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Powering up Sub-Sahara Africa's renewable energy revolution through diffusion

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Abstract

Diffusion of international regulatory policy innovations depends on a complex set of factors. For renewable energy, these include the attributes of the policy innovation such as its initial capital cost, the structures and processes of the social unit with reference to shaping national policy systems and the normative discourse in the international arena. The demand, targets and goals of a country are the benchmarks used to decipher appropriate policy innovation options. Nonetheless, many energy dissemination programmes concentrates on the supply and technology sides without adequate attention to the overall context of community life. Change agents and front-runner countries play a critical role in affecting the speed and spread of such policy innovations depending on the power asymmetry. Even though there is no consensus on an optimal renewable energy policy mix, adopting units can identify favourable combinations that suite their social system. To ensure an effective diffusion and adoption of renewable energy policy innovations in developing countries, particularly Sub-Sahara Africa, the process need to holistically integrate socio-economic dynamics as well as national energy and policy systems.

Keywords: Policy Innovation; Diffusion; Renewable Energy; Power; Development

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1. Introduction

Diffusion of policy innovations have become of great significance with reference to renewable energy innovations worldwide. Generally, globalisation is seen as a hindrance to national sovereignty and has hence created the need to find a new framework to describe and act in the international arena. This theoretical problem is linked to the practical and political problems of how to legitimize political action in a post–nation-state world (Lederer and Müller, 2005). Until recently, governments around the world have prioritized the creation and adoption of policies to promote the development and use of renewable energy innovations (Lewis, 2014). This is evident in many countries where policy-makers are considering renewable energy policies as a global governing political vocabulary "to legitimise political interventions" (Lederer and Müller, 2005, p.2).

Empirical research has shown that policy diffusion has affected a wide range of issues (Graham et al., 2013; Maggetti and Gilardi, 2016). Albeit international regimes and treaties on environmental protection gaining prominence, the diffusion of policy innovations and the factors influencing this process has not been adequately examined (Kern et al., 2001). The central challenge of diffusion research is that it often neglects national policy making process, limiting its potential impact (Tews, 2005). One of the most side-lined fields in diffusion research is renewable energy innovations. Without access to modern reliable energy sources, economic development is not possible (Wirth et al., 2003). Renewable energy is therefore key to sustainable development and has a high potential of servings as the modern reliable energy sources. Many energy dissemination programmes however, concentrate on the supply and technology sides without adequate attention to the overall context of community life (Kaygusuz, 2011). To ensure an effective diffusion and adoption of renewable energy innovations the process need to holistically integrate national energy systems. There is hence the need to include micro and meso-level perspectives of national policies in diffusion research.

1.1. Energy and development

Efficient energy supply within the framework of good governance is an asset to building the needed infrastructure for sustainable development (Khennas, 2012). This is inherently depicted in the interrelationship between energy use, industrialization, economic growth and standard of living; reflecting the direct correlation between economic growth and electricity supply (Bugaje, 2006; Kebede et al., 2010; Greenstone and Looney, 2012; Castellano et al., 2015). In recent times the need for clean, economical and sustainable energy sources has become one of the world's major concerns in tackling climate change and promoting sustainable development. Sub-Sahara Africa has been the main region bedevilled with significantly underdeveloped power sector resulting in countries in this region struggling to sustain GDP growth. With the high cost associated with conventional sources, such as environmental and climatic consequences, health hazards, effects of foreign policy vulnerabilities on imported fuels and other adverse economic effects (Dincer, 2000; Omer, 2008; Greenstone and Looney, 2012), renewable energy innovations have been identified as key to advancing sustainable development whiles meeting the challenges of the ever increasing demand for energy (Painuly and Fenhann, 2002). To achieve this, there is the need to diffuse modern renewable energy policy innovations especially in developing countries where there are acute energy challenges (Hoekman et al., 2005).

Some significant improvements in the renewable energy sector which are largely driven by policy support include innovations in financing, falling prices and the use of renewables to advance technological developments (REN21, 2014). The current paradigm of renewable energy research has therefore focused on the importance and contribution of renewable energy innovations to the development of green economies and their minimal impact on climate change. Little is however known about the role of diffusion, the "power" of change agents and the sustainability of these policy innovations in developing countries.

2. Research method

With the aim of identifying specific form of inquiries by focusing on a set of units in relation to which data is collected and analysed (Hammersley and Gomm, 2000), this study adopted an exploratory research design, a method used to explore situations in which the available knowledge is blurry with little understanding (Yin, 2003). The study used a search of literature which is one of the principal ways of conducting exploratory research (Saunders et al., 2007). The data was sourced from published books, journal articles, and annual and technical reports of some relevant institutions. In analysing the data, the study used a content analysis approach which aims at systematically identifying specified characteristics by describing and making valid inferences from data with optimum objectivity and precision (Vitouladiti, 2014). This approach permits a systematic analysis of text in order to conceptualize and identify important features of a particular phenomenon (Billore et al., 2013). The study was carried out through an inductive lens and the data examined for patterns and structures to develop categories by focusing on the key features that were relevant for the purpose of the research and aggregated into perceptible constructs (Gray and Densten 1998; Vitouladiti, 2014).

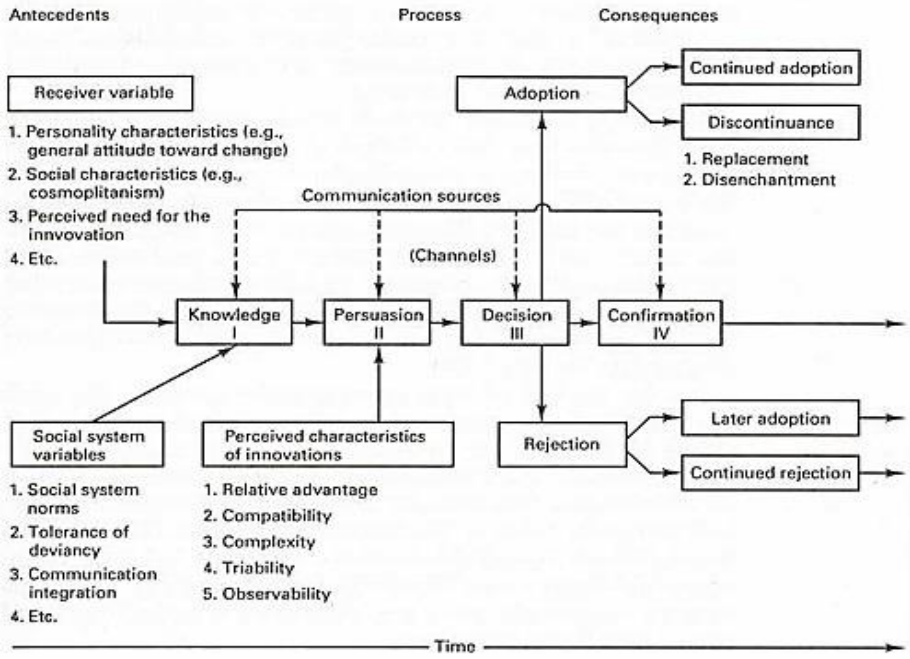

Figure 1. Diffusion of Innovation Theory (Rogers, 1995)

The underpinning theoretical framework of this research is Rogers' Diffusion of Innovation Theory (Figure 1). The theory is influenced by four major factors: time, features and attributes of the innovation, nature of the social system into which the innovation is being introduced and how information about the innovation is communicated, that is, the "process in which participants create and share information with one another to reach a mutual understanding" (Rogers, 2003, p.5). Diffusion research consequently seeks to explore how these factors interact to expedite or obstruct the adoption of new products, ideas or practices among members of a particular social system (Surry and Farquhar, 1997).

3. Results and discussion

3.1. Energy supply and development of Sub-Sahara Africa

Sub-Sahara Africa has the lowest Gross Domestic Product (GDP) per capita in the world. One of the major contributing factors to this phenomenon is the acute energy deficit in the region. The total electricity net consumption is about 139 billion kilowatt hours (kWh) compared to Spain with a total electricity net consumption of 246 billion kWh. Despite abundant renewable energy potentials in the region electricity production from renewable sources, excluding hydroelectric, is about 8.066 billion kWh compared to Denmark and Germany producing 17.438 billion kWh and 177.054 billion kWh respectively. The entire continent's installed power-generation capacity of is about 160 gigawatts (GW). The estimated average electricity consumption per capita in Sub-Sahara Africa is only about 150 kilowatt-hours per capita.

The region has 13 percent of the world's population, but 48 percent of the share of the global population without access to electricity (Castellano et al., 2015). Only fifteen countries in the region have electricity access rates exceeding 50 percent, out of which only seven (Cape Verde, Comoros, Gabon, Ghana, Mauritius, Seychelles and South Africa) have electricity access rates exceeding 70 percent (World Bank and IEA, 2017). The whole of the region however has an average grid access rate of 37 percent. Although most of the countries in the region are recording growth in access, Angola, Sierra Leon and Zimbabwe recorded a decrease in the percentage of the population with access between 2000 and 2014. This indicates that the increase in generation and supply is not proportional to the increase in population, and in some cases has remained fairly static, resulting in the decrease in total electric power consumption in the region.

Despite this situation, Sub-Sahara Africa has a huge untapped renewable energy potentials. Although some international organizations and developed countries are contributing to the diffusion of renewable energy innovations (Yildiz, 2014; Strupeit and Palm, 2016), the current wide technology gap between developed and developing countries, inadequate skills and resources needed to implement adopted innovations and the prevalence of undermining social measures and structures have resulted in many of these innovations becoming counterproductive (Able-Thomas, 1996). Many of them have rather created a dependency on foreign suppliers, increased national debts and stalled industrial and economic development (Stapleton, 2009). Bugaje (2006), describes the main challenge of the region to be due to the poor state of infrastructural support and the lack of appropriate technology to harness these energy resources for development. Limited financial

resources, weak energy planning, pressure to attract investment and population growth have restricted the capacity of many African countries to adopt green energy transition policies. The consequences are chronic power shortages, increase cost of doing business, and slow progress on poverty reduction and sustainable development strategies (Bugaje, 2006).

According to Makhtar Diop (2014), World Bank's Vice President for Africa region, about 10 million small and medium-sized enterprises in Africa do not have access to electricity. Those who have access to electricity pay as much as three times as an average American or European pays. Nevertheless, they routinely endure power outages that cost their countries one to four percent in lost GDP every year. According to Castellano et al., (2015) if Sub-Saharan Africa aggressively promotes renewables, it could obtain a 27 percent reduction in CO_2 emissions. This would result in a 35 percent higher installed capacity base and 31 percent higher capital spending. With potential power-generation capacity estimated at 1.2 terawatts without solar and a staggering 10 terawatts of potential capacity or more with solar potentials, Sub-Sahara Africa can transform its economy with renewable energy. African countries therefore need to invest in appropriate technology and policy innovations to harness its renewable energy potentials in order to drive development and improve the lives and economic prospects of its people.

3.2. Diffusion and renewable energy innovations

Diffusion research provides a logical and appropriate method of analysing the flow and adoption of renewable energy policy innovations which follows a long chain and an intense political and socio-economic deliberation before, during and after. It provide a post-modernist approach by acknowledging the plurality and variability of rationalities as well as encourages mutually acceptable arrangements and legitimacy of dissent on whether to continue or discontinue adoption. As a theory, it primarily centres on the conditions which affects the probability of a new idea, practice or product being adopted in a given social system (Dooley, 1999; Stuart, 2000; Rogers, 2003; Sahin, 2006). Rogers et al. (2005) admits the fact that most of the innovations studied are technological in nature with little done in areas related to policy or other social-learning innovations.

Globally, renewable energy policy innovations are now increasingly becoming similar due to interlinking processes of national policy decisions to foreign policies. Regulatory patterns in policy-making have changed significantly since the early 1990s, drifting largely from a sectorally fragmented and legally based regulatory approach towards a greater use of voluntary, collaborative or market-based regulatory instruments through international policy diffusion (Busch et al., 2005). Understanding policy diffusion mechanisms and process necessitates an analysis of the complex interplay between international, transnational and national drivers and the characteristics of policy innovations. Comparative research has shown that a certain threshold of social, economic and political development is needed in order to adequately perceive, adopt or develop policies to address certain problems (Tews, 2005). These thresholds are best known by the potential adopter and may vary between system units. Diligent precautions should therefore be taken to avoid a race to the top and its attendant consequences when dealing with policy innovations related to delicate sectors such as renewable energy. Inherently, the key variable to consider when assessing the diffusion of renewable energy policy innovations are their essential properties as well as the political and economic competition of actors involved

(Busch et al., 2005), as benefits of renewable energy are both locally (energy security) and globally (climate change mitigation) enjoyed whereas the cost is mainly borne locally.

3.3. Contemporary diffusion mechanisms

The interdependence between nations and international organisations is one of the main drivers for policy diffusion. According to Maggetti and Gilardi (2013), political research must focus through the explicit modelling of the interdependence between countries in the diffusion of policies. Through interdependence policy models are adopted for varying reasons such as successful implementation or adoption elsewhere, the value placed on it by international peers, need to increase attractiveness against competitors and conditions for aid. Many scholars (Shipan and Volden, 2008; Volden et al., 2008; Gilardi, 2010; Maggetti and Gilardi, 2013; Bender et al., 2014; Ancygier and Szulecki, 2014) agree that learning, emulation, competition (indirect coercion) and direct coercion are the main approaches for policy innovation diffusion.

Although the diffusion process is a multifaceted system occurring where networks connecting members of a social system are multiple, complex and overlapping, it often occurs in transitional spaces where sufficient differentiation among network members exists (Rogers et al., 2005). The key element of the definition of policy diffusion is the interdependences which acts as the main catalyst for the interactions between various units. As a result, one cannot ignore the role of power in the diffusion process. Weber (1978) describes power as the "probability that one actor within a social relationship will be in a position to carry out his own will, despite resistance, regardless of the basis on which this probability rests" (Partzsch and Fuchs, 2012, p.359). Power relations therefore significantly affects diffusion processes based on the direction and degree of skewness of the power asymmetry.

The approaches to policy diffusion has been characterised under various umbrellas. These include harmonization (Bennett, 1991), voluntary communication, regulatory and ideational competition (Tews, 2005), coercive policy transfer (Dolowitz and Marsh, 2000), regulatory cooperation (Holzinger and Knill, 2004), hierarchical imposition (Caddy, 1997) and domination (Bennett, 1991). These validate the complexity, lack of clarity and the difficulty to empirically identify policy diffusion processes. Nevertheless, these can be grouped into two main categories; voluntary and coerced (figure 2). This categorisation is based on the level of sovereignty possessed by the potential adopter or social unit with respect to the change agent.

The main factors that influence various units such as countries or regions to adopt policy innovations are favourable attributes and the potential of yielding high returns in comparison with other viable alternative options. Through effective communication flows, potential adopters or social units are able to observe the implementation of particular policy innovations and their subsequent outcomes in other social units (Busch and Jörgens, 2007). This enables potential adopters to assess the efficacy and applicability of such policy innovations to their social system. Depending on how favourable those particular policy innovations are, potential adopters may voluntarily incorporate them into their local policies or reject them based on the logic of appropriateness. State and non-state actors within the adopting social system are the main propellers of voluntary policy adoption through the exhibiting of "*power to*" (Partzsch and Fuchs 2012). Thus, the initiative is independently borne by policy-makers within the adopting country without any intervention from

international nor transnational organizations. External organizations can however, provide non-binding incentives to governments in order to encourage the adoption of such policy innovations.

In voluntary policy diffusion, policy-makers act in a rational manner by looking for effective and legitimate solutions to pressing domestic problems from across borders (Busch et al., 2005). Network of state officials are often involved in the hard transfer of policy practices and instruments whiles non-state actors such as think-tanks or transnational advocacy networks communicate ideas, local norms or the 'intellectual matter that underpins policies' (Stone, 2000, p. 47) and sometimes international norms as standards to put pressure on their domestic governments (Keck and Sikkink, 1999; Stone, 2000; Tews, 2005). This form of power relations is what Haugaard (2011) cited in Partzsch and Fuchs (2012) identifies as "*power with".* This form of power is described as the "processes of finding common ground among diverse interests, developing shared values and creating collective strength by organizing with each other" (Haugaard, 2011, p.3; Partzsch and Fuchs, 2012, p.363). This form of power relation offers a good opportunity for cooperation, learning and emulation between the originators, change agents and adopters. It presents a fairly balanced power symmetry between the various actors and allows for voluntariness while consenting them "to question self-perceptions and to actively build up a new awareness" (Partzsch and Fuchs, 2012, p.363). In effect, this approach reinforces further diffusion and the introduction of location specific as well as new ideas to improve the efficacy of such policy innovations through effective communication flows.

On the other hand, if the policy innovation does not present positive outlook to potential units of adopters, they are more likely reject such policies unless they are coerced through various forms of mediation, mainly through biased power asymmetry described by Partzsch and Fuchs (2012) as "*power over*". Although some scholars such as Busch et al. (2004) and Tews (2005) narrowly define diffusion to be voluntary or without formal or contractual obligations, this framework argues for the broad definition and sees coercion as a diffusion mechanism. This category of diffusion mechanism identifies that "policy diffusion is not always voluntary and not always beneficial" (Shipan and Volden, 2012, p.3). Dolowitz and Marsh (2000) and Ancygier and Szulecki (2014) also recognises this mechanism and describes it as an obliged form of policy transfer. "Coercion occurs when political units are forced to adopt certain policies by other actors, e.g. states or international or supranational organizations. [...] Coercion is a top-down measure and as such not a horizontal governance mechanisms as those emphasized by the narrow definition of policy diffusion" (Bender et al., 2014, p.14). Coercion is expressed through biased power asymmetry between the originator of the idea, innovation or policy and the potential adopter. This form of diffusion represents the third dimension of power over "*discursive power"* where one unit exercises power over another by getting it to adopt an innovation or policy of which it would not otherwise have (Partzsch and Fuchs, 2012). This sort of power is often expressed by international change agents as well as other donor organisations and countries whose aid play significant roles in the economic development of the recipient country, thereby giving them an invisible power to go beyond national capacities, conditions and actions to influence decisions. This is often visible in international and transnational networks and social relations which are presumed to shape the perception of particular fields and consequently the perception of adopting units or countries and their role in those fields (Tews, 2005).

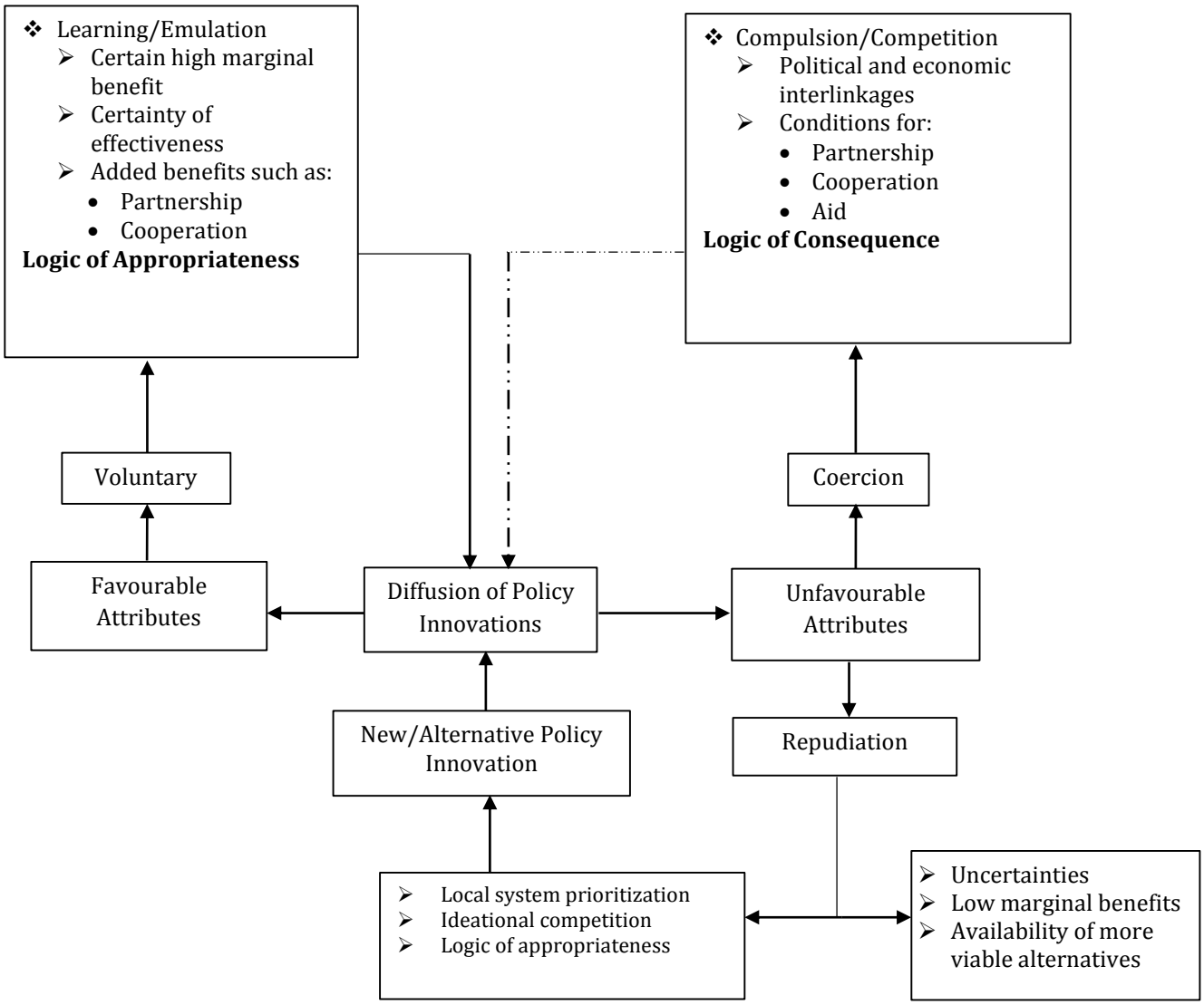

Figure 2. Diffusion of Policy Innovation

Although most international and transnational organizations impose policies through the use comparative power relations and advantage (Dolowitz and Marsh, 2000) others focus on "formulating, transferring, selling and teaching not formal regulation but principled or causal beliefs helping to constrain or enable certain types of social behaviour" (Marcussen, 2001, p.13). This normative or ideational pressure forces the adopting unit to modify its social system, institutions and regulations into adopting such policies for fear of the normative power (Drezner, 2001; Butler et al., 2017) thus, the logic of consequence. Most often developing countries fall prey to this and are coerced to adopt certain policies that might not be in line with their administrative structures and policy styles. This is evident in many Sub-Sahara African countries where most of such policies have resulted in perverse effects, making them less likely to diffuse further due to the compulsive nature of the change agents.

In other cases however, strong social units who attribute such policy innovations as unfavourable and infective are able to repudiate coercion. They often remain as non-adopters by prioritising and competing for political and policy superiority at international and multi-level settings. This in effect serves as a shield to prevent them from being obliged to implement policies and regulatory schemes that may not match their own administrative structures and policy styles (Busch et al., 2005; Butler et al., 2017). Tews (2005) describes this phenomenon as ideational and regulatory competition among policy innovators and pioneers. Here policy-makers are concerned about the anticipated economic and administrative costs and benefits which will result from an increasingly complex political and economic interdependence as well as the highest level of effectiveness and legitimacy (Butler et al., 2017). According to Partzsch and Fuchs (2012) this is a representation of the second dimension of the power over asymmetry, "*material structuralist power*" where the repudiating social unit devotes its efforts into creating or reinforcing their policy innovations so as to remain pioneers or prioritise their local systems against others.

3.4. Fostering technology transfer

About one third of the world's population is technologically deprived, and only 15% of the global population provides almost all technological innovations (Juma et al., 2001; Salicrup, and Fedorkova, 2006). Although the world is witnessing gradual progress, development of new technologies and innovations are still largely negligible in developing countries, particularly Sub-Sahara Africa. Developing countries are most often technological followers whose technical progress depend on their ability to adopt and appropriate innovations produced by advanced countries (Crispolti and Marconi, 2005). Transfer of foreign technology has negligible benefit and learning impact on developing countries, unless it is accompanied by active local policies designed to improve human capital and foster strategic technological partnerships and capabilities (Archibugi and Pietrobelli, 2003; Pietrobelli, 2000). Policies at both national and intergovernmental levels should therefore consider strategic technological agreements and partnerships as a preferential channel to transfer and acquire technological competencies (Archibugi and Pietrobelli, 2003).

Renewable energy technologies are evolving and becoming increasingly more efficient. Unfortunately, these innovations are centred in developed countries with a rather complicated diffusion process to developing countries where there are acute energy deficits. Adequate technical skill and managerial know-how is required during the selection and transfer of these technologies. The process is highly delicate and costly. As a result, much time and effort is required before and during the selection and transfer phase (Efstathiades et al., 2000). Many multilateral environmental declarations and agreements have over the years moved to support a generalized obligation of states to co-operate in transferring environmentally sound technologies to developing countries. Enhancing renewable energy technology transfer to developing countries will allow Sub-Sahara Africa to gain technological capabilities appropriate to its own regional needs and promote sustainable development. Diffusion provides the needed process for such transfer by strengthening the capacity of developing countries to identify appropriate renewable energy technologies and pursue their development through trade, investments and technical assistance (Salicrup and Fedorkova, 2006). As the world urge developed countries to create push factors, developing countries also need to create favourable conditions, thus pull factors, to attract the needed technology and initiate the transfer process. For

this to be effective, barriers such as information bottlenecks, capital constraints, trade and policy restrictions, high transaction costs, institutional weaknesses and business limitations such as risk aversion which bedevils many developing countries, particularly Sub-Sahara Africa, need to be resolved (Hutchison, 2007). Developing countries consequently need to devout more attention to developing the needed policy innovations which will serve as the foundation and create the enabling environment for appropriate technology transfer.

3.5. Policy options supporting the deployment of renewable energy innovations

Over the past decade, renewable energy has been experiencing growing importance on the global arena and the need for effective policies to support its development have been rising in both international and various national platforms (Abolhosseini and Heshmati, 2014). Policy instruments which shows promising results are often highlighted as good practices and are thus often recommended for diffusion and adoption (GIZ, 2012). One of the main obstacles hindering the successful adoption and implementation of these instruments is market failures. Policy-makers have therefore come up with various option to stimulate the diffusion of renewable energy innovations while mitigating market failures and compensating for technological and economic weaknesses (Polzin et al., 2015). Over the years many such policies have been developed, all with high expectation of boosting the diffusion of renewable energy innovations. Table 1 summarises some prominent policy options that support the development and diffusion of renewable energy innovations.

With the incorporation of environmental and natural resource goals in public policy, market mechanisms and policy instruments designed to encourage the deployment of renewable energy innovations have been gaining wider acceptance (Berry, 2002). However, international policy support activities need to focus on the design and implementation methods of these polices by taking note of the differences existing among various countries in terms of their administrative structures, stakeholder interests, political goals and market conditions. Liao et al. (2011) proposed the classification of renewable energy development into three market phases – i) Undeveloped markets – where there is the need for more research, development and awareness creation, ii) Developing markets – where governments need to provide favourable incentives/subsidies to encourage potential producers to enter the market, and iii) Developed markets – where renewable energy products are ubiquitous in the energy market and consumers are familiar with them as an alternative energy source. They suggests that governments should adopt suitable and flexible instruments to achieve their policy goals depending on which stage of the market phase they are.

A recommend approach of ensuring an effective diffusion process is to adopt an appropriate policy mix mechanism consisting of complementary instruments (Polzin et al., 2015). There is however, no scholarly consensus existing on what the optimal policy mix is or which criteria to use in determining it (Foxon and Pearson, 2007; Carley, 2009). Mir-Artigues and del Río (2014) points out that combining deployment instruments is not a cost containment strategy. However, such a policy mix may lead to different inter-temporal distributions of the same amount of policy costs and thus, differently affect the social acceptability and political feasibility of renewable energy support. Governments therefore have to evaluate the stage of their market as well as other influencing factors in order to identify the kind of policy mix that will favour their socio-economic environment.

Table 1. Overview of Prominent Renewable Energy Policy Instruments

Policy Instrument	Notable Advantages	Notable Disadvantages
Feed-In Tariffs	• High effectiveness • High investments security • Strong market dynamic • Compatible to small and large scale generation	• High electricity prices • Difficult policy design (eg. difficult control of penetration speed, false design may lead to over or under estimated expansion rates)
Renewable Portfolio Standards/Quota	• Strong market orientation • Less government intervention • Easier policy design than feed-in tariff	• Lower effectiveness than feed-in tariff particularly in case of weak penalty system • Not necessarily cheaper than feed-in tariffs
Capital Subsidies/ Grants/Rebates	• Facilitates investments in renewable energy	• Diversion or creation of new capital
Investments or other Tax Credits	• Reduces investment cost • Suitable for utility-scale investments	• May keep power producers from operating plant if tax credits are only available for investment • Less attractive to small scale investors
Tradable Renewable Energy Certificates (REC)	• Allows power producers to achieve higher share of renewable energy in their electricity mix through trading • Helps green power producers to receive additional benefits	• May keep power producers from investing in renewable energy themselves • Less attractive to small scale investors
Energy Production Payment or Tax Credits	• Fair to high effectiveness • Can complement investment tax credits	• Lower investment security than feed-in tariffs. • Has weaker legal basis
Net metering	• Less complex than feed-in tariff • Lower cost than feed-in tariff	• Lower financial benefit than feed-in tariff • Not suitable for utility-scale installations
Public Investment, Loan or Financing	• Facilitates investment in renewable energy projects	• Increase risk of public debt
Public Competitive Bidding	• Strong market-orientation • Competitive prices • Check on capacity addition	• Applications may bid too low to win the tender. This may lead to non-completion of project or bankruptcy

Source: GIZ, 2012(This is an adaptation of an original work by GIZ)

3.6. Making renewables a viable option

Although international debate on climate change propels the diffusion of renewable energy policy innovations, the demand side focuses on the initial capital investment and how low the unit generation cost is. To make renewables a viable option, cumulative generation need to increase to a threshold of triggering exponential reduction in the unit cost of generation. Instead of using political and economic pressures to coerce the adoption of such policy innovations, enticing voluntary approaches will create an appealing interest and promote sustainability in the long run. This will propel further diffusion as benefits will become more observable. Potential adopters will subsequently be more comfortable and willing to establish bilateral

cooperation and relations with forerunners and other social systems or international actors who are making considerable progress in the sector. This scenario instils confidence and trust by promoting a "power with" relationship.

Even though there are many renewable energy policy innovations available, attributes such as relative advantage, compatibility, complexity, trialability and observability of their effectiveness cannot be overlooked. These attributes are the initial factors that lay the foundation by raising interest and attracting potential adopters. The major hindrances thwarting many African countries from adoption renewables are the lack of technical know-how, substandard/inadequate grid infrastructure, unfavourable policy and regulatory mechanisms and lack of financial resources needed to procure modern renewable energy technologies. In order to attract investments, real efforts need to be made towards the promotion of efficiency, transparency and consistency in the management of energy generated and supplied from renewable energy sources. With the growing energy demand and uncertainties about emerging energy technologies, the future of renewable energy technology standards and the acceleration of energy technology innovation and policies are becoming increasingly important and nations need to make strategic policies to develop the sector and exploit its potentials. Understanding renewable energy innovation processes more fully in Sub-Sahara Africa could yield considerable benefits. To achieve an effective renewable energy policy innovation diffusion the process should be considered as an institutionalization of policy innovation transfer by establishing networks of effective communication flow where all actors involved will be permitted full access to information in a free atmosphere.

4. Conclusion

Energy plays a dominant role in the sustainable well-being and the social prosperity of all economies. Maintaining uninterrupted and efficient energy supply is therefore essential in promoting development. Currently, effort are being made worldwide to improve energy efficiency. But without new technologies and policies, particularly in the renewable energy sector, energy efficiency will be difficult to attain. Innovation in energy technology is hence becoming more active throughout the energy industry and has seen major investments and activities in recent times. The sector is continuously witnessing an increasing attention being given to energy research development with the aim of developing new cleaner and more sustainable sources of energy as well as sustainable policy regulations. Understanding the long-term patterns of innovation in energy technologies is therefore critical for technology forecasting and public policy planning. The diffusion of these policies and innovations into Sub-Sahara Africa is critical to meeting energy demand while mitigating climate change globally.

Although many literature are showing increasing interest in studying the innovation processes of technologies and policies in the energy sector more attention need to be directed towards renewable energy innovations and its diffusion and adoption in Sub-Sahara Africa. In order to adequately support the development and diffusion of eco-friendly technologies into the region, insight into their specific innovation trajectory is necessary as long-term patterns in the process and focus of innovation differ across technologies

as well as locations. Since innovation in technology is heavily affected by government policies such as technology standards, environmental regulations and subsidy schemes, the voluntary diffusion and "power with" approach presents a flexible mechanism that will allow governments to tailor regulatory strategies towards individual energy technologies to enhance the diffusion and adoption of appropriate renewable energy policy innovation.

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