International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2017, 7(5), 111-122.

Multi-level Analysis of Sustainable Energy Transition in Kenya: Role of Exogenous Actors

Le Dong[1]*, Akihisa Mori[2]

[1]Graduate School of Global Environmental Studies, Kyoto University, Japan, [2]Graduate School of Global Environmental Studies, Kyoto University, Japan. *E-mail: dong.le.78e@kyoto-u.jp

ABSTRACT

Sustainable energy transition is desirable to reduce carbon emission and to increase access to electricity from renewable energies, which hold especially true for African countries. Examining past transition pathway helps further advance the transition. Multi-level perspective has been adopted to examine technological transition and innovation in and beyond energy sector. Empirical research focused merely on energy transitions in developed countries, such as Germany, Netherlands and UK. This paper contributes by providing the lessons from developing countries, with case of Kenya. The niche-regime-landscape dynamics in Kenya's electricity sector are depicted within three stages from 1954 to 2016, revealing the unneglectable role of exogenous actors in changing the landscape and accumulating the niche novelties. The paper holds the argument that, in comparison with developed countries, the developing world in energy transitions should pay attention to the influence of exogenous actors onto its landscape, regime and niche for a better sustainability transition.

Keywords: Energy Transition, Exogenous Actors, Multi-level Perspective, Kenya
JEL Classifications: L9, Q4

1. INTRODUCTION

Many African countries embrace renewable energies for electricity generation and set energy transition towards sustainability as targets, so as to increase energy access without accelerating greenhouse gas emissions. This holds especially true in Sub-Saharan Africa, where two-thirds of the population live without electricity (IEA, 2014), and 66% of all new electricity generated from 1998 to 2008 came from renewable sources including hydropower (UNEP FI, 2012). Additionally, increasing renewable electricity also helps contribute to many of the sustainable development goals (SDGs).

Donovan (2015) declared that renewable energy investors are still in the process of recognizing the unique facts of renewables, especially the predictability of risk and return for investment. This is why only international donors have provided renewable energy financing effectively in Africa (UNEP FI, 2012) despite of a range of public support scheme for private investment in this domain. Therefore, examining the role of exogenous actors in energy transitions across Africa will help better mobilize the exogenous technical and financial resources for the sustainability transitions in this continent and other developing countries.

Examination of the current energy transition requires multi-dimensional analysis given the institutional complexity of renewable electricity. The common regulatory and policy support mechanisms for promoting renewable electricity in Africa includes: (1) Establish standard power purchase agreement (PPA), (2) ensure long term electricity generation licenses and PPAs, (3) develop a favorable tariff setting and adjustment formula, (4) light-handed regulation, (5) set explicit targets for the share of renewables in generation mix, (6) encourage local private participation in renewable development, (7) provide subsidies to renewable power systems especially in rural areas, (8) set the feed-in-tariff (FiT) policy (UNIDO, 2005b). Meanwhile, African countries also adopted the liberalization and privatization of energy sector reform in varying ways and to divergent extents, which inevitably interferes with renewable energy policies (UNIDO, 2005a).

Multi-level perspective (MLP) has considerably developed in transition study on how to analyze dynamics of change. As a shared analytical concept, it differentiates three levels to analyze dynamics: The niche, the regime, and the landscape (Rip and Kemp, 1998). MLP has been employed, but not limited, for energy sector transition study, with theoretical study (Elzen et al., 2002; Verbong et al., 2010), and empirical exploration (Verbong and Geels, 2007 on Netherlands; Verbong et al., 2008 on Netherlands; Geels et al., 2016 on Germany and UK). This paper adopts the MLP analysis on developing countries, with case of Kenya, for the first time. This paper examines the past and current electricity transition in Kenya, and draws lessons concerning the exogenous actors for future sustainability transition. Kenya is selected because it is the leading African country on exploring geothermal and wind power for on-grid electricity generation, and its electricity sector is in transition with multiple generation utilities (both incumbent and new entrants) and single buyer, a typical model in Africa. The Kenyan case may shed light on studying energy transition in other African countries.

This research is empirical study. Six informant interviews and survey in Kenya National Archives were conducted, with three staff from Kenya Electricity Generating Company (KenGen), Akiira Geothermal project, and the Public Private Infrastructure Advisory facility (PPIAF) of World Bank Groups (WBG) in Nairobi, Kenya in October 2016, and another three colleagues dedicated to energy sector reform from International Development Association (IDA) and Multilateral Investment Guarantee Agency (MIGA) of WBG in Washington DC, United States in December 2016.

The paper is organized as follows. The section two depicts the analytical framework. The section three outlines the landscape-regime-niche dynamics in Kenya's electricity sector. The section four further illustrates the interactions on geothermal and wind electricity, and the role of exogenous actors. In section five, discussion and policy implications are derived. The final section concludes the paper.

2. ANALYTICAL FRAMEWORK

MLP of transitions derives from the concept of technological regime, which was firstly proposed by evolutionary economists, referring to the prevailing successful designs predisposing innovators in firms towards development of certain marketable or feasible options but away from other less attractive options (Nelson and Winter, 1977). Rip and Kemp (1998) define a broader notion of technological regime by combining an artifact view with landscape view to produce multilayered backdrop of novelty and irreversibility. Subsequent theoretical research further advanced the notion of socio-technical regimes (Geels, 2002; Geels, 2004; Genus and Coles, 2008; Smith et al., 2010; Papachristos et al., 2013), by incorporating ideas from sociology on relations between various types of institutions and rules and technology development and use, with several empirical explorations in parallel (Bree et al., 2010 on electric vehicles; Turnheim and Geels 2013, on British coal industry).

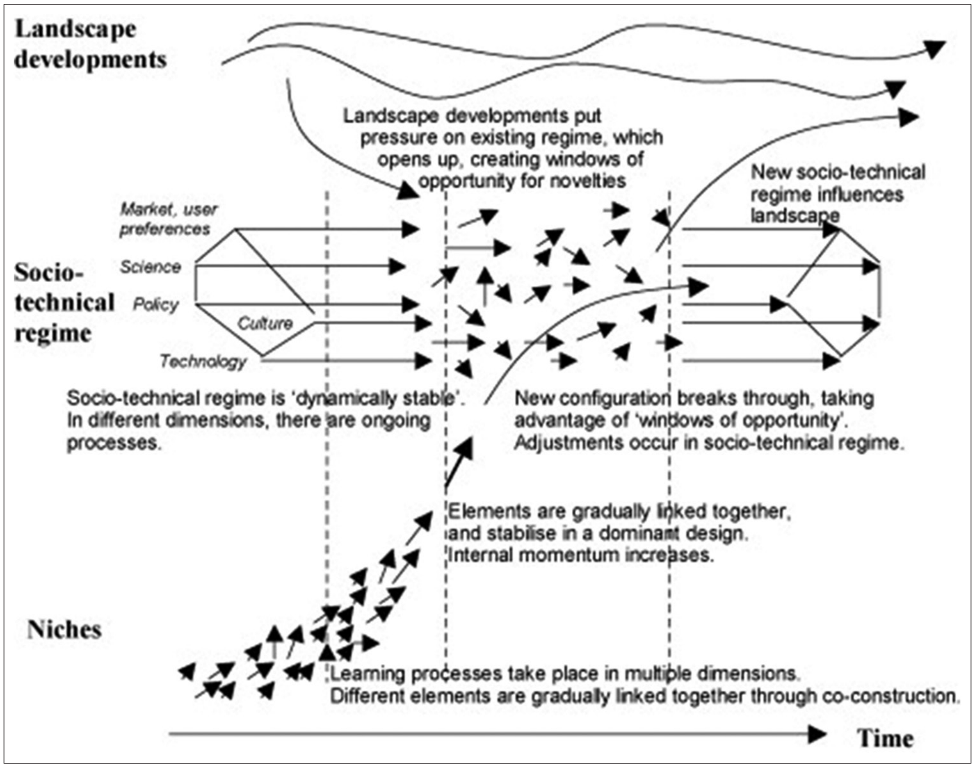
Researcher typically analyze past episodes of transformational innovation at the macro-level (landscape), meso-level (regime) and micro-level (niche) (Figure 1). The niche is built up by a small group of actors pursuing partly differing activities from the regime, and is a space prone for more radical innovations to occur at least at experimental level. Radical novelties emerge in "protected spaces" to shield from market selection. Protection is provided in terms of subsidies by public authorities or strategic investments by companies (Geels, 2004). Strategic niche management theories believe that "protective spaces" by policies can make room for experimentation, proliferation, and maturation of the early-stage technologies (Verbong et al., 2010; Bakker et al., 2015; Boon and Bakker, 2016; Raven et al., 2016), and the common existence of social, geographical, institutional and organizational proximity dimensions in niche development (Coenen et al., 2010). The socio-technical regimes include formal/regulative, normative, cognitive institutions within technological and product regime, science regime, policy regime, socio-cultural regime, and users, markets and distribution networks which are dynamically stable (Geels, 2004). The landscape in turn is the mostly exogenous context, by definition out of the influence of niche, such as global trends on climate change. It can put pressure on existing regimes, and open up windows of opportunities for novelties. Meanwhile, landscape is also affected by new socio-technical regimes (Geels, 2002).

MLP has been regarded as a relevant analytical framework for energy transition study. Elzen et al. (2002) theoretically proposed the socio-technical scenario for exploration of transition to a sustainable electricity supply, and examined two transition paths at European level: Large-scale integration of renewables, and distributed generation. Verbong et al. (2010) further described three possible transition pathways: Transformation towards hybrid grids; reconfiguration towards super-grid; de-alignment and re-alignment towards distributed generation. Three dimensions at meso-level of socio-technical regime are defined: (a) Material and technical elements, such as resources, grid infrastructure, and generation plants, (b) network of actors and social groups: Utilities, relevant ministries, large industrial users, and households, (c) formal, normative and cognitive rules that guide the activities of actors, such as regulations, guiding principles, and behavioral norms (Verbong et al., 2010). Empirical MLP analysis has been also conducted on electricity sectors in Netherlands (Verbong and Geels, 2007; Verbong et al., 2008), Germany and UK (Geels et al., 2016).

The allure of MLP rests in its ability to capture the bigger picture in socio-technical transitions. However, it also has limitations as many theories, such as emphasis too much in niche-derived agency in transitions and underemphasize the radical reforms in regimes (Smith et al., 2010), and whether transitions are as tractable to policy-makers as implied (Shove and Walker, 2007). Nonetheless, it provides an analytical framework to depict the niche, regime and landscape dynamics.

Based on the rationale of MLP, the paper contributes to the field of energy transition by: (a) In comparison to current literature on lessons from developed countries, providing empirical lessons from developing countries, in Kenya, with the adoption of MLP,

Figure 1: A dynamic multi-level perspective on system innovations



Source: Geels, 2004

(b) examining the role of exogenous actors in changing the landscape, regime, and niches in Kenya's energy transition, with focus on geothermal and wind, so as to provide lessons for future energy transition towards sustainability in developing countries.

3. LANDSCAPE-REGIME-NICHE DYNAMICS IN KENYA'S ELECTRICITY SECTOR (1954-2016)

Kenya is well-endowed with renewable energy. Over 14 potential geothermal sites locate along the Great Rift Valley with a potential of 7000-10,000 megawatts (MW), the highest potential in Africa. Kenya was the first country in Africa to adopt geothermal since 1954. Naivasha region witnesses the single largest geothermal project in the world – the Olkaria 1 and 4 (280 MW), and the first private sector greenfield geothermal project in Africa-the Akiira (70 MW). Meanwhile, Lake Turkana region in 2015 saw the construction of the largest single wind power project in Africa, with an expected installation of 365 wind turbines, and a total of 310 MW of wind energy to the national grid upon completion in 2017 (LTWP, 2017). According to the MLP theory, interactions between landscape, policy regime, actors and niche novelties employing the geothermal and wind technologies are outlined in Kenya's electricity sector from 1954 to 2016, with three stages elaborated below and presented in table (Annex 1).

3.1. Nurturing Niches in a Context of Stable State-owned Regime (1954-1995)

In 1954, when Kenya was still fighting with the British colony, the Kenya Power Company was formed to construct transmission lines, under the management of East Africa Power and Lighting Company (EAP&L). After exiting the operation in Tanzania in 1964 while Kenya got its independence, it was renamed as Kenya Power and Lighting Company (KPLC) in 1983. Archival records released in the period of 1954-1972 indicate that since 1954 the then Commissioner at the Department of Mines and Geology (DMG) in Nairobi started to reach out the British Commonwealth Geological Liaison Office in London for technical assistance from Italy and New Zealand on the early investigation on geothermal in Naivasha region. The British Balfour Beauty & Co launched the Great Rift Valley Geothermal Steam Project in 1956, and concluded that the steam did not satisfy the drilling conditions in 1958.

From 1959 to 1962, DMG turned to Philippines, Mexico and US for sampling assistance. After the independence in 1964, EAP&L conducted further survey in 1966, and obtained technical and financial support from United States Agency for International Development and United Nations Development Programme (UNDP) in 1967. In a document filed on April 19, 1967, regulation was made that the government should refuse the private company, EAP&L, to have exclusive prospection license of geothermal steam, and it should be the Government of Kenya (GoK) who lead the exploration so as to obtain substantial international assistance. In 1968, the Ministry Economic Planning and Development submitted the formal proposal prepared by EAP&L to UNDP for a three million US dollars (USD) of geothermal investigation project in Olkaria.

In 1982, geothermal resources act was enacted to vest the exploitation right of geothermal in GoK. After decades of investigation, geothermal Olkaria I was launched as the first niche novelty of renewable energy in Kenya, with 30 MW in 1981, and another 30 MW in 1985. Competition was aimed at the restrictive trade practices, monopolies and price control act in 1989, to reduce direct control of prices in the entire economy, including the electricity sector, as a prelude to the next stage.

3.2. Parallel Expansion of Regime and Niches in a Neo-liberal Landscape Context (1995-2010)

Aid embargo by international donors was imposed on GoK in 1991-1994, for reasons linked to corruption and lack of advancement in the creation of a multi-party state, which affected all sectors, including the geothermal projects. Besides the aid landscape, Kenya, as many other countries in and beyond Africa, started to be affected by the Structural Adjustment Programs proposed and promoted by WBG and International Monetary Fund (IMF) since the 1980s (Mills, 1989).

A policy paper on economic reforms released by GoK in 1995 set out to separate the regulatory and commercial functions of tis power sector, facilitate restructuring and promote private investment in 1996-1998 (GoK, 1996). It was co-prepared with WBG and IMF, requiring the separation of generation, transmission and distribution, and the reforms of KPLC (renamed as Kenya Power in 2011). It also required the International Competitive Bids (ICB) to invite investment from Independent Power Producers (IPPs) for generation (GoK, 1996). In 1995, tenders for the first two IPPs were released: One diesel (Tsavo), and the other one geothermal (OrPower4). In 1998, OrPower4 PPA was signed for between 28 and 100 MW, and Tsavo PPA was 75 MW. In 2000, OrPower4 began to operate 9 MW with 4 MW added for a total of 13 MW.

Consequently, the Electric Power Act of 1997 set to review cost-effective electricity for rural areas, including policies to encourage the use of renewables, like solar and wind. The GoK's primary function became policy formulation through the Ministry of Energy (MoE), and its regulatory authority was devolved to the Electricity Regulatory Board established in 1998 which later reformed to Energy Regulatory Commission in 2006. Unbundling is translated into a re-definition of the scope of KPLC's activities such that it now focuses only on the transmission, distribution, and retail of electricity, while KenGen was established in 1997 to take over the generation from KPLC. In 2003, geothermal Olkaria II was launched with 70 MW, and extended another 35 MW in 2010 with the supportive policy on renewables.

The policy regime and niche were affected by domestic landscape changes from 1993 to 2003 of: (a) The depreciation of Kenyan Shilling, which weighs the project financial burden heavily on GoK, considering all PPA are denominated in USD. The Kenyan Shilling against USD reached a historical record low of 36.23 in 1993, and was about 80 in 2003, (b) severe drought in 1995/96, and 1998/2000, with 4 million people in need of food assistance in 2000 (Kenyan total population of 31 million). Three emergency IPPs using diesel were introduced during drought (Aggreko, Cummins and Deutz).

In 2004, the GoK indicated the need to fully unbundle the transmission and distribution functions of KPLC. However, it would be challenging given its status as a publicly quoted company, thus it was later decided that a separate company owned by GoK and funded by the exchequer be created to construct future transmission lines. In 2008, the GoK registered the Kenya Electricity Transmission Company. And KPLC retained and continues to operate all previously existing transmission systems. The other main actors in the sector comprise the Energy Tribunal (ET, to hear and determine appeals brought against the decisions of the energy), the Rural Electrification Authority (REA, to implement rural electrification projects on behalf of the GoK), the Geothermal Development Company (GDC) (GDC, to develop steam fields to reduce upstream power development risks so as to promote development of geothermal electric power) (Kenya Power, 2017).

Kenya adopted FiT policy since 2008, covering wind, small hydro and biomass sources. Without much interests from investors – only one project has been successfully developed under the policy, the Imenti Tea 0.3 MW small-hydro project, the FiT policy was reviewed in 2010, and covered geothermal, biogas and solar. A number of renewable projects have been approved, namely, the Kinangop Wind Farm with 60 MW, Kipeto Wind with 100 MW, Kwale Sugar Mill with 18 MW, and several small ones from 0.5 to 2.0 MW. All these projects do not involve a specific payment security instrument, such as a Letter of Credit from KPLC, instead, they have a letter of support from GoK which is not a guarantee. Least cost power development plan for 2011-2031 released in 2009 (GoK, 2011) concluded that in Kenya the local energy resources (geothermal, wind and hydro) are the most economically attractive at 8% of discount rate. While at 12%, gas turbine using natural gas becomes more attractive than wind. Under this backdrop, OrPower4 expanded another 36 MW of geothermal.

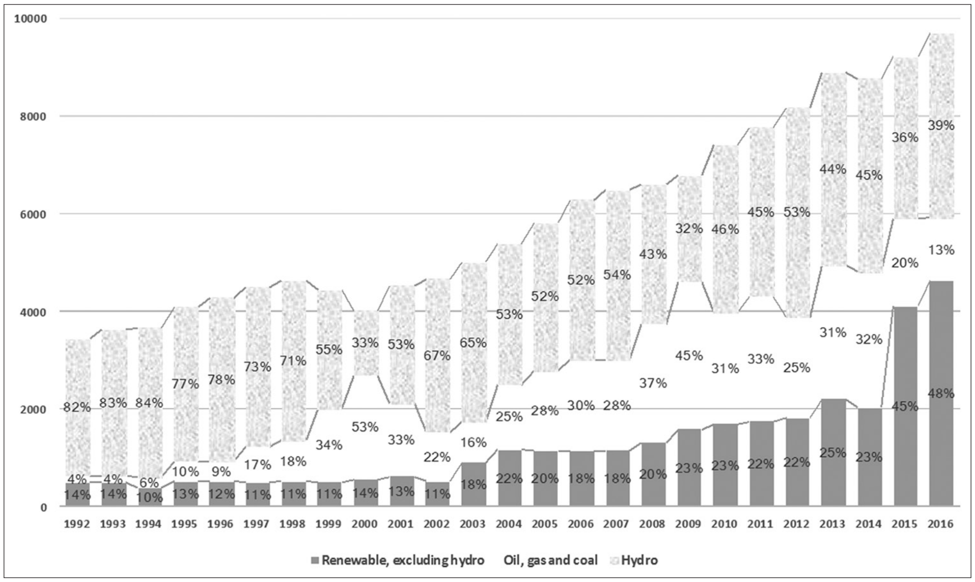
Due to the data availability, Figure 2 presents the electricity production by sources in Kenya from 1992 to 2016. The period of 1995-2010 is featured by parallel expansion of regime and niche novelties: Renewables, mostly geothermal, are steadily increasing from 13% to 23%.

3.3. Increasing Renewables in a Changing Socio-political Landscape Context (2010-2016)

Sharp growth of renewable energy in the electricity production from 2010 to 2016 became apparent, though with slight decrease in 2014. The latest data in 2016 recovered that geothermal had contributed to 48% of Kenya's electricity generation, with the rest from hydro (39%), thermal (12%) and wind (1%) (KenGen, 2016), as the result of long preparation of geothermal projects at previous stage, such as Olkaria IV with 140 MW in 2012, and OrPower4 with 36 MW in 2013, 26 MW in 2014 and another 29 MW in 2016.

The newly established constitution in 2010 divides Kenya into 47 counties, to which both political power and government functions are devolved. As the most far reaching institutional and public finance reform undertaken in Kenya to date (Ndii, 2010), it requires adequate adjustments in the policy regime of energy sector. Under the constitution, the functions of energy policy including electricity and gas reticulation and energy regulation have been assigned to the national government, while planning and development,

Figure 2: Electricity production by sources in Kenya from 1992 to 2016, unit in GWh



Source: Author's compilation based on World Bank database (1992-2013) and Kenya Power annual reports (2014-2016). Given the data availability, the 2014-2016 data is electricity purchased, thus actual production might be different

including electricity and gas reticulation and energy regulation, are assigned to the county governments.

Besides the domestic landscape change, the international landscape on climate change also affected the national landscape, resulting in relevant changes in energy policy regime. 2010 witnessed the establishment of national climate change response strategy, first of this kind to addressing the climate change threats as well as the opportunities may arise. National climate change action plan 2013-2017 in 2012 called for increasing reliability of the electricity supply by reducing reliance on hydropower. Kenya national adaptation plan 2015-2030 released in 2016 demonstrated Kenya's commitment to the Paris agreement, and aimed to increase the solar, wind and other renewable systems network to provide power to off-grid areas.

Energy policy regime also experienced internal reform. Since 2014 the GoK has been intending to replace the failed FiT policy. Kinangop, the first FiT project, had been halted by 2015 due to local protest caused by land disputes (Eberhard et al., 2016). Kipeto project also worried that the tariff for wind will most likely go down under the new FiT (CDM Executive Board, 2012). As MoE identified that one of the key challenges regarding the FiT policy – "insufficient data and analytical tools to inform the tariffs level" (KMEP, 2016). GoK decides to move to an auction system to promote renewable generation, with the aim to reduce electricity costs for consumers. The new auction regulation to be issued in 2017 is believed to mostly favor the solar sector and it is not clear how it would affect private geothermal energy development, and in particular on-going projects (Richter, 2016). The policy regime also saw the enactment of Energy Bill in 2015, and National energy policy in 2016 which calls for the establishment of two high-level agencies - the inter-ministerial Renewable Energy Resources Advisory Committee (RERAC), and National electrification and renewable energy authority (NERA) be the lead agency for development of renewable other than geothermal and large hydro.

As a result of above landscape and regime changes, by June 2016, eleven IPPs had accounted for about 30% of the installed capacity in Kenya, or 691 MW in total, which grew considerably compared with the 12% in 2005 (KPLC, 2016). KenGen still remains the largest power producer in Kenya. With an installed capacity of 1630 MW KenGen commands a market share of 69%, and generated 80% of national energy consumption (KenGen, 2016). In 2016 KenGen had a contract to drill two commercial wells for Akiira Geothermal Project in Olkaria region. Continuous growth of renewable energy novelties can be expected in future, given that the GoK encourages continuous investment in geothermal to achieve 5500 MW by 2030, and the operation of Lake Turkana Wind Project with 310 MW of capacity ready in 2017.

4. ROLE OF EXOGENOUS ACTORS IN THE INTERACTIONS ON GEOTHERMAL AND WIND ELECTRICITY

This section further examines three existing niche novelties, two on geothermal and one on wind, the actors involved and their fitness with regimes (Table 1), and the role of exogenous actors in the interactions. The first is OrPower4 geothermal project, the first operating renewable energy IPP in Kenya. The second is Akiira geothermal project, the on-going first private sector greenfield geothermal IPP in Kenya and Africa. The third is Lake Turkana Wind Project, the largest single wind power project in Africa.

4.1. Different Protective Spaces Related to Exogenous Actors in Geothermal Novelties

Two of the existing geothermal novelties in Kenya's electricity sector uncovered interesting proximities and divergent policies related to endogenous and exogenous actors. The proximities on geographical, and organizational dimensions are observed. Whilst GoK has established considerable supportive institution for geothermal exploration to create protective spaces and

Table 1: Three niche novelties, actors, and fitness with regimes in Kenya

Project	Technology	Actors involved	Fitness with regimes
OrPower4 Geothermal Project, since 1998, 140 MW in operation	Lower cost (0.10 USc/kWh) than similar projects (0.14 USc/kWh in Olkaria II by KenGen) in 2015	Ormat, a US company; Finance from US (OPIC) and EU (DEG, KFW, and co-lenders); risk insurance from MIGA; drilling from KenGen and itself	First renewable IPP after the policy on ICB for electricity generation in 1995, yet only two bids with the other as non-compliant; KPLC signed PPA of 20 years; KenGen donated 8 MW worthy of 24 million USD in 1998
Akiira Geothermal Project, since 2015, in process, 70 MW proposed	Tariff negotiated under PPA remains unknown	Kenya centum investment company and three other non-Kenyan companies; Finance from US (OPIC, USTDA), African Union, and commercial banks; risk insurance from Munich RE; drilling from KenGen and China	Quasi national background contributed to its successful application as IPP in 2009; GoK promoting renewables; GoK pending its application of using pension fund; Failed drilling by KenGen; KPLC signed PPA
Lake Turkana Wind Project, since 2014, 310 MW expected in 2017	Tariff negotiated under PPA: A base rate of 7.52 EUc/kWh for up to 1,684 GWh and 3.76 EUc/kWh for additional	Lake Turkana Wind Power including various entities from Netherlands, UK and Nordic countries; finance from EU, AfDB, US and commercial banks	Initiated as an unsolicited bid directly with MoE; GoK promoting renewables; KPLC signed PPA of 20 years

MIGA: Multilateral Investment Guarantee Agency, KenGen: Kenya Electricity Generating Company, IPP: Independent Power Producers, ICB: International Competitive Bids, KPLC: Kenya Power and Lighting Company, PPA: Power purchase agreement, USD: USD: US dollars, USTDA: US Trade and Development Agency, OPIC: Overseas Private Investment Corporation, GoK: Government of Kenya

international actors have provided financial and technological support, however OrPower4 obtained more space than Akiira.

Proximities on geographical, and organizational dimensions are observed on these two novelties and other mature geothermal projects. OrPower4, also referred as Olkaria III, locates right inside of the Greater Olkaria Geothermal Complex (GOGA) in Naivasha, Kenya. Akiira locates just south of GOGA. Geographical proximity is an important background variable as the availability of energy resource is crucial for success. Organizational proximity, referring mainly to the creation of new actors, formalization of interactions between organizations, is also found in geothermal development. Both projects signed PPA with KPLC, and gained insurance coverage respectively from MIGA and Munich RE. These formalizations indicate necessary protective institutions for the geothermal development.

However, scale of support is divergent mainly relevant to exogenous actors. Orpower4 Geothermal Project generated power at lower cost (0.10 USc/kWh) than similar projects (0.14 USc/kWh in Olkaria II by KenGen) in 2015 (Eberhard et al., 2016). The successful operation demonstrates that the combination of national government support, in the form of early-stage exploration and donation on wells from KenGen, a PPA package to guarantee the power off-taker can pay the agreed tariff, international public finance with longer terms and lower costs than locally available, and Political Risk Insurance from MIGA (Micale et al., 2015).

On the contrary, Akiira Geothermal Project gained less support. Akiira Geothermal Limited is a special purpose vehicle by one consortium owned by Centum Investment Company Limited (CICL) of Kenya and three other non-Kenyan companies. The interview with Akiira staff reveals that the previous history of CICL as a state-owned company contributed to the successful application as an IPP in 2009. However, the initial test drillings conducted by KenGen are failed. The financing process is not smooth either, for instance, the application of using Kenyan Pension Funds is still pending. The project receives commercial insurance for failed geothermal drilling by Munich RE, not from World Bank's MIGA, and financing support from African Union Commission, and US Overseas Private Investment Corporation and US Trade and Development Agency, unlike OrPower4 which mobilized additional finance from European debt providers, such as German Investment Corporation (DEG), KFW Development Bank (KFW), and other European co-lenders. Though both novelties got PPA signed with KPLC, OrPower4, as the first IPP in Kenya, received more space in terms of geothermal wells donation from KenGen, as well as more financial support and financing confidence from international financiers.

4.2. Different Niche-regime-landscape Interactions and Transition Pathways for Different Technologies

Kenya case offers interesting interactions between niche-regime-landscape in the transitions of different renewable technologies, namely geothermal and wind, indicating the critical role of exogenous actors.

Energy regime requires ICB for electricity generation. OrPower4 has only one competitor who turned out to be non-compliant in the end. Akiira got the IPP position with its quasi national background. LTWP was initiated as an unsolicited bid directly with the MoE. It occurred when GoK was actively promoting renewable. The reason why LTWP can quickly become adopted and operational within 3 years probably lie in the fact that the incumbent utilities in Kenya pose less pressure. Wind power in 2016 only contributed to 1% in Kenya's electricity generation, putting less competition on to LTWP compared with KenGen to Akiira. Though Kenya does not have abundant domestic knowledge on wind power as much as the one on geothermal accumulated from decades through learning, the international entities comprising LTWP could bring in wind technology directly for the sustainability transition in Kenya. The diverse entity composition of LTWP also enables substantial financial support from international development agencies and commercial banks.

Geels et al. (2016) summarized four transition pathways in terms of actors, technologies and institutions: (a) Substitution pathway, niche and regime technologies initially develop separately and are carried by different actors, (b) transformation pathway, gradual reorientation of the existing regime through adjustments by incumbent actors in the context of landscape pressure, societal debates and tightening institutions, (c) reconfiguratizon pathway, niche-innovations and the existing regime combine to transform the system, (d) de-alignment and re-alignment pathway, the existing regime is disrupted by external shocks, followed by the rise of multiple niche-innovations and constituencies.

The geothermal technology transition in Kenya follows the transformation pathway, in which the incumbent KenGen remains dominant in comparison with OrPower4 and Akiira. Judging from the incremental challenges posed on the latter, there is a tendency of shifting from moderate incumbent reorientation to substantial level. While the wind technology transition in Kenya follows the de-alignment pathway, where LTWP, as a pure international actor, entered the Kenya energy market without invitation, and quickly settled down with the expected installed capacity by 2017 equivalent to 17% of the country's current total installed capacity.

5. DISCUSSION

5.1. Role of Exogenous Actors in Providing Protective Policies in the Incumbent Reorientation Pathway

As briefly depicted in last section, geothermal transition in Kenya undergoes the transformation pathway featured by incumbent reorientation where KenGen strengthens its dominant role. Protective policies are needed to accelerate the transition, where the exogenous actors can play an important role.

Though geothermal has become the dominant electricity source in Kenya by 2016, with 48% (Figure 2). A deeper looker at the installed generation capacity by ownership revealed the gap between incumbent and new entrants (Figure 3). Take the year of 2005 and 2016 for comparison, KenGen's geothermal capacity increased from 10% to 21%, while IPPs' one was from 1% to 6%. Therefore, protective policies should put more weight onto the IPPs' geothermal development, given that the incumbent KenGen has already gained the technology accumulation through learning, as well as committed institution and financial support from GoK and international financiers with long-term cooperation relationships.

Adopting the five dimensions of protective policy measures (Boon and Bakker, 2016), the geothermal institution in Kenya can work on: (a) The width by covering different geothermal generation methods, such as dry steam power plants, flash steam power plants, binary cycle power plants and lately wellhead generator units, (b) the depth by offering insurance covering not only the failed test drilling, but also other failures in operations, (c) the duration by extending the period of PPA, (d) the tools by periodically examine the functions of current incentives like FiTs and renewable auction, (e) the legitimization by reviewing the assumptions and feasibilities of unbundling the generation, transmission and distribution in Kenya.

Considering the fierce competition in the game among Kenyan actors, such as KenGen and IPPs, the international actors may intrude as influential exogenous impetus, as they already did in the past. To tackle the financial constraints for IPPs on geothermal and other renewables in and beyond Kenya, the international financiers can work on: (a) The width by financing different applications on the technology, (b) the depth by financing with less criteria to be fulfilled, (c) the duration by lengthening the grace period, payment period, (d) the tools by providing various kinds of financial support, such as grant, export credits, concessional loans, and commercial loans, and making use of refinancing to reduce the borrowers' burden, (e) the legitimization by re-examine the international financing guidance against the needs in African countries.

5.2. Less Niche-social Network Interaction, Yet More Exogenous Actors in Kenya's Energy Transition

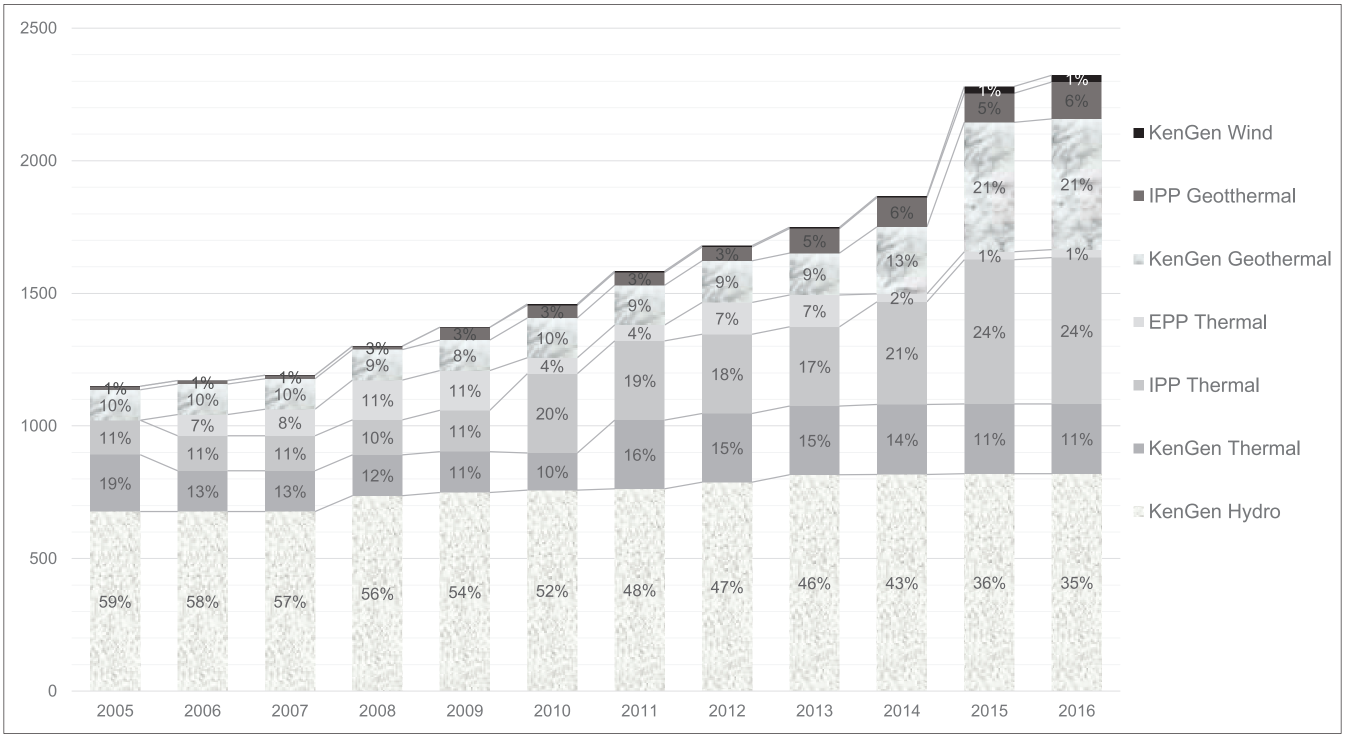
Empirical MLP analysis on electricity sectors is made in Netherlands (Verbong and Geels, 2007; Verbong et al., 2008), Germany and UK (Geels et al., 2016). Kenyan case, in comparison, revealed less interaction between niche and social networks, and more exogenous actors in the regime, especially from outside of Kenya.

Though the renewable novelties in Kenya experienced some protests from local residents at the beginning, the interaction between niche and social networks in Kenya generally did not prevent the three projects from operational. However, the Dutch institutional arrangements give stakeholders options to protest due to the disappointing results during the 1990s, therefore, environmentalists and local inhabitants can easily frustrate or delay options they dislike. In Germany, nuclear power faced great pressure in 1998-2009 due to red-green coalition. UK also experienced problems with regard to local implementation, because utilities and project developers engaged in poor consultation processes which gave rise to public opposition.

Besides the technological, science, and policy regimes, the niche development is also associated with the cognitive institutions within socio-cultural regime, and users, markets and distribution networks (Figure 1). The social awareness on the downsides of renewable energies in Kenya remains lower than the one in developed countries, which may result in quicker and smoother adoption of renewables in developing countries. However, it may also force the local residents to accept all the pros and cons of the energy projects in their environs, such as the release of toxic gases in the Olkaria geothermal projects.

Kenya has to deal with more complex exogenous actors than developed countries, especially the international finance institutions. In the regard of financiers for geothermal and other renewable in Africa, as UNEP (UNEP FI, 2012) pointed out, given

Figure 3: Electricity generation capacity by ownership in Kenya from 2005 to 2016, unit in MW



Source: Author's compilation based on annual reports of Kenya Power and Lighting Company and Energy Regulatory Commission. Percentage <1% is not indicated. EPP stands for Emergency Power Producer

that the pronounced regulatory and macroeconomic risks in Africa always bring in high return expectations of private investors, for now, the geothermal finance can only be effectively provided by the international donors. During the last decade the multilateral and bilateral development banks, in the type of official development finance, have been among the largest and most active investors in renewable in the developing world (KFW, 2005).

The most influential actor in Kenya has been the WBG. Many analysts believe the energy sector reform in Kenya is largely donor-driven, with limited local input both at the conceptual and implementation level (Turkson, 2000). Before and through the 1990s, the WBG was the prime financing agency for Kenya's electricity sector, and has been instrumental in mobilizing finance from other bilateral development agencies and banks. For instance, IDA provided loans and credits totaling about 212.2 million USD for Kenya's power investment from 1971 to 1988. The 1995 policy framework paper and the 1997 electric power act were both enacted right after the aid embargo from 1991 to 1994, and both were strongly supported by the WBG. After unbundling the generation sector in 1997, IPPs were invited to join the bids for generation. MIGA issued a guarantee of 88.3 million USD to Ormat for its 98.1 million USD equity investment in OrPower4 geothermal project, covering for up to 15 years against the risks of war and civil disturbance, transfer restriction, and expropriation in Kenya.

The Public Private Partnership Act enacted in 2013 could help Kenya derive greater value for money from both public and private actors through better project preparation, better risk allocation, increased transparency, and greater efficiency (SLS Group, 2013). Kenya has attracted much support on geothermal and wind development from multilateral development banks, bilateral development agencies, special purpose finance (Ngugi, 2012). Nonetheless, these financial supports can be further mobilized, or balanced with private investment in this domain, by strategic actor engagement, especially for the IPPs, to help Kenya increase its electrification rate from renewables.

6. CONCLUSION

Studying the past energy transition is critical for the promotion of renewable electricity, especially for the Sub-Saharan African countries whose electrification rate is the lowest in the world, 35% in average, and where renewables has a profound role to play in achieving the SDGs.

The MLP is adopted to analyze the niche-regime-landscape dynamics in Kenya's electricity sector from 1954 to 2016, with three stages: Nurturing niches in a context of stable state-owned regime (1954-1995); Parallel expansion of regime and niches in a neo-liberal landscape context (1995-2010); increasing renewables from in a changing socio-political landscape context (2010-2016). The role of exogenous actors is unneglectable in changing the landscape, and building up the niche novelties on renewable energy. Interactions of three renewable novelties are further analyzed, revealing the important role of exogenous actors in providing more protective spaces in geothermal and wind power novelties.

To gain lessons for future engagement with endogenous and exogenous actors in developing countries for sustainability transition, the paper suggests the developing countries should pay attention to the interaction between niche and domestic social networks to minimize the potential negative impacts of renewable projects to the environment and communities. At the same time, the developing countries could accumulate the negotiation skills while engaging with the exogenous actors in renewable energy financing and technology transfer process, and maintain its ownership in mobilizing both local private finance and international finance.

The paper contributes to the energy transition field by providing the lessons from Kenya, in comparison with previous study on developed countries - the role of exogenous actors in energy transition towards sustainability should be paid more attention in developing countries. Further studies on other cases from developing countries are required to better understand and guide the energy transition in the developing world.

7. ACKNOWLEDGMENTS

The authors are grateful to their colleagues for their helpful advice and comments. Special thanks go to the interviewees from Akiira, KenGen, PPIAF, IDA and MIGA for their invaluable input. This research is financially supported by Nishimura International Scholarship Foundation.

REFERENCES

Bakker, S., Leguijt, P., Van Lente, H. (2015), Niche accumulation and standardization - The case of electric vehicle recharging plugs. Journal of Cleaner Production, 94, 155-164.

Boon, W.P.C., Bakker, S. (2016), Learning to shield - Policy learning in socio-technical transitions. Environmental Innovation and Societal Transitions, 18, 181-200.

Bree, B., Verbong, G.P.J., Kramer, G.J. (2010), A multi-level perspective on the introduction of hydrogen and battery-electric vehicles. Technological Forecasting and Social Change, 77(4), 529-540.

CDM Executive Board. (2012), Project Design Document for Kipeto Wind Energy Project. Available from: http://www.cdm.unfccc.int/filestorage/B/S/W/BSWNU3MXC6RADQTIO0J4FY97ZGVH51/5867-PDD_15May2012.pdf?t=dnB8bjQxcXc3fDDxpOtbghiqpsHEU3IQ9Vc5.

Coenen, L., Raven, R., Verbong, G. (2010), Local niche experimentation in energy transitions: A theoretical and empirical exploration of proximity advantages and disadvantages. Technology in Society, 32(4), 295-302.

Donovan, C.W. (2015), Renewable Energy Finance: Powering the Future. 1st ed. London: Imperial College Press.

Eberhard, A., Gratwick, K., Morella, E., Antmann, P. (2016), Independent Power Producers in Sub-Saharan Africa: Lessons from Five Key Countries. Available from: https://www.openknowledge.worldbank.org/handle/10986/23970.

Elzen, B., Geels, F., Hofman, P. (2002), Sociotechnical Scenarios (STSc): Development and Evaluation of a New Methodology to Explore Transitions Towards a Sustainable Energy Supply. Available from: http://www.scholar.google.com/scholar?hl=en&btnG=Search&q=intitle: Sociotechnical+Scenarios+(+STSc+)#5.

Geels, F.W. (2002), Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. Research Policy, 31, 1257-1274.

Geels, F.W. (2004), From sectoral systems of innovation to socio-technical systems: Insights about dynamics and change from sociology and institutional theory. Research Policy, 33(6-7), 897-920.

Geels, F.W., Kern, F., Fuchs, G., Hinderer, N., Kungl, G., Mylan, J. (2016), The enactment of socio-technical transition pathways: A reformulated typology and a comparative multi-level analysis of the German and UK low-carbon electricity transitions (1990-2014). Research Policy, 45(4), 896-913.

Genus, A., Coles, A.M. (2008), Rethinking the multi-level perspective of technological transitions. Research Policy, 37(9), 1436-1445.

GoK. (1996), Kenya Economic Reforms for 1996-1998: The Policy Framework Paper, Nairobi. Available from: https://www.imf.org/external/np/pfp/kenya/kenya.pdf.

GoK. (2011), Least Cost Power Development Plan 2011-2031. Available from: http://www.renewableenergy.go.ke/downloads/studies/LCPDP-2011-2030-Study.pdf.

IEA. (2014), World Energy Outlook 20140. Paris: Electricity Access Database. Available from: http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase.

KenGen. (2016), KenGen Annual Report 2016, Nairobi. Available from: http://www.kengen.co.ke/sites/default/files/financial-reports/KenGenAnnualReport2016_0pdf.

Kenya Power. (2017), Kenya Energy Sector Players. Available from: http://www.kplc.co.ke/content/item/66/key-sector-players. [Last accessed on 2017 Mar 21].

KfW. (2005), Financing Renewable Energy: Instruments, Strategies, Practice Approaches. Available from: http://www.siteresources.worldbank.org/EXTRENENERGYTK/Resources/5138246-1237906527727/5950705-1239134575003/061Jan1Financing0Renewable0Energy1Final.pdf.

KMEP. (2016), Kenya National Energy Policy, Nairobi, Kenya Ministry of Energy and Petroleum. Available from: http://www.energy.go.ke/downloads/National Energy Policy-Final Draft.pdf.

KPLC. (2016), KPLC 2016 Annual Report. Available from: http://www.kplc.co.ke/category/view/39/annual-reports.

LTWP. (2017), Lake Turkana Wind Project. Available from: http://www.ltwp.co.ke/lake-turkana-ready-to-inject-33-percent-of-the-agreed-power-into-the-national-grid. [Last accessed on 2017 Mar 22].

Micale, V., Trabacchi, C., Boni, L. (2015), Using Public Finance to Attract Private Investment in Geothermal. Kenya: Olkaria III Case Study. Available from: http://www.climatepolicyinitiative.org/wp-content/uploads/2015/06/150601_Final_Olkaria_ForWeb.pdf.

Mills, C.A. (1989), Structural Adjustment in Sub-Saharan Africa. Available from: http://www.documents.worldbank.org/curated/en/570911468768036645/Structural-adjustment-in-sub-Saharan-Africa.

Ndii, D. (2010), Decentralization in Kenya Background Note. Available from: http://www.siteresources.worldbank.org/INTAFRICA/Resources/257994-1335471959878/Decentralization_in_Kenya_Background_Note.pdf.

Nelson, R.R., Winter, S.G. (1977), Search of useful theory of innovation. Research Policy, 6, 36-76.

Ngugi, P.K. (2012), Financing the Kenya geothermal vision. In: Short Course on Geothermal Development and Geothermal Wells. Santa Tecla: UNU-GTP & LaGeo.

Papachristos, G., Sofianos, A., Adamides, E. (2013), System interactions in socio-technical transitions: Extending the multi-level perspective. Environmental Innovation and Societal Transitions, 7, 53-69.

Raven, R., Kern, F., Verhees, B. (2016), Niche construction and empowerment through socio-political work: A meta-analysis of six low-carbon technology cases. Environmental Innovation and Societal Transitions, 18, 164-180.

Richter, A. (2016), Competitive Auctions for Renewables Projects could Replace Feed-in-Tariff System in Kenya. Available from: http://www.thinkgeoenergy.com/competitive-auctions-for-renewables-projects-

could-replace-feed-in-tariff-system-in-kenya. [Last accessed on 2017 Mar 24].
Rip, A., Kemp, R. (1998), Technological change. In: Human Choice and Climate Change. Ch. 6. Columbus: Battelle Press. p327-399.
Shove, E., Walker, G. (2007), CAUTION! Transitions ahead: Politics, practice, and sustainable transition management. Environment and Planning A, 39(4), 763-770.
SLS Group. (2013), A Review of the PPP Act of 2013. Available from: https://www.stralexgroup.blogspot.jp/2013/09/a-review-of-public-private-partnerships.html. [Last accessed on 2017 Mar 23].
Smith, A., Vob, J.P., Grin, J. (2010), Innovation studies and sustainability transitions: The allure of the multi-level perspective and its challenges. Research Policy, 39(4), 435-448.
Turkson, J.K. (2000), Power Sector Reform in Sub Saharan Africa. London: Palgrave Macmillan.
Turnheim, B., Geels, F.W. (2013), The destabilisation of existing regimes: Confronting a multi-dimensional framework with a case study of the British coal industry (1913-1967). Research Policy, 42(10), 1749-1767.
UNEP FI. (2012), Financing Renewable Energy in Developing Countries. Geneva: UNEP FI. Available from: http://www.unepfi.org/fileadmin/documents/Financing_Renewable_Energy_in_subSaharan_Africa.pdf.
UNIDO. (2005a), Module 8: Impact of Different Power Sector Reform Options on Renewables. Available from: http://www.africa-toolkit.reeep.org/modules/Module8.pdf.
UNIDO. (2005b), Module 9: Regulatory and Policy Options to Encourage Development of Renewable Energy. Available from: http://www.africa-toolkit.reeep.org/modules/Module9.pdf.
Verbong, G., Christiaans, W., Raven, R. (2010), Strategic niche management in an unstable regime: Biomass gasification in India. Environmental Science and Policy, 13(4), 272-281.
Verbong, G., Geels, F. (2007), The ongoing energy transition: Lessons from a socio-technical, multi-level analysis of the dutch electricity system (1960-2004). Energy Policy, 35(2), 1025-1037.
Verbong, G., Geels, F.W., Raven, R.P.J. (2008), Multi-niche analysis of dynamics and policies in dutch renewable energy innovation journeys (1970-2006): Hype-cycles, closed networks and technology-focused learning. Technology Analysis and Strategic Management, 20(5), 555-573.
Verbong, G.P.J., Geels, F.W. (2010), Exploring sustainability transitions in the electricity sector with socio-technical pathways. Technological Forecasting and Social Change, 77(8), 1214-1221.

ANNEX

Annex 1: Interactions between policy regime, actors, renewable technology and niche novelties in Kenya from 1954 to 2016

Year	Policy regime	Actors	Renewable technology	Niche novelties
1954		Kenya power company was formed; British commonwealth geological liaison office in charge	Geothermal	Early investigations on geothermal resource in Olkaria region
1982	Geothermal resources act by the PoK		Control exploitation of geothermal, vest the resources in GoK	Geothermal Olkaria I (30 MW in 1981 and 30 MW in 1985)
1991~1994	Aid embargo imposed on Kenya, for reasons linked to corruption and lack of advancement in the creation of a multi-party state, which affected all sectors, including power			
1995	Economic reforms for 1996-1998: Policy framework paper by GoK, with IMF and WBG/separate the regulatory and commercial functions of the power sector, facilitate restructuring, and promote private sector investment/separate the generation, transmission and distribution by reforming KPLC/invite bids for investment by IPPs in generation	/KenGen in 1997; ERB in 1998; a succession of IPPs/KPLC was renamed as Kenya Power in 2011	Review cost-effective options for providing electricity to rural areas, including policies to encourage the use of renewable resources, like wood fuels, photo voltaic and windmills	/In 1995, tenders for the first two IPPs by MoE: One diesel (Tsavo), the second geothermal (OrPower4) /in 1998, OrPower4 PPA signed for between 28 and 100 MW. Tsavo PPA signed for 75 MW /In 2000, OrPower4 began to operate 9 MW and added additional 4 MW for a total of 13 MW later

(Contd...)

Annex 1: ***(Continued)***

Year	Policy regime	Actors	Renewable technology	Niche novelties
1997	Electric power act by PoK/"electric power production license" means a license granted to a public or local authority, company, person or body of persons, referred to as an electric power producer, to generate and supply electrical energy to other electric power producers or public electricity suppliers/establish an independent regulator to regulate the electric power			
1999	Environmental management and Co-ordination Act by the PoK/regulate the environmental aspect of the energy sector			
1993~2003	The depreciation of Kenyan Shilling weighs heavily on GoK, considering all PPAs are denominated in USD. The Kenyan Shilling against USD reached a historical record low of 36.23 in 1993, and was about 80 in 2003. Severe drought in 1995/96, and 1998/2000, with 4 million people in need of food assistance in 2000 (Kenyan total population of 31 million). Three emergency IPPs were introduced during drought (Aggreko, Cummins and Deutz)			
2004	Sessional paper No. 4 on Energy by Ministry of Energy (MoE)/create REA to accelerate the pace of rural electrification. Establish GDC to undertake an assessment of geothermal resources. Dissolve the ERB and create a new energy sector regulator. Create an appeals tribunal to deal with complaints against ERC's decisions. Partially privatize KenGen through an initial public offering (IPO). Unbundle KPLC into two entities, one for transmission which is a 100% state owned and the other for distribution which will be private sector owned. Allow power generation companies to access bulk electricity consumers. Create a domestic power pool with a provision for wholesale and retail markets	In 2006: REA; ERC; KenGen was listed on the Nairobi securities exchange after GoK sold 30% of its stake through IPO. In 2007: ET. In 2008, GDC; KETRACO	Promote electricity generation from renewable. Promote privately or community owned vertically integrated entities either operating renewable power plants or hybrid systems, to coexist with licensed electricity distributors. 10-year tax holiday for renewable power plants. Renewable pricing will be determined by the market forces of demand and supply	In 2003, geothermal Olkaria II with 70 MW, and extended another 35 in 2010
2006	Energy Act by PoK/consolidate all laws related to energy, and provide legal framework for REA, ERC, and ET Electric power (electrical installation work) rules by ERC/set requirements for the licensing of electricians and electrical contractors			
2008	Kenya Vision 2030 by GoK/a long-term development blueprint FiT policy (revised in 2010, and 2012) by MoE/an instrument for promoting renewable electricity, allowing power producers to sell renewable electricity to Off-takers at a pre-determined tariff for a given period of time		FiT policy covered wind, small hydro and biomass sources, for plants with capacities <50 MW, 10 MW, and 40 MW respectively	

(Contd...)

Annex 1: ***(Continued)***

Year	Policy regime	Actors	Renewable technology	Niche novelties
	Electricity grid code (under discussion as of April 2016) by ERC/as the primary technical document of the ESI			
2009	LCPDP 2011-2031 by GoK/identifies existing potential in generation, possible investments in transmission, forecasts future power demand and how best it can be met at least cost. Policy target: Multiple renewable sources, geothermal, wind, hydropower/forecasted peak demand for 2031 is 15,026 MW, 13 times of the 2011 peak load		Geothermal is the least-cost choice, with capacity target 5.5 GW, 26% of peak demand by 2031. Wind and hydro power plants will provide 9% and 5%	OrPower4 expanded another 36 MW
2010	Constitution of Kenya by PoK/a two tier structure of government, the National and the County Governments. It is necessary to review and align the energy sector policy National climate change response strategy by GoK/first of this kind to addressing the threats posed by climate change as well as taking advantage of any opportunities that may arise	National Climate Change Steering Committee	FiT policy included geothermal, biogas and solar/benefit from carbon markets by RE promotion/introduce standardized PPA (up to 10 MW)	
2012	National climate change action plan 2013-2017 by GoK/zero rated the import duty on RE technologies and removed VAT on equipment and components	Low carbon climate resilient development	Increase reliability of the electricity supply by reducing reliance on hydropower	Geothermal Olkaria IV with 140 MW in 2012
2013	PPP Act By PoK/PPP regulation in 2009. In 2012, GOK received a credit from WBG for the Infrastructure Finance and PPP project. PPP bill was published in 2012			OrPower4 expanded another 36 MW, another 26 MW in 2014
2015	Energy bill by PoK/a specific obligation on GoK to "facilitate the provision of affordable energy services to all persons in Kenya"	Establish an inter-ministerial RERAC. Transform the REA into NERA to lead the development of renewable other than geothermal and large hydro	Significant proposals relating to policy formulation for renewable in the draft National Energy Policy	11 IPPs are in operation, representing 30% of installed capacity by June 2016. Lake Turkana Wind Project started construction, with 310 MW ready in 2017
2016	National energy policy (since 2012, final draft in 2016) by MoE/set up a consolidated energy fund. Competition generally means in the generation of electricity. The transportation (transmission and distribution) as well as system operation functions are natural monopolies Kenya national adaptation plan 2015-2030 by GoK/demonstrates Kenya's commitment to the Paris Agreement/Kenya's first plan on adaptation		Encourage investment in geothermal to achieve 5500 MW by 2030. Develop renewable energy master plan Increase the solar, wind network to provide power to off-grid areas	OrPower4 expanded another 29 MW. KenGen had a contract to drill two wells for Akiira Geothermal Project in Olkaria

Source: Author's compilation based on the official documents of legislation and regulation enacted in Kenya. IPP: Independent Power Producers, GoK: Government of Kenya, IMF: International Monetary Fund, WBG: World Bank Groups, KPLC: Kenya Power and Lighting Company, KenGen: Kenya Electricity Generating Company, ERB: Electricity Regulatory Board, MoE: Ministry of Energy, PPA: Power purchase agreement, PoK: Parliament of Kenya, MW: Megawatts, USD: US dollars, REA: Rural Electrification Authority, IPO: Initial public offering, ET: Energy tribunal, GDC: Geothermal Development Company, KETRACO: Kenya Electricity Transmission Company, FiT: Feed-in-tariff, ESI: Electricity supply industry, LCPDP: Least cost power development plan, PPP: Public private partnership, IFPPP: Infrastructure Finance and PPP, RERAC: Renewable Energy Resources Advisory Committee, NERA: National electrification and renewable energy authority, OPIC: Overseas Private Investment Corporation, ERC: Energy Regulatory Commission