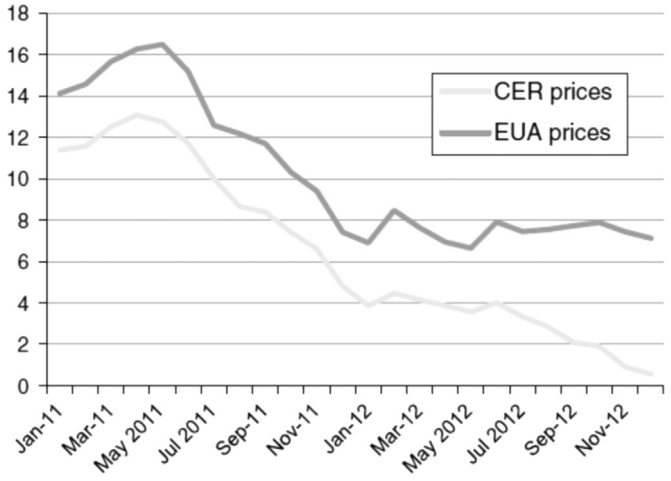

Fig. 5. CER prices January 2011–December 2012.
Source: Brohé, 2013 [86].

5.3. Case 3 – Standardised Power Purchase Agreements (SPPAs) (Tanzania)

The energy sector in Tanzania is similar to Malawi in that it is characterised by exceptionally high demand for electricity in the face of limited supply, even by the standards of other low income African countries [87]. Support mechanisms for electricity from renewable energy sources can be categorised as either price based mechanisms or quantity based mechanisms (Table 3). These mechanisms create an artificial market to stimulate renewable electricity deployment by either fixing the price so that the market decides about the quantity of renewable energy projects or fixing the amount of renewable electricity that shall be produced so that the market decides about the price. Price based mechanisms and quantity based mechanisms therefore impact the electricity sectors differently [68].

Experience and projects from around the world suggests that Feed-in Tariffs (FITs) are the most effective policy to encourage the rapid and sustained deployment of renewable energy as they offer guaranteed prices for fixed periods of time for electricity produced from renewable energy sources [89]. In developing countries however, the situation is different as FITs are experiencing slow market growth because of a range of technical, regulatory, and financial barriers [90] which cause cumbersome and lengthy administrative processes that increase costs and delay project implementation hence discouraging investors [91]. FITs can also lead to additional costs if the guaranteed tariff is above the price of electricity from conventional sources, and these costs are either passed on to consumers through increased electricity bills or the public budget hence making the systems very difficult to implement in low-income countries [92].

To overcome these issues, the Government of Tanzania has developed Standardised Power Purchase Agreements (SPPAs) as part of its FIT policy to suit the socio-economic context of Tanzania. Standardised Power Purchase Agreements have been developed for the purchase of grid connected capacity and off-grid capacity and associated electric energy between the buyers and small power project producers [91]. This arrangement has reduced the number of separate regulatory requirements in the renewable energy market and promoted the use of standardised documents which is in keeping with the needs of smaller power producers.

[1] This proposed piece of legislation has not been drafted as such it cannot be determined as to what provisions would have been contained therein.

Table 3
Renewable energy support mechanisms.
Source: Becker and Fischer, 2013 [88].

	Feed-in tariff	Auction-based Tariff
Alternative Terms Definition	Standard offer contracts, advanced renewable tariffs. –Generation based payment for electricity, –Predetermined by policy makers and constantly available to project developers.	Renewable tenders, tendering systems, competitive biddings. –Generation based payment for electricity, –Determined and allocated through auction based tenders in which project developers compete.

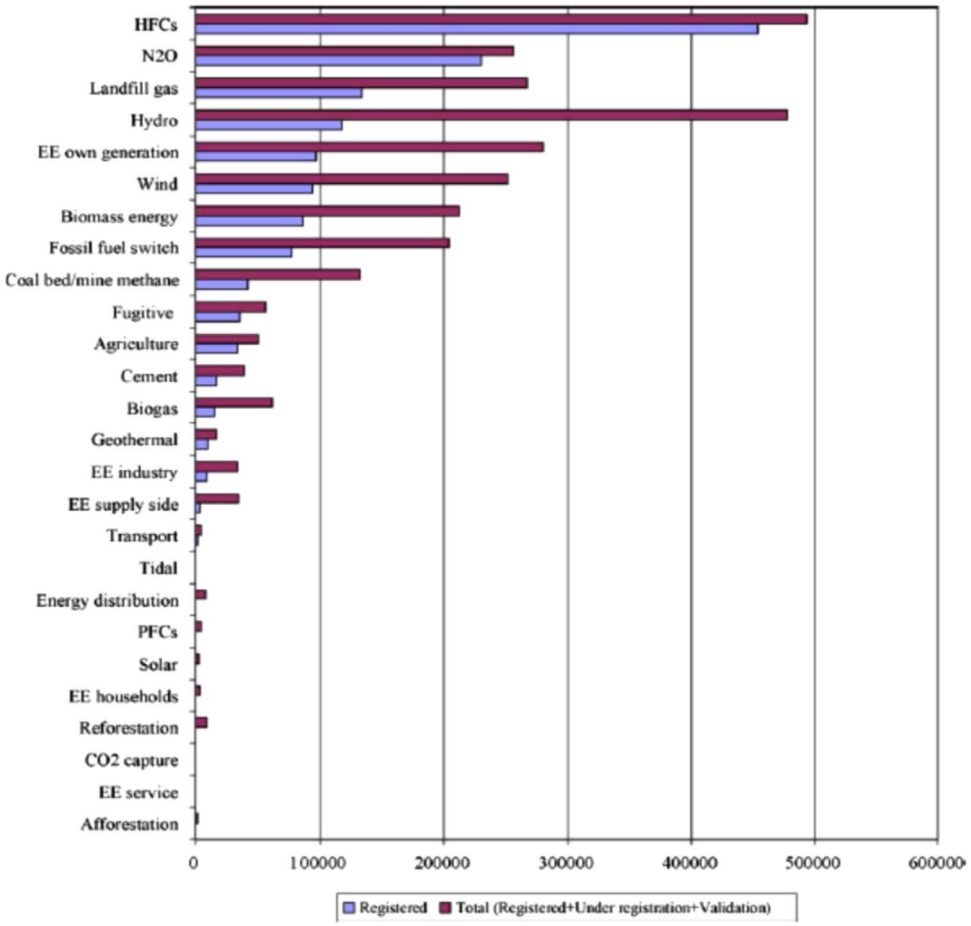

Fig. 6. Contribution of CDM projects to emission reductions (kCERs up to 2012).
Source: Boyd et al., 2012 [97].

Malawi has no FIT policy but one is currently under consideration. The country is therefore in an opportune position to be able to avoid the pitfalls which some developing countries experienced, by directly following the route that Tanzania has taken as it is well suited for low-income countries which are likely to promote the deployment of numerous small-scale renewable energy projects of less than 10 MW.

5.4. Case 4 – Carbon credit tax (China)

China is unlike most developing countries in that it has a high rate of industrialisation and stable regulatory frameworks which make it attractive for climate finance projects such as the CDM [93]. Since Carbon Dioxide (CO_2) has a global warming potential of 1, Methane (CH_4) 21, Nitrous oxide (N_2O) 310, HFC-23 (CHF_3) 11,700 and Perfluoroethane (C_2F_6) 9200 [94], it can be seen that industries that emit GHGs with higher global warming potential potentially earn more carbon credits per unit emission making such projects also attractive for revenue generation (Fig. 6). Noting this as a potential flaw to the system and also an opportunity, HFC and PFC projects are subject to a 65% royalty fee on revenue from the respective Certified Emission Reduction (CER) revenue, with the revenue going towards a Climate Fund. Such an arrangement diminishes the comparative disadvantage of renewable energy projects which are not taxed highly in comparison to N_2O, HFC, and PFC projects [95,96].

The Investors Guide to the Clean Development Mechanism in Malawi [73] shows that the country has viable projects in the areas of waste management (methane capture and electricity generation from municipal landfills) and agriculture (improved rice cultivation, animal husbandry, and conservation farming) that can provide emissions with a high global warming potential than carbon dioxide. Whilst the economic structure of the country renders the emissions small in relation to other countries where CDM inventors can go, some parallels can be made with the Chinese system where some emissions from carbon credits are taxed in-order to fund other needy areas which in this case could be renewable energy deployment. In addition to this, landfill methane emissions

are increasing in developing countries because of larger quantities of municipal solid waste from increasing urban populations, increasing economic development and, the replacement of open burning and dumping by engineered landfills [98]. There are therefore new opportunities for climate finance projects emerging as well as opportunities for taxing revenues from the sale of CERs.

Imposing a tax on a certain activity in-order to generate funds that can be utilised for another purpose is not limited to CDM activities. Various countries have introduced or are proposing to introduce various taxes which can be considered as environmental taxes. Environmental taxes impose a tax on products or activities that directly or indirectly have a negative impact on the environment. Pertinent current or proposed environmental taxes in Africa include plastic packaging materials and products tax (Ghana) [99], vehicle carbon tax (Zimbabwe) [100] and carbon emissions tax (South Africa) [101]. Such taxes are not imposed in Malawi even though the environmental issues that they are trying to address are also prominent in Malawi. There is therefore potential to impose these taxes and establish a fund for which the monies realised can be transferred to and be utilised for renewable energy development.

6. Discussion and concluding remarks

Access to modern energy is considered as one of the foremost factors contributing to the disparity between developed and developing nations [6] and as such needs serious consideration in global development agendas. Africa continues to face critical challenges related to its energy sector because the current energy policies and systems have failed to provide the platform needed to support the economic development of the majority of Africa's poor [102]. While the challenges to energy access are not unknown (i.e. poor energy financing and incentive mechanisms, inadequate energy planning, and the weakness of national energy policies), in some instances the possible solutions to address these issues have not been adequately analysed, understood and deployed [36,103]. With the Sustainable Energy for All Initiative attempting to attain universal access to modern energy services by 2030 there is an urgent need for all energy sector stakeholders such as the media, politicians and engineers to re-evaluate energy strategies and policies to ensure that the universal access target is attained especially as some studies suggest that universal access to modern energy services cannot be attained by 2030 [13].

Malawi like most countries in SSA is particularly at a disadvantage in trying to improve its energy sector due to inadequate human capital, macroeconomic instability, low productivity, exchange rate volatility, and lack of infrastructure which create an uncertain environment that deters investments in energy infrastructure and/or hampers project success [65]. Arguably, for the country to be able to achieve the ambitious goal of reaching universal access to modern energy by 2030, the country needs to adopt new innovative energy delivery models and explore synergies with climate finance modalities. This would increase funding and capacity development resources towards renewable energy initiatives in the country.

With reference to the four cases of how financing and funding constraints for renewable energy can be improved in the country (Section 5), it can be argued that Malawi now requires political will to be directed towards the enhancement of the renewable energy sector. For example, Malawi's medium term development plan, the Malawi Growth and Development Strategy [75], highlights that Integrated Rural Development is one of the country's nine priority areas for development. The document further highlights MAREP as a key component of the country's Integrated Rural Development strategy as the implementation of MAREP has shown that the programme increased the number of trading centres connected to electricity from 45 in 2005 to 182 in 2010 [75]. However, MAREP is mainly focused on supporting the expansion of the grid rather than supporting the development of off-grid renewable energy solutions. For example, Grameen Shakti, a non-governmental organisation in Bangladesh is reported to have installed over 520,000 solar home systems, over 14,300 biogas systems and 172,000 improved cooking stoves among 3.5 million beneficiaries in Bangladesh [104]. What is more impressive is that the organisation has been successful in utilising the off-grid renewable energy supply chain to improve energy access, stimulate employment and improve public health despite the political and technological constraints experienced in Bangladesh [105]. A focus on grid extension for MAREP is therefore arguably making the country forego the innovation and community level capacity building to which off-grid renewable energy technologies stimulate.

Some researchers also point out that for developing countries to successfully utilise the financing opportunities presented by carbon markets, there is a need for governments to create supporting institutions that can facilitate climate change mitigation, adaptation, capacity building and technology transfer; and enhance the climate change institutional framework [47,78,106]. Most governments that are party to the United Nations Framework Convention on Climate Change (UNFCCC) have a Designated National Authority (DNA), which in most cases is a government agency/department, as a focal point for managing climate change issues in their countries. Malawi's DNA is the Department of Environment. However, Malawi does not have any other institutions to support the DNA as it is the case in other countries like India [107]. Arguably, the lack of another institution supporting the DNA can slow the pace to which climate finance mechanisms can be utilised in the country. With the aforementioned factors in mind it can be seen that there is a need for political will to help improve the deployment of renewable energy in the country. Firstly, political will can influence the direction of MAREP so as to also focus on the deployment of off-grid renewable energy technologies in its implementation, and secondly political will can instigate the creation of a supporting institution for the DNA.

Climate finance instruments and projects which though separate from the Sustainable Energy for All Initiative are therefore also a vital element in promoting the use of renewable energy and promoting energy efficiency. However, the four cases and funding mechanisms that have been suggested in this assessment can lead to additional costs to taxpayers and consumers. An area for further research could possibly be to determine which mechanism or mechanisms can be the most effective (i.e. have the ability to deliver an increase of the share of renewable electricity) and cost efficient (i.e. offer the most benefits when the total amount of support given to the mechanism is compared to the generation costs) in the Malawi context. Such an evaluation may be beneficial to all stakeholders and policy makers in Malawi in that it could bring about transparency in renewable energy policy formulation and decision making process.

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